NORD-LOCK® A MAGAZINE ABOUT OPTIMISING BOLT SECURING # 1 2012

BOLTED

ABB USES COMBI BOLTS
RELIABILITY STARTS WITH THE RIGHT SOLUTIONS

SKANDINAVISKA GLASSYSTEM
KEEPING IT ALL TOGETHER

THE ORION PROJECT
JOINING THE SPACE RACE

BILL ECCLES
A CAREER DEDICATED TO BOLTS

A PERFECT MATCH

SUPERBOLT® JOINS THE NORD-LOCK FAMILY

For demanding environments

The Nord-Lock combi bolt is a bolt with an integrated pair of wedge-locking 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 at a minimum. Your parts will not only be safely secured, but also correctly assembled. The Nord-Lock combi bolt is an easy-to-use product in field operations, as well as in confined spaces or areas where access is difficult.

NORD-LOCK®
Bolt securing systems

Nord-Lock Group
www.nord-lock.com • info@nord-lock.com

BOLTED # 1 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 Tidningskompaniet in Gothenburg, Sweden, www.tidningskompaniet.se

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NORD-LOCK®

Same Bolted, but now with even wider scope and depth

You hold in your hand the sixth issue of Bolted. If you've read previous issues, I should warn you right now that this issue might not feel the same. Superbolt products and the team behind them have joined Nord-Lock and things will never be the same again! After close to thirty years of deep commitment to wedge-locking, we are now ready, together, to take on whatever bolting challenges the world might think of. And you can read all about it in one place – Bolted magazine!

With our wide-ranging expertise and the broad range of services currently on offer, there is so much happening and so many things to share with you that we almost don't know where to begin! It is fortunate that we have Bolted magazine to keep you up to date with an even wider range of interesting applications, and the latest news. Bolted is the place to tune in and learn about developments and innovations that are at the forefront of the bolt optimisation. I hope you know by now that you can email your contact info and full address to bolted@nord-lock.com, and we will send you Bolted free of charge, twice per year in the language of your choice. (So far, you may choose from English, German, Japanese, French, Chinese, Swedish or Finnish).

We, of course, provide a lot of information and insight into Superbolt in this issue, including a theme on multi-jackbolt tensioners (page 8). If you have any requests for future themes, don't forget to let us know. We are also proud to present a customer case with ABB, using our Nord-Lock combi bolts (page 12) and an interview with world-renowned bolt security expert Bill Eccles (page 15). Last but not least, we look back at the founding of the Nord-Lock Group and its development over three decades (page 18). In 2012, the Nord-Lock Group celebrates its 30th anniversary!

CARIN ESBERG
GLOBAL MARKETING MANAGER

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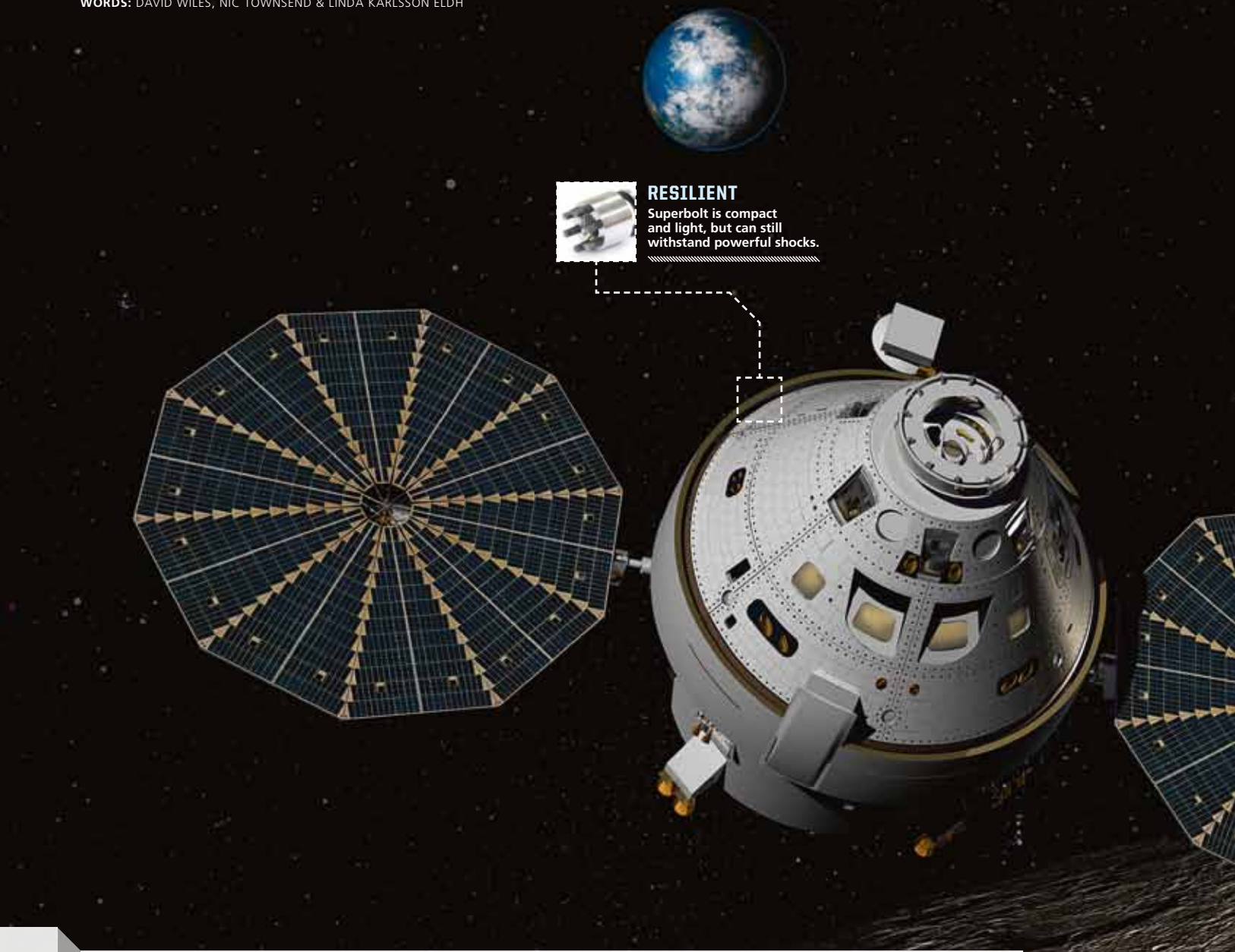
SECURED BY THE NORD-LOCK GROUP

WORDS: DAVID WILES, NIC TOWNSEND & LINDA KARLSSON ELDH



RESILIENT
Superbolt is compact and light, but can still withstand powerful shocks.

