NORD-LOCK® A MAGAZINE ABOUT OPTIMISING BOLT SECURING ☐ WWW.BOLTED.COM # 2 2012

BOLTED

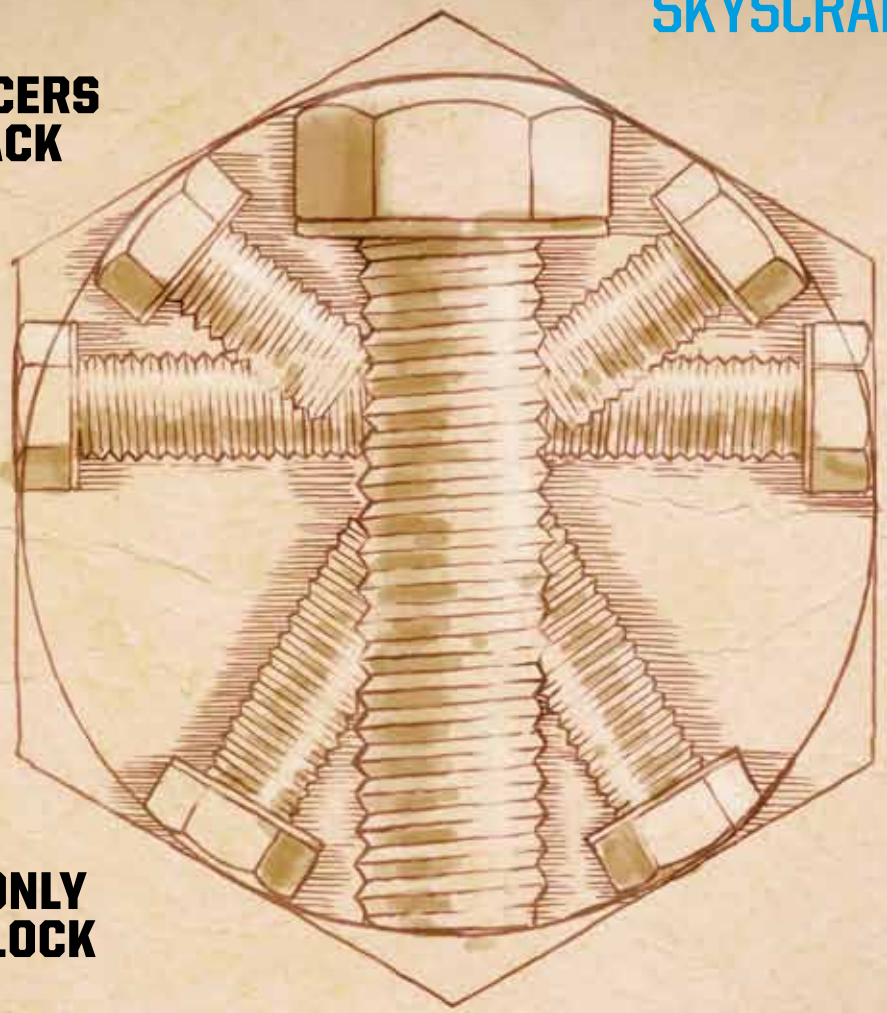
CERTIFIED SAFETY

DNV'S RIGOROUS STANDARDS FOR BOLT SECURITY

SUPERBOLT HELPS BUILD USA'S TALLEST SKYSCRAPER

DRIVING ON ICE

HELPING RACERS STAY ON TRACK



STABLE CABLES

WHY POMA ONLY USES NORD-LOCK

THE BOLT EVOLUTION

FROM LIFTING WATER TO LIFTING SPACESHIPS

When **safety** really matters

Users of Nord-Lock washers have the world's most demanding applications and require maximum control. In 2011 we began to laser mark our branded products with the control number for increased traceability and to facilitate authentication.

Our first priority is the safety of our customers. We therefore recommend sourcing Nord-Lock solely from original packaging and through our authorized partners and distributors.

www.nord-lock.com/genuine

Counterfeit and risk analysis information.
Find out more at:
www.nord-lock.com/genuine

NORD-LOCK®
Bolt securing systems

BOLTED # 2 2012

About optimising bolt securing – a customer magazine from Nord-Lock

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

Bolted is published twice a year in English, German, Japanese, French, Chinese, Swedish & Finnish. It is free to customers of Nord-Lock worldwide. Published by Spoon in Gothenburg, Sweden, www.spoon.se

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NORD-LOCK®

The past, the present and the future

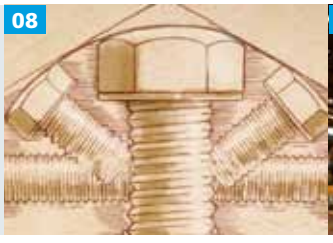
From ancient Greece to the future of bolting – all in the same issue. Yes, in this issue you can truly find out how it all started and how the fastener industry became what it is today. Bolting constitutes a major part of the design of everyday items, as well as heavy industrial equipment. As our society develops, and bolting applications need to change and evolve, the technology to ensure reliable bolted joints needs to develop as well!

Thus, in this very special issue, we have included something that will really impress you! 30 years ago, the Nord-Lock Group developed the world's most effective safety washer – and now we have made it twice as effective! These are truly exciting times so please read the attached flyer or visit **www.x-series.com** to learn more about this major development – the very first multifunctional wedge-locking washer! As usual, there has been further news since our last issue. For example, we hope that you have discovered our newly updated website **www.nord-lock.com**. Bolted Magazine also has its own section at **www.bolted.com**. One major benefit of this section is that you can now search and locate articles from previously published issues. We hope you like it!

As always, this magazine investigates exciting applications around the world. Racing enthusiasts will be particularly interested in our story on Donkervoort sports cars, which appears on page 4. Perhaps you like to hit the slopes? The French company, Poma, has probably made a ski lift you have ridden in the past. See their innovative solutions for transporting people on page 12.

Tamper-resistant Superbolt tensioners are another interesting solution in the Nord-Lock product range. This product helps companies ensure their applications will not be tampered with by unwanted parties. Learn more on page 17. And thanks for reading the magazine!

CARIN ESBERG
GLOBAL MARKETING MANAGER



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SECURED BY THE NORD-LOCK GROUP

WORDS: LINDA KARLSSON ELDH & DAVID WILES

PHOTO: MARTIN MAGNTORN

UNDER PRESSURE
56 Superbolt high-temperature tensioners are fitted on the vessel's main flange.

KEEPING UP THE PRESSURE

CUSTOMER: EKSTRÖM & SON	**USAGE:** HYDROGEN PLANT
WEIGHT: 80 TONS	**TOTAL PRESSURE:** 35 BAR
TEMPERATURE: 300 DEGREES CELSIUS	**BOLT SIZE:** M64X6

THE SWEDISH COMPANY Ekström & Son is one of Europe's leading manufacturers of pressure vessels. The pressure vessel is at the heart of any reactor. Its job is to hold gases or liquids at a pressure substantially different from the ambient pressure.

