

# BOLTED

ISSUE # 10



**GET THE KNOWLEDGE  
FROM THE EXPERTS**

**TALL ORDER  
SECURING  
BOLTS ON  
TOKYO SKYTREE**

**BRIGHT SPARK  
CAR ENTHUSIAST  
CHOOSES  
NORD-LOCK**

**POWER GENERATION  
SUPERBOLT  
PART OF HYDRO  
FUTURE**

# 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.





BolTED magazine is published by Nord-Lock and strives to increase knowledge about bolt assemblies. The 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®**

## Ten issues of bolting news and solutions

**I**N THE NEWS recently I heard about an appeal to the Swedish Supreme Court regarding a trademark infringement case. It involved counterfeit copies of SKF bearings and the prosecutor demanded that the defendant's fine be increased or even changed to imprisonment. Their argument was that the copied goods were not only damaging to a brand's reputation but also exposed customers to increased risks and put lives in danger. The prosecutor points out that using counterfeit products in critical mechanical applications in, for example, the nuclear energy industry, the railway industry and the aircraft industry, is an unwelcome and serious danger. A brand, in this instance SKF, serves as a guarantee, and customers buying that product expect a certain level of quality, reliability and durability. The prosecutor has suggested that the outcome should serve as an example in similar cases – when customers unknowingly receive copies through distribution, or third parties and are exposed to huge risks. It is an interesting case to follow and certainly relevant to anyone sourcing vital mechanical components.

And what has Nord-Lock been up to? We continue to concentrate on a bright future. The Group has recently welcomed a new CEO and we are excited about the direction we are moving in. Further improving our product development and continuing to deliver world-class

quality products allows us to serve you in the best possible way (see interview with Ola Ringdahl on page 18).

As always, we have a lot of exciting new stories covered in this issue that will be of tremendous interest to you! To mention a few, we visit the hydropower plant in Laxede, Sweden, when Andritz Hydro AB replaces the runners of the turbines. You can read more on page 12. Additionally you can read how we helped MAN Diesel with coherence in their design processes (page 18). Other interesting stories in this issue includes Nucor, one of the world's biggest steel producers (page 6), and an interview with Gordon Foat on electric cars and the environment (page 15).

This BolTED actually marks a small anniversary, our tenth issue! To celebrate it, we have gathered our ten best bolting tips. We do hope you find a few good ones!



**CARIN ESBERG**  
GLOBAL MARKETING  
MANAGER

08



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# SECURED BY THE NORD-LOCK GROUP

WORDS: NIC TOWNSEND & ADRIAN MILLERICK



## SPREAD THE WORD

Bromma spreaders are found at almost all the world's top ports, and each is fitted with hundreds of Nord-Lock washers.

## WHAT A LIFT!

### PRODUCT:

STS45E TWIN-LIFT  
ALL-ELECTRIC SPREADER

### WEIGHT:

11.7 TONNES

### LENGTH:

6.06 METRES

### LIFTING CAPACITY:

51 TONNES

### CUSTOMER:

BROMMA

**WHEN ENORMOUS** 35-tonne containers are being maneuvered into place at the world's major ports equipment reliability is paramount. The giant cranes must work under tight constraints and with exacting precision. That's why Nord-Lock and crane spreader manufacturer Bromma are the perfect match. The quality solutions Nord-Lock provides for Sweden-based Bromma help the company maintain its dominant market position, selling more spreaders than all its competitors combined.

Bromma's spreaders, which are attached onto cranes for lifting heavy loads, have been delivered to more than 500 terminals in more than 90 countries on six continents – in fact, they are installed at no fewer than 97 of the world's top 100 ports. More than 9,000 are in operation today.

Safety is critical in this tough and demanding environment. Huge loads put immense pressure on the spreaders, which are traveling at great heights. Hundreds of Nord-Lock washers are used at crucial bolted joints on every Bromma spreader, ensuring the safe transfer of containers from ship to shore.

The safety and ease of use of Nord-Lock washers help bolster Bromma's reputation for the exceptional quality and reliability of its spreaders, and keep them performing optimally over year after year of punishing dockside service. ■



## RIGHT ON TARGET

**PRODUCT:**  
BIATHLON TARGET

**TARGET MATERIAL:**  
HARD WEAR PLATE

**SHOOTING DISTANCE:**  
50 METRES

**CUSTOMER:**  
BIATHLON TARGET SYSTEM KURVINEN

**ORIGINALLY A FORM** of military training, the winter sport of Biathlon combines cross-country skiing and rifle shooting and is an immensely challenging event. To take part, participants must have the stamina and endurance to ski long distances at a rapid pace, while also having enough composure and skill to accurately shoot small targets from 50 metres.

