

BOLTTED



**COMPLETE WASHER
PROGRAMME
CERTIFIED**

SHIBUYA ARCHERY

**NEW SIGHT
SETS NEW
WORLD RECORD**

**3 NORD-LOCK
SECURITY
SOLUTIONS**

METSO MINERALS

**CONTROLLING
THE SHAKE,
RATTLE AND ROLL**

FASTENER QUALITY

**MORE THAN
MEETS THE EYE**

The Nord-Lock combi bolt

Efficient. Accurate. Cost effective.

The Nord-Lock combi bolt is a bolt with an integrated pair of Nord-Lock washers. With the Nord-Lock combi bolt, you will be able to increase the efficiency, accuracy and safety of your assembly, while at the same time keeping inventory and part count at a minimum.

Based on our proven wedge-locking technology, the Nord-Lock combi bolt secures bolted joints and maintains a high clamp force even under severe operating conditions.



NORD-LOCK®

Bolt securing system

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www.nord-lock.com



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

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EDITOR-IN-CHIEF:

Carin Esberg
carin.esberg@nord-lock.com

EDITORIAL MANAGER:

Susanne Magnusson
susanne.magnusson@tidningskompaniet.se

TRANSLATIONS:

Språkbolaget www.sprakbolaget.se

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Bringing together two of the most innovative and trusted bolt securing technologies

I AM HAPPY TO INFORM YOU that US company Superbolt Inc and Swiss company P&S Vorspannsysteme AG are now part of the Nord-Lock Group! Just like Nord-Lock, Superbolt and P&S offer an excellent solution that provides maximum security to bolted joints and holds global recognition. Read more at www.superbolt.com and www.p-s.ch. For BolTED, this promises for exciting reading ahead as our Group now comprises two of the most innovative and trusted bolt securing technologies! As this issue of BolTED was just about to be finalised when this news came through, we are looking forward to investigating this technology further in our next issue, planned for release in March (No. 01, 2012)!

CONTINUING WITH MORE GOOD NEWS – As of this issue, BolTED is available in six languages: English, German, Japanese, French, Chinese and Swedish! If you have missed any issues, you can find all existing BolTED editions at www.bolted.com.

IN THIS ISSUE we focus on fastener quality. Understanding what makes a good fastener is the key to high performance over time. Two bolts that appear identical to the eye may perform completely differently when placed in demanding applications. In this issue we provide an overview on what to focus on when sourcing fasteners (pages 8–11). We also introduce a new service, the Nord-Lock E-learning, which enables remote product training for assembly and maintenance staff (page 18). In my opinion, ensuring that the product is used correctly is just as important as choosing the right product, regardless of which industry you operate within! Contact our nearest representative or email info@nord-lock.com to find out more about our remote product training tool.

CARIN ESBERG
MARKETING MANAGER



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HIGH SECURITY

The Crystal Tourniket door is fitted with Nord-Lock washers, as are all Boon Edam revolving doors.

OPENING NEW DOORS

CUSTOMER: BOON EDAM	MODEL: CRYSTAL TOURNIKET	HEIGHT: 442 METRES	FLOOR: 124 TH (OUT OF 160)
DOORS INSTALLED: 6 (2 AT OBSERVATION DECK)		TOTAL HEIGHT OF BURJ KHALIFA: 828 METRES	

SINCE ITS COMPLETION last year, the Burj Khalifa skyscraper in Dubai has already broken numerous world records. Apart from being the tallest structure ever built, it also includes the world's highest restaurant, highest nightclub, highest elevator installation and highest outdoor observation deck. Leading to the observation deck are the world's highest revolving doors.

At a height of 442 metres, the new doors not only have to withstand high winds and extreme weather conditions, but also have to fit into the building's main façade and aesthetic setting. Boon Edam, which has been supplying revolving doors for over a century and become world leaders in the field, was a natural choice when it came to selecting a supplier. Boon Edam's Crystal Tourniket revolving door is made of toughened glass and is completely transparent, making it a perfect combination of style and functionality.

For a number of years now, Boon Edam has been using Nord-Lock washers in its revolving doors as it has found that their improved reliability and superior locking abilities have significantly reduced maintenance costs. Boon Edam supplied a total of six doors to the Buri Khalifa skyscraper, including two at the observation deck, all of them containing Nord-Lock components. □



DRILL WITH SKILL

CUSTOMER: GEAWELLTECH	MODEL: 3050CR	DEPTH: 300 METRES	HORSEPOWER: 55 kW	WEIGHT: 6,200 KG
HEIGHT: 6 METRES	LENGTH: 3.8 METRES	WIDTH: 1.7 METRES	DRILL-HOLE DIAMETER: 4-6 INCHES	

WHEN IT COMES TO DRILLS, size and horsepower are not everything. In small confined spaces or sensitive environments, it is more important to have equipment that is flexible and can drill with finesse.

For these kinds of jobs, Swedish supplier Gaewelltech uses its 3050CR – a complete drill system centred around a lightweight rig, which allows it to drill in confined spaces with minimal impact on its surroundings. Yet the 3050CR still has the capacity to reach depths of 300 metres quickly and easily.

Such high capacity in a small format puts a lot of stress on both the equipment and its components, and bolt failure is the most common cause of downtime. After seeing how effective Nord-Lock washers were on hydraulic hammers, Gaewelltech decided to apply them to the 3050CR. Today, a 3050CR is equipped with around 80 pairs of washers. □

AIDING FLEXIBILITY
A 3050CR is equipped with around 80 pairs of Nord-Lock washers.

