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## A MATERIAL DIFFERENCE

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National Composites Centre  
means for UK industry



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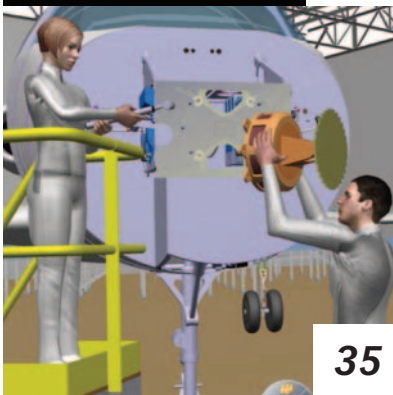
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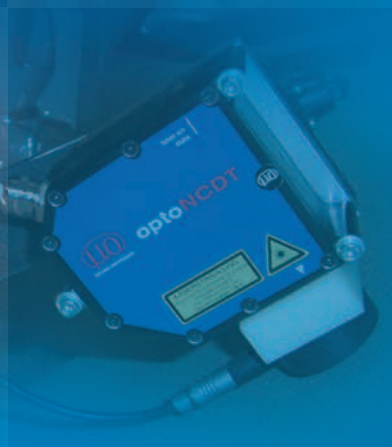


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# Helping you to do things better



Paul Fanning, Editor (pfanning@findlay.co.uk)

This month's cover story concerning the soon-to-be-opened National Composites Centre is to some extent designed to pique the curiosity of those who may have considered using composite materials in their designs, but have been hampered by a lack of information or advice to help them do so.

The barriers to adoption of new or different technologies are numerous and are precisely what institutions such as the National Composites Centre are designed to help manufacturers to overcome. These barriers include a lack of knowledge of the technical capabilities of the material or technology; a fear of the capital outlay required to adopt such a technology; a belief that any new technology is likely to be expensive and, of course, a more general aversion to the risks inherent in adopting an unfamiliar technology.

This type of conservatism is a problem that one hears about industry fairly often. Often, it should be said, it is not the engineers who are the main barriers to adoption, but those in charge of the pursestrings. And, in fairness, it is understandable. If you are doing well making a product in one way, why take the risk of doing it another way?

The answer, of course, is that that is how competitive advantages are achieved over your competitors. It is often by taking such calculated risks on new methods and materials that one product will distinguish itself from the others in its market.

'If you always do what you've always done, you'll always get what you've always got' is a timeworn saw in the world of business, but it nonetheless holds good. Organisations like the NCC can help you to do things better.



# From sketch to shop...



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## UK innovation Centres to focus on renewable energy

Business Secretary Vince Cable has announced a competition for a technology and innovation centre focusing on wind, wave and tidal power.

The Offshore Renewable Energy centre is part of a Government campaign to spend £220million over the next four years and establish a network of at least six centres.

"In creating an offshore renewable energy technology and innovation centre we are taking the next step to transforming the UK into a low carbon economy," said Cable. "There is a clear opportunity for the Government to support the UK's offshore industry and this centre will be of great benefit to the sector and the economy." The Government also plans to invest £20m in two clean technology funds: Zouk Cleantech 2 and HG Capital Renewable Power Partners 2 as part of its £325m UK Innovation Investment Fund. The funds will support companies working on alternative energy generation, renewable energy infrastructure including wind farms, energy efficiency and water treatment and conservation.

## Are you a winner?



**Entries are now being accepted for the 2011 British Engineering Excellence Awards; the celebration of all that is good about UK engineering.**

The Awards aren't just there to celebrate the successes of a few; the Awards are intended to demonstrate to all UK engineering companies that it is possible to succeed, that they can work to a high level and compete on a global level.

Chair of this year's judging panel is Colin Brown, director of engineering at the Institution of Mechanical Engineers. He said: "The proper benchmarking of our accomplishments is what drives all of us to higher levels and the recognition of engineering excellence is no exception. The British Engineering Excellence Awards are the national platform for providing for such recognition...The British Engineering

Excellence Awards are the opportunity to showcase our best products and solutions."

The Grand Prix in the 2010 BEEAs went to Andrew Burrows of i20 Water for his work in developing water conservation systems. With water becoming an increasingly precious resource, Burrows' solution is already saving 250tonne of water per day in each of the 50 systems installed in Malaysia. And a full commercial prototype system is being trialled by Thames Water. This will not only save water, but also reduce the amount of energy needed to pump water through Thames Water's network by up to 30%.

Can your designs or your business model match up? One way to find out is to enter the British Engineering Excellence Awards.

There are a range of Awards categories, ranging from product based to people. The Judges will be making a Special Award again this year and the best of the best will receive the Grand Prix Award. The Awards are open to all companies with an engineering design function. The judging standards will be rigorous and winners will be justifiably proud with their achievement.

Entries for the British Engineering Excellence Awards close on 31 July 2010 and the shortlist will be announced on 2 September. The Awards will be presented at a lunch event, being held at the Globe Theatre in London on 13 October.