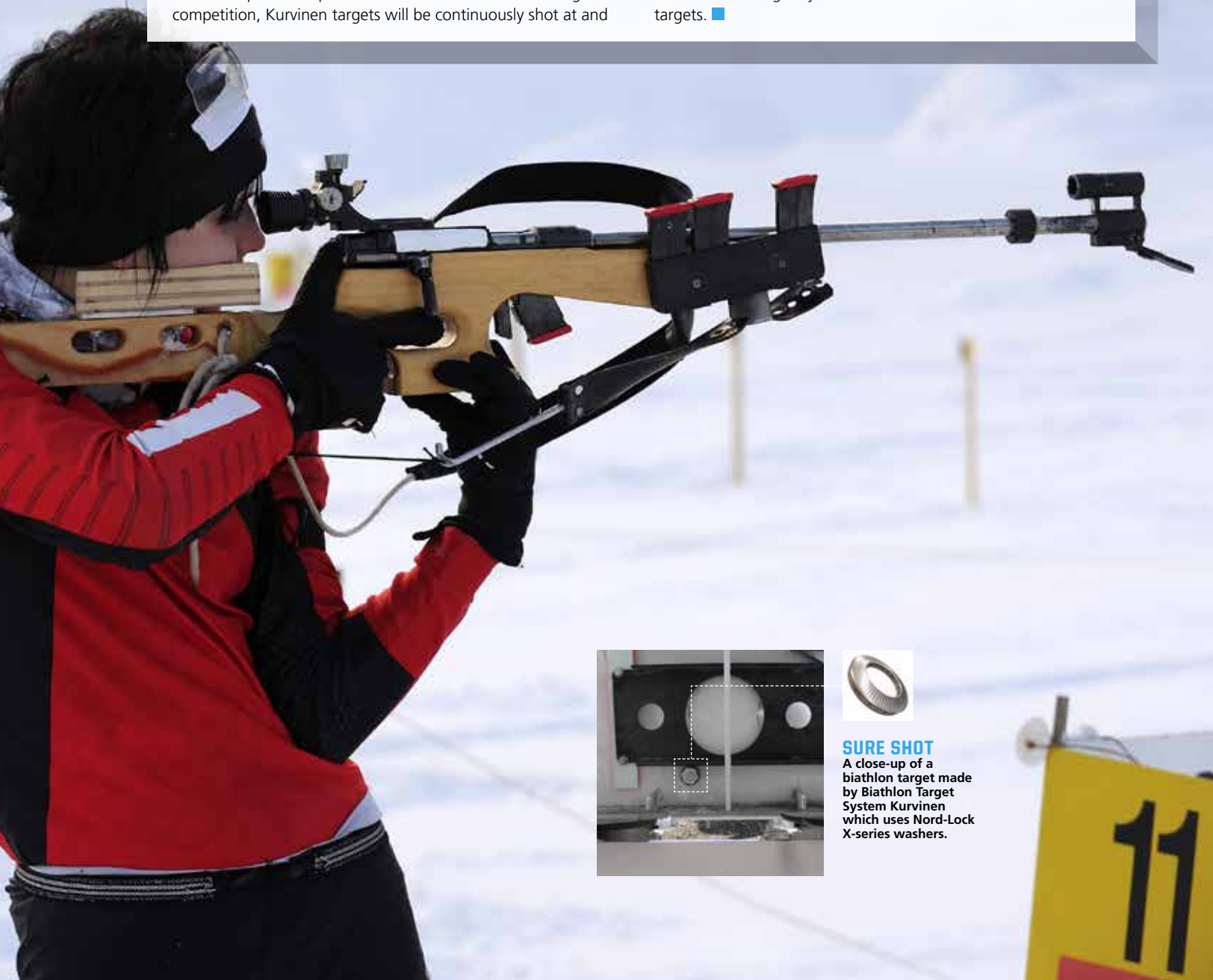
Biathlon can also be demanding for event organisers, with competition sites covering large areas in difficult conditions. Also, all of the equipment must be in perfect working order.

For over thirty years, Biathlon Target System Kurvinen has been a world-class pioneer in biathlon target and range systems and has exported its products to over 30 countries. During a competition, Kurvinen targets will be continuously shot at and

subjected to thousands of hits. Yet despite the pressure, they must maintain their strength as it only takes one faulty target to ruin a whole competition.

For the past year, Biathlon Target System Kurvinen has been using Nord-Lock X-series washers to secure all critical connections on its targets. Previously, the company had been using thread-locking fluid. However, this did not offer enough flexibility when adjustments to the targets needed to be made, especially in cold weather.

The X-series washers, on the other hand, can be removed and reapplied quickly and easily, despite freezing conditions. And now Biathlon Target System Kurvinen uses them on all its targets. ■



**SURE SHOT**  
A close-up of a biathlon target made by Biathlon Target System Kurvinen which uses Nord-Lock X-series washers.

# SECURED BY THE NORD-LOCK GROUP



## HEAVY METAL

The use of Superbolt tensioners leads to improved ergonomics and greater workplace safety for Nucor's workers.



## NO TIME FOR DOWNTIME

<b>CUSTOMER:</b> NUCOR STEEL	<b>NAME OF STEEL MILL:</b> NUCOR BERKELEY
<b>PRODUCTION:</b> STRUCTURAL STEEL	<b>ANNUAL CAPACITY OF THE ROLLING MILL:</b> OVER 635,000 TONNES
<b>STEEL TEMPERATURE:</b> RANGING UPWARDS OF 1,191° CELSIUS	

**EVERY YEAR NUCOR** produces over 21 million tonnes of steel, making it the biggest steel producer in North America and one of the biggest in the world. Since most of the steel comes from recycled scrap metal, which would otherwise be left to rust and decay, Nucor is also one of the world's largest recyclers.

In order to produce this much steel, Nucor's minimills are continuously in operation, melting down and recasting scrap metal. Despite the harsh conditions and extreme temperatures, everything needs to be in perfect working order. When dealing with a commodity as valuable as steel, any downtime is costly.

Currently, Nucor uses Superbolt multi-jackbolt tensioners in two applications on its steel mills, resulting in improved safety and reliability, as well as contributing to more ergonomic working environment conditions for its workers.

Firstly, Superbolt MJTs are used to secure the rolls to the roll chocks. Compared to torque tightened nuts, applying the necessary torque is significantly easier as it can be achieved using standard hand tools, thus eliminating the strain when assembling and disassembling equipment.

Secondly, the tensioners also secure the mill's stand to the transport cart used in the production process. Originally, this was secured using hydraulic nuts, which were cumbersome, unreliable and thus a safety hazard for employees. However, since switching to Superbolt MJTs, the connection to the cart is now safe and reliable. ■

## TURNING WATER INTO POWER

<b>PRODUCT:</b> HYDROELECTRIC TURBINE	
<b>RUNNER WEIGHT:</b> 1,225 KG	<b>OUTPUT:</b> 5,150 KW
<b>CUSTOMER:</b> CANYON HYDRO	

**FOR OVER 35 YEARS**, Canyon Hydro has been delivering hydro-electric systems to customers all over the world, and has built up a reputation for efficient designs, quality components and comprehensive support throughout the system's lifespan. Each of Canyon Hydro's turbines is individually designed to best meet the customer's needs and work most efficiently at their chosen site, ensuring customers always extract as much power from the water as possible.