BOLTING INTO SPACE

CUSTOMER:
LOCKHEED MARTIN SPACE SYSTEMS – ORION SPACECRAFT

COMPONENTS:
CREW MODULE, LAUNCH ABORT SYSTEM, SERVICE MODULE, SPACECRAFT ADAPTER

CREW:	DIAMETER:	CARRIER ROCKET:
4	5 METERS	SPACE LAUNCH SYSTEM

INTEGRATED LAUNCH DATE:	TOTAL MASS TO ORBIT:
2017	18,732 KG

MANKIND'S NEXT GIANT leap in space exploration will take us to destinations throughout our solar system never before explored by humans.The spacecraft that will take us there, the Orion Multi-Purpose Crew Vehicle, is currently under construction in New Orleans, Louisiana at NASA's Michoud Assembly Facility. It will undergo an uncrewed orbital test flight in 2014 and will fly crew atop NASA's new Space Launch System soon thereafter.

Safety and survivability are the absolute priorities for the Orion project and, as in all aerospace applications, size and weight are key factors. So it is no surprise that Orion's manufacturer, Lockheed Martin Space Systems, has chosen Superbolt products for critical locations on the spacecraft, such as the separation points between the crew module and the service module, which are forced apart by controlled pyrotechnic charges.

The compact size, lightness and preload producing capabilities of Superbolt were well suited for Orion's needs, as was Superbolt's ability to withstand powerful shocks, as proven by U.S. Navy tests aboard submarines.

Superbolt is no stranger to the Final Frontier: its products have been used previously on the Space Shuttle, and can be found on satellites. You could call the Orion project one small step for Superbolt. □

PHOTO: LOCKHEED MARTIN SPACE SYSTEMS

PHOTO: BIFFA WASTE SERVICES LTD

OH WHAT A WASTE!

CUSTOMER:	WASTE COLLECTED:
BIFFA WASTE SERVICES LTD	30 MILLION TONNES EVERY YEAR
MODEL: FITTED TO ALL MERCEDES REFUSE COLLECTION TRUCKS	
NUMBER OF TRUCKS IN THE FLEET: +2,000	**NUMBER OF WHEEL NUTS IN FLEET:** 20,000

ONCE WE THROW something away in the bin, most of us have the luxury of not having to give it another thought. But this is only because companies like Biffa have become so efficient at collecting, disposing and recycling everyone else's waste.

Over the past 90 years, Biffa has grown from a family business that collected ash from coal-fired power stations in London, into the leading nationwide integrated waste management business, providing collection, treatment, recycling and technologically-driven energy generation services. Helping to transport all this waste, Biffa has over 2,000 trucks, transporting in excess of 30 million tonnes of waste every year. Earlier this year, after extensive trials, Biffa decided to fit Nord-Lock wheel nuts to all its Mercedes trucks. Now Biffa intends to fit Nord-Lock to all its vehicles, across all models.

Previously, Biffa's trucks used another brand on their hub caps. However, these were bulky and did not fit all vehicles. Nord-Lock wheel nuts, on the other hand, are the same size as standard wheel nuts, and significantly more secure. They also fit all types of vehicles.

The switch was driven by Biffa's key focus on health and safety and its belief that all accidents can be avoided when the appropriate plans and controls are in place. As an added benefit, Nord-Lock wheel nuts are also cheaper than disk locks, thus delivering significant savings to the business. □

NORD-LOCK GOES ROCK'N'ROLL

CUSTOMER: ANACON TECHNOLOGY		
LATEST AMPLIFIER MODEL: TUBEWONDER		**WEIGHT:** 19 KG
MAXIMUM SOUND PRESSURE LEVEL: 118 DB		**INPUT POWER:** MAX 160 VA
OUTPUT POWER: 55 W	**PRICE RANGE:** FROM APPROX. USD 4,500	

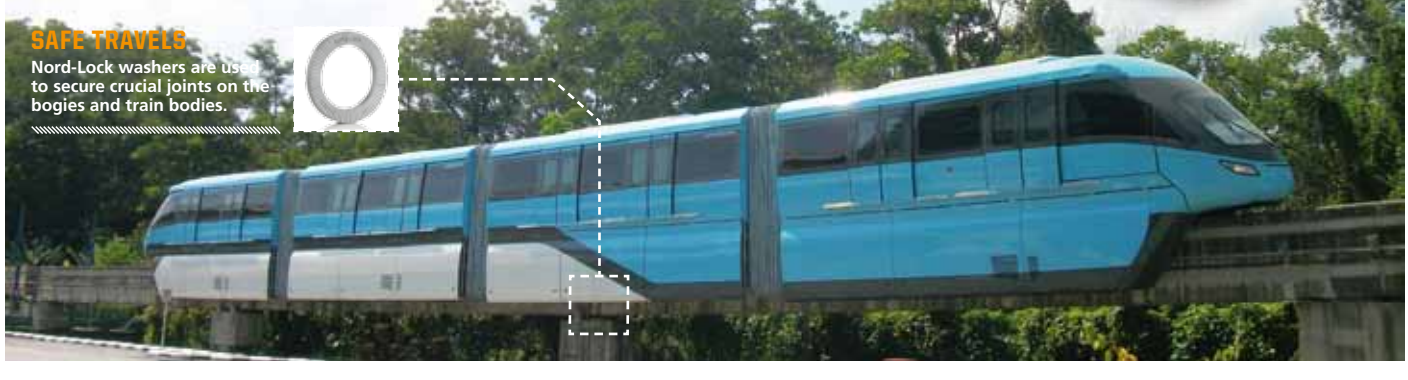
THE GUITAR AMPLIFIER is a fairly invisible device on the concert stage, but it is just as important for the sound of the electric guitar as the bow is for the violin. The amp increases the power of the incoming electrical signal from the guitar, but its most important task is to bring out that specific sound in the guitar player's head.

Anacon Technology in Gothenburg, Sweden, is a company that specialises in manufacturing high-end customised guitar amps. These amps are built using electron tubes that require high voltage for their operation. As this voltage can be lethal, bolting is a big issue. Extreme vibrations during touring, with long-distance transport on trucks and planes, can loosen the bolts that attach the amp's two electric transformers to the chassis. In the worst case scenario, the whole device could release a deadly charge of 500 volts.

Since 2006, Anacon Technology has been using Nord-Lock washers to secure the bolts in the amps. Their reliability has been proven during thorough vibration tests in accordance with electrical safety standards. The amp might be damaged or break down, but it will never give an electric shock to the guitar player or anyone else who touches it. □

HEAVY METAL

Anacon's amp transformers are secured with four pairs of Nord-Lock washers each. Thanks to these, guitar players can be sure that lethal voltage stays inside the amp.



SAFE TRAVELS

Nord-Lock washers are used to secure crucial joints on the bogies and train bodies.

A COMMUTE TO SAVOUR

CUSTOMER: SCOMI ENGINEERING		**TOP SPEED:** 80 KM/H
AVERAGE SPEED: 65 KM/H		**TRAIN LENGTH:** 4 CARRIAGES
ELECTRIFICATION: 750V DC	**DAILY RIDERSHIP (ESTIMATED):** 125,000	
LINES (PROPOSED): 8		

WITH ITS POPULATION of 20.5 million and legendary traffic congestion, the Indian city of Mumbai presents challenges to a commuter. But some relief is in sight, in the form of a USD 3.9 bn project that will provide India's commercial capital city with the world's second longest monorail corridor. Although the commuters enjoying the silky-smooth ride of the Mumbai Monorail won't notice it, vibration is a key concern for Scomi Engineering, which is building 15 sets of 4-car trains for the network at its Kuala Lumpur factory.

