NORD-LOCK GROUP

WHY DO BOLTS LOOSEN?

AND HOW DO YOU PREVENT THIS FROM CAUSING DOWNTIME AND SAFETY HAZARDS

BULLET-PROOF THE BEST WASHERS FOR FAST TRAINS FUSION POWER DESIGNING TOMORROW'S ENERGY SOURCE SOUND OF SILENCE EFFECTIVE BUT SMALL RAILWAY NOISE BARRIERS

WHEN!

(((mm)))

BEAT THE HEAT THE RIGHT ASME BOLTS FOR FLANGES



A SMARTER CHOICE

Nord-Lock wedge-locking washers prevent bolts from loosening – so you can feel safe wherever you are.

> NORD-LOCK SOLUTIONS ORIGINAL WEDGE-LOCKING TECHNOLOGY



BOLTED # 2 2018

About bolting technologies - a customer magazine from the Nord-Lock Group

Bolted magazine is published by the Nord-Lock Group and strives to increase knowledge about bolt assemblies. The Nord-Lock Group is a world leader in bolting technologies and offers a wide product portfolio, including Nord-Lock wedge-locking solutions, Superbolt tensioners, Boltight hydraulic tensioning and Expander System. For further information visit www.nord-lock.com

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Smaller world – bigger bolting challenges

Next year, *Bolted* magazine will have been spreading bolting knowledge and inspired engineers worldwide for ten years. Engineering challenges continue to fascinate us and solutions are more ground-breaking than ever before!

This issue includes a theme article which asks the deceptively simple question, "Why do bolts loosen? We also cover one of the industry's most complex projects, ITER (page 18), which aims to harness fusion power to create an unlimited source of clean energy. Custom-made Superbolt tensioners have been developed to help bring this colossal project to life.

Nord-Lock washers have long been a key solution for the railway industry, as they are ideal for challenges involving vast distances, constant vibration and maximum safety requirements. In this issue, you can read about two high-speed applications – one from Japan (page 4) and one from Germany (page 12). It's a common belief that rail can't compete with air for long-distance travel, but this may change as innovations in engineering continue to make the world a smaller place.

Speaking of a small world, at the Nord-Lock

Group, we are focused on being close to our customers with our support and expertise. This makes establishing new offices throughout the world extremely important and we are excited to be expanding to India, Australia and Latin America. Nord-Lock Germany has also moved to a new facility, which will further strenghten product availability across Europe.

In addition to strengthening our physical support to our customers, we are also developing new digital tools to make bolting easier and help customers use our products more effectively. *The Fastener Dimension Guide* and the *Torquelator by Nord-Lock* are just two of the new and useful webbased tools that you can download from our website!

Thank you for reading!

CARIN LAGERSTEDT MARKETING MANAGER



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SECURED BY THE NORD-LOCK GROUP

WORDS: KEISUKE OKADA PHOTO: BLANSCAPE

PUSHING THE BOUNDARIES OF EXPRESS TRAINS						
CUSTOMER: CENTRAL JAPAN RAILWAY COMPANY		PRODUCT: N700 BULLET TRAIN SERIES		car weight: 713 TONNES (N700A, 16-CAR SET)		NUMBER OF SEATS: 1,323 (16 CARS)
RATE OF POWER CARS: 14M2T	MIDDLE CAR DIMENSIONS (L/W/H, MM): 24,500/3,360/3,600		maxim 300 Ki	um speed: M/H (SANYO SHINKANSEN)		

THE CENTRAL JAPAN RAILWAY Company (JR Central) operates the Shinkansen superexpress bullet trains that connect Tokyo and Osaka – Japan's two biggest cities.

Along with advanced technology and operation systems, safety has always been a top priority for JR Central. On the Tokaido Shinkansen line, the current 16-car N700A bullet trains (introduced in 2013) run at a maximum speed of 285 km/h, so the bolting system must be perfectly reliable. The Nord-Lock Group has been providing wedgelocking washers since the first N700 model, which started commercial operations in 2007.

The washers helped solve a long-standing bolting issue that had previously taken many hours to secure and maintain, freeing up time for more detailed check-ups in the process. Using the washers, JR Central could also remove a significant number of locknuts, thus reducing the weight of the cars.