Canyon Hydro is continuously seeking out the highest quality components and currently uses Superbolt tensioners to secure the turbine's Pelton runners – an absolutely critical



## WATER TIGHT

Using Superbolt tensioners on its turbines' Pelton runners brings Canyon Hydro multiple benefits.

connection, where the consequences of any bolt loosening would be catastrophic. Previously, Canyon Hydro has used fitted bolts. However, it switched to Superbolt tensioners

as they are reusable and easy to reapply when replacing the runner. Superbolt tensioners also offer easy and accurate control of clamping force. ■



**HIDENORI ARAKI**  
FIELD APPLICATION  
ENGINEER

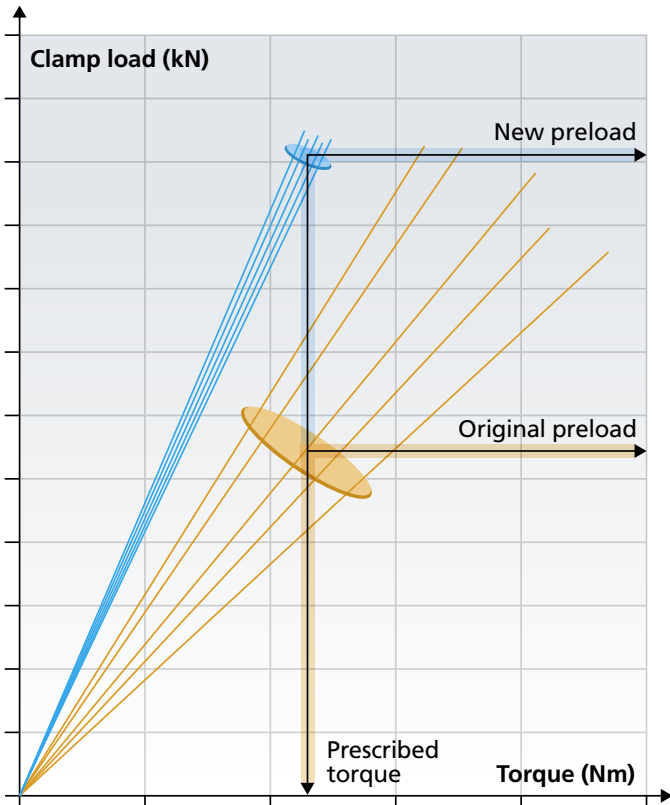


**SCOTT WHIPKEY**  
MECHANICAL  
ENGINEER



## ASK THE EXPERTS

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



Low deviation in achieved clamp load is essential to obtain control of the clamp load and to utilise the full capacity of the bolt. Torque/clamp load test: lubricated condition (blue), dry conditions (orange). Preload levels can vary significantly with the introduction of lubrication. Before lubricating it must be checked that the bolts and the clamped parts can withstand the higher load.

## Effects of lubrication when reusing fasteners

**Q: What happens to preload in the joint during reuse?**

**A:** It is common in many applications to reuse the same nuts and bolts as long as they are in good condition after operation. What happens to the joint preload during reuse is, however, not always considered.

During tightening, metal faces between male and female threads, as well as between the bolt head/nut and substrate, grind against each other causing wear to occur. The result is higher and more scattered friction.

Friction scatter is inherent in every bolted joint upon each installation and can be quite large when installing without any lubrication. When fasteners are reused and tightened to a specific torque, more of the applied torque is required to overcome the friction and less is utilised to obtain the required preload. For each subsequent reuse the preload becomes lower and more inaccurate. This

can cause issues when the designer has specified a preload range for the application to maintain sufficient clamp force to overcome the external forces on those joints. Finally, the preload may not be sufficient to withstand the working load applied to the joint, which subsequently fails.

By lubricating the fastener before every use, not only can friction be reduced to improve torque-to-load ratio, friction scatter can also be reduced to improve preload accuracy. The graph here illustrates the torque-to-load behaviour between a dry installation and a lubricated installation. While the preload scatter at a given torque is quite random, you can influence the variability of that scatter by this simple modification.

The prescriptions of the manufacturer regarding lubrication have priority and must be followed. It may be necessary to reduce the torque to avoid damage to the bolt or the clamped parts.

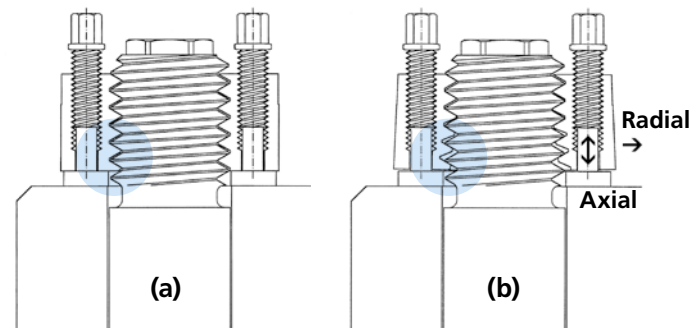
HA

## Superbolt: your flexible friend

**Q: How does the added flexibility of Superbolt improve the bolted joint?**

**A:** In normal bolted joints, the stress concentration of loads on the first 1-2 threads is one of the main reasons why a bolted joint fails. With a joint utilizing Superbolt multi-jackbolt tensioners, as the jackbolts are torqued to stretch the stud/bolt, the tensioner body radially flexes in at the top and flexes out at the bottom. This flexing action transfers the load from the first few threads and distributes the load evenly throughout the entire engaged thread length

between the tensioner and stud/bolt. This simple flexing action dramatically increases the strength of the joint by reducing the stress concentrations on the first couple of threads. In addition, this radial flexing action combined with axial flexing results in added elasticity in the joint. In a typical bolted joint, the average clamp length of the joint is around 2 to 5 thread diameters in length. The combined flexing in the MJT creates a higher load point, which increases the clamp length of the joint by as much as 2-3 thread diameters. It can be concluded that the



Schematic of stress-relieving action by torquing a nut-type MJT. (a) Before tensioning; (b) after tensioning. Flexing as shown is highly exaggerated.

Superbolt tensioner could double the elasticity of a standard bolted joint. This eliminates the need for lengthening the bolt/stud and

adding a spacer or multiple spring washers, (both of which can be costly), to improve the elasticity of the joint.

SW

# TOP

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# TIPS


# FOR SECURE BOLTING

Achieving the safest, most secure bolted connection involves many factors. To help you achieve the best possible results – and to celebrate our tenth issue of Bolted – we have summarised the in-depth know-how shared over the last ten issues into ten bolting tips. Please note that this is general advice and does not necessarily apply to all bolting situations.

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WORDS: DAVID WILES





The combination of bolt size and strength grade creates the all-important load in the bolt.

