

  
**bondura**<sup>®</sup>  
technology

# INTRODUCING BONDURA®

bondura® technology design and manufacture pin solutions to customers' specifications, based on our patented and DNV GL Type Approved bondura® pin technology.

We have more than 30 years of experience with expanding pin technology in the most challenging environments world-wide; within offshore, onshore, mining, amusement parks, heavy machineries, subsea and more - all depending on where there is a need for durable and lasting pin connections.

bondura® is an established system that simplifies design work by achieving a uniform pin design,

thus avoiding the need to employ varying pin solutions, as well as complicated housing and locking systems.

bondura® is the superior connection for increased customer value! Using the bondura® design you achieve a perfect fit every time without expensive engineering and design changes to the equipment.

Our head-office is located on the southwestern coast of Norway, close to Stavanger. We have a sales department in Sweden, and partners world-wide.



## **bondura® technology AS**

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# SIMPLY BRILLIANT



The principle of the bondura® pin is ingenious and simple. The conical sleeves are assembled and expands on the tapered pin upon tightening. Thus, the bondura® is fixed to the equipment.

The bondura® pin is suited for both new and used equipment, to avoid future play, eliminate play and repair ovality.

bondura® technology is constantly developing new solutions to solve problems and comply with customer requirements. We have pin solutions for eccentric adjustment, equipment alignment, securing of flange couplings, combination pins for axial+radial locking and much more.

## New equipment

- DNV GL Type Approval
- ABS Product Design Assessment
- prolong uptime
- increase equipment lifecycle
- decrease maintenance/refurbishment cost
- easy installation, inspection and maintenance
- 360 degrees contact surface
- 180 degrees load-bearing surface
- extremely adaptable
- manufactured to customer specifications
- bondura® Multi Tool - our disassembly tool

## Service & Repair

- DNV GL Type Approval
- ABS Product Design Assessment
- eliminate wear and tear
- reduce lifetime expenses of equipment
- reduce both frequency and length of downtime
- quick disassembly
- time-saving installation
- field installation made possible
- easy inspection and service procedures
- no need for flame cutting
- bondura® Multi Tool - our disassembly tool



## ELIMINATE

Clearance in a conventional pivot joint connection is necessary for installation, but this clearance will continue to increase due to the relative movement between pin and bore from alternating tension/compression forces, vibrations and shock loads.

The consequences of such wear can be: damage to equipment or personell, safety hazards, accuracy and maneuverability problems during operations, not to mention the time-consuming and costly repairs to get the equipment back in operation.



## SLACK & OVALITY

Our bondura® solutions eliminate play, and repair the ovality and clearance that have occurred in the joint.

The bondura® technology makes it possible to use larger assembly tolerance. When the bondura® pin is assembled the tolerance is close to zero, same as a press fit. The result is a contact surface of 360 degrees and a load surface in the support of 180 degrees.

If the diameter of the support bore is more than 2 mm larger than the pin diameter, an oversized conical sleeve may be used. In principle it is

possible to expand and remove large amounts of ovality, but in order to reduce retightening frequency and space requirements on the side of the assembly, the ovality should be no more than 1 mm. If there is more, the bore should be grinded to be as round as possible. Oversized conical sleeves may be supplied for all bondura® types.