**For more information on the British Engineering Excellence Awards, along with entry forms, go to [www.beeas.co.uk](http://www.beeas.co.uk).**

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## Leuze makes light guards even easier

Leuze Electronic's MLD light guards combine high performance with simple installation – There are no DIP switches to set and there is no PC connection, because setup is totally defined by the installation wiring to the M12 plugs.

Building upon strong positive feedback, Leuze has decided to combine this simplicity with the simplicity of being able to buy a complete kit of parts for muted entry / exit light guard systems on one part number.

These sets which come with the new brackets and arms specially design for the MLD, have the muting sensors pre-mounted and adjusted. This and the modular wiring considerably speeds up installation, with the additional benefit of knowing that everything needed has been ordered.

The muting sensors within the kit connect to a local connection box which is designed to easily mount on to the light guard or the machine in order to reduce the amount of cabling that needs to be marshalled.

The connection wiring back inside the control cabinet is used to define which one of six possible muting modes are used including parallel, sequential and partial muting.

Wiring complexity can be further reduced by using the MLD light guard's optional integrated muting lamp.

[www.leuze.co.uk](http://www.leuze.co.uk)

## Low-cost alternative to thermal imaging



Schaeffler (UK) has launched a new, low cost, easy-to-use non-contact (infrared) temperature measurement device that measures the surface temperature of components in a wide variety of applications.

The new TempCheck PRO is a handheld infrared temperature measurement device that offers engineers a genuine, low cost alternative to thermal imaging cameras. The device requires little training as the user simply aims the device at the target object and presses a button. The temperature is then displayed on a coloured LCD display.

Infrared thermometers are easy to handle; they work in a non-intrusive manner but deliver precise measurement results within seconds; users can carry out safe inspections on hot components or objects in hazardous areas; sources of problems can be located without removing or exchanging parts; and valuable time and money can be saved by detecting weak points before they become a real production problem.

The TempCheck PRO can be used in a number of applications, including the preventive maintenance of rotating machinery and components, and for locating 'hotspots' on bearings, gearboxes, motors, valves, HVAC systems, electrical connectors, fuses, electrical wiring and control cabinets. The device is supplied as standard with a surface sensor for situations where contact measurement is the preferred method, and an immersion sensor for measuring the temperature of fluids, making it ideal for use in chemicals, pharmaceuticals or food processing applications. An integrated data logger can store up to 20 recorded values.

[www.schaeffler.co.uk](http://www.schaeffler.co.uk)

## Thermal imaging guide launched

Anyone interested in deepening their knowledge of thermal imaging should make time to visit the FLIR website for a brand new download. The company has created a highly-informative guide to the technology, a serious publication for any would-be thermographer. And it's free, both as a download and a hard copy, 48-page book.

FLIR Systems is the world leader in this technology and all of its expertise, in terms of

camera/software design and applications know how, is invested in this guide. It's far from being a sales medium for FLIR however. The publication provides a thorough grounding in industrial and building science infrared.

The content takes the reader through the design of a thermal imaging camera, how it works and why the technology is so important in a world so highly focussed on thermal efficiency



and minimising energy loss. It offers an overview of typical applications and guidance on choosing the right camera supplier.

Subsequent chapters explore the science behind thermography in industrial and building applications and how to identify the camera features that best suit the task. And naturally the guide wouldn't be complete without a sizeable page allocation to thermal inspection and how to achieve the best results.

[www.flir.com](http://www.flir.com)

## Penny + Giles offers heavy-duty joystick option



Penny + Giles has introduced a new heavy-duty, single-axis joystick controller to its JC6000 product range. The company says this is in response to customer feedback and requests for a higher-strength, return-to-centre joystick for use in arduous conditions or applications such as wheeled loaders and heavy plant machinery where high 'Across Axis' loads can be an issue.

Commenting on support for existing customers, Kevin Rayment, managing director of Penny + Giles explains: "Joystick controllers manufactured with the standard-strength mechanism will remain in production to support customers' existing

systems and spares requirements."

The increased strength of the new heavy-duty JC6000 has been achieved by redesigning the body casting, which the company claims has increased across-axis fatigue life by a factor of five. The heavy-duty version will also use a new gaiter designed specifically to accommodate the increased strength of the body casting.

[www.pennyandgiles.com](http://www.pennyandgiles.com)

## The full works on linear ball guides

Full details on two new additions to the HepcoMotion LBG Linear Ball Guide range are a feature of a newly published 20-page catalogue. These high quality products are available in a wide combination of pre-loads and grades, all of which provide good accuracy, rigidity and quiet operation.

New to the product programme are HepcoMotion linear ball guides with a cost-effective, corrosion resistant coating. This hard chrome option can be specified for all rails and bearings blocks, providing an alternative for clean rooms where previously stainless steel was the only option.