1

## SIZE AND GRADE

### “Choose the right combination of bolt size and grade”

**IN BOLTING, BIGGER** does not necessarily mean better. Similarly, a higher grade bolt is not automatically an improvement to a lower grade bolt. What is important is the combination of these two factors.

“If everyone chose the right bolt size and the right material, then extra bolt-securing solutions wouldn’t be needed,” says Bill Eccles, the founder of boltscience.com.

Eccles explains that the bolt size and the strength grade can positively or negatively affect the load in the bolt. Once you have the right combination, and you correctly tighten the joint, it is this load that is the crucial factor for your bolted joint to remain secure. “You could use a larger bolt with a lower strength grade, or a smaller bolt in a high strength grade,” he says. “Both could be suitable.” When considering these type of critical design options, the engineers at Nord-Lock can be a helpful resource.

2

## SLACKENING

### “Create elasticity in the joint to compensate for slackening”

**SLACKENING IS ONE** of the main reasons bolts come loose. There are three main causes: settlement of rough or irregular surfaces; relaxation, when materials such as polymers or composites become more compact; creep, which is the tendency of materials to move or deform plastically under stress and elevated temperatures. All three cause loss of preload and can lead to bolted joint failures.

Slackening is a growing problem today as bolted joints are exposed to ever higher temperatures and loads, while components are increasingly made from composites, plastics, and aluminium.

The solution, says Robin Senn, Sales Engineer at Nord-Lock in Switzerland, is two-fold: “To compensate for slackening you need smooth and hard surfaces, and you need to introduce elasticity into the bolted connection, such as by using Nord-Lock X-series washers or Superbolt multi-jackbolt tensioners.”

Superbolt MJTs as well as multifunctional wedge-locking technology from Nord-Lock increase the elasticity of the joint to minimize slackening.

3

## LUBRICATION

### “Choose the right lubrication for your application”

**IT’S HARD TO** overstate the importance of lubrication in regards to bolted joints. It minimizes friction scatter and reduces the torque-to-load ration. Lubrication also eases installation and removal and extends the life of the bolt.

Hidenori Araki, Field Application Engineer at Nord-Lock Inc. in the USA, recommends applying lubrication under the bolt head or nut and on the engaged threaded part of the bolt.

The most important thing to bear in mind when it comes to lubrication, he says, is to choose a suitable lubrication for your application. “Some of the parameters to take into consideration are chemical composition, health and environmental impact, service temperature ranges, and friction coefficient. Check the lubrication manufacturer for recommended usage.”

# 4

## DESIGN/MAINTENANCE

### “Focus on the lifecycle costs”

**DURING THE DESIGN** stage of a project, a frequent dilemma is whether to keep costs down in the present by using more economical solutions or make savings in the long term by investing in higher quality solutions.

Martin Lindbäck, Head of R&D Project Management Office at Siemens Industrial Turbomachinery, says: “Don’t only focus on the initial costs. Making the right investment early on will reap large cost savings later. This approach will also lead to more satisfied customers.”

Siemens took this long-term approach when it came to a bolt-securing solution for its multimillion Euro gas turbines, which led to an investment in lock washers and Superbolt tensioners from Nord-Lock. This gave cost savings not only during assembly but resulted in huge savings on maintenance costs over the life cycle of the turbines.

# 6

## GENUINE PRODUCTS

### “Invest in the real thing – or you’ll pay later”

**FROM SNEAKERS TO** smartphones, cheap copies and counterfeit goods are rife everywhere. And bolting products are no exception.

The benefit of investing in genuine products, such as Nord-Lock locking washers, is that you get a product that has been on the market for a long time and has proven performance and quality.

Genuine Nord-Lock products can be identified by a laser marking. If you are unsure whether you

have bought the real thing, contact your local registered sales office, where you can get help with verification.

“As with many things in life, with bolting solutions you get what you pay for,” says Frida Cullin, Manager of Nord-Lock Technical Centres. “The purchase cost for a genuine product may be higher, but you save in the long term on reliability and reduced maintenance/repair costs.”

# 5

## COATINGS

### “Consider coatings to improve your bolted joint”

**COATINGS MAY BE** only a few micrometres thick, but they can improve a fastener’s performance in several ways: protecting against corrosion; reducing friction; enhancing aesthetic value. There are a number of coating solutions available, the most cost-effective and simplest of which is galvanisation. When this is not enough, zinc alloys can be used. If even greater protection is needed, multi-layered zinc flakes are recommended.

So which coating should you choose for your application? Csaba Madru, Global Field Engineer Oil & Gas at Nord-Lock, says some coating characteristics should weigh heavier than others. “Choose your coating based firstly on the level of corrosion protection it offers; then on what friction characteristics you need as you can always compensate with a lubricant, and finally on aesthetic properties.”

Coatings have several functions, but some are more important than others.



# 7

## QUALITY

### “Work with partners known for their expertise”

**THERE ARE THOUSANDS** of fastening solutions available. But even those widely used for a certain applications may not be approved for a specific temperature or pressure range. So finding partners to help you achieve high material reliability and the right choice of fastening is crucial.

Peter Fjordman, of Bolt Securing, says: “The cost of a recall or the damage to a brand can be significant. When I read about an accident caused by a ventilation system leaking, for example, I wonder if it may have been because the company chose the wrong fastening solution.”

“Achieving high quality is about working with partners known for their expertise, who will prioritise quality over making a quick profit,” says Fjordman.

Nord-Lock is recognized for reliability and holds several quality certificates and accreditations for demanding applications, e.g. offshore, energy and transportation.



# 8

## CORROSION

### “Consider corrosion from the beginning in bolted joint design”

**THEY SAY THAT** the only certainties in life are death and taxes. But a third can be added: corrosion. Any metal product derived from iron or steel will eventually rust and disintegrate when it comes into contact with oxygen and water. “Corrosion will inevitably occur at a certain time,” says Christian Rabe at Dörken MKS-Systeme, which develops micro-layer corrosion protection systems. “Yet there are ways to arrest its progress.”


One method is cathodic protection – where a less noble material, such as zinc, sacrifices itself – and another method is non-cathodic protection.

Rabe says there are no easy answers when it comes to corrosion. “The only solution would be to keep your endangered parts in a very dry desert climate,” he jokes.