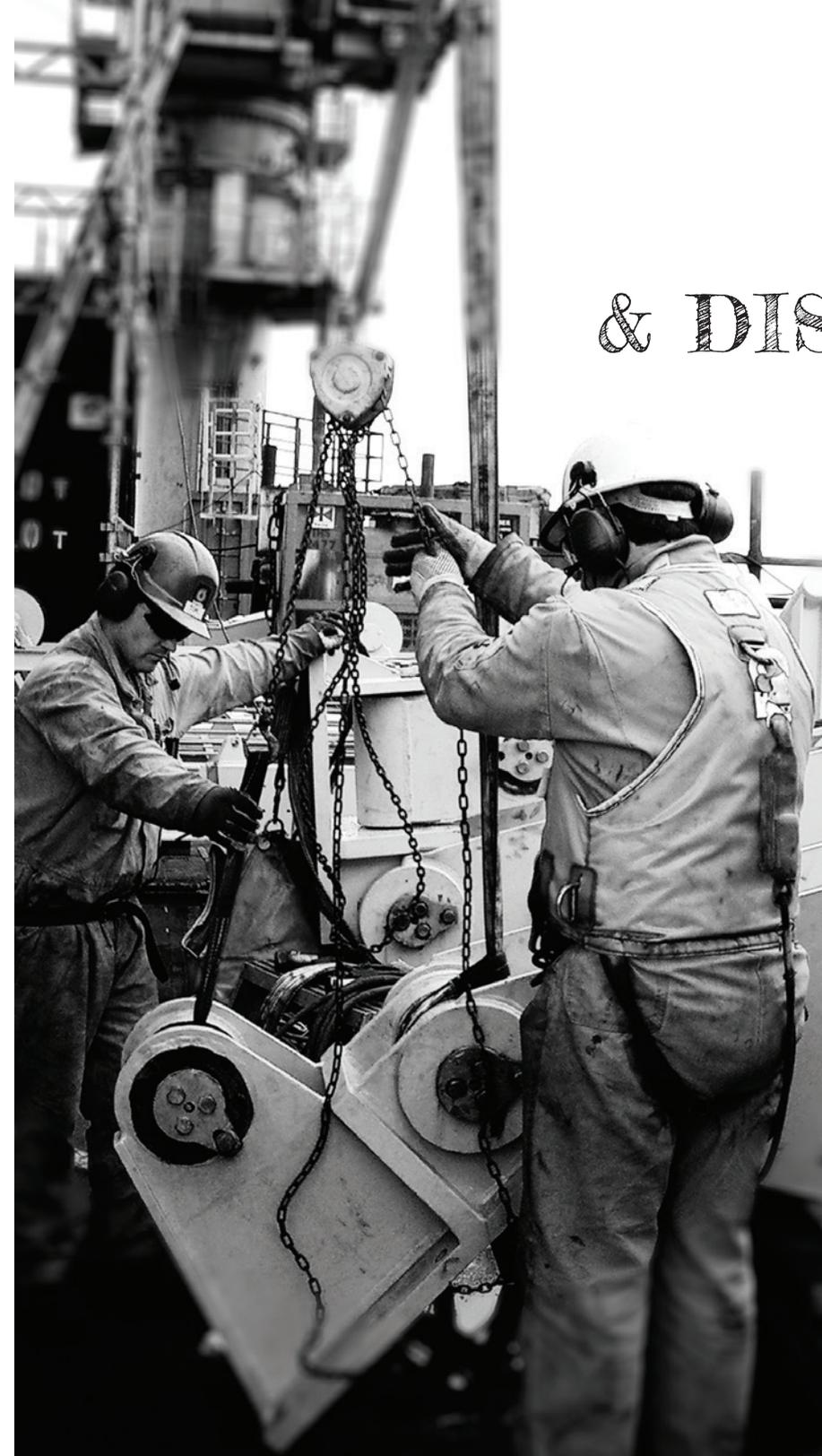
# FIELD INSTALLATION MADE POSSIBLE

Using bondura® pins reduces the risk of downtime as a result of acute repairs, or during planned servicing and certification of equipment.

If play or ovality occurs in certain positions, the need to change pins becomes urgent. These problems often occur miles away from the nearest workshop, and can be very demanding. The bondura® pins can be changed in the field, using handheld tools. The bondura® pins reduce assembly/disassembly time, ease inspection and service procedures, decrease downtime - all in all lowering the overall cost.

When new equipment has been supplied, there will often be a certain amount of service and product improvements that fall within the warranty period. This may also apply to pin play, or that pins must be removed in order to disassemble the equipment. With bondura® pins play is avoided, and labour costs and time are saved during disassembly.

Large spherical bearings create major challenges in connections when installing cylindrical pins with the necessary tight fits. bondura® pins are made to deal with these challenges.



# EFFICIENT ASSEMBLY & DISASSEMBLY

"We are very pleased with the bondura® pins and our experience with the pins is very good. We are continually replacing pins with bondura® pins as this give us less maintenance and nonproduction time. Down time caused by pin failures and extensive play have been reduced to a minimum on equipment equipped with the bondura® pivot pin technology. At the end it is all about production time and lowering the cost for operation. bondura® pins is one factor that has reduced our maintenance cost."

