

BOLTED

GREEN POWER
STATE-OF-THE-ART
TEST SYSTEMS
FOR THE WINDPOWER
INDUSTRY

NEED FOR SPEED
MEET THE
OWNER OF
HOT BITS
THAILAND

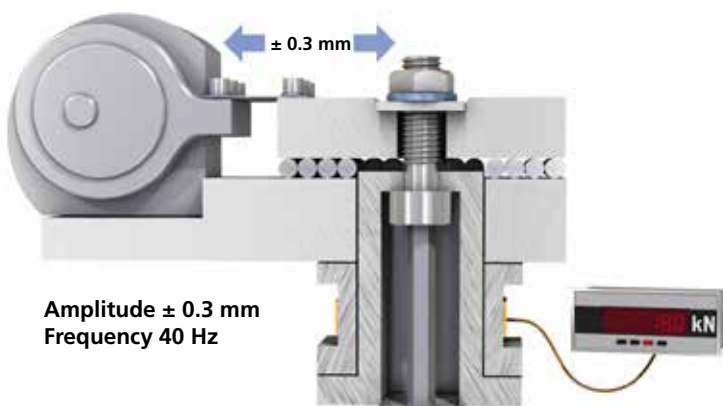
BUILDING BRIDGES
SECURING
HISTORY
FOR FUTURE
GENERATIONS

GAME ON
PADEL
- SPORT OF
THE FUTURE
MADE SAFE

SCIENCE FRICTION

SOLVING THE PROBLEM OF RESISTANCE IN BOLTING

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NORD-LOCK®
Bolt securing systems



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

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NORD-LOCK®

Expanding customer base for Expansion Bolts

First of all, thank you to all of you who participated in our Bolted survey in the previous issue. The survey ended in January, so last month we carefully reviewed your answers. We will do our utmost to ensure that your thoughts and wishes are reflected in the coming issues! Are you sitting on valuable findings about new applications or topics related to bolting? We always appreciate hearing from you, so please contact me directly or email us at bolted@nord-lock.com.

It has been really exciting to see several new Expansion Bolt projects during 2014. Our Expansion Bolts replace close-fitted or interference-fit bolts and utilise Superbolt multi-jackbolt tensioning to provide simple and safe tightening. Typically, Expansion Bolts are used on flange couplings, and what customers who choose this product have in common is that they require a very high clamping force, combined with radial expansion. Challenging coupling applications are common in hydropower as well as in wind energy, especially since turbines continue to grow in size and capacity. You can find information on this innovative technology here: www.superbolt.com/expansionbolt.

In this issue of Bolted we visit Renk Test System in Germany, where the world's most powerful wind

turbine test rigs – secured by nearly 900 Superbolt multi-jackbolt tensioners and Expansion Bolts – simulate the worst imaginable storm conditions (see page 12). We visit Thailand to meet entrepreneur, rally car builder and all-round motor-ing enthusiast, Kee, to find out why he insists on Nord-Lock washers for this highly demanding application (page 19).

We also take a closer look at finite elements analysis and why it is the best method for calculating the risk of bolt failure (page 18). The theme for this issue is a crucial topic in bolting – friction – and we explain why this force is both your friend and your enemy when it comes to bolting. We hope you enjoy this edition!



CARIN LAGERSTEDT
GLOBAL MARKETING
MANAGER

08



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Friction is not to be ignored when it comes to tensioning bolts. Most of the torque applied simply vanishes due to the force of friction involved.

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The courts used for padel experienced problems with the glass walls vibrating loose. These problems have now been solved by Nord-Lock.

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WORDS: NIC TOWNSEND

BRIDGING THE GAP

CUSTOMER: THYSSENKRUPP SCHULTE GMBH		PRODUCT: STEEL BEAM BRIDGE SLEEPER (SBS)			
APPLICATION: HOENZOLLERN BRIDGE, COLOGNE, GERMANY	LENGTH: 410M/ 1345FT	WIDTH: 26M/ 85FT	SLEEPERS: 1,346		

THE HOENZOLLERN BRIDGE is not only one of Cologne's most recognisable landmarks, but also a vital link across the Rhine River, connecting the city's two main train stations. In fact, approximately 1,200 trains cross the bridge daily, making it one of the busiest rail bridges in Germany.

Since the Hohenzollern Bridge is the gateway to Cologne's central rail station, tremendous strain is put on the bridge's sleepers and tracks, caused by accelerating or braking trains. For this reason, it is fitted with ThyssenKrupp Schulte's unique SBS (Steel Beam Sleepers). They meet the strict safety requirements of both the German Federal Railway Authority

and Deutsche Bahn. Since the first installation in 1999, over 8,000 SBS sleepers have now been installed in 50 bridges across Germany.

Before electing to use Nord-Lock, ThyssenKrupp and Deutsche Bahn tested the SBS in single test cycles at the Technical University of Munich and it successfully passed them all.

Today, every SBS sleeper, including each of the 1,346 beams on the Hohenzollern Bridge, is fitted with Nord-Lock washers on all safety-critical joints. This secures the sleepers' horizontal, vertical and longitudinal position, as well as the rail fastening system on each sleeper. ■

SOUND SLEEPERS

Each sleeper is secured by 8 NL16sp washers and 10 NL20 washers.



Cologne Cathedral, pictured alongside the Hohenzollern Bridge on the river Rhine.

PHOTO: HIROTAKA IHARA



SECURED BY THE NORD-LOCK GROUP



JOINING THE JOYRIDE

During the season, part of the chute is underwater and it is therefore very difficult to perform any retightening. With Nord-Lock washers, retightening is not necessary.