With commercial operations planned for 2020, the new N700S (S=Supreme) trains are currently being tested. The main feature of this new model is the improved underfloor equipment, which uses brand new technology to reduce the number of cars – from sixteen to twelve or even eight. This could make the N700S cost-effective for overseas markets, fitting well with the Japanese government's infrastructure export policy.

JR Central is already developing the next big technological advancement in rail – the Superconducting Maglev magnetic levitation line. With an amazing maximum speed of 500 km/h, commercial operation is planned for 2027.





"At first, we weren't keen on adopting new products"

Today, Central Japan Railway Company is very pleased with how the Nord-Lock wedge-locking washers are performing, but there was some initial doubt.

"To be honest, an extremely high reliability is required for this part and, at first, we weren't keen on adopting new products," says Tadashi Fujii, Manager, Shinkansen Operations Division Rolling Stock Department Rolling Stock Section. "We gradually placed our trust in the Nord-Lock washers when seeing the actual performance on a vibration-testing machine, the comparison with the existing bolting parts referring to quantitative data, the technical support system, and so on." At the time, the pair of washers were not glued together like the current ones, but the Nord-Lock Group quickly responded to requests for improvements. "This was important, as we felt that we could always depend on the Nord-Lock Group's support, whatever the circumstances," Fujii says.

WHEN THE GOING GETS TOUGH

CUSTOMER:	LOCATION:	established:	PRODUCT:
PRO COMP USA	COMPTON, CALIFORNIA	1992	BEADLOCK FOR OFF-ROAD WHEELS
TESTED: TORQUE-TENSION OF 5/16" BOLTED JOINT		SOLUTION: NORD-LOCK WASH	ERS



OFF-ROAD VEHICLES are built to handle what would break most cars and trucks. Whether driving through mud or racing up a mountainside, these vehicles need state-of-the-art technology to stay in top condition. A beadlock is a crucial device on off-road vehicles, since it secures the bead of a tyre (the tyre's edge) to the wheel of a vehicle – even in harsh conditions.

In 2015, Pro Comp USA – a manufacturer of high-quality tyres, wheels, suspensions and shocks for on- and offroad enthusiasts – contacted Nord-Lock about the high vibration requirements of the bolts on their beadlock rings. Pro Comp needed a better way to secure the rings. They also needed a recommendation for a tightening torque process that would enable them and their end-users to easily and properly install the washers.

At its Technical Center in Lyon, France, the Nord-Lock Group performed vibration testing on Pro Comp's sample wheels. Nord-Lock then provided the optimal torque procedure, as well as design changes that further strengthened the joint. As a result of the successful testing, Pro Comp was able to meet the regulations and sell the wheels for off-road competitions. Pro Comp now uses Nord-Lock washers on every wheel they manufacture.

CHAD HENDERSON

THE HEART OF CIVILIZATION

CUSTOMER:	FOUNDED:	PRODUCTS:		APPLICATION:
TORISHIMA PUMP MFG. CO., LTD., JAP/	AN 1919	HIGH-QUALITY ENGINEERED PUMPS		BOILER FEED PUMP
BOLTED JOINT: BOLTS ON RING SECTION CASING	NORD-LOCK GROUP PRO	DDUCTS: BOLT TYPE CY MJTS		

PUMPS ARE ESSENTIAL wherever water is used. They are therefore indispensable in modern society and are used in many critical applications, such as water supply and sewerage systems, electrical power plants, and steel plants.

Torishima Pump is a global manufacturer of reliable and high-efficiency pumps. One example is their MHG multi-stage pump, which is used as a boiler feed pump in electrical power plants. Although the pump is well-proven worldwide, Torishima Pump still had concerns about the bolting method of its ring section casing, which uses a tie bolt.

Due to the very high pressure of multi-stage pumps, exceptionally high axial force accuracy is required. During operation, the bolted joints are also exposed to severe conditions, such as high temperatures, high pressure and others.

The advanced MHG-A model uses a larger tie bolt diameter, so the company had

to find another option in addition to the conventional hydraulic bolt tensioners.

Thorough research led Torishima Pump to Superbolt multi-jackbolt tensioners (MJTs), which can be tightened without any special tools, and don't loosen – even under severe conditions. Their internal tests revealed that the axial force generated by the MJT has high accuracy when compared with the target value.

Nord-Lock Group Japan's field support made sure that the MJTs were tightened properly on-site. After many verification tests, such as a hydrostatic pressure test on the prototype, Torishima Pump decided to make Superbolt the one option for MHG-A.