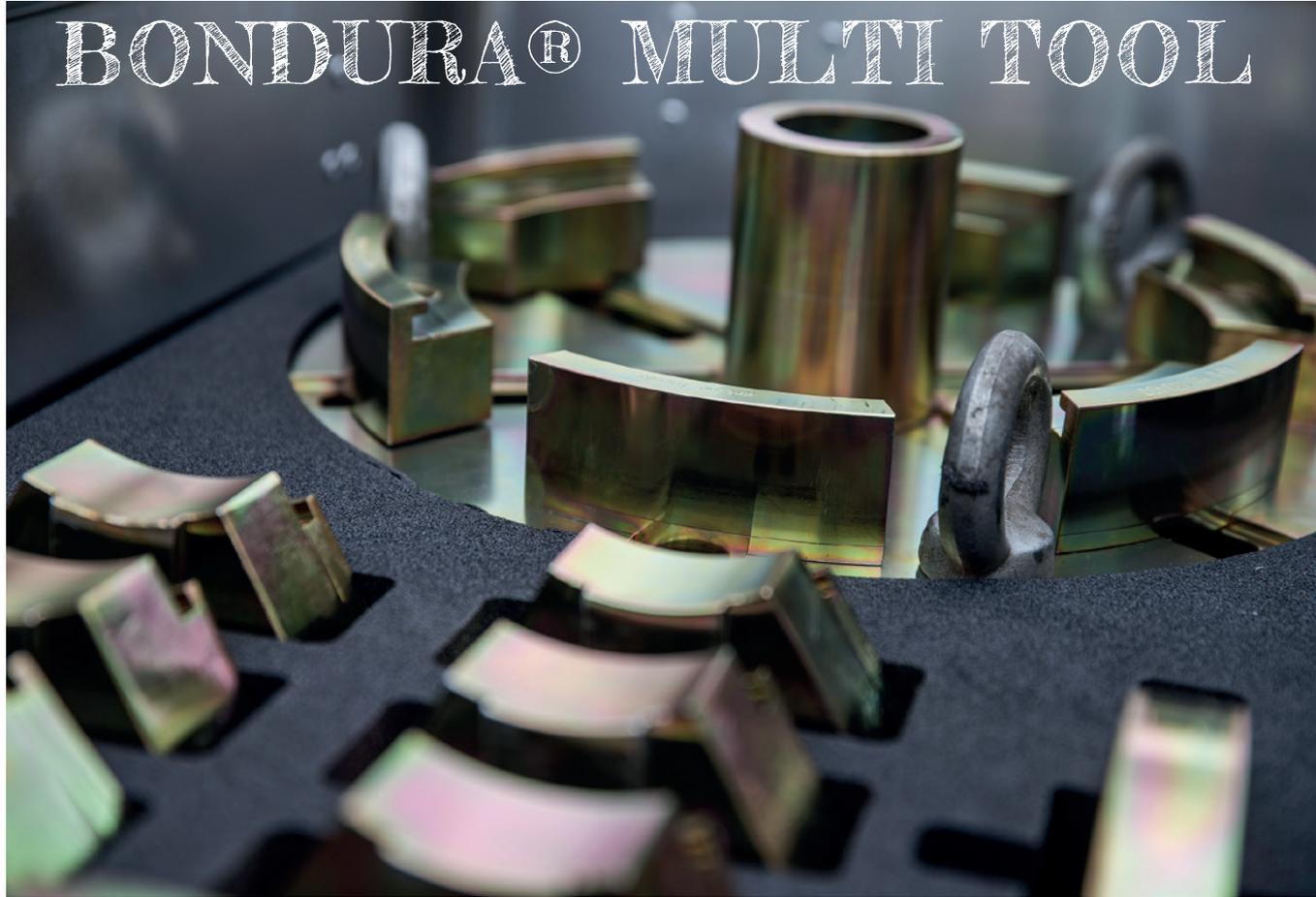
Geir Johnny Eide, Stena Don, Stena Drilling

Using a standard cylindrical pin you may have issues with corrosion in the connection and jamming of the pins. This creates a problem for the removal and the disassembling becomes a problem. Typically, the only way to remove the standard cylindrical pin is through torch cutting.

The design of the bondura® solutions results in easier assembly of equipment and an extremely solid connection, avoiding future play.

Disassembly of the bondura® is very simple as the pin becomes loose when the conical sleeves are removed. We have developed a removal tool to make the job even easier; the bondura® Multi Tool is available for both rental and purchase.

# BONDURA® MULTI TOOL



In order to simplify the removal of conical sleeves and pins we have developed a tool: bondura® Multi Tool. This is a special tool for gentle and easy removal of conical sleeves and pin - to be used on bondura® pins with diameters redundant from  $\varnothing 30$  to  $\varnothing 500$  mm.

The bondura® Multi Tool is available for both purchase and rental.