Scomi had previously used other bolt securing solutions such as glue and locking wire at crucial joints on the bogies and the train bodies, but with unsatisfactory results. Scomi turned to Nord-Lock and has been delighted with the outcome in an application where safety is paramount.

Scheduled to enter operation in May 2012, these sleek, fast, air-conditioned cars could yet make commuting in Mumbai a pleasure. □

THE EXPERTS

ULF WENDT
APPLICATION ENGINEER

FRIDA CULLIN
MATERIAL EXPERT

STEVE BUSALACCHI
ENGINEERING MANAGER

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.

Material fatigue explained

Q: What is the fatigue phenomena in bolted connections?

A: Material fatigue occurs when a component is subjected to cyclic loading. If the cyclic loads applied are too high, microscopic cracks will form, and when they reach a critical size the part will fracture. Material fatigue occurs at a stress level below the yield strength of a material.

When designing a bolted joint it is crucial to minimise the cyclic loads applied to the bolt to avoid fracture and subsequent failure of the connection. The basic principle for achieving this is to use an elastic bolt to clamp stiff members and to tighten the fasteners to a high preload.

A bolt's elasticity may be improved by using a long bolt, for example, or by reducing the shank diameter. Generally, it is preferable to use several thin bolts rather than one large one if the large bolt cannot be preloaded properly or the clamping length cannot be increased suitably. The clamped members can be kept stiff by avoiding the use of steel in preference to soft materials such as cast iron, light metal alloys, polymers and similar.

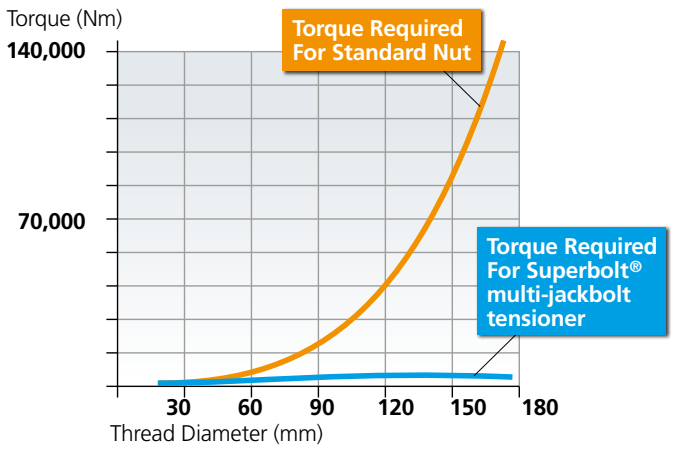
A possible cause of fatigue failure is the over-dimensioning of bolts which are too stiff. Also, the most common failure position is in the first engaged thread. **UW**

Why do Superbolt multi-jackbolt tensioners prevent loss of preload?

Q: Superbolts have been used in numerous demanding bolting applications with extreme working loads and high vibrations. What mechanical principle of Superbolts prevent loss of preload?

A: Preventing loss of preload is certainly a major advantage of a Superbolt. However, it stems from Superbolt's ability to attain the proper preload in the first place. This is because, for a properly designed bolted joint, achieving the proper preload (clamping load) over the working load (separating force) is what keeps fasteners tight. However, in the majority of cases, achieving proper preload is extremely difficult, especially when tightening conventional hex nuts. This is because as the bolt diameter increases, the torque required to reach a certain bolt stress increases by a power of three. Therefore it is very difficult to easily tighten hex nuts that are over one inch.

The torque required to tighten Superbolt tensioners, on the other hand, are kept low since the large preload is spread over many smaller bolts known as jackbolts, which need only to be torqued with simple hand tools. Also, with controlled lubrication and minimal frictional losses, Superbolt reaches high preloads with superb accuracy and repeatability. Integral to the design, Superbolt adds desirable elasticity to the bolted joint, which helps maintain preload, especially in thermal or dynamic applications. Testing shows that Superbolt tensioners maintain the preload even when subjected to a million cycles of high dynamic load at a level of 98% of the applied preload. Many other tests, including fatigue and vibration tests, have been performed. For further details, test reports are available. **SB**



Nord-Lock combi bolts offer several benefits in terms of faster or easier assembly and handling.

SEMS overview

Q: What are SEMS?

A: SEMS are a bolt combination with a permanently attached washer or set of washers. It is also referred to as captivated washers, screw/bolt-washer assemblies or combi bolts. The word SEMS originates from The Illinois Tool Works Inc., who made machines that produced pre-asSEMbled washers and screws. In spite of the original patents and trademarks, the word SEMS is generally recognised as a generic term applicable to screw and washer assemblies. The washers are installed on the bolt blank before thread rolling. Since the outer diameter of the threads becomes larger than the inner diameter of the washers, the washers are prevented from prising loose from the bolt. It is normally possible for the washer/washers to slide on the non-threaded part of the bolt.

SEMS offers several benefits in terms of faster or easier assembly and handling. The Nord-Lock combi bolts, which are relatively new within our product range, combine the convenience of a bolt with a pre-assembled Nord-Lock washer pair for superior locking capacity.

The Nord-Lock combi bolt offers the following:

- Ensures faster product assembly, thanks to pre-assembled and pre-lubricated parts.
- Decreases failures relating to improper mounting or failing to attach washers.
- Facilitates product assembly in the case of extremely small dimensions.
- Makes service and repair in rough surroundings or hard-to-reach areas easier and safer.
- Facilitates inventory and logistics, thanks to having fewer item numbers.
- Makes disassembly faster and easier, as loose washers can be hard to remove, especially from tapped holes. **FC**


THINK
BIG

Like the Nord-Lock wedge-locking products, Superbolts offer a simple but ingenious design that significantly increases bolt security while saving time and labour.

With Superbolt® you can tighten even the largest bolts with hand tools. Like the Nord-Lock product range, the result is safer, faster and more accurate bolting, making them a perfect match. Bolted takes a closer look at Nord-Lock's latest acquisition.

WORDS: DAVID WILES

PHOTO: CHRISTER EHRLING, SUPERBOLT & CERN

OLF STEINBOCK'S EUREKA moment, which came in 1974 while on a service call to one of his scrap choppers in a US steel mill, solved at a stroke two basic problems with big bolts. One is that they take a massive amount of torque to tighten. The second is that they have a nasty habit of working loose. When told that the bolts on the gearbox of the otherwise perfectly-functioning scrap chopper required tightening a couple of times a day, Steinbock had a flash of inspiration which he hastily scribbled down on the proverbial napkin. His solution worked perfectly, and the bolts never came loose again.

Steinbock's solution, to split one big torque into a number of smaller torques, was commercialised as Superbolt. "He was actually surprised that nobody had thought of it before," says his son, Allan Steinbock, who is the company's Vice-President. Word spread to customers beyond the steel industry and, today, Superbolt's multi-jack-bolt tensioners can be found in a wide range →

As a bolt's diameter increases, the torque required for tightening soars, but Superbolt tensioners reduce the torque required by splitting one big torque into a number of smaller torques.

→ of applications, from satellites to submarines to the Large Hadron Collider at CERN.