Also new is the LBG brake, a simple and compact stainless steel bodied device for locking the bearing block. Although principally designed for use with LBG it is also compatible with all other ball guide systems with which HepcoMotion LBG is interchangeable.

This new catalogue is freely available from the HepcoMotion sales office on 01884 257000 or as a download.

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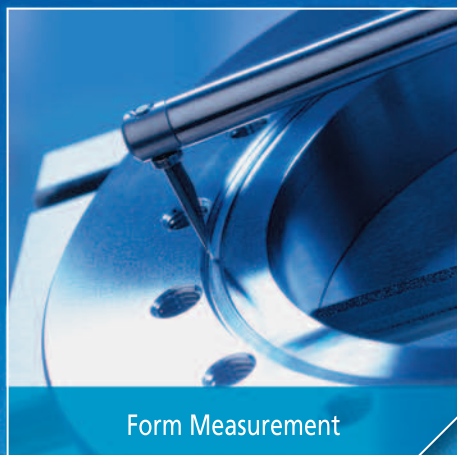
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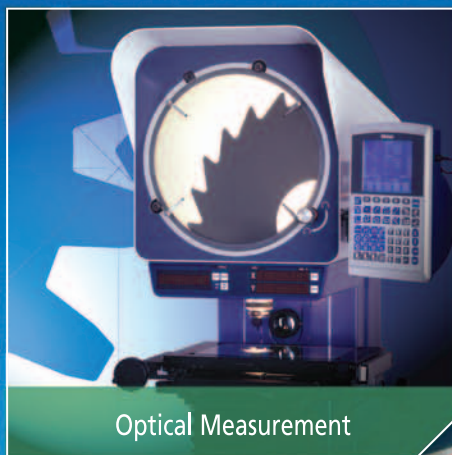
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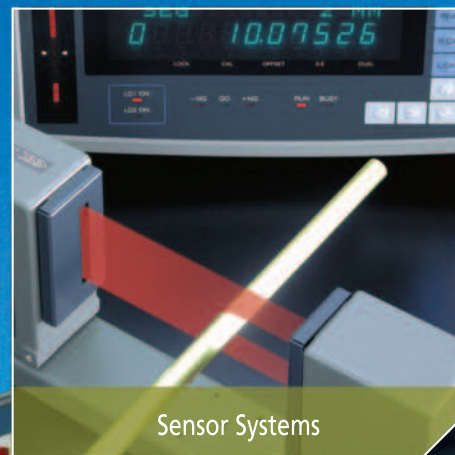
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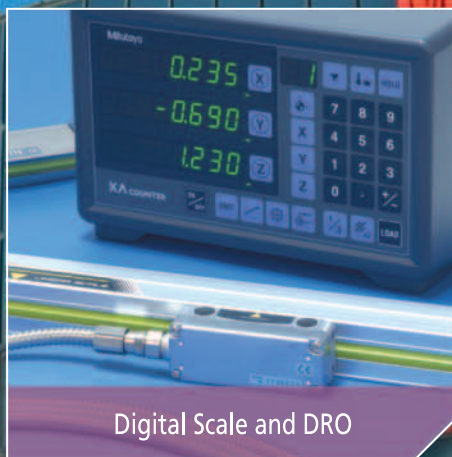
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## TL bearing material for paper making



NSK has developed TL (Tough and Long Life) bearing material, to overcome the problem of damage due to inner ring fracture encountered on spherical roller bearings in the dryer sections of papermaking machines. In addition to its primary function of preventing inner ring fracture, TL also contributes to an increased surface hardness on the bearing raceways, and provides enhanced dimensional

stability under high temperature conditions.

TL has been developed to address the trend to higher operating temperatures in the dryer sections of paper making machines. Today, with the moves toward higher performance equipment, the temperatures in the hollow cylinder of the dryer section, through which steam or oil passes, can reach 180 degrees C; and sometimes on newer machines, even 200-250 degrees C.

These temperatures cause high thermal stresses, which can lead to fracture of the inner rings of the spherical roller bearings used in the dryer sections. During the drying operation, thermal expansion of the cylinder takes place. This increases the tensile stress on the bearing inner ring due to the temperature difference between the cylinder and the ring. Under these conditions there is a greater risk of failure due to inner ring fracture.

[www.nskeurope.com](http://www.nskeurope.com)



## Solution to last month's Coffee Time Challenge

The solution we offer to our May Coffee Time Challenge is the Talus MB-4H tractor, developed by Clayton Engineering in Powys for the Royal National Lifeboat Institution.

The RNLI has largely given up conventional slipways, partly because they cost £12 million each, and partly because inshore RIBs – Rigid Inflatable Boats – originally invented by the RNLI, have to be got across mud flats at low tide. Despite the image of heroic men and women braving stormy seas, quite a lot of their work involves recovering people stuck on mud banks, either in or out of boats.