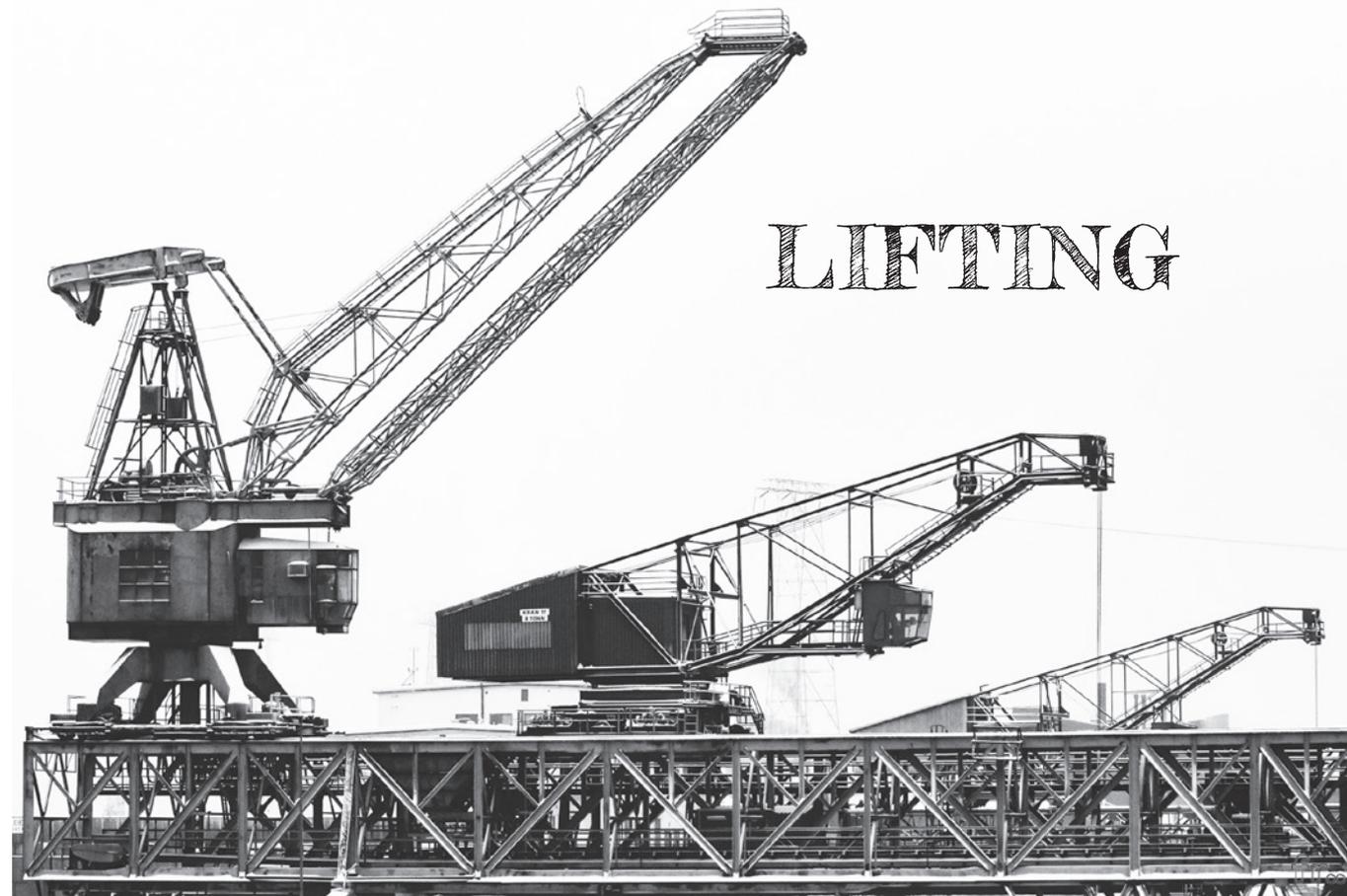
# BONDURA® ASSEMBLY PASTE

bondura® technology has now introduced its own thread and lubricant paste for use in all bondura® assemblies; bondura® Assembly Paste is a non-metallic anti-seize lubricant paste designed for high temperatures and pressures, and it prevents seizure at temperatures up to +1500 degrees Celsius. The paste is highly water resistant and corrosion inhibiting. It is based on synthetic base oil, and can be used in temperatures as low as -40 degrees Celsius. bondura® Assembly Paste is based on Molykote P74. Coefficient of friction is in the same region as oiled bolts, and the paste provides a low resistance when tightening while preventing stresscracking and embrittlement.

Typical applications:

- bondura® assemblies
- Threaded connections in all dimensions
- Threaded connections for all bondura® approved materials
- Central lubrication systems
- Sliding bearings and sliding surfaces
- Flanges, splines, exhaust parts, brake mechanics
- Expansion - and locking bolts





# LIFTING

Removal and installation of large & heavy Crane pins can present a whole set of demanding challenges such as: stuck pins due to corrosion, wear, lack of lubrication procedures, wrong use of lubrication, damaged or failed spherical bearings, and you also run the risk of damaging the bearing during installation and removal of the pin.

bondura® is installed on newbuilds and as retrofit with crane manufacturers worldwide, sizes ranging from Ø100 mm to and above Ø480 mm. Examples of positions where bondura® is used are section joints, cylinders and boom.

The bondura® technology enhances the total quality of the crane; not to mention the increased life cycle.

bondura® is certified according to requirements of NS 5514 / FEM (Federation Europeenne de la Manutention) and Rules of Certification of Hoisting Appliances. The product is approved to replace existing pins in cranes and hoisting equipment.