PHOTO: GEAWELLTECH

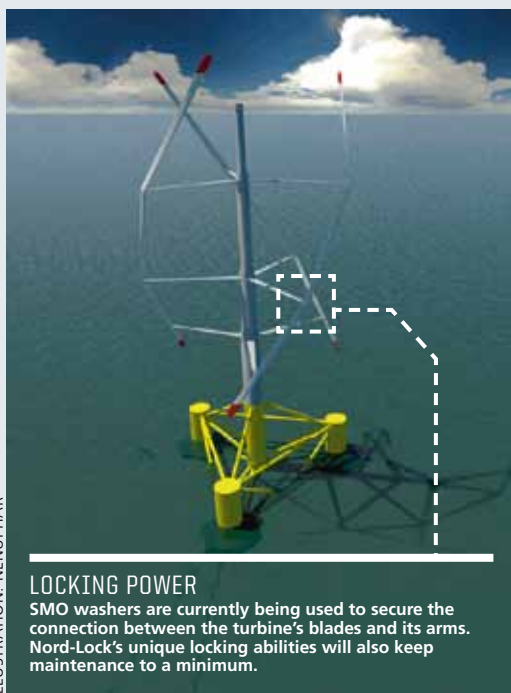


ILLUSTRATION: NENUPHAR

LOCKING POWER

SMO washers are currently being used to secure the connection between the turbine's blades and its arms. Nord-Lock's unique locking abilities will also keep maintenance to a minimum.

THE LOW-COST WIND ENERGY ALTERNATIVE

CUSTOMER: NENUPHAR	MODEL: VERTIWIND	HEIGHT: 100 METRES	OUTPUT: 2 MW
FLOTATION SYSTEM UNDERWATER EXTENSION: 9 METRES			

FRENCH MANUFACTURER Nenuphar is currently on track to make a huge breakthrough in floating wind turbine technology with its VertiWind project. Unlike traditional wind turbines, the VertiWind turbine has a vertical axis, which allows for a lower centre of gravity and a significantly smaller flotation system. It can also be installed in water deeper than fifty metres, enabling it to capture more powerful and consistent winds further out to sea. As it does not require a subsea structure, installation costs are significantly lower, and it can potentially be a low-cost alternative to conventional offshore wind turbines.

Nenuphar is currently working on a full-scale two megawatt offshore prototype, after successfully constructing a 35 kilowatt onshore prototype last year. Once it is launched at sea, the prototype will be subject to severe stress, so it must be robust. With the help of Nord-Lock Performance Services, Nenuphar is continuously optimising and improving its design, and SMO washers are currently being used to secure the connection between the turbine's blades and its arms. Nord-Lock's unique locking abilities will also keep maintenance to a minimum, which will be vital if the VertiWind is to be a viable low cost solution. By the end of 2013, Nenuphar hopes to have deployed a full-scale offshore turbine in the Mediterranean Sea. □



DAMIEN THOMAS
FIELD APPLICATIONS
ENGINEER

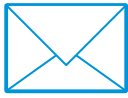


CSABA MADRU
MANAGER, GLOBAL DEVELOPMENT
PERFORMANCE SERVICES



CHRIS TATAK
APPLICATIONS
ENGINEER

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



ASK THE EXPERTS

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

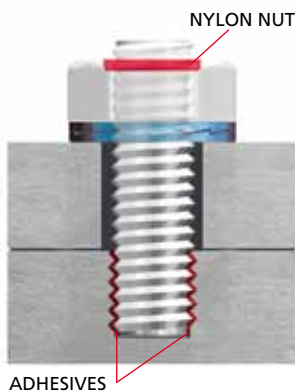
Can I use an additional locking system?

Q: Can I use an additional locking system with Nord-Lock washers?

A: It is recommended to use only standard fasteners (nuts and bolts) with Nord-Lock washers. Other specialised locking systems, including prevailing nuts and adhesives, are not advisable and would not add any benefits to the joints.

Theoretically, it is possible to use prevailing nuts and adhesives together with Nord-lock washers, but they will increase the thread friction when tightening the joint. When tightening, less of the torque can be converted into useful clamp load because the torque must overcome the additional friction. Also, increased thread friction raises the risk of torsional stress in the bolt and may lead to unexpected bolt failures. Additionally, these systems will add more cost to the joint.

Nord-Lock is a reliable, engineered system and there is no need to use any additional locking systems. The superior quality guarantees excellent tightening control and the joint is exceptionally secure.



How do I take torsion into consideration when tightening?

Q: How do I take torsion into consideration when tightening a bolted joint?

A: Torsion is the twisting of the bolt when applying the tightening torque. When a bolt is tightened it is subjected to tensile stress as preload is introduced but also to torsion stress as a result of thread friction. Torsion generates a shearing stress that is perpendicular to the radius in the circular cross section of the bolt.

Bolts are designed to support a certain stress [N/mm²] before yielding, known as the yield strength of the material. Torsion increases the total stress in the bolt, which may break at a lower preload than expected; the greater torsion stress, the lower the tensile stress that can be introduced. Therefore, when designing a bolted joint, it is important to consider both tension and torsion in order

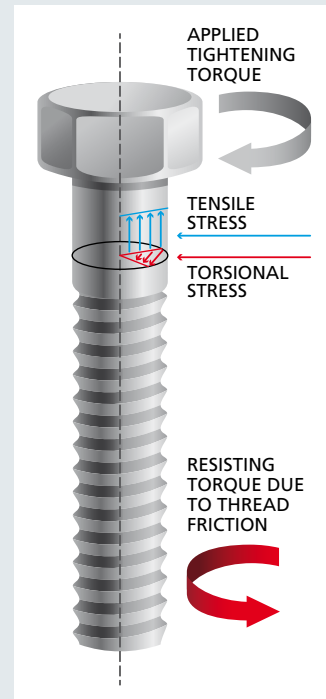
to utilise maximal axial load in the bolt without yielding it.

It is possible to anticipate the amount of torsion stress using the following two methods:

- By calculation, according to international standards and recommendations.