The problem Steinbock tackled is the fact that for bolt diameters bigger than about M24, it is very difficult to create enough torque to tighten or loosen a bolt. Simple physics shows that the torque needed to properly pre-stress a bolt increases by the third power of the bolt diameter. Therefore as the bolt diameter increases, the torque requirement for tightening it soars.

Traditionally this has required some heavy-handed methods, but all have their drawbacks. The sledgehammer gives little control, is inconsistent and often causes injuries. Thermal tightening, crane wrenching, hydraulic wrenching and hydraulic tensioning can be expensive, inaccurate, time consuming and unsafe.

However, Superbolt tensioners, which are designed as direct replacements for standard nuts and bolts, allow for the tightening of large bolts with simple hand tools, making bolting more accurate, faster and safer. "The primary benefit of Superbolt is the reduction of torque required," says Steinbock. "You only need a handheld torque wrench or air tool."

SUPERBOLT TENSIONERS UTILISE a ring of hardened jackbolts threaded into a nut body. The Superbolt tensioner is first threaded by hand onto a new or existing bolt or stud. Once positioned, bolt tensioning is accomplished by tightening the circle of jackbolts. A number of different product lines are based on the same basic concept.

"Because we are able to generate the proper preload, we achieve the proper holding power and we don't have bolts or nuts coming loose, even in high-vibration situations," says Steve Busalacchi, Engineering Manager. "This reduces expensive downtime: both downtime required for maintenance to retighten loose bolts, but also downtime caused by studs breaking due to insufficient holding power."

Because Superbolt can be installed with hand tools, there are also time savings. "We install quicker and we remove quicker," says Busalacchi. "People's first impression is that it will take longer because they have several bolts to tighten instead of one. But once they see that you spin it on by hand and perform a quick tightening pattern similar to mounting a wheel on your car with hand-held tools, then they are impressed by the time savings we provide."

The safety benefits of the Superbolt solution are highly appreciated at a time when many industries have implemented safety programmes. "Safety is a huge factor for us," says Steinbock. "Alternative methods require equipment which can create extremely dangerous conditions. Our products are safe to use, and this is a huge benefit to our customers."

Superbolt's distinctive circle of jackbolts help obtain proper holding power and bolt tensioning, ensuring bolts do not come loose, even in high-vibration situations.

SUPERBOLT®

FACTS:

BENEFITS OF SUPERBOLT

- Only hand tools are required
- Time and labour-saving
- Maximum holding power
- Increased workplace safety
- Accurate preload
- Ideal for restricted areas
- Flexing adds elasticity to the joint
- Tightens in pure tension
- Economical and reusable

Superbolts in use

Gold award from CERN

SUPERBOLT SUPPLIED MORE than 1,500 high-strength mechanical tensioners, expansion bolts and multi-jackbolt tensioners to the CERN Large Hadron Collider in Switzerland. Multi-jackbolt tensioners were used for an application requiring a very high clamping force, but with limited space for tightening the bolts. Since only hand tools were required, the need to create anchor points for heavier tightening equipment was eliminated. Superbolt won the CMS gold award for its contribution to the project. □

Ideal mine solution

THE SEVERE ENVIRONMENT of an underground coal mine takes a brutal toll on crusher drum bits. It is a violent application with high RPMs and constant pounding as the bits cut into coal and rock and often break off, requiring repair underground, where accessibility is limited. With Superbolt, space restrictions are of little concern because only small hand tools are required, making the process easier and faster. □

Cheaper and faster

LARGE AMMONIA REACTORS often require the use of large and expensive hydraulic tensioners, and tightening or untightening can take several days, working around the clock, and using cranes. At one such reactor, not only was the initial cost of the Superbolt tensioners only a fraction of the cost of the hydraulic tensioners they replaced, but the installation took two labourers only 5 hours. □

WHILE SUPERBOLT PRODUCTS are available off-the-shelf, about half its sales are for special non-standard items in sizes all the way from M16 to over M1450. "What makes Superbolt unique is our ability to adapt to different situations, whether this is reviewing temperatures and changing materials, or customising designs to fit customer requirements. We are very adaptable and want to make sure that the customer receives the right solution and is satisified," says Busalacchi.

Users of Superbolt products including General Electric, Siemens and Rolls-Royce appreciate the fact that that they can receive finite element analysis (FEA) carried out by independent organisations. "These organisations can provide an independent assessment of what we are telling our customers about our calculations," says Norbert Schneider, Head of Engineering at Nord-Lock AG. "It boils down to safety and customers' peace of mind."

A CURRENT INSTALLATION of Superbolts shows just how extreme an environment they can handle. About 2,000 tensioners made from exotic nickel-based alloys have been installed at the Max Planck Institute for Plasma Physics in Greifswald, Germany, where research will be carried out into the principles of a fusion power plant, which, in the future, could provide safe, green energy from the same process that takes place inside the sun.

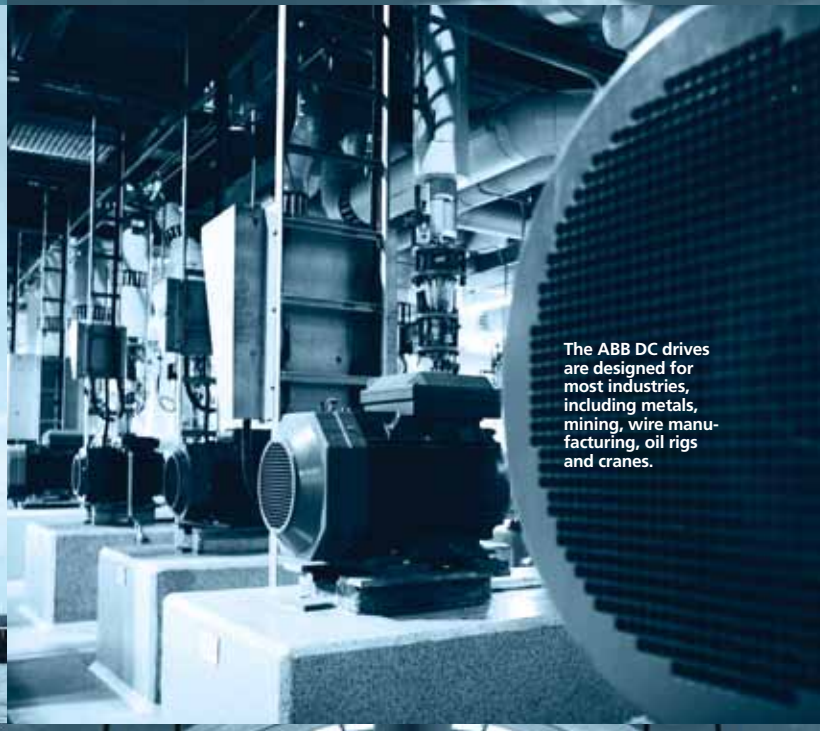
"The Max Planck Institute has chosen Superbolt because the ambient conditions under which the research is to be carried out are quite horrendous - we are talking about -270°C, radiation and an absolute vacuum, as well as extremely high loads," says Schneider. "Basically, we are dealing with outer space conditions found close to the sun." And highly compact machines mean that there is no access for heavy tools. "The forces are so immense that they require large bolts and the only way to tighten large bolts without heavy tools is the Superbolt principle," says Schneider.