In the past, the bolting of the main flanges of a vessel for the hydrogen industry was a problem. Heavy hydraulic wrenches were needed to tighten the nuts and excessive tightening often damaged the gasket, causing leaks. The damaged gasket then had to be replaced, involving many hours of disassembly and reassembly for this part of the 80 ton vessel.

To avoid this, the company recently fitted 56 Superbolt high-temperature tensioners on the bolted connection of the vessel's main flange. The tensioners, made with high temperature, high strength alloys, can be tightened with regular air tools. Accurate preload permits the tensioners to distribute the pressure evenly, preventing damage to the gasket.

After installation, the flange proved leak-proof during the first test. The engineering team saved almost two days of work by not having to disassemble the construction, retighten the bolted connection and re-test the vessel. This improvement prevented delays and the customer was very pleased with the results. □

RAVISHING AND RELIABLE

SPORTSCAR: DONKERVOORT D8 GTO	
CAR WEIGHT: FROM 695 KG	**POWER OUTPUT:** FROM 340HP
ENGINE: AUDI 2.5L R5 TFSI	**TORQUE:** 450 NM AT 1600 RPM
TOP SPEED: 255 KM/H	**0-100 KM/H:** 3.0 SECONDS

SINCE 1978, DONKERVOORT Automobielen has been hand-building bespoke sports cars for true motoring enthusiasts. The Dutch family-run company's stunning vehicles are sought after for their light weight, performance and exclusivity – only about 40 to 50 are made each year – and their track pedigree is well proven: last year a Donkervoort D8 GT won its class at the prestigious 24 hours of Dubai endurance race.

This summer, production will start on the Lelystad-based company's latest model, the awesome D8 GTO, which has been developed in close collaboration with Audi Quattro GmbH. It will be one of the fastest sports cars made in Europe.

As with all Donkervoort sports cars produced in the last two decades, key bolted joints on the D8 GTO are secured with Nord-Lock washers. Dozens of pairs of washers are used on each car. For instance, mounting of the front and rear suspensions to the hybrid steel and carbon fibre chassis, and bolting on the engine mounts, is secured with Nord-Lock washers.

The company is quick to credit the Nord-Lock Group as an important contributor to both its reputation for quality and to its win in Dubai. Despite 24 hours of flat-out racing and the extreme forces and vibrations that came with it, the pit crew had no problems with any bolted joints held together by Nord-Lock. □

PHOTO: DONKERVOORT

HOLDING FIRM

Nord-Lock washers are used on key bolted joints, including front and rear suspensions.

A TALL ORDER

CUSTOMER: ONE WORLD TRADE CENTER (FREEDOM TOWER)		
HEIGHT: 541 METRES (1,776 FT)	STOREYS: 108	BUDGET: $3.1 BN
FLOOR SPACE: 242,000 SQ. METRES	TONNES STEEL: 46,000	

SOARING INTO THE Manhattan skyline at the site of the world's worst terrorist atrocity, One World Trade Center (also known as the Freedom Tower) will be the United States' tallest skyscraper. This symbol of pride and hope is currently under construction where the Twin Towers once stood, and is an integral part of the renewal of this site, which will be comprised of five new skyscrapers.

The task of moving construction material from the base of the tower up hundreds of metres to where the building work is underway has been entrusted to four hoists designed and built by FKC (Frontier-Kemper Constructors) -Lake Shore, a company that more commonly supplies equipment for mining and other underground applications. Each of the Indiana-based company's hoists can lift more than 6,300 kg at a speed of around 200 metres per minute.

Safety is paramount in such applications where a bolt failure could have disastrous consequences. Therefore, FKC-Lake Shore chose multi-jack-bolt tensioners (MJTs) from Superbolt. The MJTs – 40 per hoist – are used to secure the hoist drum, which is spooled with more than 900 metres of wire rope. The method used previously by FKC-Lake Shore to secure bolts – a slap wrench and sledgehammer – could not generate the large specific torque required.

Whether it is for sending people and material hundreds of metres above ground or below it, these days, FKC-Lake Shore trusts Superbolt on all its hoists. □

REACH HIGH
Each hoist is equipped with 40 Superbolt tensioners.

PHOTO: JOE WOOLHEAD

CRUCIAL JOINTS
Dozens of Nord-Lock washers are used throughout the carriage.

END OF THE LINE FOR FROZEN RAILS

CUSTOMER: RVEL	LENGTH: 22 METRES	WEIGHT: 44 TONNES
SPEED: 97 KM/H	DE-ICER VOLUME: 8,000 LITRES	

SNOW CAN TRIGGER travel chaos for the hundreds of thousands of commuters who pour into London each day. One particular winter problem on southeast England's rail network is the vulnerability of the conductor rail (which runs parallel to the running rails and supplies the trains with electrical power) to cold weather, and in particular snow and ice.

Therefore Network Rail, which owns and operates Britain's rail infrastructure, has invested in 12 snow and ice treatment trains (SITT) which plough the tracks and de-ice the conductor rail. RVEL in Derby was commissioned to convert existing rolling stock into six SITTs, each consisting of two ploughs, two locomotives and two snow and ice treatment wagons. As they roll along the tracks, the SITTs apply deicing fluid, brush, scrape, brush and then leave a trail of deicing fluid on the conductor rail to prevent further ice build-up.

With these trains taking such a large responsibility for keeping southeast England moving in the event of a big freeze, RVEL chose Nord-Lock washers for several crucial applications throughout the wagons. Dozens of the locking washers are used: on the main fluid tank, the generator module and control module fixings, the handrails and the external lighting, to name just a few. Already proven and trusted in rail applications around the world, Nord-Lock washers are ideal for this challenging and high-vibration environment. □

THE EXPERTS

NORBERT SCHNEIDER
HEAD OF ENGINEERING

FRIDA CULLIN
MANAGER TECHNICAL CENTRES

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.

How to determine a suitable tightening torque

Q: I don't know the tightening accuracy of my tool. How should I proceed with my torque calculation?

A: All tightening tools have a certain inaccuracy that must be accounted for in order to determine a suitable tightening torque.

The accuracy of a tightening tool can generally be obtained from the manufacturer or retailer. However, there are standards that categorize tightening tools and their accuracy level including the tool operator. If you do not know the tightening accuracy of your tool, the values in the table could be applicable.

It is also important to remember that friction variance influences the final preload. It often has a greater impact on the final preload than the tool inaccuracy. A cost effective way for an accurate tightening process is therefore to properly lubricate the fasteners.