PHOTO: FAARUP SOMMERLAND

BOLTING SOLUTION MAKES A SPLASH

CUSTOMER: FAARUP SOMMERLAND		PRODUCT: "RAFTING" RIDE	BUILT: 1998
LENGTH: 488M/ 1601FT	WATER VOLUME: 2 TONNES PER SECOND	PASSENGERS (2014): 463,082	

AS PART OF THE RECENT OVERHAUL of the 16-year-old "Rafting" amusement/ride at the Faarup Sommerland amusement park in Denmark, the chains on the chute that returns the gondolas were due for replacement.

In total, 96 metres of chain, two chain wheels and all the transverse carriers that lift the gondolas to the next level were removed and replacements fitted.

"When it came to the assembly of the 186 transverse carriers, we decided to use Nord-Lock washers to secure the 372 M16 steel bolts. These bolts can rotate loose due to vibrations and movements. We want our rides to be safe at all times, as the safety of our guests is paramount for us," says Flemming Bro, the attraction's Maintenance Manager.

"It is always a pleasure when customers – on their own initiative – choose to use our products to ensure the safety of their guests, while at the same time investing in a maintenance-free system," says Brian Troest, Sales Manager, Nord-Lock Denmark. ■



A DRIVEN SOLUTION

Superbolt tensioners and Nord-Lock washers are used to fasten the larger components on the cranes' hydraulic hammers.



PHOTO: DFI

GIANT HAMMER

CUSTOMER: DFI	PRODUCT: HHB600-60 HYDRAULIC PILE DRIVING HAMMER
MAXIMUM DRIVING ENERGY: 105 KILOJOULES/ 78,000 FT LBS POUNDS	BLOWS PER MINUTE: 60

DRIVING A PILE INTO THE GROUND involves lifting a 6,000 kg (13,200 pound) weight and accelerating it from a 150 cm (five feet) height, creating a 105 kilojoule force (78,000 foot pound) collision – a process that is repeated 60 times a minute, for hours at a time. Understandably, it is incredibly demanding on equipment.

Since it was founded nearly fifty years ago, Canadian company DFI has acquired plenty of experience, having driven over one million steel piles, measuring over 11,000 km (7,000 miles) in depth. In addition to transporting and driving piles, DFI also designs and manufactures most of its equipment, and operates an entire fleet of purpose-built cranes and hammers. Its latest hammer, the HHB600-60, is its most durable and capable hammer yet.

DFI has used Superbolt tensioners to fasten the larger components on its cranes' hydraulic hammers since its first design in 1996. Since then, the DFI engineers have continuously improved and upgraded the cranes, and every component from the original design has been replaced, except one – the Superbolt tensioners. The conventional lock washers have also been replaced by Nord-Lock washers due to their proven reliability. ■



KINGSLEY TANG
FIELD APPLICATION
ENGINEER



BRICE CALVARESE
APPLICATIONS
ENGINEER

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



ASK THE EXPERTS

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

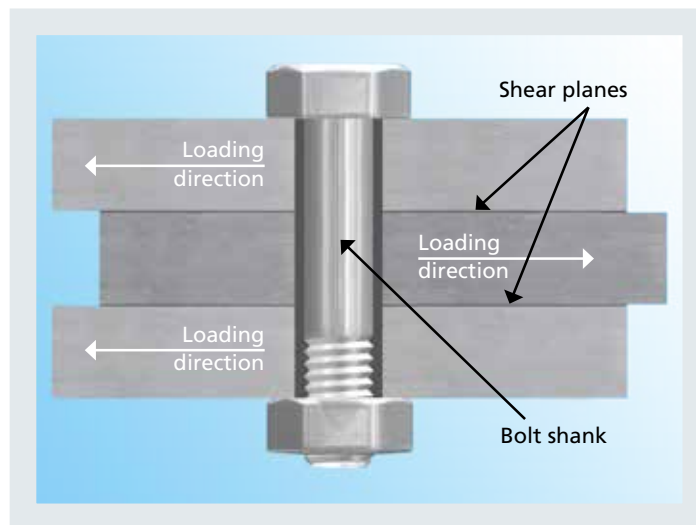
The benefits of bolt shanks

Q: What is a bolt shank and what are the benefits and advantages of this solution?

A: The shank is the threadless part of the bolt between the head and thread. There are two main ways of using the shank of the bolt. One is to make the shank increase the shearing capacity. The other way is to reduce the shank to increase the elastic resilience of the joint.

Under shear load (see the illustration), the bolt experiences force perpendicular to its axis. Shanks with larger areas and the absence of stress concentration points increase the bolt's performance in shear loading. For this reason, designers should ensure that the shear plane is across the shank, not the threads.

When bolts are being used as tension bolts, they should be more



elastic than the joint members. In high performance bolts, shanks could be reduced to the minimum

tensile area to compensate for the increase in rigidity due to its high level of hardness, ensuring a relative-

ly elastic bolt. In cases where bolts failed due to cyclic bending, such as eccentric loading, replacing the original bolt with a waisted shank bolt could improve the joint performance. Due to its smaller diameter, the waisted shank would result in lower fatigue stress under the same bending condition, thus increasing the life of the joint. This is a typical scenario of how improving joint design could reduce maintenance and repair costs - something that many customers overlook - and where our Performance Services team could assist.

There are also other benefits. For example, where a long bolt is required, leaving the shank unthreaded should reduce both manufacturing time and cost. This could be an important factor for mass-produced bolts.

KT

Thread engagement in a tapped hole

Q: What is the recommended thread engagement to make a strong connection for a component with a tapped hole?

A: Basic design rules require the bolted joints to be designed so that the screw breaks before the threads strip.

For components with tapped holes the length engagement (i.e. the number of threads which are engaged between the screw and the tapped hole) has to be adapted to respect this criteria.

The critical areas of stress are as follows: tensile stress area of the bolt, stress area of the male thread, and stress area of the female thread.