Such characteristics and performance mean that once customers have tried Superbolt, they rarely return to the troublesome methods of the past.

"The hardest part, as with any product, is to get people to try it," says Steinbock. "But once people have tried it, our repeat order rate is phenomenal. Customers now count on us to provide a quality product and we receive tremendous loyalty from them in return." □

"The forces are so immense that they require large bolts and the only way to tighten large bolts without heavy tools is the Superbolt principle."

NORBERT SCHNEIDER, HEAD OF ENGINEERING AT NORD-LOCK AG



The ABB DC drives are designed for most industries, including metals, mining, wire manufacturing, oil rigs and cranes.

MOTORS Electric motors are often called the "workhorses of the industry", running all kinds of machinery ranging from escalators and ski lifts to huge port cranes. Heavy mechanical movements require a reliable drive that ensures the best torque, speed, and motor efficiency. This reliability often starts with the right bolt securing system.

WORDS: LINDA KARLSSON ELDH
PHOTO: KLAUS HECKE & ABB

POWERING THE INDUSTRY

DIRECT CURRENT (DC) MOTORS have been around for almost 100 years. Efficient speed regulation, a compact design and low maintenance make them a great option for almost any industrial application. As the electronics in heavy machinery has to cope with high levels of thermal stress and vibrations, the right bolt securing system is vital to ensure the DC drive's reliability.

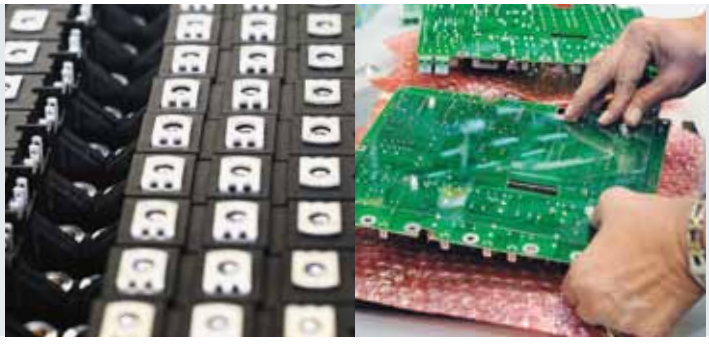
ABB is the world's largest drives manufacturer, operating in around 100 countries and employing more than 130,000 people. The company's DC Drives production operation is headquartered in Ladenburg, Germany. The drives are designed for most industries, including metals, cement, mining, pulp and paper, printing, food and beverage, wire manufacturing, oil rigs and cranes.

The DC drive converts AC power to DC voltage in order to vary the speed and torque of the motor. Bolting is an important issue because heavy machinery, such as port cranes, often need to double or even triple the load on the motor, which heats up the power bus bar and can cause the bolts to loosen.

SINCE THE BEGINNING of the year, ABB in Ladenburg has been testing a Nord-Lock combi bolt wich is a bolt with integrated Nord-Lock washers. The bolt is a M10x20 to be used for fitting copper bars with thyristor modules. This bolt connection is the core component of the bolt structure in the D4 and F4 power units in two of the company's most important series – the DCS550 standard drives and the DCS800 industrial drives.

"We were used to conventional bolts loosening by 10 to 20 per cent after being tightened," says Holger Kröhler, head of DC Drives Quality Management and Development Design. "But after testing the Nord-Lock combi bolt in more than 1,000 devices, there hasn't been a single situation where the bolts loosened." →

Nord-Lock combi bolts being mounted onto a module at the ABB DC Drives production facilities in Ladenburg, Germany.



Last year, the team delivered 13,000 DC drives. Process optimisation is important in order to keep pace with the growing demand.

"To stay number one, you always have to optimise the process. That's what we are doing right now, testing the combi bolt from Nord-Lock."

HOLGER KRÖHLER, HEAD OF DC DRIVES QUALITY MANAGEMENT AND DEVELOPMENT DESIGN AT ABB LADENBURG

FACTS:

ABB GERMANY

WHAT IT DOES:
POWER AND AUTOMATION TECHNOLOGIES

PART OF:
ABB GROUP, ONE OF THE LARGEST ENGINEERING COMPANIES IN THE WORLD, WITH HEADQUARTERS IN ZÜRICH, SWITZERLAND.

HISTORY:
ABB WAS FOUNDED IN 1988 IN A MERGER OF THE SWEDISH COMPANY ALLMÄNNA SVENSKA ELEKTRISKA AKTIEBOLAGET (ASEA) AND SWISS BROWN, BOVERI & CIE (BBC).

ANNUAL SALES 2010:	NUMBER OF EMPLOYEES:
EUR 3.03 BILLION	AROUND 10,000
BOLT SECURING:	
NORD-LOCK	

Business arguments

THIS IS HOW ABB benefits from the Nord-Lock combi bolt:

- **TIME-SAVING** – with just one component instead of three, the bolts are faster to install.
- **EASE OF USE** – fewer components, fewer errors.
- **SAFETY** – bolts don't loosen.
- **SPACE SAVING** – small diameter bolt design enables bolts to be placed close to each other in the device.

The combi bolt is being tested on the newest member of ABB's DC drive family: the DCS550 series. Holger Kröhler is happy to note that, so far, not one single bolt has loosened.

→ Each power unit contains eight bolts. Previously, ABB used two plain washers to secure a bolt. The Nord-Lock washers have a much smaller diameter, which makes it possible to place them nearer to each other in the device. A compact design is crucial for applications where space is at a premium. ABB's DC drive portfolio, which ranges from 9 to 18,000 kW, provides the highest power-to-size ratio on the market. For Holger Kröhler, this is one of the main advantages of ABB drives compared to the competition.

"This is due to the fact that ABB completely separates the manufacturing of AC and DC drives", he explains. "Other companies use the same electronics for both AC and DC. They are therefore much more constrained by restrictions than we are."

FORTY TO FIFTY per cent of ABB's DC drives are used to revamp ageing electric components in older plants, making them a simple and cost-effective solution to reduce operational costs and increase capacity. There is a booming demand for this kind of modernisation. The production volume in Ladenburg has increased steadily by 10 per cent per year since 2008. Last year, 13,000 DC drives were supplied by the production facilities and the company expects growth to continue. Holger Kröhler is proud to state that ABB has managed the increased demand without having to hire new employees.