FC

Tools and deviations on achieved torque according to nf e 25030-1

CLASS acc. To NF E 25030	TIGHTENING TOOL	ACCURACY ON THE TIGHTENING TORQUE
A	Digital torque wrench	± 10%
	Electric gun with a reaction arm	± 10%
B	Calibrated torque wrench	± 15%
	Pneumatic tool with auto air-stop	± 15%
C	Pneumatic tool	± 20%
D	Impact wrench	± 50%

The formula for calculating jackbolt torque

Q: How do I calculate the jackbolt torque (based on a formula)?

A: Superbolt multi-jackbolt tensioners (MJTs) use small jackbolts to achieve the preload. These work similar to regular bolts except they are preloaded in compression instead of tension. The preload generated by the jackbolts when tightened with a certain torque depends on the friction coefficient of the lubricant, size of the jackbolt and pitch of the jackbolt thread.

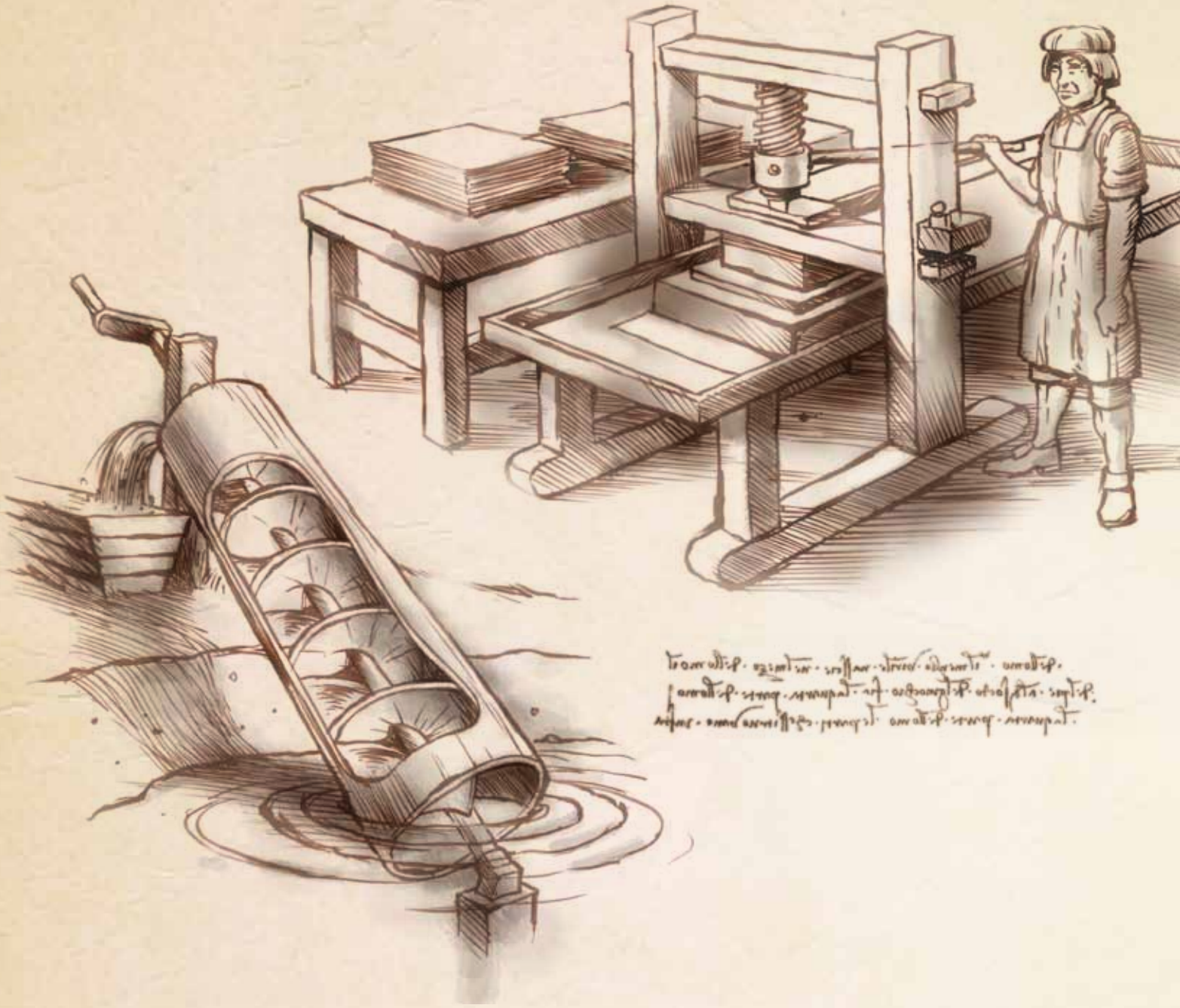
Of the three, only the pitch of the jackbolts contributes to the preload. The other two determine the energy lost due to friction. To minimise this loss it is beneficial to use many small jackbolts and a lubricant with a low but stable friction coefficient. For speed of tightening and cost efficiency, fewer but larger jackbolts are desirable, while a higher friction coefficient reduces the risk of self-loosening. Finding the optimal configuration is best left to our experts.

The torque to preload relationship for the specified lubricant is indicated on the drawing or in the Superbolt product brochure. Calculating the required torque for any desired preload is simple because torque and preload are proportional within a wide range. Thus, half the torque results in half the preload.