Nord-Lock offers a wide range of protective coatings and surface treatments as well as several grades of stainless steels and nickel-based alloys.



Corrosion can't be avoided – but it can be slowed down.



The right tool and the right tightening sequence are highly important for achieving a secure bolted joint.



# 9

## REUSE

### “If you have to reuse, lubricate”

**TO REUSE OR** not to reuse, that is often the question. Reusing fasteners – particularly in the field – is more convenient than carrying around replacements of various sizes and grades. Plus, it is cheaper.

However, it is hard to know if used fasteners are damaged, and might therefore fail. To check if a bolt you are planning to reuse is up to the task, Lena Kalmykova, Application Engineer at Nord-Lock, recommends a visual inspection. “If you see signs of corrosion, avoid reuse if possible. And the same goes for visible thread damage.”

“But there may be times when you have no alternative but to reuse a damaged bolt as a temporary solution. If you have to reuse, then lubricate,” says Kalmykova. “It provides a degree of protection against corrosion. And if you have a damaged thread, lubrication will help achieve the clamp load you require until you’re able to install a new bolt.”



# 10

## PRELOAD AND TIGHTENING

### “Choose the right tool and the right sequence”

**THE PRELOAD LEVEL** determines the capacity of a bolted joint. Therefore it is crucial to determine the preload level required in a joint and then to achieve it through a suitable tightening method and a proper tightening sequence.

Preload must be sufficient to prevent movement between, or separation of, clamped parts, but still be within the yield limit of the material to avoid embedment of mating surfaces and thread stripping.

Zouhair Chaib, Senior Technical Expert at Nord-Lock in France, says it is also important to differentiate between the static and dynamic capacity of a screw; a screw can withstand a high static load, but only a small amount of dynamic load. Therefore it is important to have a high preload to reduce the effect of dynamic working loads applied to the joint.

“When tightening, it is important that you choose a tool and a tightening sequence that enable you to achieve the preload that the design engineer has specified,” says Chaib.

Nord-Lock engineers are experts in providing complete solutions for bolted joints including design, product selection and on site support.

Note that this is general advice and does not necessarily apply to all bolting situations.



# THE CHALLENGE

## ANDRITZ HYDRO AB HELPING HYDROPOWER LOOK TO THE FUTURE

The hydropower plant in Laxede on the river Luleälven was built more than 50 years ago. The turbines in two of the three units are now being refurbished and, for the first time, the runners will be replaced – a challenge taken on by Andritz Hydro AB.

“This is the largest impeller we’ve replaced to date,” says Åsa Eklund, System Engineer at Andritz Hydro AB.

WORDS:  
ULRIKA VALLGÅRDA

PHOTO:  
RICHARD GOETZE

**H**YDROPOWER CURRENTLY meets about 16 percent of the world’s total electricity needs. For Sweden the figure is about 45 percent. Andritz Hydro AB is a highly respected company with more than 175 years of experience in turbine design. The Andritz Group is a global leader in hydraulic power generation and

electro-mechanical systems and services for hydropower plants.

The majority of the hydropower plants along the Luleälv River, in the far north of Sweden, were built from the 1950s through to the 1980s. Many of them are now beginning to show their age and are in need of refurbishment.

The hydropower plant in Laxede, 100 kilometres from the mouth of the Luleälv River, is normally unmanned. But while refurbishment is underway, about 25 persons will be working at →



Anders Fundin, Site Manager at Andritz Hydro, is responsible for the company's work at the Laxede hydropower plant, which is currently undergoing a major renovation.

**FACTS:**  
**THE LAXEDE  
HYDROPOWER  
PLANT**

The fall height is 25 metres and average annual electricity production is 885 GWh. As much as 980 cubic metres of water per second passes through the power plant's three units.



**“It feels really good to work with these bolts from a technical perspective.”**

ÅSA EKLUND, TECHNOLOGY PROJECT MANAGER

Åsa Eklund, System Engineer for the refurbishment of Laxede power station, believes that the SB12 bolt-style Superbolt tensioners from Nord-Lock, which they are using for the first time, have worked well. The bolts are attached to the blades and the runner – see picture to the left.

→ the plant. The water that normally flows into the facility to drive the runner in the unit that is being refurbished, has been diverted. The runner has been removed along with all other technical gear.

Gunnar Engström from Vattenfall is the project coordinator. He guides us around the site, where both Vattenfall employees and consultants are working.

“This is a big project for us,” he says.

**THE SECOND TURBINE** will be replaced in 2015, while the third, which is much newer, is in full production.

The contract was signed with Vattenfall in 2011. Shortly afterwards, intense work started on calculations, design and manufacturing. The dismantling of the unit started in August 2013.

Andritz Hydro AB has five people working at the site. Åsa Eklund from Andritz Hydro AB is responsible for technological matters.

“Even if you do careful studies regarding what to renovate, it is only when everything is dismantled that we can see exactly what needs to be repaired.”

The runner, situated at the very bottom, will be completely replaced.

“The new runner has been designed by Andritz Hydro AB,” says Åsa Eklund.

In order for the work to be carried out as smoothly as possible, Andritz Hydro AB has chosen to use Superbolt tensioners from Nord-Lock to secure the blades.

“We began discussions with Nord-Lock about a year and a half ago, and after a couple of months’ work, we decided on the SB12 Superbolts.”

Andritz Hydro AB has previous experience of working with Superbolt nut-style tensioners and they are being used in the runner.

“However, this is the first time we’re using SB12 Superbolts,” she says. “But this is also the

largest runner we’ve assembled so far – 6.5 metres in diameter.”

If they had worked with conventional bolts, she explains, the tools they would have needed for tightening the bolts would have been very large.

“This would not have been good from a work environment perspective, when people are working at a height of a couple of metres.”

They can now manage with a normal-sized standard hand tool, barely one metre long.

“This means that more people can work on installation simultaneously and, consequently, the job is completed more quickly.”

Another benefit is that it is very easy to check how hard the screws have been tightened. “We can constantly and easily measure elongation to attain the right preload we have calculated.”

Åsa Eklund appreciates the collaboration with the Nord-Lock Group.

“Nord-Lock’s personnel are very service-minded. As an example, we needed advice on mounting an M375 Superbolt nut that would be fitted with stainless steel against stainless steel. Nord-Lock sent up one of its experts and we received excellent support.”