- By considering that torsion stress will represent 15% of the total stress. Nevertheless, in respect of thread friction, this usual value can be adjusted: from 10% if the fasteners are lubricated, to 20% in dry conditions and even more when using friction-based locking fasteners.

Since torsion originates from thread friction, it can be simply reduced by applying a lubricant to the threads of the fastener. There are also tightening methods utilising tensioning of the bolt either by hydraulic equipment or special nuts. Since no turning movement occurs between the threads, tor-



sion can be completely eliminated and a higher axial tension obtained without any risk of the bolt yielding. **CM**

The prevailing nut category includes a multitude of fasteners. Nylon insert nuts, metal insert nuts, flex top expanding nuts and distorted thread nuts are just some of the products that are available. These products add friction to the bolted joint and are more costly than a standard nut.

Adhesives are a little different but can cause the same problems. Some existing adhesives are thread lockers, joint sealants and thread sealants. In addition to adding undesirable friction to the bolted joint, the option of using a thread lubricant is also eliminated. A good lubricant is recommended in order to reduce friction, further minimise clamp load deviation and protect against corrosion.

To optimise your joints it is recommended to use lubricated standard fasteners together with Nord-Lock washers which will result in a secure joint, predictable preload and low deviation. **CT**

How much thread engagement is needed in a tapped hole?

Q: Is it possible to determine the minimum thread engagement in a tapped hole to avoid thread stripping?

A: Every threaded joint must fulfil a simple engineering rule: any fastener failure must occur in the shank of the male fastener – bolt or stud. It implies that the shear strength of both internal and external threads overcomes the tensile strength of the bolt. Therefore the choice of the fasteners and the design of the assembly must avoid any possibility of thread stripping while making sure the weakest element in the joint is the bolt or the stud.

The shear resistance of any thread can be calculated by following E.M. Alexander's method¹⁾, depending on four main parameters:

- The Young modulus E of the material

- The shear strength t_m of the material

- The shear area of the thread, related to both the clearance between internal and external threads, and the effective thread engagement which is equal to the depth of tapped holes, minus the height of entry chamfers.

Nevertheless, tolerance can modify the previous indications: the wider the thread clearance, the smaller the thread stripping load. Calculation tools according to Alexander's method can deliver accurate results. Note also that Nord-Lock offers a calculation service. **DT**

¹⁾ Analysis and design of threaded assemblies, E.M. Alexander, 1977

Fastener quality

ALL IN THE DETAILS

Quality fasteners are essential for safe, economic designs. But what determines quality, and how do we make sure we obtain good quality? *Bolted* has conducted an in-depth study of the subject.

WORDS:
INGELA ROOS

ILLUSTRATIONS:
ROBERT HILMERSSON

If the wheel nuts on your car come loose while you're driving, the whole car will probably sustain damage. If a fastener in the engine breaks the entire car is also at risk of sustaining damage. The consequences of a fastener failure tend to be significant.

"Joining parts together is one of the most critical steps when delivering a product or a system. And the fastener is the key component in this," says Maxime Thonnerieux, Global R&D Director at Nord-Lock.

It is absolutely crucial that fasteners fulfil their function. They must be safe and depend-

able throughout the product's life cycle, and this is where the quality concept enters the picture.

When we use poor quality fasteners there is always a risk that parts cannot be assembled at all, or that they break during assembly. However, the most serious consequences often occur when everything seems to be in order during assembly, and the poor quality gives rise to faults at a later stage. This may be corrosion, loosening or fastener failure due to metal fatigue.

"We have seen many such cases where people have installed fasteners in good faith only for them to fail later," says Bengt Sehlå at the Swedish Institute of Steel Construction.

For example, the less experienced manufacturer may accidentally expose fasteners to so →





Threads

The standards specify a number of thread parameters, but not the actual shape, which is difficult to control. Shape defects – not even noticeable beneath the coating – may give rise to weakened threads.

→ much heat when applying a coating that hydrogen migrates into the steel causing embrittlement and steel strength to fall below the stamped value.

The first step in ensuring good quality is to choose fasteners that meet the relevant standards. For example, in Europe all construction materials must be CE-marked, which entails their conformance with basic function and safety standards and compliance with prescribed inspection procedures.

“But there may be manufacturers that CE mark their products without having the right to do so, which is why it’s advisable for purchasers to frequently carry out random sample tests to see if the fasteners meet their standards,” says Bengt Sehlå.

UNFORTUNATELY it’s not possible to inspect every single fastener as it is often a matter of very large quantities, and the tests destroy the fasteners. There are also parameters that are difficult or impossible to check on the finished product, and which are therefore not covered by the standards. The best thing the purchaser can do to ensure he gets good and consistent quality is to set up a quality acceptance level depending on the potential consequences affecting the final product and accept only lower quantities of defected fasteners (PPM) from the manufacturer.

MANUFACTURING FASTENERS is a very complex process. A fastener is not just an object but a product that must fulfil its function safely and reliably. Every stage of the manufacturing process is important to final quality, some stages more so than others.

Supervision of the manufacturing equipment is an important element to verify consistent quality. If a machine performs the same operation on bolt after bolt, then its load curve should appear identical every time the machine carries out the operation. If the load begins to deviate from the usual curve it’s time to stop the machine and look for the problem.

The stage most critical to quality depends on the type of fastener. For nuts and bolts, thread rolling and the coating are good examples of critical stages; the coating, because it often involves temperature variations that may have an adverse

Labelling

Batch numbers for traceability. If a problem occurs, the manufacturer can re-check the specific batch from which the fastener came. Traceability is important for the manufacturer’s quality management.