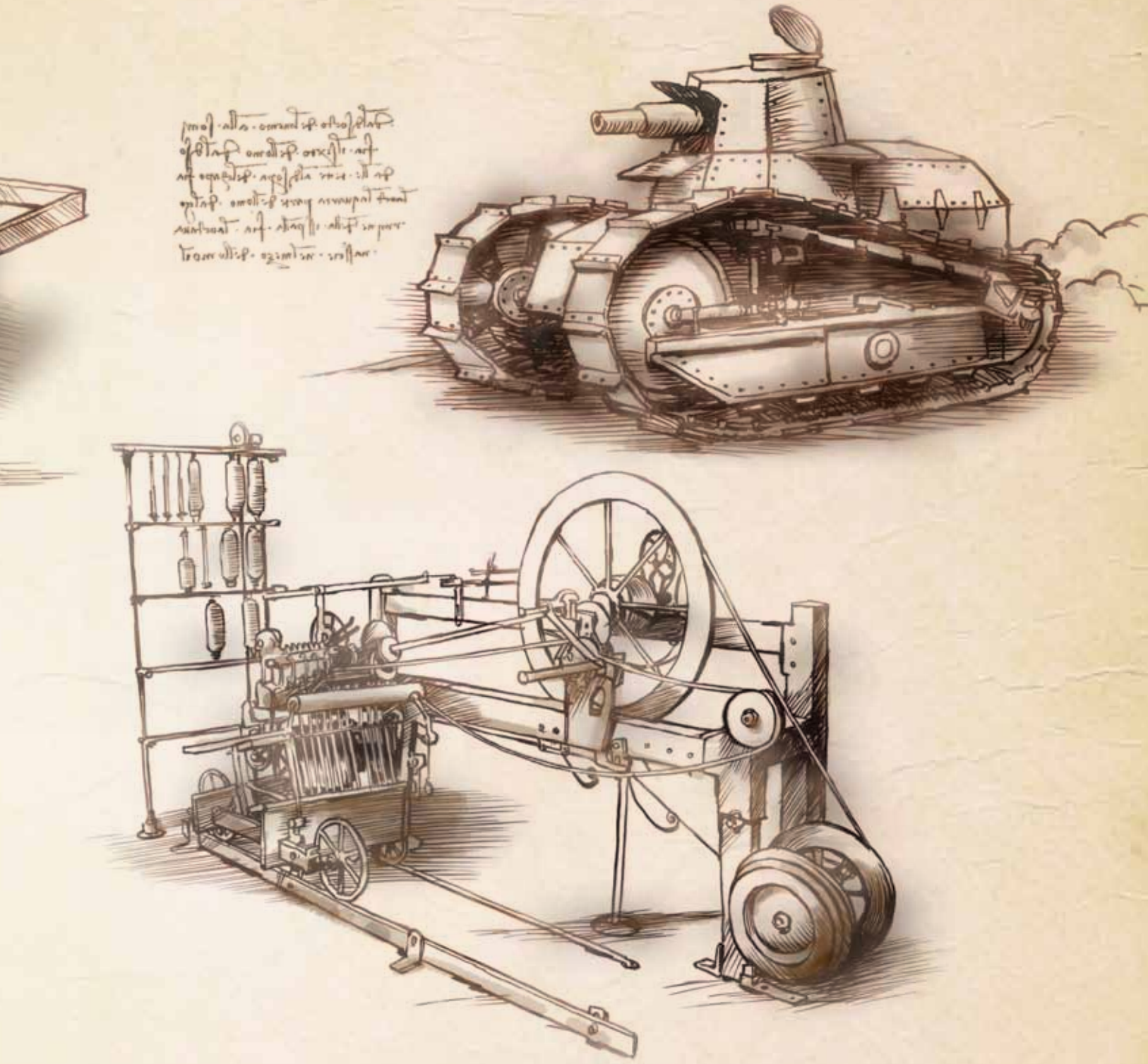
$$\text{required torque} = \frac{\text{listed torque}}{\text{listed preload}} \times \text{desired preload}$$

For special designs and upon request we recommend the tightening torque for your application. When in doubt, please contact your local Nord-Lock office. We're always glad to help.

NS



THE HISTORY OF THE BOLT



At first glance, a bolt may seem like a very simple item that holds things together. But dig a bit deeper and you'll realise there's more behind seemingly insignificant bolt and screws than first meets the eye. Without them, all our gadgets and machines would fall to pieces.

WORDS:
ALANNAH EAMES

ILLUSTRATION:
KENT ZEIRON

BOLTS ARE ONE of the most common elements used in construction and machine design. They hold everything together – from screws in electric toothbrushes and door hinges to massive bolts that secure concrete pillars in buildings. Yet, have you ever stopped to wonder where they actually came from?

While the history of threads can be traced back to 400 BC, the most significant developments in the modern day bolt and screw →

→ processes were made during the last 150 years. Experts differ as to the origins of the humble nut and bolt. In his article "Nuts and Bolts", Frederick E. Graves argues that a threaded bolt and a matching nut serving as a fastener only dates back to the 15th century. He bases this conclusion on the first printed record of screws appearing in a book in the early 15th century.

However, Graves also acknowledges that even though the threaded bolt dates back to the 15th century, the unthreaded bolt goes back to Roman times when it was used for "barring doors, as pivots for opening and closing doors and as wedge bolts: a bar or a rod with a slot in which a wedge was inserted so that the bolt could not be moved." He also implies that the Romans developed the first screw, which was made out of bronze, or even silver. The threads were filed by hand or consisted of a wire wound around a rod and soldered on.

ACCORDING TO BOLT expert Bill Eccles' research, the history of the screw thread goes back much further. Archimedes (287 BC–212 BC) developed the screw principle and used it to construct devices to raise water. However, there are signs that the water screw may have originated in Egypt before the time of Archimedes. It was constructed from wood and was used to irrigate land and remove bilge water from ships. "But many consider that the screw thread was invented around 400 BC by [Greek philosopher] Archytas of Tarentum, who has often been called the founder of mechanics and considered a contemporary of Plato," Eccles writes on his website.

The history can be broken down into two parts: the threads themselves that date back to around 400 BC when they were used for items such as a spiral for lifting water, presses for grapes to make wine, and the fasteners themselves, which have been in use for around 400 years.

Moving forward to the 15th century, Johann Gutenberg used screws in the fastenings on his printing presses. The tendency to use screws gained momentum with their use being extended to items such as clocks and armour. According to Graves, Leonardo da Vinci's notebooks from the late 15th and early 16th centuries include several designs for screw-cutting machines.

What the majority of researchers on this topic do agree on, though, is that it was the Industrial Revolution that sped up the development of the nut and bolt and put them firmly on the map as an important component in the engineering and construction world.

THE "HISTORY OF the Nut and Bolt Industry in America" by W.R. Wilbur in 1905 acknowledges that the first machine for making bolts and screws was made by Besson in France in 1568, who later introduced a screw-cutting gauge or plate to be used on lathes. In 1641, the English firm, Hindley of York, improved this device and it became widely used.

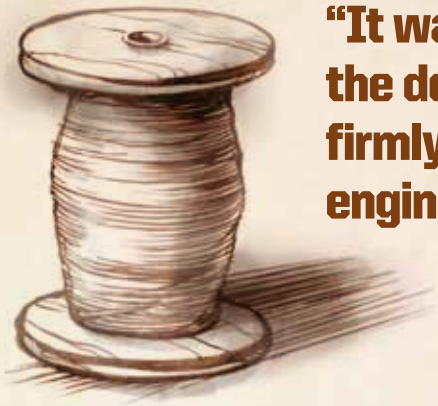
Across the Atlantic in the USA, some of the documented history of the bolt may be found in the Carriage Museum of America. Nuts on vehicles built in the early 1800s were flatter and squarer than later vehicles, which had chamfered corners on the nuts and the flush was trimmed off the bolts. Making bolts at this time was a cumbersome and painstaking process.

Initially, screw threads for fasteners were made by hand but soon, due to a significant increase in demand, it was necessary to speed up the production process. In Britain in 1760, J and W Wyatt introduced a factory process for the mass production of screw threads. However, this milestone led to another challenge: each company manufactured its own threads, nuts and bolts so there was a huge range of different sized screw threads on the market, causing problems for machinery manufacturers.