**INSIDE THE POWER** plant, Magnus Ekman from Andritz Hydro AB is busy securing the blades on the runner using the SB12 Superbolt tensioners.

“It’s easier than working with regular bolts,” he says. “It’s simpler when there are several small bolts instead of one larger bolt.”

The units they are now refurbishing will be completed and back in service in May 2014. Work will begin on unit number two the following year.

“It feels really good to work with these bolts from a technical perspective, which means it’s good for the guys who install them, too,” says Åsa Eklund. ■

**FACTS:**

**ANDRITZ HYDRO AB**

**ABOUT:**

Supplies equipment and services for new hydropower plants and refurbishes older plants.

**PART OF:**

The Andritz Group’s parent company is in Austria. The Head office is in Graz but the company and its various subsidiaries are represented in nearly every country in the world. Besides hydropower, the Andritz Group also operates in the pulp and paper industry, among others.

**TOTAL NUMBER OF EMPLOYEES IN SWEDEN:**

320, of which 155 are in the Hydroelectric industry.



**Business argument**

This forms the basis of Andritz Hydro AB’s decision to choose Superbolt tensioners from the Nord-Lock Group.

- **WORK ENVIRONMENT:** It is not necessary for us to use large and heavy hydraulic drivers.
- **SUSTAINABILITY:** We can guarantee a better work environment when and if service is necessary at the runner.
- **SAFETY:** Superbolt MJTs can be safely utilized in confined and obscure installation conditions.



Gordon Foat's passion is to find a cleaner, greener way ahead for the motor car. He is an enthusiastic user of Nord-Lock Washers.

**FACTS:**  
**GORDON FOAT**

**AGE:** 40.  
**BACKGROUND:** Gordon gained a BSc in Environmental Science from Kingston University, London and also studied engineering at Brooklands Technical College.  
**CURRENT:** Director and founder (in 2001) of Green MotorSport Ltd.  
**LIVES IN:** Woking, England.

# In the fast lane to greener motoring

**WORDS:** CHRISTINA MACKENZIE  
**PHOTO:** LEORA ROSNER

**IF THE JOB** you want to do doesn't exist, then invent it. That's what Gordon Foat did to combine his two passions: motor cars and safeguarding the environment.

**Aren't these two passions contradictory?**

"Not at all! A love of motor cars runs in my veins. My father was a car restoration expert but I wanted a cleaner, greener way ahead for automobiles. So that's what my business works at."

**Do you build whole cars?**

"No, we make liquid cooled electric motors and supply lithium-ion-phosphate technology batteries to car builders. However, we have developed a brand new electric motor, which we're currently testing on the first car, which is being prepared for WAVE 2014. I'll be using Nord-Lock washers on it for the same reason that I used lock washers from Nord-Lock on my WAVE 2013 rally car: to secure the motor to the car and make it tamperproof and also to lock the engine into place against vibrations."

**WAVE?**

"World Advanced Vehicle Expedition! I've been involved with these expeditions since the

first one was held in 2011. The 2013 rally was across the Austrian Alps."

**How did you discover lock washers from Nord-Lock?**

"On the Internet. I thought they seemed to be exactly what I was looking for so I just phoned up. Nord-Lock was very responsive. I think they realised that I knew a lot of people in the sector and I was more than pleased to spread the word about the Nord-Lock wedge-locking technology."

**How did you do that?**

"Nord-Lock supplied me with over 200 samples, which I brought out at the very first meeting of the 2013 rally to give to my co-competitors and tell them how I was using them on my car. And halfway around the rally one car experienced a technical problem which we sorted out with a Nord-Lock washer."

**How did you "fill up" with electricity during the rally?**

"The support team drove ahead and installed the electric infrastructure so we always had a place to plug in. But if you're driving on your own without this type of support you know every petrol station has at least one ordinary plug. I have never, ever driven more than

30 minutes without finding a plug and I have driven my electric car from Woking to Prague. I was the first person in the world to do that."

**How did the electric cars handle the altitude in the Alps?**

They had no trouble at all. With an electric motor, engines don't overheat or explode. The joy of driving in the Alps is that once you've climbed up to the pass and are then driving down the other side, you use regenerative braking. So by the time you get to the bottom your battery is fully charged again.

**Regenerative braking?**

"It's an energy recovery mechanism, which slows a vehicle or object down by converting its kinetic energy into another form, which can be either used immediately or stored until needed."

**Are the WAVES just for fun?**

"No, they're not only for fun. At every overnight stop we visit the town's school or college and line up the cars for the students to admire. We also try to answer all their questions about this new technology. Climate change is a big problem which we really have to prepare for. And we need to develop the technology now. That's really what this is all about." ■

### SKY-HIGH DEMANDS

The height, corrosion risk and constant threat of earthquakes made Nord-Lock washers a natural choice for Tokyo Skytree.



# The height of safety

**WORDS:**  
DAVID WILES

**PHOTO:**  
TOKYO SKYTREE

**THE CHALLENGE** When you are building the world's tallest freestanding broadcasting tower in one of the world's most earthquake-prone countries, using anything but the highest quality materials and the safest construction solutions is just unthinkable.

The 634 metre high Tokyo Skytree, recognised by Guinness World Records in 2011 as the tallest tower in the world and the second tallest structure, is a marvel of modern architecture and the absolute state of the art.

But the challenges facing such an extremely tall structure are many: besides the high winds and the ever-present threat of earthquakes, the fact that its upper reaches spend much of their time enveloped in cloud and smog require that all components have the highest possible corrosion resistance.

When it came to bolt securing, the extreme height, the small spaces in which the construction workers had to operate and their varying levels of technical expertise, meant that Tokyo Skytree had very specific demands.

**THE SOLUTION** Faced with these challenges, and with Tokyo Skytree's sky-high demands on quality, Nord-Lock washers were the inevitable solution. More than 10,000 pairs of various sizes have been used on the tower, making it almost certainly – with the possible exception of the aerospace industry – Nord-Lock's highest-altitude application. The washers have been used to secure many crucial bolted joints on this awe-inspiring structure.

To meet the customer's exacting demands for corrosion resistance, Nord-Lock supplied washers in high-grade 254SMO® stainless steel, originally developed as a substitute for titanium for use in seawater and other aggressive chloride-bearing environments.