Coating

Good quality coatings are not only important for rust resistance, but also for ensuring that the applied torque creates the correct tension in a joint.

affect on steel strength. It is also important that the coating is good, particularly in respect of its capacity to grip the steel, as well as its ability to ensure sufficient friction. It is friction that determines the amount of tension in a joint when it is tightened to a given torque.

“A poor coating may induce a higher or lower tension than anticipated,” explains Maxime Thonnerieux.

Excessive tension may cause a fastener to

shear during assembly, while insufficient tension may lead to bolt loosening or fatigue failure at a later stage.

HOWEVER, for washers it is the final coining that is of greatest importance. A quality-conscious manufacturer will naturally make certain that every stage of the manufacturing process is checked, and be extra thorough with those stages that are especially critical.



Nuts

It is important that nuts are manufactured to the same standard as bolts, so that their threads are cut correctly in relation to each other. Otherwise there is a risk of the threads stripping at low torque values.

“It’s advisable for purchasers to frequently carry out random sample tests to see if the fasteners meet their standards.”

BENGT SEHLÅ, THE SWEDISH INSTITUTE OF STEEL CONSTRUCTION

The steel

One of the most important quality factors. First-rate manufacturing materials are the basis of good final quality. Fastener strength depends largely on the steel’s composition.

The head

Defects in bolt head shapes hinder installation. Above all, this applies to the use of automatic tools. Unfortunately, the shape is difficult to check on finished products.

The quality initiatives of a manufacturer should also extend beyond the factory. Batch numbers on every fastener permit traceability, which forms an important part of the total quality management system. If a customer suffers problems with a fastener the batch number allows the manufacturer to re-check the manufacturing batch and perhaps identify the root cause of the problem. Sometimes it is also advisable to notify other customers

that have purchased fasteners from the same batch.

So, as customers what do we do to make sure we’ve bought good quality fasteners? Identifying certification carried out by 3rd party bodies can be helpful in the search for quality-conscious manufacturers. The certification is a guarantee that the company fulfils precise standards.

MAXIME THONNERIEUX recommends the purchaser chooses fastener suppliers that can prove they meet the required standards and have approvals and certificates from different industries.

“I would ask the manufacturer how he could assure me that all his products fulfil performance requirements.

Are there any occasions when the choice of high-quality fasteners is of the utmost importance?

“Perhaps in structural applications for bolts exposed to high loads, temperature variations, shocks or vibrations, where safety really matters. But in my opinion, safety matters every time,” says Maxime Thonnerieux. □

Business arguments

■ **HIGH QUALITY FASTENERS** guarantee high safety levels.

■ **HIGH QUALITY FASTENERS** have the correct shape which aids installation, especially where automatic tools are used.

■ **HIGH QUALITY FASTENERS** have good coatings that protect against corrosion, which reduces the requirement for rust damage inspections.

■ **HIGH QUALITY FASTENERS** significantly affect life cycle costs. In the long run, they save you money.

Staying true to the original

Böllhoff has become one of the world’s leading suppliers of fastening, assembly and systems technology, through its long-standing commitment to quality. When it comes to washers, Nord-Lock easily fulfils the high Böllhoff standard.

WORDS: NIC TOWNSEND

BÖLLHOFF IS A FAMILY-RUN business based in Germany that goes back four generations. Today, it has more than 2,000 employees and its technology can be found all over the world. Over time, it has built a solid reputation for high quality, continuous improvement and a zero-tolerance policy when it comes to errors.



Frank Nientiedt

“**AS FAR AS QUALITY** is concerned, we have no room for compromise,” says Frank Nientiedt, executive board member at Böllhoff. “The same is true of Nord-Lock.” For the past ten years, the two companies have been working together. This has proven to be a highly successful partnership.

To ensure that its high standards such as ISO, IRIS (International Railway Industry Standard) and DIN (German Institute for Standardisation) are maintained, Böllhoff is regularly audited by several accredited certification bodies. Nord-Lock washers have also been subjected to similar testing and have had their effectiveness verified by independent institutions, including the German Federal Railway Authority (Eisenbahn-Bundesamt, EBA) and Deutsche Bahn.

“As far as quality is concerned, we have no room for compromise.”

FRANK NIENTIEDT, EXECUTIVE BOARD MEMBER AT BÖLLHOFF

SUCH ACCREDITATIONS have given Böllhoff full confidence in Nord-Lock’s locking capabilities, which is vital for the safety and reliability of its applications. It also welcomed Nord-Lock’s decision in 2011 to provide laser marking on all its washers. “By labelling its products, Nord-Lock ensures that the original can be distinguished from a copy at a glance,” says Nientiedt. “This is particularly important in applications where copies could cause problems.” □

GOOD

VIBRATIONS

AGGREGATE The huge machines made by Metso Minerals France are a mechanical nightmare. Whereas vibrations are usually eliminated from machines, the very raison d'être of the Metso machines is to vibrate as much as possible in order to sort and grade stones so they can be used by the construction industry and, to a lesser extent, in the mining sector.

WORDS:
CHRISTINA MACKENZIE

PHOTOS:
NIKOLAI JAKOBSEN



WHO WOULD IMAGINE that the burgeoning skyscrapers emerging from the desert sands of Dubai and Abu Dhabi are made with machine-made sand? The Emirates are surrounded by the great wastes of the Arabian desert and yet all this sand is useless for making cement. “The grains are too perfect, too round and smooth as they’ve been worn away over aeons by wind,” laughs Vincent Celsi, Metso Minerals’ Product Manager, Vibrating Equipment for Europe, the Middle East and Africa. “In order to make good quality cement the grains need to be cubic so that they lock together,” he explains.

And so the sand has to be made from rocks taken from Fujairah, the only Emirate of the United Arab Emirates that is almost totally mountainous. The machines that turn rocks into cubic sand grains by crushing or smashing and then sorting them into size by vibrating are made by Metso Minerals France.