IT WASN'T UNTIL 1841 that Joseph Whitworth managed to find a solution. After years of research collecting sample screws from many British workshops, he suggested standardising the size of the screw threads in Britain so that, for example, someone could make a bolt in England and someone in Glasgow could make the nut and they would both fit together. His proposal was that the angle of the thread flanks was standardised at 55 degrees, and the number of threads per inch, should be defined for various diameters.

While this issue was being addressed in Britain, the Americans were trying to do likewise and initially started using the Whitworth thread. In 1864, William Sellers proposed a 60 degree thread form and various thread pitches for different diameters. This developed into the American Standard Coarse Series and the Fine Series. One advantage the Americans had over the British was that their thread form had flat roots and crests. This made it easier to manufacture than the Whitworth standard, which had rounded roots and crests. It was found, however, that the Whitworth thread performed better in dynamic applications and the rounded root of the Whitworth thread improved fatigue performance.

"Johann Gutenberg used screws in the fastenings on his printing presses. The tendency to use screws gained momentum with their use being extended to items such as clocks and armour."



"It was the Industrial Revolution that sped up the development of the nut and bolt and put them firmly on the map as an important component in the engineering and construction world."

DURING WORLD WAR I, the lack of consistency between screw threads in different countries became a huge obstacle to the war effort; during World War II it became an even bigger problem for the Allied forces. In 1948, Britain, the USA and Canada agreed on the Unified thread as the standard for all countries that used imperial measurements. It uses a similar profile as the DIN metric thread previously developed in Germany in 1919. This was a combination of the best of the Whitworth thread form (the rounded root to improve fatigue performance) and the Sellers thread (60 degree flank angle and flat crests). However, the larger root radius of the Unified thread proved to be advantageous over the DIN metric profile. This led to the ISO metric thread which is used in all industrialised countries today.

Those working in the industry have witnessed much fine-tuning of bolts during recent decades. "When I started in the industry 35 years ago the strength of the bolts was not as fully defined as it is today," recalls Eccles. "With the introduction of the modern metric property classes and the recent updates to the relevant ISO standards, the description of a bolt's strength and the test methods used to establish their properties is now far better defined."

As the raw materials industry has become more sophisticated, the DNA of bolts has changed from steel to other more exotic materials to meet changing industry needs.

Over the last 20 years there have been developments in nickel-based alloys that can work in high temperature environments such as turbochargers and engines in which steel doesn't perform as well. Recent research focuses on light metal bolts such as aluminum, magnesium and titanium.

TODAY'S BOLT TECHNOLOGY has come a long way since the days when bolts and screws were made by hand and customers could only choose between basic steel nuts and bolts. These days, companies like Nord-Lock have invented significant improvements in bolting technology, including wedge-locking systems. Customers can select pre-assembled zinc flake coated or stainless steel washers, wheel nuts designed for flat-faced steel rims, or combi bolts, which are customised for different applications. The acquisition of US company Superbolt Inc. and Swiss company P&S Vorspannsysteme AG (today Nord-Lock AG) has added bolting products used in heavy industry, such as offshore, energy, and mining, to Nord-Lock's portfolio, taking a huge step in becoming a world leader in bolt securing.

There is also much more emphasis now on analysing joints. "In the past, people used to decide upon a certain size of fastener based on their experience alone. And, fingers crossed, it would work," Eccles explains. "Nowadays, people focus more on analysis and making sure things work before products are built and sent out into the market." □

CABLE TRANSPORTATION Whether you like to ski in France, or further afield in Northern China, Korea, the United States or even Dubai, chances are you won't walk to the top of the slope. You will sit on a ski lift or take a cable car. And chances are high that the cable system you are relying on to get you quickly and safely to your destination has been designed and manufactured by French company Poma.

WORDS: CHRISTINA MACKENZIE
PHOTO: POMA & DENIS CHAUSSENDE



The French company Poma was founded in 1936 and designs and manufactures cable-based public transport solutions. Safety is absolutely paramount to the company.

SAFE TRANSPORT

WHILE YOU HAVE SAT, or stood, on a seat or in a cabin, dangling from a cable with a little – or a lot – of empty space between you and the ground, you've probably wondered whether you were being foolhardy and if this cable-based transportation system was entirely safe. Well, the answer is 'yes'.

There is some dispute as to who exactly created the world's first ski lift as two were built in 1936, one in France, the other in the United States. The one in France was the brainchild of a Polish-born Frenchman, Jean Pomagalski, raised in the French Alpine city of Grenoble, who built his first ski lift in l'Alpe d'Huez.

Today, the company he founded, Poma, has changed hands several times, though up to 70% of its activity is still linked to the ski industry. The rest is split between urban transport, tourism, science and industry.

Cable cars have proved more than just a transport system in South America: they have brought city slums that were previously no-go areas into the mainstream. Poma built the first cable car system to be seamlessly integrated into a public transport system in Medellin, Colombia. It allowed inhabitants of the poor barrios perched on the hillside, accessible only by steep steps, to cut their commuting time into the city from upwards of two and a half hours to just minutes. It was such an instant success that the South American city now has six such cable car lines. "People are incredibly respectful of the installations," remarks Edouard Dovillaire, Innovation and Product Deputy Director for Poma. "They are very proud of their cable car or MetroCable® and the measure of its success is that when you get off, there are people sitting in cafés, children playing, a public library; all this in areas which were no-go zones even for the police!"

OFFICIALS OF RIO de Janeiro in Brazil approached Poma to undertake a similar project for their city and in July 2011 the first cable car public transportation system opened linking the favela of Complexo do Alemão with downtown Rio. The cable car line is 3.5 km long, stops at 6 stations and carries 152 gondolas, each of which can hold 10 passengers. The journey from →

In July 2011 the first cable car public transportation system in Rio de Janeiro opened, linking the favela of Complexo do Alemão with downtown Rio. It was designed and manufactured by French company Poma.

Poma has been using Nord-Lock washers on the critical bolts since 2002.

"Passenger security is paramount in our business and we know we can rely on Nord-Lock to meet our requirements."

EDOUARD DOVILLAIRE, INNOVATION AND PRODUCT DEPUTY DIRECTOR

→ the first station (Bonsucesso) to the last (Palmeiras) takes 17 minutes, instead of an hour, as it did in pre-cable car times. By May 2012 it had already transported 2 million passengers!

THE OLDEST URBAN aerial tramway may be found in New York, linking Roosevelt Island to Manhattan in 3 minutes. Originally built as a temporary solution and despite the arrival of the metro on the island, the 'Roosevelt Island Aerial Tramway' remains the most popular form of transport. It too is seamlessly integrated into the public transportation system and was recently subject to a complete renovation by Poma.