It is commonly known that the minimum recommended thread engagement to make a strong connection for a component with

a tapped hole is approximately 1 times the nominal diameter in steel and 2 times the nominal diameter in aluminum. In many cases, (tapped hole in a softer material, special alloys, etc.) these values are not sufficient and the formulae to the right must be applied.

These formulae are simplified and give only an estimation. Calculating the precise required thread engagement is a very complex issue that had been studied by E.M. Alexander who had defined an analytical formula taking into accounts all parameters.

When analytical calculation gets more complicated, a Finite Elements Analysis can be performed. Read more about Finite Element Analysis on page 18. **BC**

THREAD ENGAGEMENT IN A TAPPED HOLE

$$\left. \begin{aligned} L_{\text{tapped hole}} &\geq \frac{R_m^{\text{screw}}}{R_{\text{e tapped hole}}} \times \frac{2AS}{0.6\pi d} \quad (1) \\ L_{\text{screw}} &\geq \frac{R_m^{\text{screw}}}{R_{\text{e screw}}} \times \frac{2AS}{0.6\pi d_2} \quad (2) \end{aligned} \right\} L_{\text{min}} \geq \max(L_{\text{tapped hole}}, L_{\text{screw}})$$

Le: minimum length engagement / Rm: ultimate strength / Re: yield point / As: stress section/ d: nominal diameter/ p: pitch/ d₂: pitch diameter (d₂=d-0.6495.p)

Example of a M16 8.8 screw with a coarse pitch in a tapped hole in aluminum alloy AlCu4Mg1-T351.
Rm screw=800 MPa Rm hole=435 MPa p=2 mm As=156.7 mm²
Re screw=640 MPa Re hole=290 MPa d=16 mm d₂=14.7 mm

$$\left. \begin{aligned} L_{\text{tapped hole}} &\geq \frac{800}{290} \times \frac{2 \times 156.7}{0.6\pi \times 16} = 28.7 \text{ mm} \\ L_{\text{screw}} &\geq \frac{800}{640} \times \frac{2 \times 156.7}{0.6\pi \times 14.7} = 14.1 \text{ mm} \end{aligned} \right\} L_{\text{min}} \geq 28.7 \text{ mm}$$

FRICTION

A FORCE OF NATURE

Friction is a factor not to be ignored when it comes to tensioning bolts. Always present in a bolted joint, friction can be part of the problem – or part of the solution. →

WORDS:
MARTIN NEANDER

PHOTO:
SUNNYBEACH

ILLUSTRATIONS:
NORD-LOCK, MATS THÖLIN







Friction is a force that appears whenever two objects come in contact with each other. It is the opposite of all motion. No matter which direction something moves in, friction pulls it the other way.

Yet, we need friction. Without it, we would not be able to walk, sit in a chair, or climb stairs. Everything would just keep slipping around.

FRANK NAUMANN, former Managing Director of the German Fasteners Association and with more than fifty years of expertise in the field of friction, explains that friction always exists in a bolted joint. On one side, it limits the efficiency to transform the torque into the desired preload, on the other hand it is necessary to keep the preload in the joint to prevent loosening of the parts.

"There are two coefficients, which describe the friction between the rotating parts during the tightening process," Naumann says. "First, it is the coefficient of friction between bearing surfaces under the screw head or under the nut μ_b (μ_b = washer friction) and second, the coefficient of friction between the threads μ_{th} (μ_{th} = thread friction). Both of them are consuming a big amount of energy, which is converted in useless heat. For example, in the case, that $\mu_b = \mu_{th} = 0.10$, only 16 % of the torque is transformed into preload. One can influence the size of the coefficients by controlled lubrication. In the automotive industry, they mostly use a range between 0.08 and 0.16."

IN TERMS OF BOLTED CONNECTIONS, friction is sometimes part of the solution as well as part of the problem. Of course, the clamp load in a bolt is mainly determined by the torque required to tighten the bolt. But it is also a function of aspects such as bolt diameter and length, the geometry of the threads and – not to be forgotten – the coefficients of friction that exist in the threads and under the bolt head and nut.

"There are two coefficients, which describe the friction between the rotating parts during the tightening process... between bearing surfaces under the screw head or under the nut and between the threads."



FRANK NAUMANN, FRICTION EXPERT

The coefficient of friction is necessary in calculating tightening torques and the resulting bolt tensile forces and stress, and in calculating the resulting friction force between the connected surfaces.

However, the approximate values of friction coefficients found in charts are only representative values. They should be confirmed against other sources of information and preferably testing.

THE TORQUE VALUE is dependent on the friction, present in the threads and between the torqued bolt head and nut, and the fastened material or washer if used. In fact, during tightening almost all of the input energy is lost in overcoming the friction under the head, nut and threads. Just a small fraction of the torque is converted into the clamp load or tension.

Torque wrenches do not give a direct measurement of the preload in the bolt. As the torque is applied, it must overcome static friction under the head of the bolt and nut, depending on which end is being torqued, and also in the threads.

Much of the torque applied, around 50 percent, is lost overcoming friction under the torqued bolt head and nut, and about 40 percent is lost in thread friction. Only the remaining ten percent of the applied torque

does useful work in stretching the bolt and providing the preload.

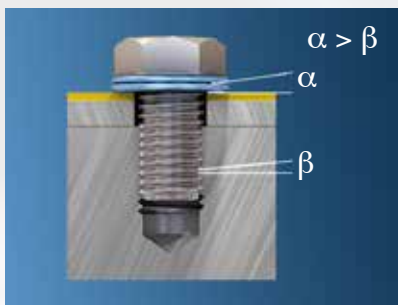
Friction is frequently used as a method for locking bolted joints. The most common examples include deformed thread or nylon insert lock nuts, or serrated/teeth/star washers. In these solutions, the principle of friction locking is based on increased friction in the thread or under the bolt head and nut.

However, factors such as torsion, seizing and galling may impact these friction-based solutions in a negative way.