The vibrating screens and feeders marketed by Metso throughout the world are designed and, in some cases, built in Mâcon in a 51,000 sq-metre factory which has grown on the picturesque site bordering the wide, slow-moving and frequently flooded Saône river in central France since Joseph Bruno founded a small wood and iron construction company there in 1867.

DAVID BELLEC, ENGINEERING manager for vibrating equipment mining and construction technology, says that wherever possible the machines, some of which are so large they can only be transported by special road conveyer, are built close to the clients. The parent company, Metso Corporation has over 30 manufacturing units, including five foundries, throughout the world. “Even if the manufacturing is regional the overall conception and design is global,” he says, so that wherever the machine is built it will be constructed according to a template designed in Mâcon.

There are three different machines used to turn rocks into gravel or sand. The “jaw” is a crusher which can transform a rock that weighs 3 tons and measures 2 m³ into one that measures

just 40 cm³. As its name suggests it works like a giant jaw, biting down on the rock and crushing it. The “cone” resembles two shortened ice-cream cones placed inside each other: the larger outer one remains static while the smaller, inner one vibrates against the walls of the outer cone thereby crushing the stones that are caught between the two surfaces. The “impactor” looks like a water wheel in a box where the blades of the fast-spinning wheel catch the rocks and hurl them against the walls of the box, thereby smashing them.

“The choice of machine depends entirely on the crushability and abrasiveness of the rocks being handled,” explains Mr Celsi. →



The machines made by Metso Minerals France turn rocks into cubic sand grains by crushing or smashing and then sorting them into size by vibrating.

“If we didn’t use Nord-Lock washers the bolts would disassemble and the machines would self-destruct.”

VINCENT CELSI, PRODUCT MANAGER AT METSO MINERALS



Every single bolt on Metso Minerals vibrating machines is made safe with Nord-Lock washers.

➔ In addition there is the “scalper.” This is a more sophisticated and automated version of the pan that you see in every cowboy film involving gold diggers. It also vibrates a lot harder! It is basically a sieve that vibrates allowing smaller particles to fall through to the next level where there is a finer sieve that catches these and allows even smaller ones to fall through to another level, and so on. At each level the material is evacuated by means of conveyor belts and ends up as those large mounds of differently graded gravel and sand that can be seen at quarries and at sand and gravel companies.

WHAT THESE MACHINES, which range in size from 2.5 tonnes to 40 tonnes, have in common is that they vibrate “at between 700 to 1,000 turns a minute causing the particles inside to accelerate

to between 3 and 6 G forces,” says Mr Bellec. “You can imagine that to make a 40 tonne machine vibrate you need to produce the equivalent of 160 tonnes of effort,” he says. “By definition this is self-destructing. Vibration is anti-mechanical,” he smiles, “and so you need extremely safe and solid equipment to lock the bolts.”

And that’s where Nord-Lock comes in. Every single bolt on these vibrating machines is made safe with Nord-Lock washers. “If we didn’t use Nord-Lock washers the bolts would disassemble and the machines would self-destruct,” says Mr Celsi. “These washers guarantee that everything assembled with nuts and bolts – the only other way we assemble is through riveting – will resist the vibrations,” he adds. “If we didn’t use Nord-Lock washers our machines would not meet the tests and norms for this type of equipment,” he says. □

FACTS:

METSO MINERALS FRANCE, MÂCON, FRANCE

WHAT IT DOES:

MANUFACTURES MACHINES THAT CRUSH AND SORT STONES FOR THE CONSTRUCTION AND MINING INDUSTRIES

PART OF:

METSO CORPORATION OF FINLAND WHICH ALSO WORKS FOR THE POWER GENERATION, OIL AND GAS, RECYCLING, PULP AND PAPER INDUSTRIES

FOUNDED:

IN 1867, ATELIERS BERGEAUD MÂCON BECAME NORDBERG BERGEAUD UNTIL 2004, WHEN IT WAS BOUGHT BY METSO CORP

ANNUAL SALES:

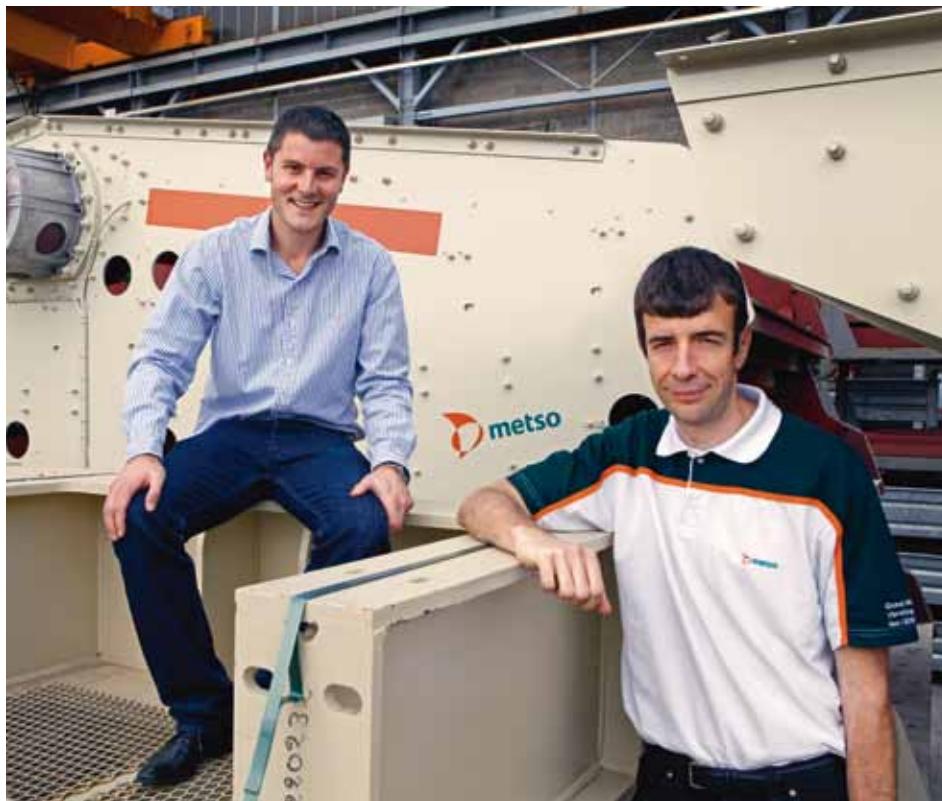
€235 MILLION

NUMBER OF EMPLOYEES:

471

BOLT SECURING:

NORD-LOCK



Vincent Celsi (left) and David Bellec (right) at Metso Minerals rely on washers from Nord-Lock to ensure that their vibrating machines do not self-destruct.



Business arguments

THIS IS HOW Metso Minerals France benefits from Nord-Lock washers:

- **RELIABLE** – will not loosen on heavily vibrating machines.
- **EASE OF USE** – bolts can be disassembled for necessary machine maintenance.
- **QUALITY** – a guarantee of safety for clients.
- **CORROSION-RESISTANT** – Nord-Lock washers are coated with zinc flake, Delta Protect®, as a standard.
- **TIME-SAVING** – machine shut-downs for maintenance are minimal.

Railway safety lies in maintenance

WORDS:
DAVID WILES

PHOTO:
TOMAS BERGMAN

RAILWAYS Why is railway maintenance so important – and what could the consequences be if it isn't carried out correctly?

"A railway system is a complex mode of transport with high demands on safety to eliminate the risk of accidents. If maintenance is not carried out properly it may result in delays or, in the worst case, accidents. To ensure a high level of reliability and availability, implementation of an effective maintenance programme is a must. Wear and rolling contact fatigue in rails and wheels are significant problems for the railway sector."

What are some of the common causes of maintenance-related incidents?

"In general, maintenance-related incidents or accidents are the result of improper maintenance execution or poor maintenance strategy. Some of the research carried out at Luleå Railway Research Centre indicates that many accidents happen during execution of maintenance rather than as a consequence of lack of maintenance. However, lack of maintenance or poor maintenance has also been reported as a major cause of recent accidents."

What sort of forces are rails, sleepers and their bolts exposed to?

"Temperature changes and fluctuations impose longitudinal stress on rails. These forces are then transferred to the sleepers and substructure via rail fastenings. When trains are operating, horizontal and vertical track forces, vibrations, and imposed forces from carriage steering ability, as well as poor subgrade/subsidence, are other types of interacting forces. Different vehicle types have different degradation processes: badly-maintained trains damage rails, sleepers and sub-



FACTS:
UDAY KUMAR

POSITION: Professor and Head of the Division of Operation and Maintenance Engineering, Luleå University of Technology, Luleå, Sweden.

NATIONALITY: Indian.

LIVES: Luleå, Sweden.

CAREER: Previously PhD student at Luleå and lecturer at University of Stavanger, Norway.

"In a high-speed regime, any bolt-securing engineering solutions will definitely be useful investments for the railway sector", says Professor Uday.

structure and cause increased fatigue rates of materials. Poor maintenance of vehicles and wheel sets increases track forces and increases the degradation rate."

What will the future of faster trains running with shorter interval mean for the forces that the rails and their bolts are exposed to?

"Nuts and bolts will have very high demands placed on them due to safety-related issues. The higher the speed, the greater the dynamic forces causing loosening of nuts and

"The higher the speed, the greater the dynamic forces loosening nuts and bolts."

UDAY KUMAR, PROFESSOR, LULEÅ UNIVERSITY OF TECHNOLOGY

bolts. Since nuts and bolts will need more maintenance and service to ensure safe travel in a high-speed regime, any bolt-securing engineering solutions will definitely be useful investments for the railway sector. They would not only make the

train journey safer but would also increase the capacity of the track and eliminate track maintenance-related accidents. I think any such bolt-securing solutions would be attractive to railway operators, especially those in the high-speed sector." □

Bullseye! Right on target

WORDS:
DAVID WILES

PHOTO:
DEAN ALBERGA

THE PROBLEM In the world of archery, accuracy is everything. The latest high-tech compound bows use a system of pulleys to produce ferocious amounts of power, but that power is useless if the arrow does not fly where the archer wants it to. Therefore the sight on a compound bow is of utmost importance. However, the accuracy of these sights can easily be affected by the sheer forces involved, and screws are prone to vibrating loose. "When the screws first come loose it affects your aim," says Philipp Knall, head of international sales at Japanese archery equipment manufacturer Shibuya Archery. "You don't notice it, but your aim wanders off so your arrow will hit the wrong part of the target – which is, of course, a big problem for professional archers." If force continues to be exerted on loose screws, they can break. "You have part failure and your competition is basically over," says Knall.

THE SOLUTION Shibuya had tried various solutions to this problem – which affects all sight manufacturers – including using larger diameter screws and various kinds of washers, but none had worked. Then Shibuya's chief engineer came across Nord-Lock at a trade show for precision parts manufacturers, and soon realised that Nord-Lock's solution

would solve the vibration problem once and for all. Now four Nord-Lock washers are used at the critical points on Shibuya's Ultima CPX compound sights.

THE RESULT The results speak for themselves: Christopher Perkins, a hugely talented 19-year-old Canadian archer who had been using Shibuya's previous model, switched to the new sight and immediately set a new world record. From 18 metres, 59 of his 60 arrows landed within the 2 cm diameter bullseye at the centre of the target. And Perkins is not the only archer to be impressed by the performance of the new sight. "We've had extremely good feedback from our distributors and very noticeably increased interest from professional archers," says Knall. "The main thing creating interest is the fact that it is more robust and more reliable than previous sights. The fact that the screws don't come loose is an important factor in the reliable image that the sight has built up." □



Christopher Perkins set a new world record with the new sight.