Slightly different visually – because it looks like a train, even if it is pulled along by a cable – is Poma's first forray into Africa with MiniMetro® (the automated people mover) between the three terminals at Cairo International Airport. Super-silent, gliding at 13.5 metres/second (compared to 3-5 metres/second for a traditional hanging-type cable car), the system became operational in April 2012 as part of the airport's move towards becoming a more efficient hub.

Because travelling in a cable car is different and exciting, and because growing economies mean more leisure time and thus more tourists, authorities in Asia are often opting for the aerial tramway solution to make their tourist sites even more attractive.

One of the most spectacular is the cable car at Nha Trang in Vietnam which carries tourists across the China Sea to the Vinpearl amusement park. Each gondola can carry eight people a distance of over 3 km suspended 40-60 metres above sea level. Another awe-inspiring cable car trip is the almost vertical 7.5 km ride up to the Tianmenshan temple in Zhangjiajie, China.

But whatever the end use, "what we sell to our clients is safety," stresses Mr. Dovillaire, "because our business is to transport people in places where no other transport system is feasible so safety is absolutely paramount. That's why we've been using Nord-Lock washers on critical bolts since 2002 because they are the only ones on the market to meet the quality and the security we need. We would not want to be caught out by using products of another brand." □

"Nord-Lock washers are the only ones on the market that meet the quality and security we require and we would not want to be caught out using products made by a different manufacturer.", says Edouard Dovillaire, Innovation and Product Deputy Director for Poma.

FACTS:

POMA, VOREPPE, FRANCE

WHAT IT DOES:
Designs and manufactures cable-based public transport solutions.

PART OF:
High Technology Investments, a holding company, whose group provides a comprehensive range of equipment for ski resorts.

FOUNDED:
In 1936 by Jean Pomagalski, a French engineer of Polish origin.

ANNUAL SALES:	NUMBER OF EMPLOYEES:
Eur 263 million	850
BOLT SECURING: Nord-Lock	

Business arguments

THIS IS HOW Poma benefits from Nord-Lock washers:

- **SAFE** – for transporting people high above ground across difficult and/or dangerous terrain.
- **GUARANTEED** – counterfeit washers are considered a risk.
- **SECURE** – they never come loose.
- **EASY** – a bolt may still be unscrewed for necessary maintenance.
- **ADAPTABLE** – can be used on any bolt.

Andrzej Serednicki has nearly a quarter of a century of experience testing bolted connections at Det Norske Veritas (DNV).

FACTS:
ANDRZEJ SEREDNICKI

ROLE: Principal Engineer, Technical Advisory Ship and Offshore, Det Norske Veritas
BACKGROUND: Masters Degree in Civil Engineering from the Technical University of Łódź, Poland. Following further studies at Chalmers University of Technology in Gothenburg, Sweden, Serednicki started work at Det Norske Veritas as a concrete specialist. He has been working with bolted connections for nearly 25 years.
LIVES IN: Oslo, Norway.

Improving offshore safety through certification

WORDS: DAVID WILES
PHOTO: ANITA ARNTZEN

WITH NEARLY A QUARTER of a century of experience testing bolted connections at Det Norske Veritas (DNV), Andrzej Serednicki has carried out dozens of highly demanding tests to ensure the highest safety standards in the offshore oil and gas industry.

What is Det Norske Veritas and what is its role in the offshore industry?

"DNV was established as a small society in 1864 with the aim of saving lives and the assets of Norwegian shipowners. After North Sea oil production started on a large scale in the 1970s, it moved into verification of oil and gas equipment and today has 300 offices in 100 countries, as well as clients including Exxon and Shell. As a foundation – it is neither owned by the state nor by private industry – we are truly independent and all our revenues are put back into developing our services."

Why do companies come to you for product certification?

"If you are the owner of a ship or an oil rig and are investing hundreds of millions of euros, you don't want to have any failures. You want a third party to check that the components work as they should. This is where we come into the picture – to ensure that the design and manufacture of a particular product is correct and meets certain specifications."

What is the certification process?

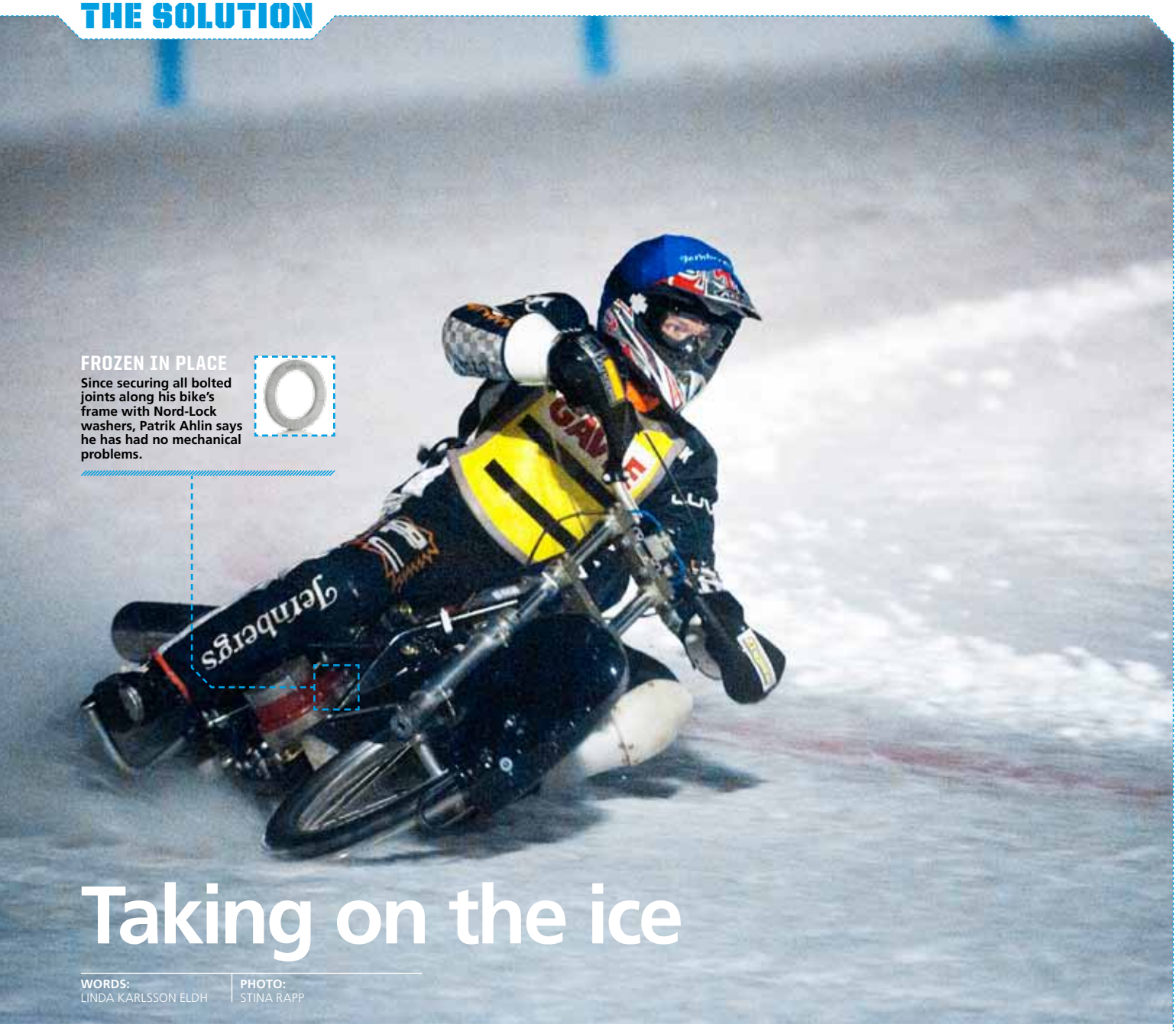
"This is an extremely rigorous process so we start with a review of the design documentation. Once we have gone through the design and are satisfied with it, then we may test the product to ensure that it meets the requirements that will be placed on it. We then proceed to the production process. We want to know that when the company starts manufacturing this product, the quality and the desired properties will also form part of the manufactured items. So we send our inspectors to the manufacturing plant to check the company's management system and see how they handle their production to ensure the quality of the product. Then, and only then, can we issue the certificate."