THERE CAN ALSO BE PROBLEMS because of increased torsion stress in the joint in friction-based locking methods. High torsion may cause the fastener to yield at a lower preload than expected. As friction conditions are uneven, the necessary preload may not be reached.

Fasteners made of stainless steel, aluminium, titanium and other alloys can also sustain unpredictable thread galling (cold welding). In bolting, thread galling appears during fastener tightening as pressure builds up between the contacting and sliding thread surfaces.

In extreme cases galling leads to seizing, which is the actual freezing together of the threads and bolt lock-up. Continued tightening



FRICTION WITH A NORD-LOCK VIEW

NORD-LOCK WASHERS secure bolted joints with tension instead of friction. The washers are designed to create a wedge effect and the proof of this can be seen by the increase in tension during un-tightening.

This wedge effect prevents the bolt from rotating loose. The bolted joints only lose some initial preload due to normal settlements between the contact surfaces.

Reducing thread friction while safely securing the joint is often considered impossible. However, with the tension-based wedge-locking of Nord-Lock this can be achieved with lubrication.

"The wedge-locking method is based on tension instead of friction," says Lena Kalmykova, Application Engineer at Nord-Lock. "The most common example of the wedge-locking system is a pair of washers which have cams with a rise

may cause the fastener to be twisted off or result in ripped out threads.

Lubricants are often used to reduce friction and to obtain uniform clamp load. Lubricating the internal and external threads frequently can also eliminate thread galling.

According to Michael Stähler, Product Manager at Dörken, the current trend is to have the bolt or nut coated with the right coating for the task it is expected to perform. This is mainly a coating with an integrated lubrication; a separate lubrication added after a coating is not comfortable any longer as it is an additional step. Also, coatings that are not stable against temperature can cause self-loosening of the joint.

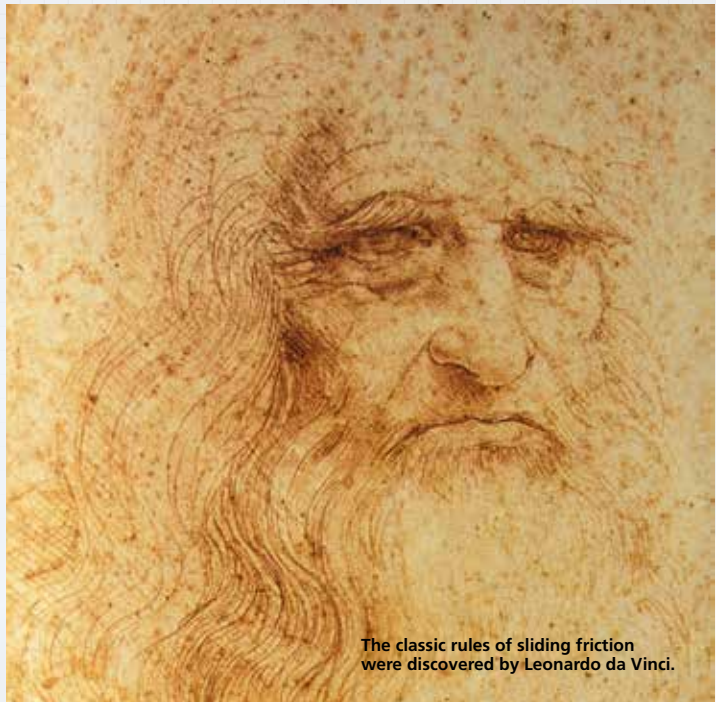
NONETHELESS, lubrication will significantly reduce or even discharge the locking ability of any friction-based method. Lubrication should never be used in conjunction with friction-based locking because it will counteract the locking capabilities.

Controlling the clamp load is vital, and this can be achieved by reducing the spread of friction. When using bolted joint solutions that are not based on friction for locking, lubrication can be used.

By reducing the friction through lubrication, the preload control is increased and the spread is significantly lowered. Then the bolt's full capacity can be used and the life cycle of the bolted joint is extended. A bolt that fails due to fatigue causes unwelcome production stoppages. ■



greater than the thread pitch of the bolt. The washer pair is installed cam face to cam face. When the bolt/nut is tightened, teeth grip and lock the mating surfaces, allowing movement across the cam faces only. Any rotation of the bolt/nut is blocked by the wedge effect of the cams. The wedge-locking ability is not affected by lubrication. Moreover, by using it you can utilise each bolt to its full capacity."



The classic rules of sliding friction were discovered by Leonardo da Vinci.

FASCINATING FRICTION FACTS

FRICTION DEPENDS on the characteristics of the surfaces – how flat, round or rough they are. Friction is also dependent of what kind of medium the surfaces are in, if it is wet or dry, or what particles there are in the medium.

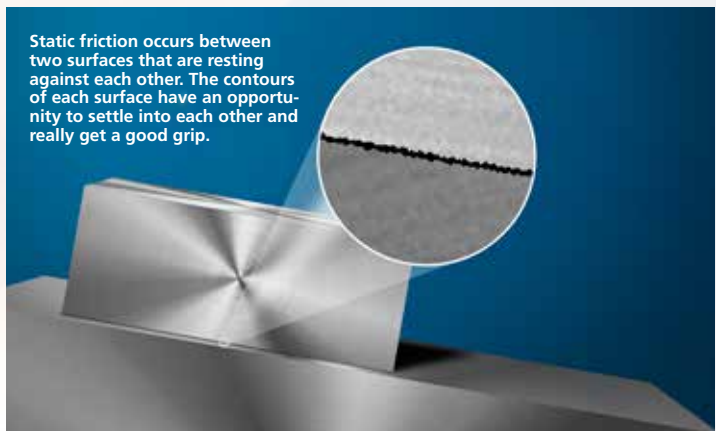
It is a very multi-disciplinary field, because it involves different areas such as mechanics, chemistry, and fluid dynamics. You have to go all the way to the atomic level to fully realise in detail what is going on in terms of friction.