We happened to be shown over an MB-4H tractor at Whitstable Lifeboat Station and learned that it is air cooled when out of the water, but watertight doors close when it is deep in the water, and it is then cooled by two protected keel coolers, which allow use of full power when wading. The tractor is pivot steered, has a totally enclosed cab and can operate to a depth of 1.6m in calm, level sea conditions.

It has four, large, low pressure tyres, but should it get stuck in the mud, which we were told, has happened, it can be quickly fully sealed, including the top of the vertical air intake/exhaust stack. The cab is then allowed to flood to ensure stability if the tractor has to be left on the sea bed. When the tide has gone out again, it is then recovered by an even larger tractor that RNLI keeps for this purpose and brings by low loader.

[www.claytonengineering.co.uk](http://www.claytonengineering.co.uk)

[www.whitstablelifeboat.org.uk](http://www.whitstablelifeboat.org.uk)

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# Making a material

In September this year, the National Composites Centre will open officially. The 8500m<sup>2</sup> state-of-the-art NCC building opens in summer 2011 at SPark, the Bristol and Bath Science Park. Designed to bring together dynamic companies and enterprising academics to develop new technologies for the design and rapid manufacture of high-quality composite products, the centre has its origins in November 2009, when the then Government launched the UK Composites Strategy, in which it outlined the importance of composites to the future of UK manufacturing and the its plans for ensuring that the UK has the means to succeed in intensely competitive global markets.

In the original UK Composites Strategy document, the then Secretary of State for Business, Innovation and Skills Peter Mandelson outlined the strengths of the UK composites market, but also made clear its shortcomings, saying: "The UK already has a developed expertise in using composites in aerospace and high-performance cars but we need to do better in the increasingly competitive composites industry. Up to now activity has been too sector-specific which has limited the development of a cohesive composites industry and the transfer of technology to the manufacture of other products in other sectors which could be built using composites."

The Strategy document identified a number of barriers to market in the composites sector. One of these is that the UK composites industry is fragmented and lacks a single voice to articulate industry requirements. This has tended to mean that few firms have the critical mass to invest in equipment to make composite structures at the speed and cost industry requires. Consequently, technology and skill transfer between companies and sectors has been hindered by the industry's structure.

Alongside this, according to the document "there is a shortage of the necessary skills at nearly all levels, as training is difficult to identify and access and qualifications address specific industry sectors rather than the composites industry itself."

The National Composites Centre is designed – at least in part – to help companies overcome these barriers. The man tasked with this is Peter Chivers, the Centre's Executive Director. He acknowledges that the adoption of composite solutions has historically been largely limited to certain sectors, but believes that this is changing and will change further when the Centre opens.

He says: "We have to support existing sectors like aerospace, defence, etc, but we also have to make a strong push for cross-sectoral knowledge transfer and support for new sectors. By trying to work with those sectors in supporting them in understanding what they've got to do to apply these technologies. And helping them solve the problems they have. The

**"Composites are not going to solve every problem. It's about intelligent material selection as always. We're just starting to add a suite of new materials that you can throw into the mix, but there are always going to be right and wrong times to use these materials."**

**Peter Chivers**



*The manufacture, transport and install single-span bridges made of composites is one of the newer applications of the technology, while the lightweight nature of composites means their use is widespread in the automotive industry.*



application of the technology will obviously not be the same in every sector. So we will try and work with them either as private companies or potentially through, for example, Technology Strategy Board-funded programmes to develop the solutions that they need."

The advantages of composites, such as high strength-to-weight ratio, good fatigue endurance and lower maintenance costs are, Chivers believes, quite widely understood, but he feels there is still a lot of work to do in translating that into more widespread use throughout industry. He believes

# difference

In advance of the opening of the National Composites Centre in Bristol this year, Paul Fanning finds out what this facility could mean for UK industry.



## UK TICs show the way

The National Composites Centre will be one of the partners in the High Value Manufacturing Technology and Innovation Centres, the first of which was opened in Sheffield in March.

This was the first of an elite network of Technology and Innovation Centres that will be established by the Technology Strategy Board with over £200m of Government investment overall. Other centres will be founded and announced in due course, each in technology areas of high growth potential.

The other partners are the Advanced Manufacturing Research Centre (University of Sheffield), Nuclear Advanced Manufacturing Research Centre (Universities of Manchester and Sheffield), Manufacturing Technology Centre (Coventry), Advanced Forming Research Centre (University of Strathclyde), Centre for Process Innovation (Wilton & Sedgfield) and the WMG (University of Warwick).

that this requires a philosophical shift on the part of engineers as much as a technical one. He says: "Composites are not going to solve every problem. It's about intelligent material selection as always. We're just starting to add a suite of new materials that you can throw into the mix, but there are always going to be right and wrong times to use these materials. The first thing we have to do is get the designers to understand the merits and demerits of the use of composite materials and where they fit into the design spectrum. Perhaps a really key issue is that you can do it in two steps. You can start to do it on a substitutional basis, but the real benefits don't come from pure substitution. To just replace a part that was in metallic and redesign it as a composite typically doesn't lead you to the best solution. You need to understand the way the material operates not just from a pure material point of view but how you can customise the material to the application."