Exports account for more than 50 percent of the company's sales, and long-term stable operations using Superbolt ensure higher efficiency and reliability of their pumps.



THE EXPERTS



JIUNN RON TAN FIELD APPLICATION ENGINEER, SOUTH EAST ASIA



Email your questions about bolting technologies to experts@nord-lock.com

ASK THE EXPERTS

 \supseteq Do you have a question about bolting technologies? Put the Nord-Lock Group experts to the test.

The heat is on

Q: How does temperature affect bolts in ASME standard flange applications? A: The A193-B7 and A193-B16 bolts are two of the most common bolts for these applications. They have very similar material composition: (1Cr-1/5 Mo) and (1Cr-1/2 Mo-V) respectively. Vanadium is the main composition difference that separates the B16 from the B7, allowing for higher temperature limits. Both bolt materials have the same specified tensile strength (125 ksi) for bolt sizes of $21/2^{"}$ and below. With larger sizes, the tensile strength and yield strength vary a little between the two bolts, but they are still relatively similar.

When temperature comes into play, both the B7 and B16 bolts maintain the same maximum allowable stress up to $371^{\circ}C$ ($700^{\circ}F$). From $399^{\circ}C$ ($750^{\circ}F$) upwards, the maximum allowable stress for the B7 starts to decrease a little, but it is still good to use up to $454^{\circ}C$ ($850^{\circ}F$). Beyond this point, the maximum allowable stress is half of what the bolt can take at room temperature.

The B16 bolt maintains its strength at



higher temperatures and starts to show a decrease at $454^{\circ}C$ ($850^{\circ}F$). It is still usable up to $510^{\circ}C$ ($950^{\circ}F$). Beyond this point, its maximum allowable stress is less than half of its maximum capacity.

To summarize: the B7 and B16 bolts

share similar mechanical properties at low to medium temperatures, but, at high temperatures, the B16 can take more stress and is suitable to use at a temperature range of between 399°C (750°F) to 510°C (950°F).

JRT

The making or breaking of bolted joints



Q: What is Hooke's Law and why is it crucial to bolted joints?

A: Hooke's Law relates to the accurate tightening of bolted joints.

When examining a bolt's behaviour, the axial force is plotted against the extension. During tightening, these two properties increase simultaneously.

Hooke's Law states that, up to its yield

point, the bolt acts elastically, meaning that the extension is directly proportional to the axial force. This relationship is essential for safely securing bolted joints.

Within this range, the bolt will return to its original length upon disassembly. This predictable behaviour is essential to the bolt's integrity. However, if the safe working range (the elastic limit) is exceeded, permanent deformation will occur, eventually leading to bolt failure.

The law was discovered by the 17th century physicist Robert Hooke. It assures the reliable operation of many components, including springs, beams and bearings – not just bolts. In fact, its applicability to all elastic materials makes it an essential part of the design of numerous engineering applications.

ΗР



Bolts are the fastener of choice in multiple industries and applications for the simple reason that they are easy to dismantle. However, this also makes them vulnerable to self-loosening and lose of preload.

WORDS: NIC TOWNSEND

1000

PHOTO: UNSPLASH ILLUSTRATIONS: DAN HAMBE



epending on the application, bolt loosening can have profound consequences. One loose bolt can bring a whole production plant to a standstill and cost a company tions lose bolts can pose a significant safety hazard.

ing? Broadly speaking, there are two main causes: spontaneous loosening and slackening.

"THE MAIN CAUSES and the consequences of failure depend on the purpose of the bolted joints, on the environment and usually on the industry," says Georg Dinger, Siegenia-Aubi KG, who has studied the causes and effects of bolt self-loosening extensively. "For example, the petrochemical industry is primarily concerned with corrosion problems, while fatigue and vibration loosening are usually of minor concern. On the other hand, the automotive industry would probably name self-loosening and corrosion as the two main problems. The primary concerns for the structural steel industry are joint slip and corrosion, but self-loosening and leakage are less common. The aerospace industry would probably list fatigue first." "Repeated relative displacements between

thousands, while in other applica-

So, what are the main causes of bolt loosen-

Georg Dinger, Siegena-Aubi KG

the contact surfaces, under the influence of the shank torque, resulting from the thread pitch torque, can lead to a gradual rotation of the bolt or the nut," continues Dinger. "This causes a preload loss and consequently a loss of function of the bolt connection. The effect is well known, but prevention is usually per-

formed experimentally only after occurrence of self-loosening events."