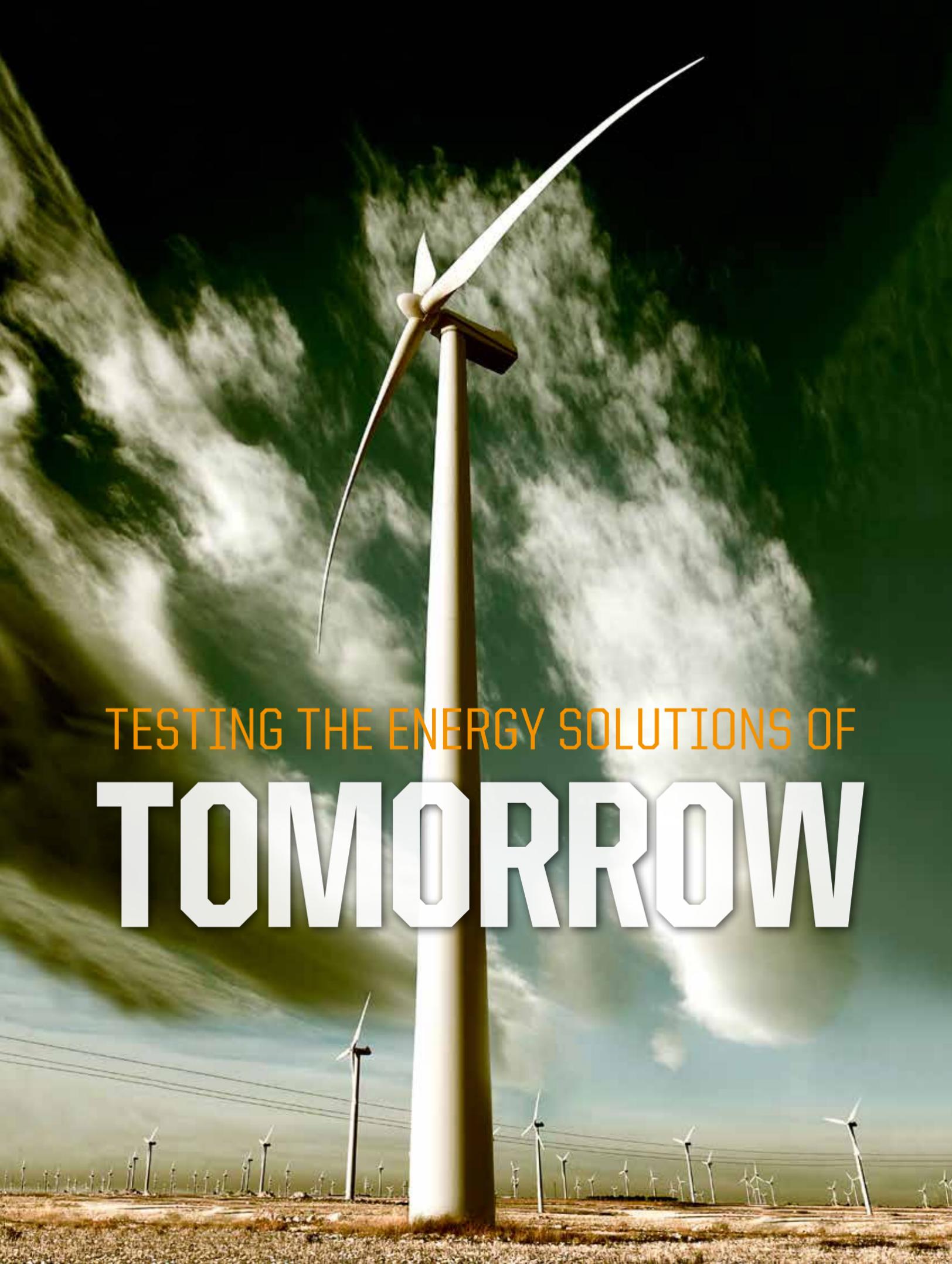
The classic rules of sliding fric-

tion were discovered by Leonardo da Vinci. They were rediscovered by Guillaume Amontons, who presented the nature of friction in terms of surface irregularities and the force required to raise the weight pressing the surfaces together.

In the last century it was shown that at a microscopic level, the actual area of contact between surfaces is a very small fraction of the apparent area. The development of the atomic force microscope has enabled scientists to study friction at the atomic scale.

Static friction occurs between two surfaces that are resting against each other. The contours of each surface have an opportunity to settle into each other and really get a good grip.





TESTING THE ENERGY SOLUTIONS OF
TOMORROW



Renk Test System: part of the wind turbine delivered to the Clemson project in the USA. This is the part of the wind turbine to which Superbolt technology has been fitted.

At Clemson University, an old shipyard has been turned into the world's largest wind energy testing centre. Renk Test System (RTS), a German company, has provided a facility containing the world's most powerful wind-turbine tests rigs, which permit simulation of any type of wind force.

WORDS:
LINDA KARLSSON ELDH

PHOTO:
BARBARA HARTMANN, CARLOS CASTILLA & RENK

AS WIND ENERGY RAPIDLY DEVELOPS worldwide, the US government plans to expand the country's production from 35 to over 300 gigawatts, equivalent to 270 medium-sized nuclear power plants. The new testing centre at Clemson University in South Carolina plays a crucial role in achieving this goal. For the first time, it will test wind turbine prototypes of up to 15 megawatts (MW) with every type of wind force, including hurricanes. The fact that today's average wind turbines generates 3-7 MW indicates the power of the testing facility.

"YOU DON'T NEED to wait for the storm of the century," says Jens Schneider, Project Manager at RTS in Augsburg, Germany. "The rigs simulate the most extreme conditions in a matter of months and manufacturers save hundreds of millions of dollars by detecting weak points before deploying new systems. The savings in time and money are one reason why interest in

our testing systems has skyrocketed recently."