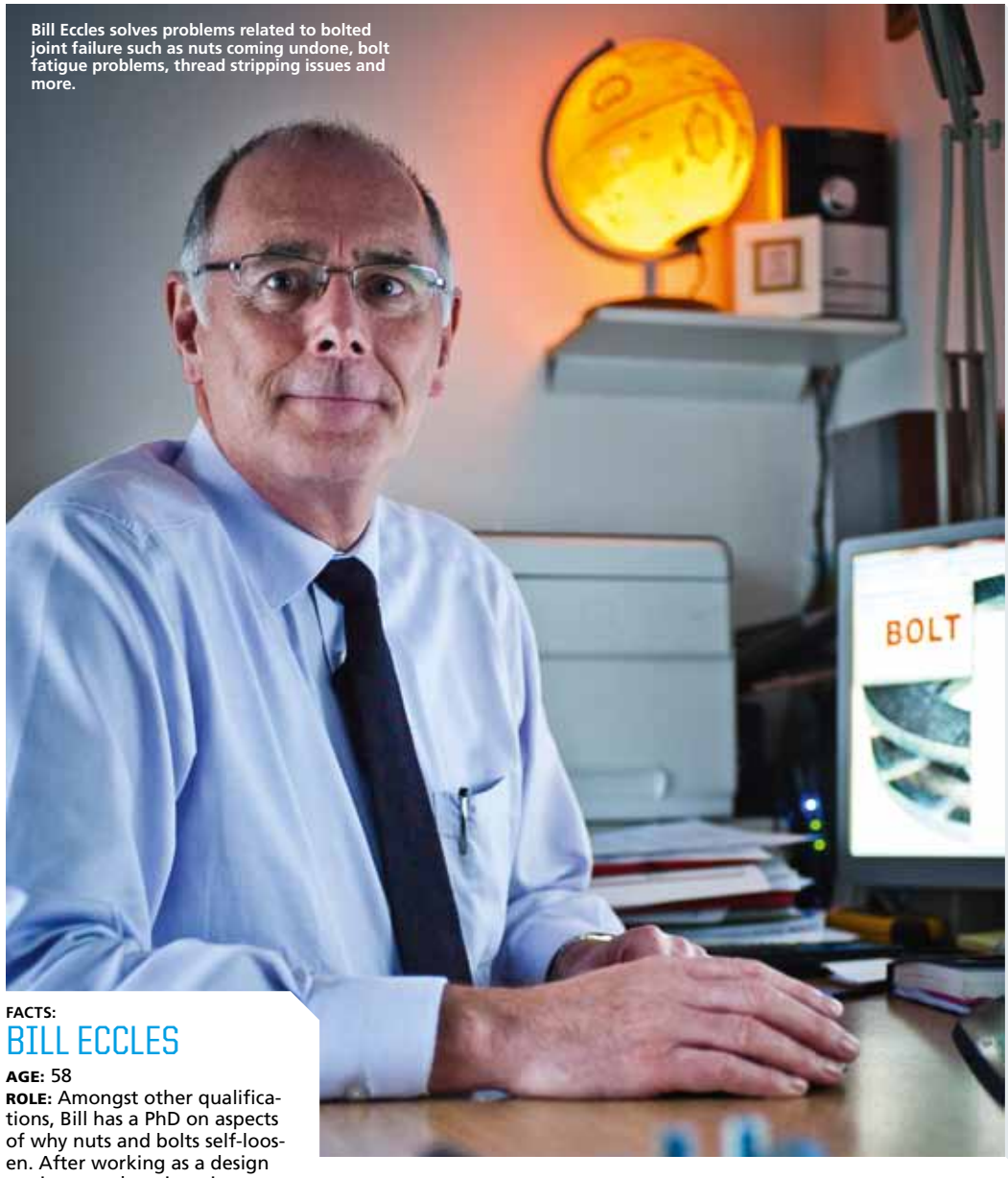
"We put a lot of effort into process optimisation", he says. "We've installed modern equipment and improved handling practices. The new combi bolt from Nord-Lock is another step in this direction."

FOREWOMAN JUTTA ZEHNBAUER has worked at ABB for 26 years and can't even begin to guess how many bolts she has handled over the years.

"With the Nord-Lock combi bolt, we only have one part to work with, instead of three", she says. "That makes the work a lot quicker and easier. Our production people are really happy working with it". □

Knowledge prevents bolt failure

WORDS: CHRISTINA MACKENZIE | **PHOTO:** DAN DUNKLEY



Bill Eccles solves problems related to bolted joint failure such as nuts coming undone, bolt fatigue problems, thread stripping issues and more.

ADVISER When Bill Eccles was a design engineer, he noted that people generally agreed on many different things. "However, as far as nuts and bolts were concerned, everyone had different information." So he paid closer attention to this sector, even earning himself a PhD on why nuts come loose. Today, his expertise is called upon by companies and regulatory authorities worldwide.

Regulatory authorities?

"Yes, I often act as an expert witness. For example, in 2011, I testified during the inquest into the Grayrigg accident when missing bolts contributed to the February 2007 derailment of a train in northern England in which one person was killed."

What kinds of companies do you work with?

"Oh, all sorts! I didn't realise when I was younger that the industries which rely on nuts and bolts range from electric toothbrush manufacturers to those of oil and gas pipelines, for example."

Can't in-house engineers handle bolting problems?

"Not always. They graduate from university, often with no theoretical knowledge on analysing bolted joints. Many joint failure problems are due to the joint not being designed correctly. There is a significant lack of knowledge out there. If you design the joint properly from the outset and the fasteners are tightened correctly, you don't need something to stop it from coming loose."

What sort of problems do you solve?

"Very specific ones related to bolted joint failure such as nuts coming undone, bolt fatigue problems, thread stripping issues etc. I have also covered tightening problems both with fastener tool companies and end users working on such issues as what the appropriate tightening torque should be and what tightening methods and procedures to use to reduce bolt preload scatter."

What do you think your added-value is?

"It is providing expertise in solving problems with state-of-the-art knowledge and, not only solving the problem, but solving it economically. I keep myself up-to-date by reading research papers published on the subject together with working with a local university."

Are there many?

"Quite a lot of work has been done since the 1960s but unfortunately research is not getting broadcast. For example, the fact that helical spring washers do not work was first shown in a 1969 research paper and has subsequently been proved by other studies. However, they are still being used and failures are occurring as a result, some of which are catastrophic in nature."

You also provide training?

"Yes, I typically train the design engineers, not the people actually tightening the bolt. I basically show them how to prevent bolted joints failing and how to optimise the fastener size, i.e. to decide what size and strength of bolt should be used, and what the tightening torque should be so that the structural integrity of the joint can be assured. I work in North America, Europe and the Far East and for companies ranging from defence companies, lots of nuts and bolts on armoured vehicles and warships!, to car and machinery manufacturers and so on."

Has the economic downturn influenced your business?

"No. There was a significant drop-off when the crisis first hit in 2008 but things picked up and I'm now as busy as ever. Perhaps many engineering firms have escaped the worst?" □

FACTS:

BILL ECCLES

AGE: 58

ROLE: Amongst other qualifications, Bill has a PhD on aspects of why nuts and bolts self-loosen. After working as a design engineer and engineering manager for a number of companies, Bill founded his consultancy company Bolt Science in 1992 and now travels the world giving advice on various aspects of bolted joints.

Safe travelling

WORDS:
LINDA KARLSSON ELDH

PHOTO:
SKANDINAVISKA GLASSYSTEM

THE CHALLENGE The City Tunnel is a rail link between Malmö and the Öresund Bridge in Sweden, with a six kilometre railway running under Malmö city centre. The glasswork company Skandinaviska Glassystem, was assigned the task of constructing the roof of the new Triangeln railway station situated in central Malmö. This required a bearing frame in high strength stainless steel covered in 1,200 square metres of glass comprising 1,600 different sections. The steel construction's arms meet in nodes, which are exposed to vibrations from outside, as well as from the trains below ground. After the glass has been put in position, it is impossible to check if a bolt inside a node is coming loose or not. For this reason, the team had to find a bolting solution guaranteed to stay in place.