Offering an example of this, he says: "You've only got to look at the way bicycle frames have evolved to understand more and more how composites now are changing the architecture of components. You can also start to think much more fundamentally about the way in which products are designed and start to come up with some really radical design concepts. Of course, you don't have to go there from day one. You have to develop that

## Peter Chivers on composites

"Composites are useful anywhere you have a product that moves. Saving weight means using less energy to make it move. Be that accelerating or going round corners or whatever. Less energy means lower CO2 emissions and less cost to run it.

have become such big drivers that the benefits of composites in terms of performance have become ever more important. The automotive industry has started to recognise that and they are trying to find ways to make the technology shift from metallics to composites because the emission reductions you're going to get in the automotive industry are potentially quite significant. And with the move to electric vehicles, where you get the gearing on weight reduction whereby for every kilo you save in structural weight, you can save the same amount of weight in the battery, then it's a powerful driver as well. So we're seeing everything from existing sectors which have some challenges to meet in cost and rate of manufacture, but are still looking for performance advantages. And there are relatively low-tech users who want to move into high-tech use and new sectors who want to move into it,

Then there are other interesting ones such as the construction industry, where they're seeing significant advantages not because of weight savings – not many buildings accelerate or decelerate – but for other interesting reasons. For example anything where weight is a design criterion if you can make that thing lighter then you can, for instance, achieve a greater span in a bridge and make the bridge structure lighter.

Another interesting area is where you can make a bridge structure in one piece rather than in lots of pieces. There's a growing market for composite footbridges for railways where the bridge can be made off-site in one piece. Because it's so light, it doesn't need a central pier and it's light enough to be handled as a whole construction. There are two advantages to that: they can bring it to site as a complete structure and they can install it virtually overnight.

The downtime for the railway or motorway is so much reduced because you don't have to build a central pier and you don't have to build the bridge at site. You just do some work to either side of the railway or carriageway and then bring the bridge to site, bolt it down and it's done. Through-life maintenance is also massively reduced because you don't have the issues of corrosion and you don't have to paint it as often because the composite bridge is much more tolerant of weathering and environmental impact. "

knowledge and that confidence before you go there."

In terms of helping designers to develop that knowledge and confidence, the National Composites Centre will offer companies both expert advice, facilities and equipment designed to allow concepts to be developed to prototype stage. Describing the Centre as: "Essentially a research factory. A design and build facility", Chivers says: "We see ourselves starting with universities and academia – bringing through some really good ideas and trying to mature those with the customer base in industry."

The opportunity also exists for companies to work at the Bristol site in order to bring projects to fruition. The Centre provides what Chivers calls "a collaboration space", as well as state-of-the-art equipment that can be



*The National Composites Centre will offer state-of-the-art equipment for companies to use.*

used on a 'power-by-the-hour' basis, meaning that the capital outlay is kept to a minimum.

As well as space to rent to carry out project work using their own resource and working with their partners and supply chain, the National Composites Centre also offers access to its own expert developers, according to Chivers. "We are building up a team of expert composite engineers," he says. "We're calling them research engineers because these are people who are in the space between academia and industry – some of them are drawn from industry and others from academia. By bringing them together into that world of applied research, we are already developing an excellent team of real experts in maturing technology and technology application. They are expert in taking things to a point of prototype where the design is proven and the manufacturing process is validated.

"We will have people from all disciplines – designers, stress engineers, structural engineers, materials and process people, quality and cost engineers. A complete sweep of capabilities is our plan. Internal consultants effectively, but charged as engineers (so we're not talking about great expense) but real engineers who can bed into your team and help you solve real engineering problems."

Chivers believes that the wider adoption of composite technologies and solutions is already well underway and sees the role of the National Composites Centre as being to facilitate that transition as effectively as possible. "There are a lot of people out there with a growing familiarity with composites and their capabilities and will look at investing in them," he says. "If we can identify real engineering, manufacturing and economic benefits, then our role is to provide support for that investment and help in developing new applications. That's a real opportunity to convince those who don't see how composites will work for them."

[www.nationalcompositescentre.co.uk](http://www.nationalcompositescentre.co.uk)



*Construction is one sector that is increasingly realising the potential of composite materials.*

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# Making green safe

Paul Fanning talks to a man who is at the cutting edge of ensuring that low carbon vehicles are also safe and crashworthy.

**T**he rapid advances in alternative fuel vehicles are not only affecting the way in which cars are powered, but are having a significant impact on the way in which they are designed for safety as well.

Phil Glyn-Davies is manager of Crashworthiness & CTL Engineering at leading automotive proving ground Millbrook and has had to learn the hard way that every change to the motive technology of a vehicle has major significance for its crashworthiness.