RTS was commissioned to build two test stands when the Clemson project started a couple of years ago. The company, a subsidiary of RENK AG, has developed and manufactured high-end testing facilities for gears, drive components and complete vehicles since the 1960s.

THE CLEMSON PROJECT is the largest single contract in the company's history so far and RTS added personnel to its Mooresville and Augsburg offices to meet the requirements. It designed two test rigs: a 15 MW stand with a fully dynamic load application that uses hydraulic cylinders and an 11,000-horsepower motor to impart force and moments onto the turbine's rotating shaft, and a smaller stand for test objects up to 7.5 MW.

The 15 MW rig is 30 m (98.5 ft) long, 13 m (42.5 ft) wide and 14 m (46 ft) high. Ever since wind energy took off in the 1980s, tests have been limited to components, but these huge test rigs allow a complete wind turbine nacelle with an

"We needed bolting security that can cope with tomorrow's more powerful wind turbines as well as today's."

JENS SCHNEIDER, PROJECT MANAGER AT RTS





The new testing centre at Clemson University in South Carolina plays a crucial role in the greening of US energy production. The first of its kind, it can test wind turbine prototypes of up to 15 megawatts (MW) with every type of wind force, including hurricanes.

➔ average weight of 300 to 400 tonnes to be attached to the test bed, simulating dynamic loads in six axes of freedom. RTS shipped 800 tonnes of components to the US, including Superbolt multi-jackbolt tensioners and Expansion Bolts.

“THIS IS STATE-OF-THE-ART TECHNOLOGY that will be used to test new wind turbines over the next 30 years,” says Jens Schneider. “That’s why we needed bolting security that is able to cope with tomorrow’s more powerful wind turbines, as well as today’s.”

874 Superbolt MJTs and Expansion Bolts, varying in size from M42 to M125, secure the most critical bolted joints of both test rigs. The largest ones fix the test rig’s single units to the

6,000-tonnes concrete foundations. These ensure the test beds are detached from the main structure, preventing vibrations from reaching it and impacting the test results. The rest are fitted to the test bed gears controlling the speed of the test object, as well as in the load unit’s shaft connection which simulates the wind.

“These parts must handle extreme dynamic loads, replicating the harshest offshore conditions, and huge bolts are needed to keep everything in place,” Jens Schneider explains. “Conventional bolts require heavy hydraulic wrenches for tightening and removal. Superbolt products provide same or elevated preload levels, but allow us to work with normal hand tools, which are much more flexible.”

“90 percent of the rig’s components were manufactured in Augsburg, but there wasn’t space to pre-build and test the whole facility here,” Jens Schneider says. “We only had one shot to get it right and using Superbolt tensioners made it possible for us to install both rigs within just six months.

AS THE FIRST WIND TURBINE TESTS started at Clemson in 2013, wind had just become the USA’s primary source of new electric power, although it still only produces 3.5 percent of the nation’s electricity and there are currently no offshore wind farms on the US coast. With test facilities such as the one at the Clemson University, this may change sooner than expected. ■

FACTS:

WIND POWER

WORLDWIDE WIND CAPACITY:

>336 gigawatt (covers the current demand of up to 200 million homes).

AVERAGE ROTOR DIAMETER:

97 m/ 318ft.

AVERAGE HUB HEIGHT:

113 m/ 370ft.

WORLD’S LARGEST WIND TURBINE:

SeaTitan 10 MW (rotor diameter: 190 m).

WORLD’S LARGEST WIND FARM:

Gansu Wind Farm, China (capacity: 6,000 MW).

LEADING WIND POWER NATION:

Denmark (33 percent of electricity generated by wind).



Business arguments for Superbolt

- **COPEs WITH** extreme dynamic loads without bolt loosening.
- **ALLOWS FASTENING** and loosening with regular hand tools.
- **ENABLES EASY** on-site installation.



"The standards organisations play a significant role as the standards are important tools to facilitate trade," says Salim Brahimi.

FACTS:

SALIM BRAHIMI

TITLE: President, IBECA Technologies Corp.

AGE: 48.

LIVES: Montreal, Canada.

BACKGROUND: Master of engineering in metallurgy and a graduate diploma in management. Over 25 years of experience in fasteners, as well as quality systems and process optimisation. Active in several standards organisations (e.g. ASTM). Leads research programme on fastener hydrogen embrittlement at McGill University, Montreal.

An insider's outlook

WORDS:
ULF WIMAN

PHOTO:
ALLEN MCEACHERN

IF YOU WANT TO KNOW what is going on in the world of fasteners, ask Salim Brahimi, the authority on fastener hydrogen embrittlement and an active member of several standards committees, for example as chairman of the ASTM International Committee F16 on fasteners and the Advisory Committee that represents Canada on the International Standards Organization (ISO) Technical Committee 2 on Fasteners. His company, IBECA Technologies, solves complex problems for high-profile projects, and he leads university research programmes on fastener materials and coatings.

What are some current fastener industry trends?

"The majority of fasteners are mass-produced commodity products, so cost-effectiveness is crucial. The capabilities of the manufacturers vary and while the expertise is growing, there is not yet consistency. Manufacturing should focus on producing value-added products, for example, to the automotive and aerospace industries."

Going forward, what are the challenges?

"Apart from producing commodity products at a competitive price, the challenge is also to maintain quality and consistency for products used in critical applications. It requires high-quality personnel, but there currently is no institutional approach for training that focuses on the fastener value chain. There is a lot of reliance on handing down knowhow; how to operate the machines, but also how the standards work."

What do the standards organizations bring to the table?

"They play a significant role as the standards are the technical blueprints that facilitate trade. I can't emphasize enough that experts from all over the world are involved in this. People don't necessarily appreciate the importance of that. It is something that I am proud to be part of."