TO PREVENT SPONTANEOUS loosening, the slip between the joined parts needs to be eliminated, or at least reduced to below critical levels. This can be achieved by either increasing the axial tension, increasing the friction between the clamped parts, or decreasing the cyclic

loading - for example, shock, vibration or cyclic thermal loading.

Another common method is to increase the friction between the bolt threads. There are a number of solutions for doing this, and while some of them are effective, they also have their disadvantages. Glue or adhesives can be an effective friction-based method, but dried glue can be problematic when it comes to dissembling and removing the bolt.

Furthermore, increasing the friction between threads would decrease the achievable preload at a specific torque level. Locking wire is a common method in the aviation industry.

FATIGUE IS PERMANENT damage or deformation in the bolt and clamped parts. It is caused by loss of preload resulting in opening in the joint. There are two basic mechanisms for loss of preload spontaneous loosening and slackening.

Spontaneous loosening, or rotational self-loosening, is essentially when a bolt rotates loose due to shock, vibration or dynamic loads. Even a slight rotation can be enough for a bolted joint to lose all its preload. This is the most common cause of bolt loosening. Slackening is caused by three mechanisms: settlement, creep and relaxation.

Settlement is critical when it happens due to dynamic loads. It is the permanent deformation of the clamped material when the joint is subjected to the increase of stress from dynamic working loads, explains Harlen Seow, Technical Manager with the Nord-Lock Group. "Most parts of a bolted joint will revert to shape after being released if the stress in the parts has not gone beyond their yield strengths. Some materials in the contact surface, such as paint, will most likely deform permanently," he says and continues: "If the material settles, even just a few micrometres, the stretching of the bolt will decrease and will lead to a loss of preload."

Creep is permanent deformation that occurs due to long term exposure to high levels of stress below the yield strength of the materials in the joint. It is more severe in high temperature applications.

Relaxation is when the micro structure in the materials of a joint restructure, converting existing elastic deformation to plastic deformation over a period of time. Unlike settlement

"If the material settles, even just a few micrometres, the stretching of the bolt will decrease and will lead to a loss of preload."

HARLEN SEOW, TECHNICAL MANAGER WITH THE NORD-LOCK GROUP

THE JUNKER TEST



ESEARCH INTO THE causes of selfloosening have been ongoing for nearly 60 years, however it is still the pioneering work of German engineer Gerhard Junker in the 1960s that forms the basis of modern methods and theories behind self-loosening prevention. His testing methodology, which he used to determine at which point a fastener rotates loose when subjected to vibration, is now universally known as the Junker Test and has been adopted as the international standard, such as the DIN 65151.

Results from Junker tests of six different friction-based bolting solutions, showing the time it takes for them to loose preload. The tests were performed at the Nord-Lock Group Technical Center in Lyon, France, and are featured in a video available on the Nord-Lock Group's official YouTube channel.

or creep, the clamp length does not change, which makes it harder to detect. "One way to measure preload loss is to measure bolt length after a period in operation and compare to the bolt length immediately after tightening," adds Seow. "However, this will not detect relaxation, which makes it more problematic."

THE KEY TO avoiding fatigue is good design, which has grown in importance in recent years due to the increased demands on many bolted joints and increased use of lightweight materials. It is important to not only focus on the tensile capacity of bolts, thus overlooking other parameters such as elasticity and stiffness that can also be important.

"Correct joint design is the key to achieving a high strength friction grip connection with a high preload level, and thus a high slip resistance over the entire lifetime," says Dinger. "Up until now the focus for design engineers has been on the failure with bolts breaking. Other failure mechanisms have become more and more important as performance is increased and the weight of joints is decreased. The mechanisms of preload relaxation and self-loosening are more and more common in lightweight designs." Depending on the bolt and the application, and the cause of preload lose, there are generally multiple options for designing more optimal bolted joints.

"IN CASES WHERE THERE IS thermal loading, the joint can be optimised by choosing materials with equal thermal expansion coefficient for the clamped parts," says Dinger. "To help minimise settlement and maintain a high preload during operation, you can reduce the roughness between contact surfaces. Measures such as fine hole diameters or toothed surfaces can help minimise relative displacement."