THE SOLUTION Skandinaviska Glassystem started to evaluate different solutions and soon discovered Nord-Lock washers.

"These washers were the only ones that could offer this kind of wedge-locking effect, thanks to the cams on the inside of the washers", says Stefan Abrahamsson, Project and Marketing Manager at Skandinaviska Glassystem. "We were absolutely sure that the bolts wouldn't come loose, but we needed to convince the customer that Nord-Lock washers were better than any of the bolt locking systems approved in the Swedish Regulations for Steel Structures."

Nord-Lock therefore performed extended tests of the washers' ability to secure bolts safely in this kind of glass and steel construction. These tests were successful and more than 5,000 Nord-Lock washers were used to secure the bolts in the nodes of the Triangeln steel construction. Different washers were used for bolt sizes ranging from M12 to M24, depending on the pressure or pulling effect of the steel arms.

THE RESULT The City Tunnel was inaugurated by the king of Sweden at the end of last year and the Triangeln is now the third largest railway station in Sweden. Every day, 37,000 travellers pass under the glass roof that is so safe that it has even been officially branded "hooligan proof", which means that it could cope with four football hooligans, each weighing 100 kilo, simultaneously jumping up and down on every single square metre of the roof. In November 2011, the Triangeln won the Kasper Salin prize, which is the most prestigious architecture prize in Sweden. □

ACCESS DENIED
Bolts need to be secure because, once the glass sheets have been installed, it is impossible to inspect them.

Nord-Lock gets type approval by ABS

No certifications in the marine-related world are as important as those given by the two giant classification organisations, the American Bureau of Shipping (ABS) and Det Norske Veritas (DNV). Having one of these certifications is a feat. With its recent ABS type approval certification, Nord-Lock now has both.

THE ABS TYPE APPROVAL is a voluntary programme whereby ABS certifies manufacturers around the world, "who are capable of consistently producing a product in compliance with product specifications." The application involves a lot of paperwork, thorough product testing and an extensive factory audit. However, for Nord-Lock, it was worth the two years of work to obtain an ABS Type Approval for all of its washers.

"It was a strategic decision to apply for the ABS Type Approval," says Csaba Madru, responsible for Global Development Performance Services at Nord-Lock International AB. "Oil & Gas is one of our most important target groups and ABS is the most important certification in the USA and Asia. This will further open up these markets for us."

OIL AND GAS rigs are considered to be among the most dangerous places in the world to work: long shifts, highly combustible materials, storms and the risk of natural disasters. Safety requirements are extremely stringent, since even small mistakes can lead to disasters. For many companies in the field of offshore and shipbuilding, ABS Type Approvals are a must.

"To them, it's a guarantee that an independent, neutral authority has stated that our products work in this special environment," adds Csaba Madru.

Nord-Lock is the only locking component used to prevent or minimise the dynamic, vibration, shock or impact-induced loosening of threaded fasteners, which is certified with an ABS Type Approval. Nord-Lock passed all tests, as well as the factory audit.

"Often, ABS requires follow-up from a manufacturer before a product can receive a type approval," Csaba Madru explains. "In our case, no complementary tests were needed, which is great proof of the high quality and functionality of our products."

Since Nord-Lock continues to develop new products, a close cooperation with ABS will be maintained over the next few years. Each and every new product has to be checked and approved. To the company's customers, this is a guarantee that new products work and old products maintain consistent quality levels. ABS controls the approved production on a regular basis and every five years the type approval has to be renewed.

"SOME CUSTOMERS ARE very surprised to learn that we have both of the two principal certifications, DNV and ABS," Csaba Madru says. "But for us, this is a way to show our customers that we don't just talk about quality, technology, expertise and safety. We implement it. We don't tell them that we're one of the best. Instead, we prove to them that we're number one." □

LINDA KARLSSON ELDH

"For us, this is a way to show our customers that we don't just talk about quality, technology, expertise and safety. We implement it."

CSABA MADRU, RESPONSIBLE FOR GLOBAL DEVELOPMENT PERFORMANCE SERVICES AT NORD-LOCK INTERNATIONAL AB

Superbolt tensioners meet DNV standards

BOLT SECURING COMPANIES, Superbolt Inc. and P&S Vorspannsysteme AG in Switzerland (today Nord-Lock AG), both acquired by Nord-Lock in August, have received certifications by Det Norske Veritas (DNV) for several series of Superbolt multi-jackbolt tensioners.

"These certificates lend credibility to our technology", says Allan Steinbock, Vice President at Superbolt.

DNV is an independent foundation aimed at safeguarding life, property and the environment, at sea and onshore. DNV provides service specifications, standards and recommended practices. Superbolt's tensioners are used for offshore applications such as mounting cranes to the drilling rig and securing the drawworks. A DNV approval certificate number is often crucial.

"DNV certification is proof that our products are trustworthy and safe to use in this field", Allan Steinbock explains. "In the case of our customer, Dreco Energy Services Ltd. (Div of NOV), an offshore application was even put on hold until we had gained DNV certification." □

BOLTING NEWS

News from the world of the Nord-Lock Group and bolt security

Nord-Lock granted membership to AFNOR

IN SEPTEMBER, the French national organisation for standardisation, AFNOR, appointed Nord-Lock as a member of the commission for fasteners. Nord-Lock will work side by side with the main players in the French fastening systems industry. One of the most important tasks is to review old standards and bring them up-to-date.

Damien Thomas, Field Applications Engineer at Nord-Lock, is proud of the appointment.

"Developing standards is a great way to work in the interests of our end-users", he says. "Our customers are very pleased." □

Saint-Laurent Nuclear Power Station is one of the nuclear plants in France where Nord-Lock's solutions contribute to the safety.

Nord-Lock Group part of French Nuclear Industry Association

GIIN REPRESENTS the French manufacturers and service companies involved in the nuclear Industry. Countries from all over the world consult the association about safety issues in nuclear plants. This is where Nord-Lock comes in.

"Nord-Lock's solutions contribute to the safety in every nuclear plant in France", says Denis Mullenbach, Global Industry Manager Energy at Nord-Lock Group. "As a member of GIIN, we advise nuclear energy companies not only in France, but at an international level too." □

NORD-LOCK:

30 years of respected expertise

FROM HUMBLE BEGINNINGS in a remote barn set among the forests and lakes of central Sweden, Nord-Lock has grown during 30 years to become a truly global solutions provider.

The locking washer concept was fine-tuned and perfected during those early years, thanks to hard work, dedication and the desire to develop the best possible system for securing bolted joints. "We saw its potential from the start, but we never imagined we would achieve the kind of success that we see today," says co-founder Kurt Persson.

His colleague, Anders Keife, travelled the world with his Junkers machine, demonstrating to impressed engineers just how effective the solution was. "I had no problem convincing them that this works," says Keife.

Nord-Lock established a global network of distributors and grew from being a manufacturer of washers to a provider of engineering competence based on its respected expertise.