Tell us about the standards organisations' work.

"Consensus standards organisations all have

their respective perspectives, geographical penetration and structure. Technical committees in ISO and in the European CEN are made up of delegations of experts representing each member country, technical committees in North American bodies such as ASTM and ASME are made up of individuals who commit on a volunteer basis. This makes them quicker to respond to market trends. Regardless of the model, it comes down to expert consensus. When you bring people with different perspectives together, the results receive wide scrutiny, which means robust standards in the end."

Are there other differences?

"In North America we have both metric and inch fasteners and to complicate things, the US market has its own, independent metric system. But in reality, in terms of metric standard, ISO is the way the world has gone. The trend is for USA and Canada to defer to the ISO standard. At the same time, they want a say at the table and are increasingly active in ISO." ■



GAME-SET-MATCH!
Nord-Lock washers are used to lock the nuts to the frame, keeping the walls from collapsing.



Order in the court

WORDS:
LINDA KARLSSON ELDH

PHOTO:
ANTONIO GARCIA RECENA

THE CHALLENGE Invented 50 years ago in Mexico, the racquet sport padel tennis is now played all over Europe. In Sweden, sport floor specialist Unisport is riding the hype, having built around 60 padel courts

so far. However, the harsh spring storms in Malmö, in the south of Sweden, created an unexpected challenge by battering the courts' glass walls and causing the bolted joints to vibrate loose. At the very worst, the walls could collapse.

THE SOLUTION Unisport's tool supplier recommended Nord-Lock, who suggested using NL10spss

washers to lock the nuts to the frame and then use adhesive in the threads between the bolt and nut. To secure the bolt with Nord-Lock was not an option due to the shape of the bolt head, as it would have affected how the ball bounces against the surface.

THE RESULT The padel court has not experienced any problems since,

and padel tennis has become safer for players as the risk of collapsing glass walls has been eliminated. The solution also saves money for Unisport because the court needs less maintenance. After this success, Nord-Lock and Unisport are discussing changes to padel court construction by securing the bolt with a mechanical lock instead of the adhesive, increasing safety even more. ■

OIL & GAS UPDATE Recent developments within the oil and gas industry include Kværner selecting Nord-Lock steel construction washers (NLSC) for the Nyhamna Expansion Project, as well as the recent launch of 'No Need For Retightening'.

Kværner selects Nord-Lock for Nyhamna

KVÆRNER, A NORWAY-BASED engineering and construction services company, recently won a contract from Shell to develop and expand the Nyhamna plant, one of Norway's largest mainland developments. Kværner has chosen Nord-Lock to prevent the bolts from loosening. More than 300,000 bolted joints will be assembled with Nord-Lock. "Safety always comes first and it was very important for our customer, Shell, to prevent the bolts from loosening," says Ove Sætrevik, Project Engineer at Kværner. "At Kværner, we've worked with Nord-Lock before and we know it is the number one solution for locking bolt connections."

KVÆRNER HAS SELECTED Nord-Lock SC-washers for the Nyhamna project, which are designed to fit HR/HV bolts in accordance with EN14399-3/EN14399-4. The Nyhamna Expansion Project is planned for completion by mid-2016, in parallel with Statoil's Aasta Hansteen development in the Norwegian Sea. Ove Sætrevik thinks similar projects will follow. ■

LINDA KARLSSON ELDH



Aerial view of the Nyhamna Expansion Project.

PHOTO: SVEIN ROGER IVARSEN

New concept to save millions for rig operators

THE HARSH working environments of onshore and offshore oil and gas facilities demand strict international regulatory requirements on the industry. These regulatory requirements are set by different classification societies. One such requirement is annual torque controls on 20 percent of all bolt connections on drilling equipment. These torque controls cost USD 25-40 million during the 25-30 years lifetime of an offshore rig.

In Norway, one of the world's largest oil-producing countries, Nord-Lock addresses this time-consuming and costly practice with its new

concept No Need for Retightening (NNFR). The concept is to be offered together with a fastener and logistical partner. The kit is supplied pre-lubricated and comprises the required nuts, bolts and Nord-Lock washers, and ensures that bolts do not loosen, regardless of dynamic loads and vibrations.

WHILE NNFR INCREASES SAFETY, operators and rig owners can apply to classification bodies for exemption from the annual torque control, thereby saving millions. Rig owners or operators must also meet the requirements for as-

sembly (namely, that NNFR is fitted and tightened by certified installers) before they can apply for exemption from the torque controls.

The solution was nominated for the ONS 2014 Innovation Award, reflecting its potential importance for the oil and gas industry worldwide. "The benefits for both land-based and offshore operators are huge," says Petter Viken, Business Developer oil & gas, at Nord-Lock Group. "With NNFR, the operators make significant savings on maintenance, while ensuring the safety of their equipment," he concludes. ■

LINDA KARLSSON ELDH

Stronger, safer bolting with FEA software

NORD-LOCK'S Finite Element Analysis (FEA) offers a fast and convenient method for calculating the risk of bolt failure. By entering the relevant data into the mechanical analytical software, including material and bolt length, customers can identify stress points in a given assembly and accurately calculate the risk of bolt failure.