# DRILLING

The bondura® pins are installed in many different types of drilling equipment worldwide. Examples of positions where bondura® is used are clevis, dolly, top drive, compensation systems, pipe rack cranes and other pipe handling equipment.

The bondura® pins eliminates wear, ensuring a solid 180 degree distribution of the load within the supports of the pivot joint.

Our technology also reduces the need for maintenance on the support by reducing the need to line bore. The risk of cracks forming in the support will be reduced and the equipment's life cycle will be extended.

bondura® pivot pin technology will reduce downtime, optimize machinery performance, ease and speed up maintenance, planned and unplanned, cut maintenance cost, dramatically increase equipment life cycle and increase the overall quality of the equipment.

bondura® is certified according to API 8C- and FEM-regulations (Federation Europeenne de la Manutention), and is approved to replace existing pins in offshore equipment.



## CONSTRUCTION

bondura® pin technology has been the standard of the industry since the early 1990's on eliminating pivot wear in heavy equipment permanently. Machinery used in forestry and construction see a lot of wear and tear due to frequent and heavy strain - with continuous shock loads to the machine throughout its operational lifecycle.

bondura® has a great record of accomplishment in machinery such as: feller bunchers, harvesting heads, felling heads, log skidders, loaders, log-stackers, mulchers, dozers, excavators, drilling machines, concrete boom pumps, wheel loaders and blast-hole drill rigs.

Any kind of heavy machinery exposed to heavy loads will experience wear on certain positions. Be it the boom base on your excavators, bucket pin on your loaders, or a tilt cylinder on your articulated dumpers, mobile cranes or any other kind of industrial equipment.

When play or even ovality occurs in crucial positions, the machinery becomes less precise and more difficult to control, and as the play increases, the need for changing pins becomes urgent. By using regular pins there will eventually be a need for expensive and time consuming line boring and welding, and this is only a temporary solution to a problem that will keep recurring with regular pins.

The bondura® pin eliminates these problems. Used in new machinery, the positioning and the actual system prevents any wear in the joint, making the machine work with the same precision throughout its life span. You can also use the bondura® technology for your older equipment, replacing any other pin, thus avoiding line boring and welding, and still making sure the joint in question works as good as on a brand new machine.

Often these kinds of problems occur in the field, and to change regular pins miles away from the nearest workshop can be extremely demanding. And downtime on the machines are prolonged for days, and some time weeks. When using the bondura® system, the pins can be changed in minutes, using hand held tools and often it can be done by only one person. This of course, saves a lot of time and money, as well as being a safe and clean way to solve your problems.





# MINING

bondura® is approved to replace existing pins in the mining industry.

The main challenges are shock loads due to falling objects, sudden increase in resistance from different minerals, and vibrations from drilling and ramming. Resulting in heavy strain on vulnerable joints.

We can provide materials with durable hardchrome surface to prevent abrasion. Our bondura® solutions can be delivered with the required documentation to comply with strict health and safety regulations.



# DREDGING

bondura® is approved to replace existing pins in dredging equipment.

The dredging- and construction industry have a lot in common in terms of equipment, but the environment is more challenging in the dredging industry; corrosion being the largest concern.

Our material portfolio include several stainless and acid-proof materials to comply with customer requirements.

# AMUSEMENT PARKS

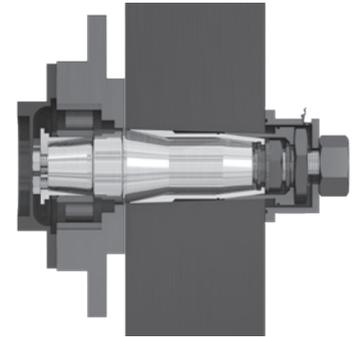


Safety is of utmost importance in the amusement industry and an error can have critical consequences. bondura® pins addresses safety by eliminating slack in joints in all machines where there is a conventional cylindrical pin connection. Sound due to unwanted movement is eliminated and the overall quality of the rides increases. bondura® pins are easy to install and easy to extract which is important when you have to assemble and disassemble equipment.

bondura® pins are tailor made according to customer needs, can be designed to fit in all types of rides, and can be used in new builds and retrofits.

# BEAM PUMP

Beam Pump maintenance and efficiency are also critical factors in artificial lift operations, due to remote locations, tight tolerances and health & safety regulations - bondura® Crank Shaft technology gives you easy onsite installation, maintenance & replacement of bearing stack, no unwanted movement in joints, the ease of working with smaller hand tools, as well as significantly reduced downtime and maintenance costs.



# STANDARD BONDURA®

All of our solution can be delivered with single, double or customized lubrication if needed.  
Most of our solutions with positioning details can be delivered with two circular plates instead if that is preferable.