How do you test bolting solutions?

"Our tests are extensive, going deep into the problem using experts from disciplines such as metallurgy, structural strength, corrosion protection, and instrumentation technology. Tests can take weeks or months. When we are asked to test a product, the first step is to establish the conditions in which it will be used. We then aim to simulate these conditions in the laboratory. When we tested Nord-Lock washers, for example, we knew they had been verified in a Junkers vibration test, but we know from working with bolted connections offshore that impact and fatigue loads must also be taken into account. So we proposed additional tests to address these properties."

What proportion of the products you test attain DNV certification?

"If the owner of a product does not truly believe that their product will meet our standards, they won't ask us to certify it, so normally the manufacturers that come to us are very confident that their product is good. If a product does not meet our requirements, then we will sit together with the designer or manufacturer and try to find out what the problem is, and how it can be rectified." □



FROZEN IN PLACE

Since securing all bolted joints along his bike's frame with Nord-Lock washers, Patrik Ahlin says he has had no mechanical problems.

Taking on the ice

WORDS: LINDA KARLSSON ELDH
PHOTO: STINA RAPP

THE CHALLENGE Invented in Sweden in the 1930s, ice racing is a motor sport unlike any other. Equipped with tyres covered with 28 mm spikes, the racer accelerates from zero to 100 kilometres per hour in less than three seconds. The bikes have front and rear suspension in order to cope with the extreme vibrations caused by up to ten centimetres deep ice furrows that occur on the track after only a few heats. But the bolts still tend to shake loose during racing, a problem that is aggravated by the 500 cubic centimetre engine mounted directly onto the frame, and the temperature fluctuation of the bike's steel frame – it expands when the motorcycle gets warmed up for a race, and contracts when it cools down again, which makes the bolts loosen.

"Normally, only five percent of ice racing is about actual racing, whereas 95 percent is about checking and repairing the bike between heats and before and after a race," explains Patrik Ahlin, who entered the Swedish top division league of ice racing for the first time this season.

THE SOLUTION With a background as a maintenance technician at a large steel company, Ahlin was quite familiar with Nord-Lock's products. Therefore, while preparing his first ice racing bike, he secured all the bolted joints along the bike's frame with a total of 20 Nord-Lock locking washers with both standard and enlarged external diameters.

THE RESULT Already after the first race, the Nord-Lock washers proved that they could cope with the racing bike's frame expanding and contracting due to temperature differences. Instead of breaking, cracking or loosening, they moved with the materials and kept the bolts locked. Since the washers secured the bolts safely, the mechanic team saved time by not needing to check them – a saving of up to 30 per cent between the heats and as much as 40 per cent after a race.

Patrik Ahlin

With 22 races, Ahlin has driven the highest number of heats of all ice racers this season without any mechanical problems. Most important of all: he feels safe on the ice.

"When I'm racing, I don't have time to worry about the bolted joints," he says. "With the new washers, I go out there and concentrate on the race, knowing that the bike is in the safest possible shape." □

CONTINUED INNOVATION:

Tamper-resistant tensioner ready for the market

ONE OF THE KEY benefits of many Nord-Lock Group technologies, such as Superbolt's multi-jackbolt tensioners, is that they're easy to apply and can often be tightened and removed with basic hand tools. The only problem is that this also makes it easier for non-authorised removal. For such applications, the Nord-Lock Group has developed the tamper-resistant multi-jackbolt tensioner.

"The concept was developed after one of our customers in Africa was having problems with thieves breaking into their oil pipelines and stealing oil," says Robert Steinbock, President of Superbolt. "They want to use multi-jackbolt tensioners to tighten clamps to seal off the holes, but since they can easily be removed using common hand tools, it would be easy to reopen the holes and steal more oil. Therefore, we developed a new solution that couldn't be loosened with conventional tools."

The tamper-resistant tensioner is much like an armoured version of the multi-jackbolt tensioner, except it requires a specially designed socket for tightening and removal.

As a result, users gain the bolt security and ease of using standard tensioners, while also significantly reducing the threat of unwanted loosening as a result of tampering. While it has been developed for oil pipelines, the new product is ideal for any security sensitive applications, such as road signs, and has huge potential in a number of fields. □

NIC TOWNSEND

The tamper-resistant tensioner is much like an armoured version of the multi-jackbolt tensioner, except it requires a specially designed socket for tightening and removal.

The split-nut thrust collar (STC) is a new style of tensioner that makes it even easier to secure large threads and press columns.

STCs offer a unique alternative for large press columns

THE ACQUISITION OF Superbolt has brought a number of exciting and unique solutions into the Nord-Lock Group's portfolio, one of which is the split-nut thrust collar (STC). This patented design is a new style of tensioner that makes it even easier to secure large threads and press columns.

"This is a highly unique solution," says Steve Busalacchi, Engineering Manager North America. "It is safe, accurate and effective, as well as quick and easy to apply."

The STC consists of a threadless thrust collar with jackbolts threaded through, while a split-nut is fitted above the collar, and clamped together with small multi-jackbolt tensioners. Tension is created by the jackbolts as the collar thrusts against the threaded split-nut.

The combination of this unique design distributes the load along the threads, as well as allowing for greater tolerances of slight thread variations.

STCs are much easier to handle, as well as to install and remove, compared to other threaded fasteners. Nor do they cause galling or seizing. Overall, they represent a perfect method for securing bolted press columns and large threads. □

QUALITY IN EVERY STEP

Nord-Lock gets Lean

Just one year after Nord-Lock's new Lean Production System was first launched at its factory in Mattmar, Sweden, lead times have shortened considerably and order precision has increased. Now the Nord-Lock Production System (NLPS) is being initiated at the company's US and Swiss manufacturing plants.