"In general," Seow says, "a good bolted joint is made up of very elastic bolts and very stiff clamp parts, and there are different ways of achieving this. One way of improving bolt elastically is to have long clamp length. But if you have a flange, where the clamp length can't be too long, you can change the design by using more but smaller bolts. So instead of using five bolts, you can use ten smaller bolts, which will create a more elastic joint."

Overall, achieving the optimal bolted joint involves factoring in multiple variables and design options.

PRELOAD

TERM WITH MANY meanings in engineering. One is the tension (load) that is created in a fastener when it is initially tightened. As the bolt stretches, the components between the bolt and the nut compresses, thus increasing the so-called clamp load until the end of the tightening process.

The main causes of **BOLT LOOSENING**



Deutsche Bahn (DB) has set the objective of halving its rail traffic noise by 2020 compared to the year 2000. To achieve this, another 2,000 kilometres of the existing tracks need to be equipped with noiseabsorbing solutions in less than two years.

1

MISSION: NOISE CONTROL

Europe's largest railway operator, Germany's Deutsche Bahn (DB), has promised to halve its noise pollution by 2020. With less than two years to go, new innovations are high on the agenda – including the smallest noise-absorbing wall ever made.

WORDS:					
LINDA KARLSSON					

PHOTO: KRAIBURG STRAIL

HE FASTER THE TRAIN, the louder the noise and the higher the soundproof barriers have to be to protect the surrounding environment. Experts recommend that sound barriers should be no higher than two metres in order to maintain the railway experience for train passengers. Today however, walls up to six metres high cut through

the landscape and have become more the rule than the exception – a development that German company Kraiburg Strail GmbH hopes to change.

Late last year, the company installed a new noise protection mini-wall made of rubber, only 36 centimetres above the tracks along a railway line in central Neuss – a city located in Germany's far west. A small team of six prepared the tracks, whilst another team of six put up the wall. The pilot project was completed within roughly a week, translating into 25 meters per hour - an impressive feat considering the teams could only work at night while the train line was closed.

"Our product STRAILastic_mSW reduces sound via a fibrereinforced elastomer element directly at track level," explains Andreas Herder, CEO of Kraiburg Strail. "That makes the construction simpler and the system very flexible. Traditional sound protection walls require an extra foundation, which can only be built with a construction plan approval. We don't need that, which saves time and money and allows the railway operators to react quicker to noise hotspots on existing lines."

ASSEMBLED DIRECTLY ONTO THE TRACK, the STRAILastic_ mSW comes closer to the so-called railway clearance outline – the buffer zone for passing trains – than any other system on the market, which allows it to absorb noise effectively in spite of its small size.

"This gives the further advantage of not spoiling the passengers' view," says Herder.



The STRAILastic_mSW noise barrier absorbs noise effectively in spite of its small size. It reduces sound via a fibre-reinforced elastomer element directly at track level. This also means that it doesn't block the passengers' view.

Kraiburg Strail started out as a rubber plant in 1947. Recycling was high on the agenda from the start, and the company spent decades optimizing its vulcanizing process to improve rubber properties such as shape stability and elasticity. After manufacturing just about any rubber component possible, the company split into two branches in the 1990s (agriculture and transport) with Kraiburg Strail supplying the railway industry with systems for level crossings, sleepers, tramways and increasingly noise protection.



The pilot project was completed within roughly a week - even with the team working only at night - completing an impressive 25 metres per hour.

→ The company's growing focus on noise protection is no coincidence. According to the World Health Organisation, noise is the second largest environmental cause of health problems, after air quality. The organisation states that at least one million healthy life years are lost every year from traffic-related noise in Western Europe alone.

THE EU ENVIRONMENTAL NOISE DIRECTIVE commits member states to creating a noise map and noise management action plans for major agglomerations, roads, railways and airports.

Following this directive, DB decided to halve its rail traffic noise by 2020 compared to the year 2000, with measures taken both on infrastructure and rolling stock. In order to achieve this, another 2,000 kilometres of the existing tracks need to be equipped with noise-absorbing solutions in less than two years.

Kraiburg Strail's new noise-absorbing solution was developed in close cooperation with DB – the company's largest customer and operator of the railway line in Neuss. After the substructure was inserted, the rubber elements were put in position. These were mounted onto the sleepers using aluminium plates secured by Nord-Lock washers, which are the DB standard.