**THE RESULT** Tokyo Skytree, its Nord-Lock washers and other components, were subjected to an unexpected and extreme test on March 11, 2011 when a terrifying 9.03 magnitude earthquake struck off Japan's east coast. While this earthquake and the tsunami that followed caused devastation across the country, the tower – which was then approaching completion – was undamaged, and its Nord-Lock secured bolts had not shifted.

Since its opening in May 2012, Tokyo Skytree has become one of Japan's most high-profile buildings and a major tourist destination. But one sight that visitors to its two observation decks – at 350 metres and 450 metres – will not witness are maintenance workers scaling the tower to tighten those 10,000-plus bolts, because those are secured for good. ■

Tokyo Skytree is a trademark of Tobu Railway Co., Ltd. and Tobu Tower Sky Tree Co., Ltd. in Japan.





2013 Mexican HPVC winner Stingray ITM boasts excellent driver safety. All important mechanical systems are secured by Nord-Lock.



The winning vehicle from 2012 was also built by a Nord-Lock sponsored team.

Naturally, bolt security was a key area of concern, and a decisive factor in helping Stingray win the HPVC Mexico final, which was held in Mexico City in April 2013. "HPVC is a competition that inspects security systems in a very strict way, which is why our team decided to ensure that all important mechanical systems such as steering, brakes, transmission and suspension systems, were secured with Nord-Lock washers," adds Pimentel. "In comparison with other vehicles, we didn't have any mechanic problems or accidents during any of the events."

In fact, it was the second year in a row that the competition was won by a Nord-Lock sponsored team from the University Technological Institute of Morelia. In 2012, Nord-Lock provided bolt securing components to Tarasco ITM, who finished first in the Mexican final, and second in the Latin American final, which was held in Caracas, Venezuela in February 2013.

Through its involvement in the competition, Nord-Lock hopes to reach out to local university students and future engineers in Mexico, and raise awareness of its products and capabilities. The participating students are all in their last year of studies and expecting to enter the industry within the next 12 months. After their experience in the HPVC competition, it is hoped that they will now have a renewed appreciation of the importance of reliable bolt security, and what Nord-Lock has to offer. ■

NIC TOWNSEND

## Nord-Lock supports Mexican students in global competition

For the second consecutive year, a Nord-Lock sponsored team of engineering students has won first place in the Mexican national final of the Human Powered Vehicle Challenge (HPVC). The winning vehicle, Stingray ITM, now progresses to the next stage of the competition, which will take place in Orlando, USA in 2014.

**THE STINGRAY IS** a 27-speed tri-cycle specially designed to be used in city streets in low-density traffic. The vehicle's structure protects the driver, and includes front suspension and an ergonomic adjustable seat.

"Stingray's level of safety is unique since it offers excellent stability, braking and a great turning

radius, making it the best human powered vehicle from HPVC Mexico," says Manuel Pimentel Vega, one of the students involved in the project. "Nord-Lock's contribution was one of the most important factors as it ensured all bolted joints were secure and that really made a difference compared

with the other human powered vehicles."

The Human Powered Vehicle Challenge is organised by the American Society of Mechanical Engineers (ASME), and is an international engineering competition for university students. The objective is to motivate new generations of engineers to develop low-cost and environmentally-friendly transportation.

The competition format encompasses the full engineering process, including design, budget, idea analysis, testing and final implementation.

## Nord-Lock Group welcomes new CEO

Last August, Ola Ringdahl took over as the new CEO of the Nord-Lock Group. He talks to Bolted about his impressions of the company, plans for the future and what he has learned from travelling halfway around the world in a Land Rover.

### Why did you decide to join Nord-Lock?

"What appeals to me about Nord-Lock is that it is a well established industrial company offering high-quality products. Nord-Lock has everything including R&D, production, distribution and sales. Its products (Nord-Lock and Superbolt) are critical for many applications and highly appreciated by demanding customers around the world. The owners of the Nord-Lock Group have an industrial mindset, with a long-term perspective. This appeals to me and fits in with my management philosophy."

### What are your first impressions?

"Nord-Lock is a relatively small company, with 400 employees. However, it is surprisingly global. It boasts a high level of expertise and has a lot of very skilled people



Ola Ringdahl, new CEO of the Nord-Lock Group.

within engineering, manufacturing, sales and marketing."

### What do you see as being your biggest challenge?

"Innovation and growth – they always are. We of course need to continue to deliver world-class quality products. But we also need to accelerate our product development and further develop our customer-focused sales and performance services in order to continue our growth."

### What can we expect from you as a CEO?

"I have a structured approach

and one of my strengths is creating organisations that help people to perform. I can be very demanding but also very supportive. I want to be a visible and accessible CEO. My background is mainly in sales, so I will be very customer-oriented in my management approach."

### Should we anticipate a lot of changes?

"There will be some structural changes in order to further improve our product development. But I will mainly build upon the good work that has been done in previous years. Nord-Lock already has a

good, customer-oriented strategy." **You're also known for your long-distance overland journeys. Can you tell us more about that?**

"Yes, my wife and I are keen on adventures, and we have travelled extensively with our children. It started when we were living in South Africa, and my wife bought a second-hand Land Rover, which we used for short trips around Southern Africa. Shortly after the birth of our first child, we decided to drive from Cape Town to Cairo. Once we reached Cairo, we decided to keep going and drove all the way to the North Cape in Norway. We continue to travel as often as we can, even with four children. The longest overland trip we've done so far was from Sweden to Cambodia. I've written two books about our travels."

### Have these adventures helped you in your career in any way?

"Absolutely. We've been to many different countries and met many different people. I think this has improved my ability to communicate across cultures, which is important when working for a global company like Nord-Lock. I also think travelling to other countries gives you a certain perspective on things." ■

NIC TOWNSEND



Nord-Lock is helping MAN Diesel & Turbo to develop guidelines for how its washers should be utilised.

## Sharing the knowledge

**AS WELL AS BEING** able to provide high-end bolt securing products, the Nord-Lock Group also offers customers its expertise and extensive industry knowledge, as exemplified in two recent initiatives.

Earlier this year, representatives from the Nord-Lock Group held a seminar for the Israel Electric Corporation (IEC), where they presented Superbolt technology and X-series washers.