## bondura® 6.6

The 6.6 is our best-seller. It is the most cost-effective bondura® solution. It consists of one pin with tapered ends, two conical sleeves to fit on to each tapered end, fasteners to provide axial force and end plates to transfer that axial force to the conical sleeves. The conical sleeves will expand to provide a zero tolerance fit in the support bores. This solution requires enough space to insert the pin on one side and mount a conical sleeve, plate and fasteners on the opposite side. A torque wrench is used on both sides to apply the correct torque to the assembly. A bondura® multi tool (BMT) is recommended to disassemble the 6.6.



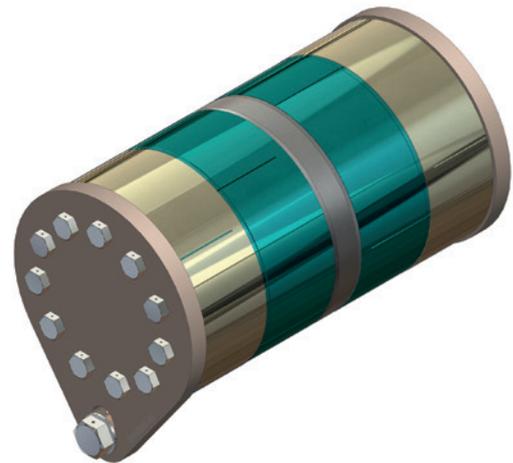
## bondura® 3.3

The 3.3 is the easiest bondura® solution. It consists of one pin with tapered ends and threaded studs, two conical sleeves with connected flange nuts, circlips to secure the flange nuts and o-rings to keep the conical sleeves and flange nuts connected during assembly and disassembly. The flange nut provides axial force to the conical sleeves and in turn expansion in the support bores. This solution requires enough space to insert the pin on one side and mount the conical sleeve/flange nut assembly on the opposite side. A torque wrench is used on both sides to apply the correct torque to the assembly. There is no need for any special tools to disassemble the 3.3.



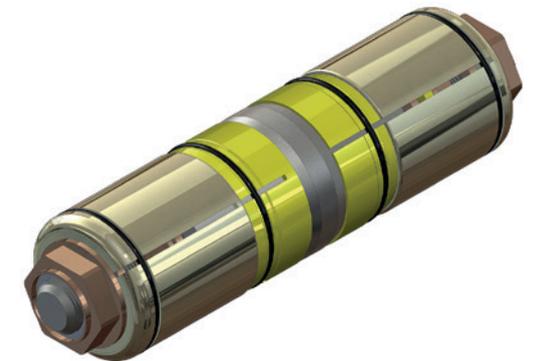
## bondura® DUAL 66

The Dual 66 is recommended when the pin needs to be locked to the inner ring of a bearing to ensure that the joint only moves between the inner and outer ring of the bearing. This solution consists of a pin with long tapered ends, two inner conical sleeves fitted on to the long tapered end of the pin, two outer conical sleeves fitted on top of the inner conical sleeves, fasteners for the inner conical sleeves and end-plates pushing on the outer conical sleeves. The inner conical sleeve expand to form a zero tolerance connection in the inner bearing ring and the outer conical sleeve form a zero tolerance connection in the support bores.



## bondura® DUAL 36

The Dual 36 is recommended for static joints without a bearing in the center. This is a combination of the 3.3 and the Dual 66, it has two long threaded studs on each end of the pin instead of threaded holes and one flange nut connected to each of the four conical sleeves instead of fasteners. This solution requires space for assembly of conical sleeves/flange nuts and torquing on both sides. There is no need for any special tools to disassemble the Dual 36.



# STANDARD BONDURA®

All of our solution can be delivered with single, double or customized lubrication if needed.  
Most of our solutions with positioning details can be delivered with two circular plates instead if that is preferable.

## bondura® 6.1

The 6.1 is used when there is very limited or no access to one of the support bores. It consists of one pin with tapered ends and a center hole, one center axle working together with a nut and conical sleeve on the limited side, one regular conical sleeve working together with an end-plate and fasteners on the reachable side. The truly unique attribute of the 6.1 is the ability to ensure a zero tolerance fit in the limited support bore as well as in the reachable support. This solution only requires space to assemble from one side. A torque wrench is used on one side to apply the correct torque to the assembly. A bondura® multi tool (BMT) is recommended to disassemble the 6.1.



## bondura® 6.2

The 6.2 is a combination of the 6.6 and 3.3, it is used when there is limited access to one of the support bores. The entire assembly can be installed from one side, but it requires torquing from both sides. It consists of a pin with one tapered end with threaded holes for fasteners and one tapered end with a threaded stud, a plate pushing on one of the conical sleeves and a flange nut connected to the other. A circlip is used to secure the flange nut and an o-ring to keep the conical sleeve and flange nut connected during assembly and disassembly. A bondura® multi tool (BMT) is recommended to disassemble the 6.2.