"Actually, the washers posed our only problem in Neuss," says Herder with a laugh. "It was extremely important to get the work done at night in order not to conflict with the railway schedule. Before we could start the installation however, somebody stole every single washer from the site!"

This could have been devastating for the project, but the commitment of those involved turned the situation around. "The only thing we could do was to call our contact, Jochen Süßenbach, at Nord-Lock in the middle of the night and ask him for replacement washers," Herder says. "Then, one of our employees drove 1,000 kilometres to Nord-Lock's German headquarters and back again. That's how we managed to meet the deadline."

AT KRAIBURG STRAIL, nobody wants to get ahead of themselves before the official evaluation of the project has been completed, but the first DB simulations show a noise reduction of up to 7dB(A). This is quite an accomplishment considering that a 'normal' 2-metre-high noise protection wall on a separate foundation reduces noise by approximately 10 dB(A).

"One thing is for sure," says Herder. "Noise reduction measures on existing railway lines are a very interesting new segment for us. The market potential is huge."

He adds that the Nord-Lock Group will join them for the ride, and not only in applications where the washers are required due to customer standards: "After this first project, we've decided to use Nord-Lock wedge-locking washers in all future projects where dynamic forces occur."

FACTS: THE SOLUTION

CUSTOMER: Kraiburg Strail GmbH & Co. KG.

END CUSTOMERS: Railway operators across the globe. DB in Germany and SNCF in France are the largest customers.

LOCATION: Tittmoning in Bavaria, Germany.

APPLICATION: Securing a rubber noiseabsorbing mini-wall directly onto the railway track.

NORD-LOCK GROUP SOLUTION: approx. 7,400 SMO Washers NL 254-12 and NL 254-16.

BENEFITS GAINED: Permanent security. Low tightening torque needed. Long-term corrosion resistance.

Nord-Lock as a DB Standard

CONSTRUCTION WORK for a railway giant such as Deutsche Bahn (DB) is a lucrative business, but for an enterprise of that size, with tens of thousands of product types and suppliers, the process of selecting products and awarding contracts can be extremely complex. For this reason, DB has created a centralised specification template for the materials used by its contractors.

Last year, the company presented a specifi-

cation template for noise protection walls, with the objective of setting a standard for planning quality, increasing efficiency and achieving comparability of costs between projects.

"This was a healthy step," says Jochen Süßenbach, Manager Sales, Nord-Lock Group. "Comparing offers had become almost impossible. One contractor would suggest gabions, the next concrete, and another a transparent wall made of Plexiglas. And there is always a wall with more features, which often makes you end up with the most expensive solution."

Nord-Lock has been a long-time partner of DB, with several certifications for the railway industry. The specification templates for DB noise protection walls couldn't be clearer, stating that every bolted connection exposed to a dynamic load from railway operations must be secured with Nord-Lock wedge-locking washers.

"We need larger components – and that includes fasteners"

As a Mexican married to a Greek and living in Brussels, Ivan Pineda, Director of Public Affairs for WindEurope, has an international outlook. And he certainly needs it to coordinate the organization's 450 members across 40 countries – from manufacturers and developers to NGOs and insurance companies. He briefed us on the outlook for the industry.

WORDS:	PHOTO:	
RICHARD ORANGE	JASON BICKLEY	

What's new in the wind power industry?

"One big trend is integrating wind energy into the larger electricity system. Wind energy was a niche sector some years ago; today, it supplies 12 percent of the electricity we consume. We inform stakeholders that, although it's variable, it's highly predictable. There will always be wind blowing somewhere in a large geographical area like Europe. What we need is an interconnected grid system that is able to deliver the electricity to where it is needed."

How will the trends affect the consumers?

"Cost reduction is another significant trend. Today, onshore wind energy is the cheapest new form of energy generation in many parts of Europe, and offshore wind is no more expensive than investing in conventional power production. Many consumers are still paying to maintain the old support mechanisms that were used to develop the industry, but in the future, offshore wind is going to bring down the cost of energy to households – we need to make that widely known."

What place do fasteners and bolted joints have in the wind power industry?

"To the general public, it might sound trivial, but these are huge machines, with the nacelle and rotor assembly alone weighing up to 200 tonnes. We need bolt solutions that are able to supply significant strength – it's not the same kind of bolt that you have in your furniture at home!"