"The participants greatly enjoyed the presentations,"

claims Asher Zaguri, CEO at Lillytech Israel, a Nord-Lock distributor. "Following the seminar, Nord-Lock was invited to visit two of IEC's power plants where they were asked to offer solutions to bolting problems. We are now discussing an initial order for Superbolt tensioners."

Nord-Lock is also working with MAN Diesel & Turbo, who have been using Nord-Lock washers to secure bolted joints on its diesel engines since the 1990s. Through extensive tests

carried out at the Nord-Lock Technical Centre in Malmö, Sweden, Nord-Lock is helping MAN Diesel & Turbo to develop guidelines for how its washers should be utilised.

"In striving to increase the coherence in our design processes, we have developed an internal standard or best practice guideline stating which kinds of parts should be used for different bolted connections in general, including Nord-Lock," says Mikael Henrik



The Nord-Lock X-series won the Innovation Award at the Nuklea 2013 exhibition in Orleans, France.

## Nord-Lock X-series wins Innovation Award in France

**LAST OCTOBER**, at the Nuklea 2013 exhibition in Orleans, France, the Nord-Lock X-series won the Innovation Award. Nord-Lock France was one of 350 exhibitors that attended the trade fair, which brought together suppliers from the nuclear energy industry.

"The Gold award to the Nord-Lock X-series shows once again the added value offered by Nord-Lock as an expert in the bolting industry, as well as being ahead of its time," claimed Denis Mullenbach, Global Account Manager, Nord-Lock France. "This award is also an acknowledgement of all our colleagues involved in the project." ■

Andersen, Mechanical Engineer, MAN Diesel & Turbo. "Now, we want to add a user-friendly choice flow chart, specifying where and how to reuse the product, and the Nord-Lock Technical Centre is helping us with test results for our documentation."

These are just two examples of the countless seminars, meetings and customised tests Nord-Lock organises every year as part of its efforts to better support its customers. ■

# Comparison of common bolt tightening methods

**PROPER PRELOADING** of a bolted connection is a difficult task. Therefore, several different tightening methods were developed – each with their specific advantages and disadvantages. So, different methods are preferred in different industries or for certain applications.

Generally, tightening methods can be categorised according to the

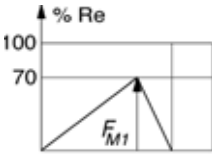
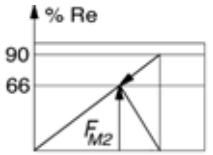
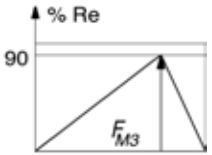
principle of how the preload is generated. There are 2 basic principles:

- Rotational tightening (torque controlled, angle controlled, yield controlled), where the tensioner is rotated to directly produce the preload.

- Tensioning (hydraulic, thermal, mechanical), where the bolt is stretched without rotating the

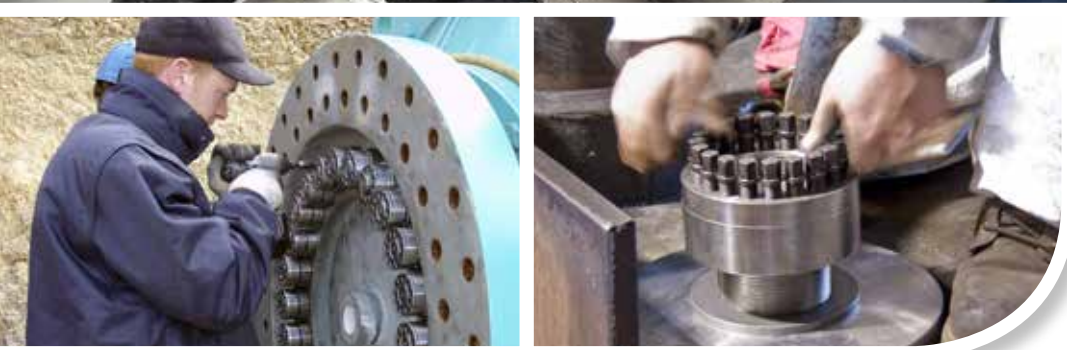
tensioner, typically by means of an external power supply.

For large boltings, especially for large sizes above M39 or 1.5", the three tightening methods shown below are predominant. This comparison is based solely on the indisputable physics behind these methods and illustrated with the help of Roetscher's diagram.

	Torque tightening	Hydraulic tensioning	Mechanical tensioning with Superbolt MJTs
	Consider an ideal bolted connection where the thickness of the clamped parts is 5x the diameter of the thread. The typical design criteria is that the tensile stress in the bolt may not exceed 90% of the yield strength.	If this connection is torque tightened, the bolt can only be used to 70% of its yield strength (Re) because approx. 30% is lost due to torsional stresses induced by the tightening torque.	With hydraulic tensioning the bolt is stretched by means of a powerful hydraulic tool to the permissible 90% of the bolt's yield strength (Re). The nut is spun down and snugged up to the clamped members to remove all backlash. When the hydraulic pressure is relieved, the bolt springs back again to tension the nut. Thereby approx. one third of the load produced by the hydraulic tool is lost. Thus, the bolt can only be used to around 66% of its yield strength (Re). For longer tie rods this value may increase up to 80%.
<b>Roetscher's diagram</b>			

As this comparison shows, a substantial benefit of Superbolt MJTs lies in the improved use of the material strength of the bolt. If already considered in the design phase, more clamp load ( $F_{M3}$ ) can be generated with less bolted connections, or the bolted connections can be made smaller to reduce the overall size, weight and cost of the machinery. With Performance Services, Nord-Lock offers a unique service to optimise the design with the help of our skilled engineers, so customers will profit most from the use of Superbolt MJTs.

# Eliminate bolting problems



Large diameter bolting can be challenging. An ideal solution is one that can be installed and removed safely and quickly. One that will keep your bolted joints tight throughout demanding operations.

That's where Superbolt tensioners come in.

Only hand tools are required to install and remove any size tensioner, increasing worker safety. Superbolt tensioners have been proven to deliver accurate, even tension and reduce downtime. They aren't called 'Superbolts' for nothing - discover the difference at:

[www.superbolt.com](http://www.superbolt.com)



 **SUPERBOLT™**  
Part of the Nord-Lock Group