"We've got these business units here at Millbrook – Powertrain and crash," he says. "But as we move forward, we're finding that everything that has an impact on fuel consumption or range also has an impact on the crashworthiness of the vehicle. And the Powertrain guys do have this really annoying habit of putting big, stiff lumps in the middle of cars that don't improve crashworthiness at all."

The speed with which the alternative fuel vehicle market has progressed has meant that crashworthiness issues have often taken a back seat in the development process. Says Glyn-Davies: "I think it took a while for people to realise you couldn't just swap from one power source to another and everything else would be basically the same. Possibly more in a crash environment than in any other environment, in fact – because, by its nature, it tends to come at the end of the process."

One of the major issues to have been revealed is that new powertrain systems tend to mean increased weight for the vehicle and, because of the increased number and size of components needed within the car, a reduction in 'crush space' to absorb impacts. Says Glyn-Davies: ". Packaging with hybrid electric vehicles or fuel cell electric vehicles is a real challenge – it's hard to fit everything in.



..There are things you can do from a crash point of view. One is to put more investment into your restraint system. You have to have a much cleverer restraint system if you've got a stiffer car because you're trying to manage the occupants' loads against a much stiffer crash. So you need to have better pre-tensioning, better load limiters and better airbags. So, for instance, you might use two-stage airbags to change the bag's response depending on the size of the occupants and different positions of the occupants and – to an extent – the severity of the crash. So it's possible to manage these things but you have to put more investment into the safety."

This 'packaging' issue also affects the car when it comes to pedestrian protection. "Pedestrian protection is impacted by packaging," says Glyn-Davies. "Pedestrian protection relies on free space behind impact points and it's quite hard to find that free space



*"I think it took a while for people to realise you couldn't just swap from one power source to another and everything else would be basically the same". Phil Glyn-Davies*

if you significantly change the packaging. Hi-tech deployable bumpers or bonnets that give you that crush distance back are one solution."

Of course, regulation and legislation are crucial when it comes to car safety issues, but here again the speed with which the technology is moving causes significant difficulties, as Glyn-Davies acknowledges. "Legislation is a real challenge," he says. "You typically have to give legislation a long period of notice for its implementation and the problem is that those implementation periods are starting to exceed the time being taken to develop new technologies that will render that legislation obsolete.

"There are a lot of challenges in that sense. And it's hard for legislators because they are a barrier to market if you don't meet the legislation. So if you do introduce it too early you can cause havoc.

There is a higher level of agreement and co-operation with

legislative bodies now, though. Because there basically has to be!"

Clearly, then, there are huge challenges to be addressed when it comes to safety and crashworthiness in alternative fuel vehicles, but Glyn-Davies is keen to reassure that this is not the same as saying that such vehicles are unsafe. He says: "The thing I want to do is to dispel any impression that alternative fuel vehicles are inherently unsafe. It does present new challenges and there's quite a lot of engineering that has to go into ensuring that they don't present a hazard. If you took people who'd never driven a petrol car and told them that you were going to put a plastic tank full of highly-flammable fuel under the back of your car that's going to be providing your motive power, then they would probably express some concern. Ultimately, good engineering can overcome most of the challenges."