What are the main threats facing the industry?

"The key challenge is that many European countries are losing ambition in the deployment of our technology, which affects the whole value chain: the fewer the projects, the fewer the turbines, and this affects all suppliers, down to the supplier of every last bolt."

How will future changes in the industry affect manufacturers and suppliers?

"There are plans to have turbines of an even larger scale, so we need larger components – and that includes fasteners. Suppliers must be able to innovate and keep pace with how the industry is developing, and also contribute to the cost reduction of the technology. With respect to maintenance, that means fewer components to inspect and maintain – a philosophy of 'install, build and forget'."

facts: IVAN PINEDA

TITLE: Director of Public Affairs. AGE: 37. LIVES: Ixelles, Brussels, Belgium. BACKGROUND: After a career as industrial engineer at Procter & Gamble, moved to wind energy after doing an MSc in Sustainable Energy Futures. PASSION: "Wind energy, of course!"

Steering pins replaced fast

WORDS: CHAD HENDERSON PHOTO: GETTY IMAGES

THE CHALLENGE A mining company in Canada needed a better solution for replacing the steering pins on its fleet of one hundred Komatsu trucks. With the traditional method, replacing the pins took around 36 hours. The company wanted to reduce this downtime, much of which was caused by line boring that also decreased the life of the joint. The company looked for help from SMS Equipment, a leading distributor of Komatsu construction and mining equipment in Canada, as well as other brands.

THE SOLUTION SMS Equipment works with Expander System when maintaining their customers' mining equipment. The system completely eliminates line boring by ensuring a proper fit of the steering pin every time. It includes an axle/pin that is tapered at both ends along with an expansion sleeve. When the pin is inserted into the bore and torqued into position, the sleeve conforms to the ovality of the bore, providing full surface contact.

"With the conventional method of replacing a pin, you have to do extensive line boring that has to be perfect," says Gene Roberts, Business Development Manager, OEM Division, Expander. "You have to make your first cut, make the bore concentric, line weld the inside, then do another pass. With the Expander System, our sleeve adapts to the wear pattern so line boring is not needed."

THE RESULT Expander System reduced the steering pin replacement time for the mining company from 36 hours to just six hours. Because line boring is eliminated, the system also extends the life cycle of the joint from 15,000 hours to 50,000 hours.

"With the Expander System, we are able to increase our customer's production hours, reduce maintenance time, and increase safety," says Scott Muir, Manager of Product Support Sales at SMS Equipment. "Since line boring has so many steps, this increases the risk that something could go wrong. The Expander System involves less work and less dangerous materials, so it is a quicker, safer solution."

The Expander pin is also designed for easy removal, which is a big benefit to the mining company. The pin can be removed in 10 to 15 minutes, compared to hours of work with a conventional method. Upper hoist cylinder Body pivot

It is not Komatsu's largest electric drive truck, but at 7.37 metres high and 9 metres wide, the 930E is still an impressive vehicle.

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What is going on in the world of bolting

Bringing star power to Earth

FOR 60 YEARS, people have dreamt that fusion power could be the clean, safe source of energy the earth needed to stay powered forever. Sounds like science fiction? It's not.

In Saint-Paul-lez-Durance in the south of France, the world's biggest nuclear fusion research project, the International Thermonuclear Experimental Reactor (ITER), is halfway to completion. The 18 billion euro reactor is a collaboration between 35 nations to prove the technology's commercial potential. Its start-up in 2025 is expected to result in fusion electricity power being a widespread solution by 2050.

ITER is the world's largest tokamak – a 23,000-tonne doughnut-shaped vacuum chamber that uses a powerful magnetic field to confine plasma, in which the fusion reaction takes place. At 150 million degrees Celsius, or ten times the temperature of

the sun, particles overcome their natural electromagnetic repulsion to fuse, releasing huge amounts of energy that are absorbed in the walls of the vessel.

THE ITER TOKAMAK is the most complex machine ever designed, with one billion parts and ten billion components manufactured around the world. The Nord-Lock Group

facts: FUSION

Fusion is the nuclear reaction that powers the sun and all other stars. Light hydrogen nuclei collide and fuse into heavier helium atoms, releasing huge amounts of energy in the process. Harnessing this energy on Earth is all about finding a way of containing it, which is what the ITER project sets out to do. is contributing its Superbolt multi-jackbolt tensioners, which connect the tokamak's 18 toroidal field (TF) coils. At 17 metres high and 9 metres wide, with a weight of a fully loaded Boeing 747-300 (310 tonnes) each, these coils create the magnetic 'cage' for the plasma. The bolted connections handle temperatures of minus 269 degrees Celsius (-452.2°F). This is the largest single project in the Nord-Lock Group's history. Regular deliveries started this April.