ANDERS JÖNSSON, Nord-Lock's Global Supply Chain Director, says: "We constantly want to improve, to satisfy our customers' needs and expectations on product quality and delivery performance. Our new Lean Production System adds more value for our customers."

Jönsson, who has more than a decade of experience running Lean production in contract and electronics manufacturing, was brought in by Nord-Lock last year to implement a Lean Production System at its manufacturing facilities. "Some people say that Lean manufacturing is a set of tools, but for me Lean manufacturing is a culture to improve everything we do each and every day," he says. "We are already seeing results: we have improved delivery precision, improved lead times and reduced inventories."

Delivery precision for Q1 2011 – before Lean manufacturing was implemented – was 95%. By the end of the year it was up to 100%, which exceeded targets. Lead time for the same period was reduced by 29%.

"We constantly want to improve, to satisfy our customers' needs and expectations on product quality and delivery performance"

ANDERS JÖNSSON, NORD-LOCK'S GLOBAL SUPPLY CHAIN DIRECTOR

"Our new Lean production system adds more value for our customers", says Anders Jönsson, Nord-Lock's Global Supply Chain Director.

"Lean production is making us look at where our waste is and where we can be more efficient," says Bill Myers, Director of Operations at the Superbolt factory in Pittsburgh, Pennsylvania

Erik Jonsson, who is responsible for implementation of the Nord-Lock Production System, calls the progress made so far "amazing". "We've only been doing this for about a year, but we have seen the kind of results that other companies take several years to achieve," he says.

Involving employees has been a central part of implementing Lean manufacturing, and in the last seven months they have made more than 700 suggestions for improvements. "These include everything from better lighting to new tools and technologies," says Erik Jonsson "350 of these improvements have been implemented, but what is most important is that employees feel empowered to improve their working environment and conditions."

Bill Myers, Director of Operations at the Superbolt factory in Pittsburgh, Pennsylvania, says he expects the Nord-Lock Production System to lead to effectiveness that can be passed on to customers. "Lean production is making us look at where our waste is and where we can be more efficient," he says. "I believe that we will be able to maintain our overall costs as prices around us increase."

The next step in Nord-Lock's rollout of Lean manufacturing is to look more closely at its total global supply chain. "We will connect the total physical flow of our products, including our distribution centres in USA and Germany," says Anders Jönsson. "And by working this way, we will involve our suppliers. We started to see the major improvements when we look at the total flow." □

DAVID WILES

Values in the Nord-Lock Production System (NLPS)

- Safe workplace
- Involved leadership
- Respect for the individual
- Employee development
- Quality assurance
- Long-term perspective
- Reducing waste
- Cutting throughput times

Results of Lean improvements in Mattmar Q1–Q4 2011

- Delivery precision confirmed: +5%
- Delivery precision request: +10%
- Lead time: -29%
- Throughput time: -46%

Comparing Superbolt nut-style multi-jackbolt tensioners vs. hex nuts

	MJTs	HEX NUTS
		
TOOLING	Only hand tools are required for any size tensioner.	Above 1" in diameter, hex nuts require expensive and potentially dangerous high energy tooling.
PRELOADS	Allows for higher preloads on the same size bolt due to pure tension.	As size increases, the required torque increases by a power of three. It is difficult to achieve proper preload levels. Torsional stresses reduce use of material strength.
DESIGN	High preload capacity and accuracy allow for the design of smaller bolt sizes, providing benefits in the design of machinery.	Tooling requirements can cause problems with space restrictions, awkward locations.
SAFETY	Eliminates common injuries associated with other bolting methods.	Injuries to fingers, hand, back, and face can occur when using common bolting methods.
INSTALLATION TIMES	Using air tools & multiple workers can result in time and labour savings.	Set-up time plus actual tightening for common bolting methods used with hex nuts usually result in longer installation times compared to MJTs.
THREAD GALLING	Tightens in pure tension without rotation of the main thread, prevents thread galling & stud seizure.	Threads slide during tightening, thus galling and stud seizure are common.

TRUE OR FALSE?

Many people believe that after tightening part of the torque still remains in the bolt.

THE TRUTH: The torque is a force multiplied by a moment arm. The force is applied at the moment arm (e.g. a wrench) and then rotates around the bolt axis. The moment arm is the length from the centre of the axis to the point where the force is being applied. Once the tightening is complete this external force is reduced to zero and with it the torque.

During tightening the bolt will work as a torsional spring and twist. The twisting will result in some residual torsion stress in the bolt that will work to unscrew the bolt. This can be interpreted as residual torque left in bolt.

To keep the residual torque as small as possible a low friction coefficient inside the bolting would be desirable. However, since friction is the only reason why the bolt does turn loose under its own preload, the friction coefficient should remain as high as possible.

The Nord-Lock group offers two ideal solutions for this dilemma. If torquing is the preferred tightening method, our wedge-locking washers will prevent the residual torque from unscrewing the bolting. Alternatively, twisting can be avoided completely by using Superbolt MJTs for torsion-free, purely axial preloading. Rely on our bolting experts to help you make the right choice. □

The Nord-Lock Group's new website.

Nord-Lock Group launches new website

IN LINE WITH the company's recent expansion, the Nord-Lock Group is proud to launch a new website. The new site provides comprehensive information as well as improved functionality. "The Nord-Lock Group has made some giant leaps in becoming a true market leader," says Jason Milburn, Marketing Manager North America. "Our website has been developed to reflect the wide range of solutions we offer our customers globally."
Visit the new site at **www.nord-lock.com**.

Nord-Lock launches copy campaign

IN AN EFFORT to inform the market of the growing emergence of counterfeits, Nord-Lock has launched a campaign to raise awareness of the potential risks this poses for safety and quality.

"Increasingly, non-authorised distributors are substituting Nord-Lock washers with copies, but are not informing their customers," says Frida Cullin, Manager Technical Centers. "We have encountered a number of cases where customers have unwittingly been using copies, and experienced bolt failure as a direct consequence."

Under the heading: 'Copies could cost you dearly', the campaign comprises a short film, a brochure, as well as real-life case studies. With Nord-Lock's help, customers can ensure that they receive the products they are paying for. To find out more, visit: **www.nord-lock.com/genuine**.

Creating customer value with our **Production System**

For Nord-Lock it is crucial to constantly improve in order to remain the world leader and a trusted partner in bolt optimization.

With the Nord-Lock Production System, we are able to achieve high product quality and increased productivity. This is our promise to our customers, ensuring that they are always satisfied with our performance and products.

www.nord-lock.com

NORD-LOCK®
Bolt securing systems