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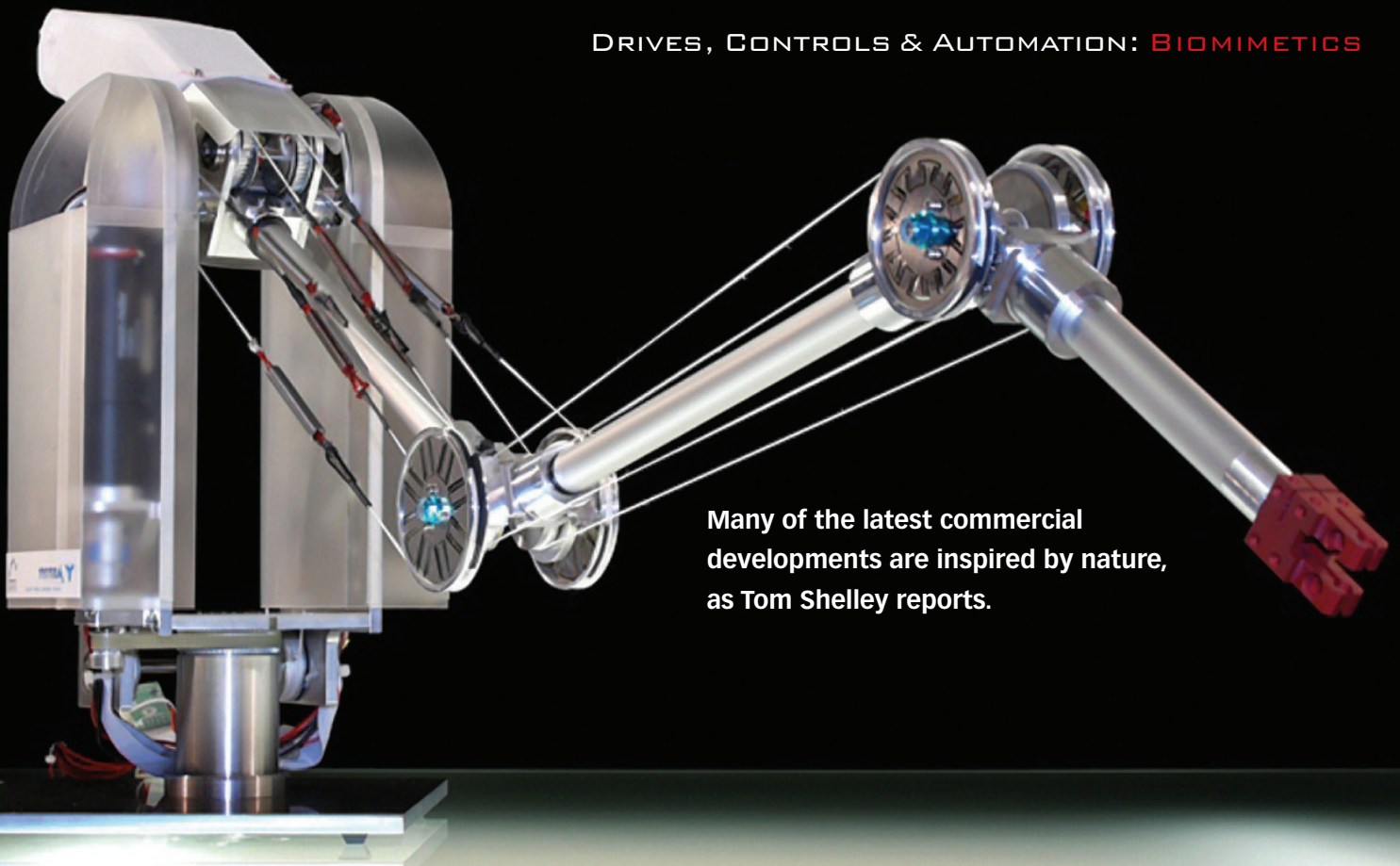
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***Orientalmotor***



Many of the latest commercial developments are inspired by nature, as Tom Shelley reports.

# Plants and animals offer models for efficient movement

A robot arm inspired by human anatomy that is exceptionally light and uses a tenth of the energy of conventional designs caught the eye at this year's Hannover Fair as well as flower-inspired mechanisms, animal-inspired manipulators and rat-inspired robots.

The robotic arm employed antagonistic tensions, similar in operation to human muscles and tendons, while the blind operating mechanism was derived from studies of what happens when birds land on the blooms of the bird of paradise flower, *Strelitzia Reginae*, causing a structure that distorts to enable contact between the bird and pollen-bearing stamens.

Simon Poppinga, from the plant biomechanics group at the University of Freiburg explained that plants avoid the need for hinges, yet can construct mechanisms that achieve rapid changes in orientation. These can be imitated by making use of fibre-reinforced polymers of high tensile strength and low bending stiffness to produce useful mechanisms.

In the flower, two petals form a perch. When a bird lands, the petals bend downwards and at

the same time, flick open to expose the pollen bearing stamens to the bird. The mechanism was studied by cutting away all parts of the plant that were not required to produce the movement and studying it, and constructing a physical model that demonstrated the same kind of mechanical behaviour. This was then analysed using finite element analysis, and led to the development of the 'Flectofin', by Simon Schleicher and others at the Institute of Building Structures and Structural Design at the University of Stuttgart. The mechanism is described as depending on torsional buckling of a shell component as a result of uniaxial bending of an attached beam.

The actual device is made of glass reinforced plastic laminate, and the fin rotates through 90° when the rib on which the fin is mounted is bent slightly. The bending can be accomplished by applying external force, or by employing thermal expansion. The device is currently being tested and evaluated in prototype shading façades for buildings, but also offers potential for use in air control vanes in heating and ventilation

systems, valves generally, micro engineered silicon devices and aircraft control surfaces. For its initially identified market for shading buildings, it has been computer modeled in designs from 1m to 14m long. A large mockup is currently being developed for endurance tests, and a system is to be implemented in the theme building at the 2012 Expo in Korea. Performance is optimised, as in plants, by adjusting fibre orientation and thickness within the structure. The developers note that in the turned state, the double curved surface that is developed generates enough stiffness to withstand wind loads.

The developers claim to have identified nearly 100 plant movements with a potential to be transferred into mechanical engineering products. Plants have evolved all kinds of structures to ensure that they maintain integrity in spite of severe external load conditions. These usually incorporate natural means to avoid stress concentrations.