STEADY SIGHT

Nord-Lock's solution solved the vibration problem for Shibuya once and for all. Now four Nord-Lock washers are used at the critical points on Shibuya's Ultima CPX compound sights.





After ten years of intensive work, Nord-Lock Germany's efforts have paid off. General Manager, Wolfgang Ulbrich, displays one of the certificates proving that the entire Nord-Lock washer range is now certified by TÜV.

Safety guaranteed

For over 10 years, Nord-Lock Germany has been working intensively to have its washers certified by renowned test institutes. This strategy has paid off. Today the company is well equipped to combat the many counterfeit products which have flooded the market.

NORD-LOCK GERMANY pursues a specific strategy to guarantee customers the high level of safety and unique quality of Nord-Lock bolt locking systems. The company submits its washers for strict certification processes with various recognised test institutes. The entire Nord-Lock washer range is now certified by the German Technical Inspectorate TÜV.

"The certificates show that our products are suitable for safety applications and cannot be replaced by any old washers. This tested level of safety is extremely important for our customers," says General Manager Wolfgang Ulbrich, who has worked

"This tested level of safety is extremely important for our customers."

WOLFGANG ULBRICH, GENERAL MANAGER, NORD-LOCK DEUTSCHLAND

for the company for 22 years.

He notes that there is one main reason why the certificates are now more important than ever:

"For about a year, we have noticed that manufacturers from Europe and Asia are launching poor copies on the market. With the certificates and the laser labelling of our washers, our customers can be sure that they are getting the proven safety level offered by the original product," he explains.

Obtaining a certificate for a bolt locking system takes a long time. The entire process – from the first application, through numerous tests

to the highly sought after stamp – can take up to four years.

"For a soundproof wall, the bolt connection had to be tested five million times, which took us days and weeks," Ulbrich continues.

But it was worth the effort. The quality of Nord-Lock safety washers, which is guaranteed by the various certificates, means that they are now approved, or even stipulated for use as components, in more than 100 company standards at major companies such as Siemens, MAN and Voith. Deutsche Bahn and the Eisenbahnbundesamt (Federal Railway Authority) also have numerous directives and approvals that specify Nord-Lock washers as original components.

After many years of success in Germany, the certification strategy is now being continued by the Nord-Lock Group at an international level.

"My colleagues in other countries now follow this strategy and use our model to work with certificates just as actively," Wolfgang Ulbrich concludes. □

LINDA KARLSSON ELDH

HELLO THERE...



Max Höhler,
Automotive Product
Certification at TÜV SÜD

"Choose certainty. Add value" is the core idea behind the services of TÜV SÜD. Headquartered in Munich, Germany, the globally-renowned inspection organisation employs approximately 16,000 people at over 600 locations in Europe, America and Asia.

Mr. Höhler, how hard is it to get a TÜV SÜD certificate?

"The level of testing is high. A company can only receive a certificate from us for the whole product, not for parts of it. Therefore we need comprehensive tests to check functionality, quality and technology. We also test the manufacturing processes."

What does the certificate mean?

"The company has the right to use the TÜV SÜD certification mark, which is proof that the product is safe to use. TÜV is known world-wide and is therefore a great asset to those companies that pass our tests."

What happens after achieving a certificate?

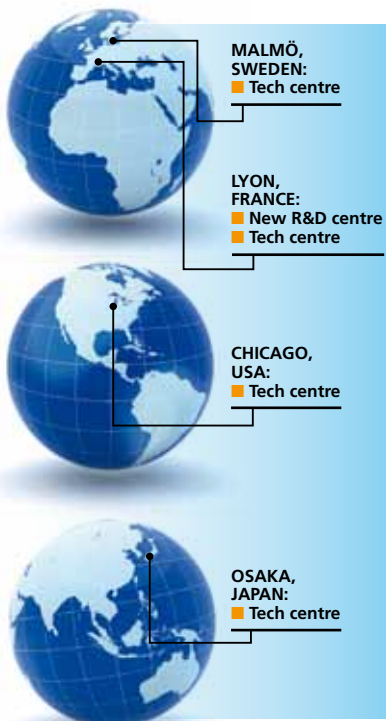
"We visit the production facilities once a year to ensure that quality is still maintained. The certification mark is not time-limited, therefore this follow-up is very important."

Increased level of expertise through new R&D centre in Lyon

NORD-LOCK IS SET to open a brand new Research and Development Centre in Lyon, France. The centre will be able to support the Field Application Engineers help customers of Nord-Lock with extensive testing and verification, as well as training.

"Our objective is to offer a bolted joint securing solution that is even more comprehensive and global. One way to achieve this is to increase the level of technical support," says Maxime Thonnerieux, Global R&D Director. "This new centre will extend our capacity to study bolted joint applications and increase our level of expertise in the field."

The new centre is part of Nord-Lock's broader strategy to expand development and testing globally, with technical centres in the US, Sweden and Japan. "The establishment of the new R&D centre is perfectly in line with Nord-Lock's strategy to maximise our added value through Performance Services to customers," says Mr Thonnerieux. "Through this global presence, we will ensure that we fulfil customer needs, as well as taking opportunities to follow market expansion." □



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

QUALITY IN EVERY STEP

E-learning offers product training at no extra cost

There is little point in investing in the best components if your personnel aren't trained in how to use them effectively. But with the new E-learning service, Nord-Lock customers can now have access to an effective, free, online training course.