Production remains in central Sweden but the company now has global reach. Today Nord-Lock has 350 employees, 17 subsidiaries and technical centres of excellence in North America, Europe and Asia. Last year's acquisition of Superbolt Inc. and P&S (today Nord-Lock AG) marked a major step towards the company's vision of becoming the undisputed leader in bolt securing. □

Brickan det lossnar för

Förspänningsökning och sättning

The success of Nord-Lock's locking washer concept has surpassed even the expectations of those who developed it.

NORD-LOCK TIMELINE

1982: Nord-Lock is founded and production starts in Mattmar, Sweden.

1990: First annual meeting brings together distributors from 14 countries.

1994: Investment AB Latour acquires Nord-Lock.

SUPERBOLT TIMELINE

1985

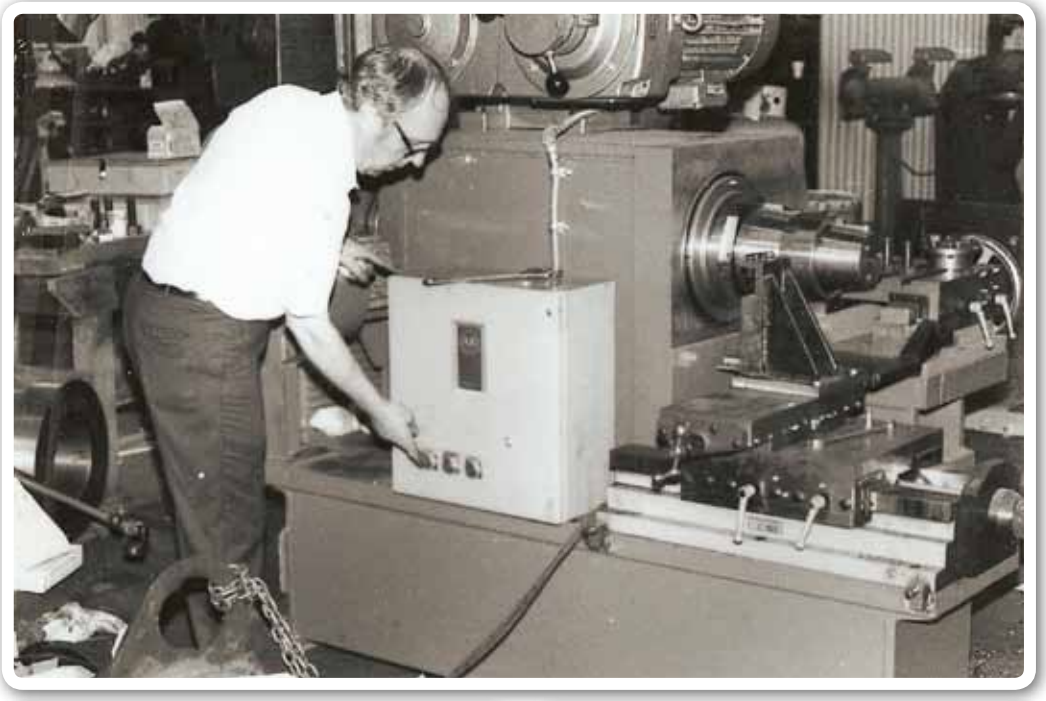
1990

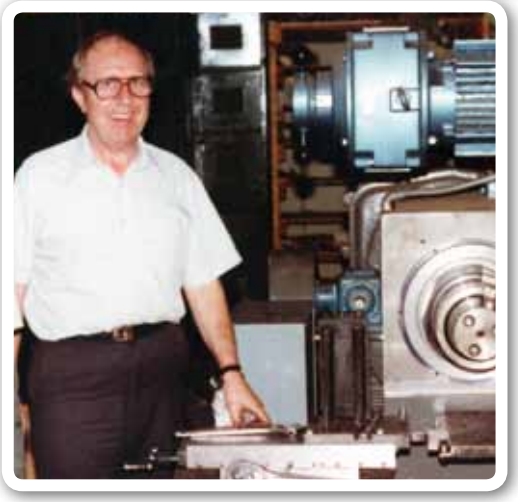
Mid 70's: First use of Superbolt technology by Rolf Steinbock for scrap-chopper application.

1984: Patent for multi-jackbolt technology issued and Superbolt, Inc. is founded.

1987: Gert Ploke & Rolf Steinbock start a joint venture in Europe (P&S Vorspannsysteme AG).

1989: Previously dependent upon the Steel industry, Superbolt begins to diversify.





Superbolt started life as a bolting solution for the steel industry but soon spread to other sectors. *Top and above left:* **company founder Rolf Steinbock during testing of a steel mill roll grinder he designed and built in Carnegie, Pennsylvania.** *Above right:* **the first promotional photo of a Supernut tensioner, representing a tie rod application on a hydraulic press.**

SUPERBOLT:

A simple idea with global potential

THE SUPERBOLT SOLUTION grew out of founder Rolf Steinbock's experience with large bolts in the US steel industry in the 1970s. He knew first-hand that large diameter bolts were prone to coming loose and were difficult and often dangerous to tighten. His idea of splitting one big torque up into several smaller ones solved both problems.

Starting out in a rented workshop with two employees, having double-mortgaged his house to fund the venture, Superbolt grew rapidly as customers in the steel industry became aware of his simple but ingenious idea. Steinbock's sons entered the business and Superbolt began to diversify into other markets. The family-run company went on to establish a joint venture in Europe through P&S Vorspannsysteme.

A culture of innovation led to new product lines based on the original multi-jackbolt tensioner design, and Superbolt continued to expand its Carnegie, Pennsylvania site in what was the heart of the US steel industry.

Rolf Steinbock died in 2001, but it had always been part of his plan for the company to become part of a bigger entity to help it reach its global potential. "Joining forces with Nord-Lock creates some great synergies and is the start of an exciting new period in our history," says Vice-President Allan Steinbock. □

1998: The first subsidiary, Nord-Lock Inc, is formed in the US.

2001: Test lab is established and sales staff taken on in Malmö, Sweden.

2008: Nord-Lock Germany, Nord-Lock Benelux and Nord-Lock Japan are acquired.

2010: Nord-Lock wheel nuts are launched.

2011: Nord-Lock Group acquires Sigma3 in Italy, Superbolt in the US and P&S in Switzerland.

1995 2000 2005 2010

Mid-1990's: Day to day running of the company is handed over to sons Robert and Allan.

2000s: Continued innovation with new patents issued, including Split-Nut Thrust Collar and Tapered Threaded Jackbolts.

2004 – 2010: Superbolt continues to grow, sales more than double during this period.

2011: Superbolt is acquired by the Nord-Lock Group.

2012: 30 year anniversary of the Nord-Lock Group.

Your trusted global partner in bolt optimization

Two of the most innovative and trusted bolt securing technologies have joined forces. The combination of Nord-Lock and Superbolt is unique in the bolt securing industry. Together we are able to serve global customers with an impressive line-up of innovative bolting solutions. Our mission is to safeguard human lives and customer investments by securing the world's most demanding applications.

NORD-LOCK®

Bolt securing systems

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