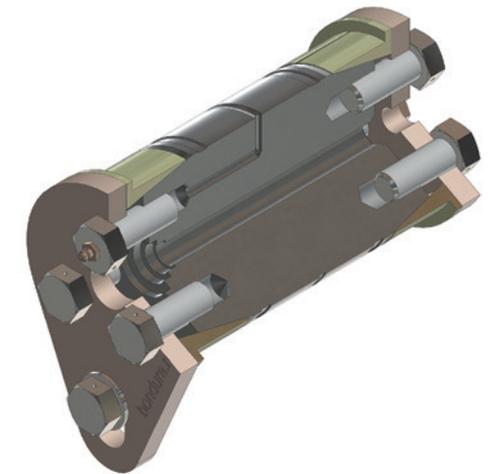


## bondura® LMP

The bondura® Load Monitoring Pin contains a combination of a specially designed bondura® expanding pin solution with high quality load monitoring electronics from Strainstall.

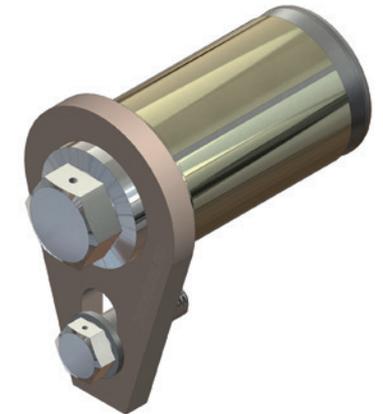
We have created one of the best load monitoring pin solutions available on the market. Our load tests confirm that the accuracy of our pins are amongst the most accurate available with up to 0.3% accuracy of full scale expectancy.

bondura® 6.6, 6.2 and 3.3 are available with load monitoring technology.



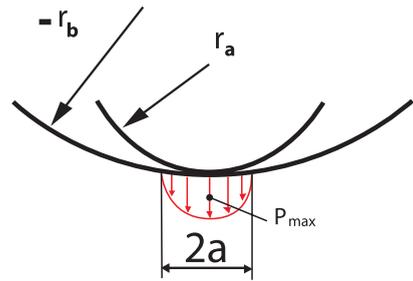
## bondura® 6.0

The 6.0 was initially made for alignment of foundations, but it can be used for all installations where only one expandable surface is required. The pin is only tapered on one side with a single conical sleeve expanding from the axial force from a plate and fastener(s). Depending on the size, a bondura® multi tool (BMT) may be recommended to disassemble the 6.0.



# THE THEORY BEHIND

The contact surface between pin and support will be reduced significantly by increasing the level of tolerance between pin and support. The figure below shows the relationship between tolerances and contact surface.

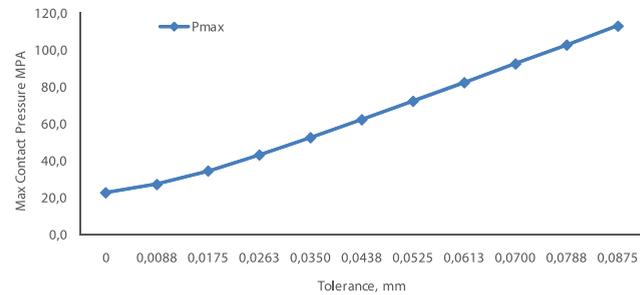
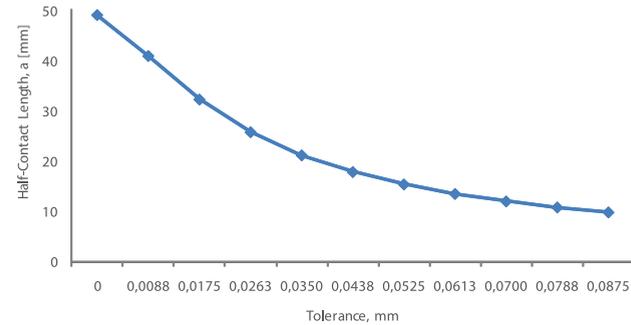


The ever present contact surface can be derived by the projected contact length (a) in the Hertz contact formula:

$$a = \sqrt{\frac{2F}{\pi L} \frac{\left( \frac{1-\nu_a^2}{E_a} + \frac{1-\nu_b^2}{E_b} \right)}{\frac{1}{2} \left( \frac{1}{r_a} - \frac{1}{r_b} \right)}}$$

L Support Width (mm)     $\nu$  (nu) Transverse Contraction (poison numbers)  
 F Load (FSy/2) , (N)    r<sub>a</sub> Radii bolt (mm)  
 E (E<sub>a</sub>=E<sub>b</sub>) Elasticity Module    r<sub>b</sub> Radii hole (mm)