"We've spent ten years developing bolting solutions for this extreme environment," says Adrian von Däniken, Production Director and Site Leader of Nord-Lock Switzerland. "Everything about ITER goes beyond standard manufacturing, and though such development timeframes seem extreme, they are short considering the benefit for humanity."

<image>

Designing the future of forestry



CLOSE TO THE ARCTIC CIRCLE in Sweden, a student project at Luleå University of Technology (LTU) is spearheading the development of forestry machinery. Started in 2014, the project has focused on sustainability, productivity and safety.

Mechanical engineering student teams have in relays designed and built an automated terrain vehicle that will be used as a research platform. The assembly of the basic hardware of the vehicle, such as the chassis, was finished during spring 2018.

The vehicle's modular design makes it easy to rebuild in order to test various hardware config-



urations, technologies and tools. It will also carry as many sensors as possible. On-site functionality tests of software and steering systems will start during summer/autumn 2018. Using GPS signals and information from maps, the vehicle will be able to steer clear of hindrances. All control of vehicle and tools is down to algorithms.

"AUTOMATED VEHICLES will bring new ways of working," says Magnus Karlberg, Professor, LTU, and project supervisor. "Forestry companies can reduce wage costs, but the personnel can also be used more efficiently. For example, one operator may oversee or remotely control several smaller vehicles, rather than operating a single, large machine. This set-up will also reduce soil structure damage."

There is also the safety aspect: removed from the vehicle, the operator is not subject to vibrations and risks associated with the operation, such as overturning and logs smashing the cab.

KARLBERG PRAISES the project's sponsor companies: "They've made the project possible, not only by contributing necessary parts, but also through sharing invaluable knowledge."

The Nord-Lock Group has provided wedgelocking washers for most of the bolted joints as well as Expander System pivot technology.

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FACTS: FORESTRY MACHINERY PROJECT

PROJECT: research platform for autonomous terrain vehicle. LENGTH: 5.8 metres. WIDTH: 2.5 metres. WEIGHT: 7-8 tonnes. LOADING CAPACITY: 3-4 tonnes.

Up to the plate: Boltight bespoke solutions

WHEN AN OIL FACILITY shuts off the flow to a part of its plant for maintenance, it is critical that the valve holding back the gas or liquid is reliable; but also, that maintenance is easy.

So, when an oil and gas company wanted tools for a large valve bonnet kept in place with 18 M150 bolts, they contacted Boltight, asking for a design that could be removed more rapidly.

"This valve is very expensive and very critical, so it needs to be serviced regularly," explains Harry Perkins, Design Engineer at Boltight. "During maintenance, the production is stopped, so you are making no money on the facility. It needs to be as quick as possible."

PERKINS AND HIS TEAM had previously supplied four tools to the same customer to remove M120 bolts from a valve bonnet. They now suggested increasing the number



of tensioning tools to six to speed up disassembly and reassembly. But moving six tools simultaneously presented its own problems.

"They are so big and heavy and cumbersome that it's really difficult. We had the idea of lifting them all together," Perkins says.

The solution was to mount the tools on a lifting plate, which could then be used to

manoeuvre them into place. The plate, at two metres in diameter, was the largest Boltight had ever supplied, and the first one for a valve bonnet.

BUT IT IS NOT UNUSUAL for Boltight to tailormake products. "We like one-off, bespoke projects," Perkins says. "We'll put the time in and help customers achieve what they want."

Boltight worked closely with the customer throughout the design phase. The customer was concerned about the safety of making the plate out of multiple segments. Perkins solved this by finding a local supplier able to make it out of a single piece of metal.

In less than two months from the time the customer got in touch, the tools and lifting system were delivered.

RICHARD ORANGE



WHEN SAFETY REALLY MATTERS

With Nord-Lock Group, you never have to question the integrity of mechanical solutions so critical to our way of life.



NORD-LOCK SUPERBOLT BOLTIGHT CExpander