NORD-LOCK PRIDES itself on the fact that its components are easy to use, requiring no specialised training or skills. However, as long as the possibility exists of mounting them incorrectly, a little extra training certainly does no harm.

"E-learning does not cost anything and is easy to use. All it requires is an Internet connection and it will take less than half an hour to complete," says Gösta Rydin, Global Industry Manager for Oil and Gas.

Once individuals register to use the programme and receive their log-in information, they gain complete access to the training programme, which includes text, short films, diagrams and images to illustrate the optimum method of using Nord-Lock components. The programme is divided into two chapters. Firstly, users may read about the principles of the Nord-Lock securing system and what makes it unique. Secondly, users receive guidance in how to use and apply Nord-Lock products. "Even if a company feels it isn't necessary, E-learning is a worthwhile measure. Once completed,



E-learning does not cost anything and it is easy to use. All it needs is an Internet connection.



Gösta Rydin, Global Industry Manager for Oil and Gas.

the user will gain complete knowledge of how Nord-Lock components should be used."

The idea for E-learning started in the oil and gas industry, where safety on offshore rigs is paramount as small mistakes could have disastrous consequences. Oil and gas

companies have long known that proper training is vital to offshore safety. However, the distances and remote locations of offshore rigs can make training expensive. With E-learning, all personnel can now complete the training programme anywhere, anytime, as long as they have Internet access.

"Oil and gas companies have been the first to see the advantages, but E-learning can be utilised by all industries," says Gösta. "It is particularly useful for companies with many employees, or who operate in remote locations."

Anyone interested in finding out more about E-learning is welcome to contact their nearest Nord-Lock representative or email info@nord-lock.com □

Comparing solutions for bolt securing

Safety wire/locking wire or Nord-Lock washers? Let us take you through the key parameters so that you can make the right choice.

	NORD-LOCK	SAFETY/LOCKING WIRE
		
LOCKING CAPABILITY	Reliable. Quality is consistent.	Not reliable. Installation requires special tools and expert knowledge. Functionality highly dependent on operators' skill and experience.
PRODUCT RANGE	M3-M130.	Safety wire is commonly .020, .025, .032 or .041 inches in diameter and usually made of stainless steel, although other materials are available. Difficult to use on very small or very large bolt sizes.
CONTROL OVER CLAMP LOAD	Constant coefficient of friction under the driven element. Plus, the locking function is not affected by lubrication, which provides good control over clamp load.	Possible to lubricate as locking function is not affected by lubrication. Installation is carried out after the tightening operation, thereby losing the ability to control the clamp load and even risking a reduction of the original clamp load.
REUSABILITY	Reusable.	Not reusable. Also leaves behind waste products when ends are clipped off or when cut off from secured fasteners that need to be removed during maintenance.
USE IN CONFINED SPACES	Suitable and easy to assemble in confined spaces.	Limited use in confined spaces, as it is difficult to mount when bolted joints are already tightened.
LIFE CYCLE COST	Low. Due to improved productivity, minimised maintenance costs and reusability.	High. Not reusable. Fasteners require drilled holes and installation is time-consuming, requiring specialised tools.

ACTIVITIES

Forums



Association of German Railway Engineers

FOR 60 YEARS, the Association of German Railway Engineers (Verband Deutscher Eisenbahn-Ingenieure e. V., VDEI) has been the only association of engineers in the field of track-guided transport and is a recognised partner in the rail sector. The aim of the VDEI is to support and promote the technical, commercial and scientific development of track-guided transport systems. Another important aim is to strengthen the rail network.

"Nord-Lock GmbH is a member of the VDEI because it offers us important information and we are invited to events where we have a unique opportunity to present our washers to the entire rail sector," explains Wolfgang Ulbrich, General Manager, Nord-Lock Germany.

<http://www.vdei.de>

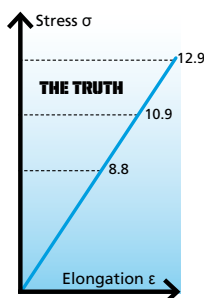
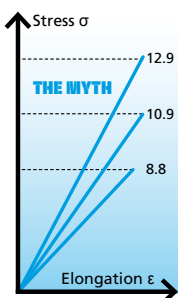
Exhibitions



EACH YEAR, Nord-Lock participates in over 60 major exhibitions and events for various industries. At the Nord-Lock stands you will meet experts of bolt securing and see live Junker demonstrations, a comparative worst-case scenario vibration test for bolted joints.

Visit www.nord-lock.com/events for a complete list of exhibitions.

MYTH BUSTERS



THE MYTH: The higher the bolt grade, the lower the stretching ability of the bolt.

THE TRUTH: whatever their grade, bolts made from the same material have the same modulus of elasticity E:

- For carbon steel bolts (ISO 898-1): $E = 210 \text{ kN/mm}^2$.
- For stainless steel bolts (ISO 3506-1): $E = 170 \text{ kN/mm}^2$.

According to the law of Hooke, the stretching ability of a material depends on its modulus E while its stress σ and elongation ϵ are linked as follows: $\sigma = E \times \epsilon$. Therefore, the higher grade means same elongation under the same force for same bolt sizes, but a greater load can be supported before yielding or breaking. □



An extra safety barrier

Nord-Lock E-learning

When you choose Nord-Lock you take a giant leap towards bolt safety. We at Nord-Lock know that it is also important to ensure that you and your colleagues have right product knowledge and understanding regarding assembly designs.

Nord-Lock's E-learning provides an extra safety barrier. With our online training you can verify that the entire staff has received the correct knowledge in order to achieve maximum safety and potentially prevent fatal consequences caused by human error. Contact us for further information.

Nord-Lock Group
Tel: +46 (0)31 7192 300, Email: info@nord-lock.com
www.nord-lock.com

NORD-LOCK[®]
Bolt securing system