"The main purpose is to help customers check their designs through simulation," says Maxime

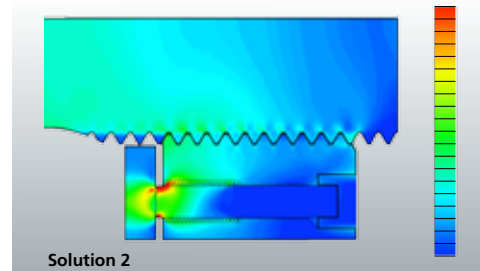
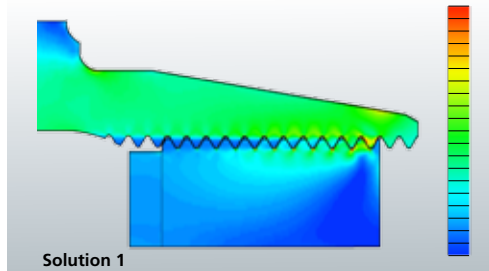
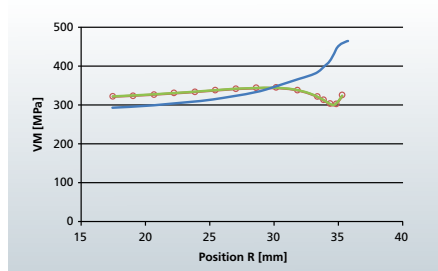
Thonnerieux, Global Business Development Director, Nord-Lock Group. "Using the software, mathematical formulas and models can be fine-tuned and perfected, reducing the need for physical experiments and tests."

FEA also offers a convenient method for checking and comparing different bolting solutions, so that the best option can be identified. "Customers can use the software to perform simulations

and see what works in their specific application," adds Thonnerieux. "They can check if a fastener offers superior security, or if a more cost-effective fastener can offer the same level of security."

Already, a number of Nord-Lock customers have used FEA to improve their designs. For more information about the software and technical advice, contact Nord-Lock Performance Services at performance.services@nord-lock.com ■

Comparison between existing solution and new design:



New solution n°2 reduces the maximum stress in the threads.



Nord-Lock has added the SMO washers to its product range permitted in track systems and construction engineering for the German railway industry.

German railway certificate for SMO washers

WITH THE RECENT EBA certificate from the German Federal Railway Authority, Nord-Lock has added SMO washers to its product range permitted in track systems and construction engineering for the German railway industry. Their mechanical strength and resistance to corrosion makes SMO washers ideal for securing railway bridges, noise barriers and rail sensors where wind, rain and de-icing salt corrode conventional stainless steel washers. It can take up to two years to receive certification and the technical documentation from Deutsche Bahn (DB), Europe's largest railway operator, confirming its approval. Until then, nobody is allowed to use the product.

"In Germany, it's sometimes harder to receive approvals for trains than for airplanes," says Jochen Süßenbach, Railway Manager at Nord-Lock.

"But it's worth waiting for. The German railway industry is booming and this opens up the market even more for Nord-Lock. We're providing DB with laser marked washers to ensure full traceability and extra-high security." ■

Rallying for safe bolted joints

MOTOR SPORTS are not easy on the cars. High speed, torque, vibrations, g-forces and hard knocks put enormous strain on the cars and their components. Bolted talked to Kee, manager and owner of Hot Bits (Thailand) Co., Ltd, subsidiary of Hot Bits Sdn Bhd, a leading manufacturer of shock absorbers and suspension systems, mainly for demanding customers in motor sports – race, rally, drift and drag.



brand. For many years we supported Asia Cross Country Rally teams, for example, Mazda Speed Team, RalliArt Thailand, Toyota Team Thailand, as well as the Nissan and Isuzu teams, tuning and modifying suspensions. We have now been engaged by Isuzu Thailand to build up their motor rally cars."

What are the upcoming races?

"In 2015 we are going to attend two cross country rallies: the Asia cross country rally 2015 and the Australasian Safari 2015, which is a very challenging rally with tough tracks. We also have some local cross country rally championship in Thailand. We hope to finish among the top three in all rallies. We will be using Nord-Lock washers of various sizes for the Isuzu Thailand team to make sure that their rally cars are



"We tested Nord-Lock washers and had no problems with loose suspension nuts. We won that first race and have been using their products since," says Kee.

sufficiently secured to battle the Australian race tracks and to beat the local teams."

How did you end up using Nord-Lock products?

"I had been looking for a good lock nut to use in the rally cars that we supported. After the last race of each special stage in the rallies, we used to check all of the nuts and bolts under the suspension and, most of the time, we found loose nuts. We had to tighten all of them again and again. Then earlier this year, one of Nord-Lock representatives introduced the company's portfolio to us. We tested Nord-Lock washers and experienced no prob-

lems with loose suspension nuts. We won that first race and have been using Nord-Lock products ever since. It also makes our mechanics' work under the vehicles easier and safer." ■

ULF WIMAN

FACTS:

NATTAWAT RATTANASAKSOPANA (KEE)

AGE: 57.

BACKGROUND: After university he helped his father in the jewellery business. In 1978 he started importing Japanese used parts and in 1984 premium cars. In 1997 he started importing suspensions from Australia.

READER SURVEY

Thank you for participating!

BOLTED MAGAZINE would like to thank all who participated in our reader survey. All your input and responses are valuable and very beneficial to Bolted magazine, as well as an idea of your overall reading experience. ■



Would you like to read about your company in Bolted?

NORD-LOCK IS ALWAYS on the lookout for good stories for its customer magazine, Bolted. If you currently use Nord-Lock products in a unique product or interesting application, we would love to hear from you. Contact us at: bolted@nord-lock.com. ■



Save time with Expansion Bolts

Heavy machinery requires bolting elements that can be easily installed and removed. This is especially true on large and high-performance flange couplings where the bolting elements produce an interference fit for proper torque transfer.

Superbolt Expansion Bolts replace large fitted or interference fit bolts. Its outer diameter can be expanded to fit the actual bore size.

Easy: Loose fit sleeves are easily inserted even in holes not fully aligned due to rotation. Only hand tools are required for installation and removal.

Fast: Tightening requires only minutes per assembly.

Safe: Eliminates the need for special high powered tools, bolt deep freezing and high pressure hydraulic systems.

Economical: Save money over hydraulic systems in time and tooling.



Download the Expansion Bolt brochure at:
www.superbolt.com/expansionbolt