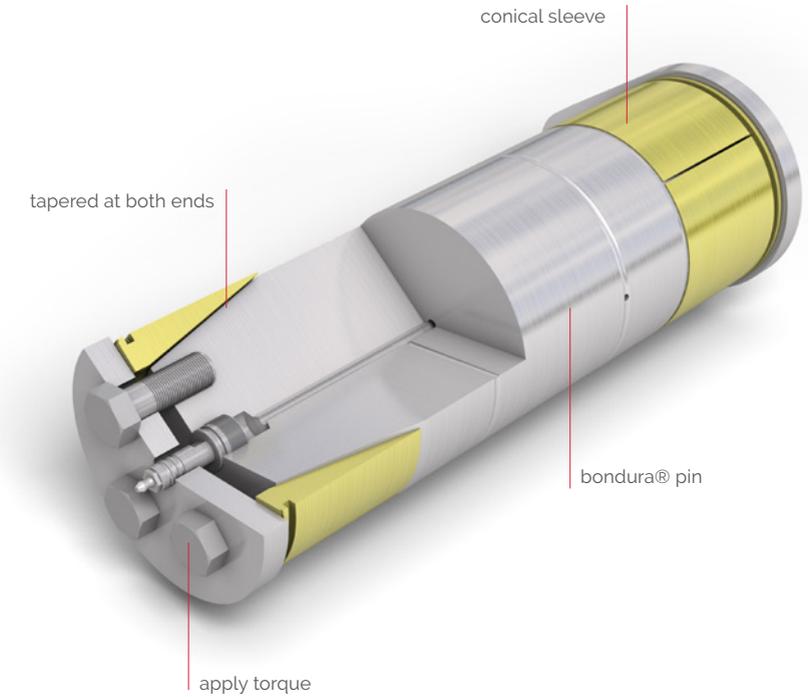
An increase of assembly tolerance from 0.04 mm to 0.1 mm will reduce the contact surface between pin and support by 78%, and thereby increase contact stress by 4 times!



## TRAINING

With our expansion worldwide, we have seen the need for more in-depth knowledge regarding design, assembly and disassembly of the bondura® product line and technology. In this regard we offer you the opportunity to learn more about the bondura® technology in general, either at your location or at ours. You will learn about the basics of the bondura® solutions and how to apply it in your field of service.

# STUDIES BY ENGINEERING DEPT.



Our engineering department will provide assistance early in the project phase, ensuring the best possible solution for product functionality. Not only from an OEM's point of view, but also with regard to the equipment lifecycle, service intervals etc.

Safety, functionality and quality are always top priorities for us. We can help to develop and assist with pin solutions for overhaul and upgrade of equipment, and redesign from a conventional cylindrical pin solution to a bondura® pin solution. This will keep expenses to a minimum by not having to make expensive design changes, and by improving the overall quality and life cycle of the equipment.

We will provide our customers with assembly drawings and 3D models of the design for use in their own system.



The new bondura® bolt-nut self-locking system prevents unintentional loosening of the nut during operation. Easy to install and retrieve when required. Perfect for use in high-risk and exposed bolting connections. Can be delivered in any size and material quality.

"...The bondura® pins makes the replacement of cylinders faster and a lot easier"

Geir Johnny Eide, Stena Don

"When our front loader had become too worn in the bolted joints, we chose to go for a bondura® upgrade. We then got all the worn pins replaced with new expanding bondura® pins.

We are very pleased with the work that was performed and the final result. The front loader is almost like new, and we do not envisage that we will get similar problems again during the equipment's life time.

The cost was only a third of the price of a new device. We highly recommend the bondura® technology!"

John Olav Haraldsen - Head of Section, municipality of Sandnes, BYDRIFT

## REFERENCES

"...we found that since the installation of the bondura®, we found the pins to be as tight as the day they left the shop"

Dean Young, Transocean

"The assembly of the bondura® pin went very good, and the bushings fitted nice. Both the standard one and the one with oversize. The digging machine has been used for about 40-50 hours after the assembly, and we have retightened the pin two or three times, and all the pre-existing clearance has disappeared.

As the repair of the machine was finished (after about 6 hours; pin assembly 20% and change of bushings 80%) I knew this looked perfect, and the others person had a smile knowing that there were no more noise from the machine anymore. The boom worked well going both up and down. The axis was also working perfect."

Oskar Alme - Alme Maskin

## CERTIFICATIONS

bondura® is a patented product, and has been classified as "Proven Technology" within the offshore-, construction- and general industry since 1994.

We have got DNV GL Type Approval, ABS Product Design Assessment and is certified according to ISO9001:2015.



SUPERIOR  
CONNECTION FOR  
INCREASED  
CUSTOMER VALUE