Simon Poppinga is currently engaged, along with others, in a study of the mechanics of the

underwater suction traps in bladderworts. These are of interest because they typically operate in about 0.5ms, although it has to be pointed out that they are only a few mm across. The way they work is that during the course of about an hour, glands pump water out of the trap interior, so that elastic energy is stored in the trap body owing to lowered internal hydrostatic pressure. A flexible door with protruding hair closes the entrance watertight. A small animal touching trigger hairs results in: the door opening, the wall relaxing and water and the prey animal being sucked into the trap. Maximum measured fluid acceleration is 600g. The door changes from convex to concave when contact between the prey animal and the hairs triggers a buckling wave. Poppinga has not yet identified a practical application for the underlying mechanics, but feels there must be one somewhere.

Festo has for some years been studying biologically inspired mechanisms for robotics. Apart from the flapping winged robotic seagull which the company had flying round its stand at this year's event, we were shown autonomous mobile robots with the company's biologically inspired 'Fin Ray' grippers on elephant trunk inspired arms. The grippers are particularly good at grasping delicate objects. Examination of the flying bird showed that it flapped its wings thanks to a three-part, mechanical crank mechanism. The wings were in two parts, with an 'arm' wing to generate lift, and a hind wing behind a trapezoidal joint to generate thrust. While constituting a considerably achievement, in designing a mechanical flapping wing bird that can autonomously fly, take off and land, nobody was able to advise us of any practical usefulness for the technology.

## DESIGN POINTERS

- Fins can be made that flick round by applying slight bending to a beam, taking their inspiration from Bird of Paradise flowers
- Robots arms with a small fraction of the weight and power consumption of conventional constructions use antagonistic tensions on cables, in an analogous method to that use of move the human arm
- Rats, bats, and dinosaurs have are also currently inspiring novel engineering designs



Of immediate practical usefulness however, is the 'BioRob' robotic arm that has been developed by Tetra. By using antagonistic tensioned cables to move its various parts, it is at the same time, much lighter in weight than a conventional robot arm, and consumes much less energy, one tenth as much, according to Christian Trommer, the company's head of division lightweight Mechatronics. For the same reasons, we know that NASA has also studied related mechanisms for use in space (Eureka June 2010). With four joints, the company's model X4-SR has a total weight of 5kg, including control units, yet can lift 2kg with its 700mm long arm, or deliver a contact force of 25N. Nominal power consumption is 15W. Each joint is actuated through a DC electric motor. Joint position feedback is from an encoder on each motor and another absolute encoder in each joint. Interface is by EtherCAT from a PC and the design is protected by patent.

The robot, being low powered, is exceptionally quiet running, and one of its application areas is medical. Its low weight also allows it to be used in other novel applications, such as on a helium balloon, for ceiling and wall inspection in buildings, and also performing light tasks, such as marking cracks and cleaning. This

does away with the need to erect scaffolding, which is liable to be both time consuming and expensive, as well as possibly damaging the floors of old constructions.

Still in the research stage is the 'RatNic' climbing robot rat, which uses claw analogues for gripping pipes and cables as it climbs, light weight elastic legs, and a construction based on a rat's skeleton. The small robot, which is rat sized, is designed to carry sensors such as cameras, temperature and humidity and gas sensors, into high corners of buildings. Weight of the development prototype is 1.1kg and it can crawl through a 150mm diameter pipe.

Slightly more down to earth, around the back of the stand exhibiting the BioRob, we encountered Fatih Bagkesen, from the Institute for Textile Technology and Process Engineering Denkendorf, who showed us how only 0.2bar air, blown into a structure, could reverse its curvature.

<http://itke.uni-stuttgart.de>

<http://simonschleicher.wordpress.com>

[www.botanischer-garten.uni-freiburg.de](http://www.botanischer-garten.uni-freiburg.de)

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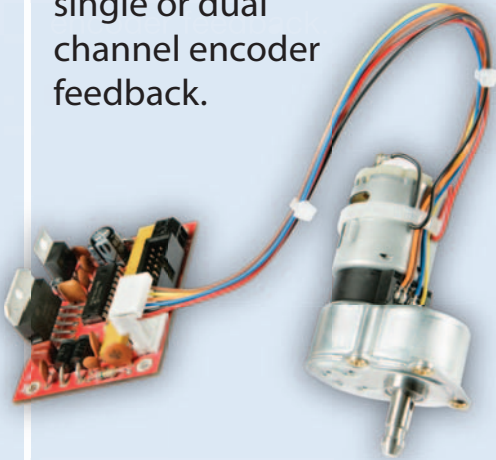
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## 10 dB noise reduction for bell housings

Modern cost effective aluminium bell housings have comparatively poor damping characteristics compared to traditional cast iron versions. The pulsation of hydraulic pumps generates very strong vibrations that are not damped sufficiently by an aluminium bellhousing. Vibration studies have revealed that airborne and structure-borne vibration is at frequencies where human hearing is at its most sensitive. Under certain unfavourable circumstances, the thin-walled aluminium bellhousing amplifies the running noise of the pump; in these cases, the bellhousing resonates in sympathy, similar to a real bell, which can then lead to an additional increase in oscillation amplitude.

In line with EC Directive "Noise" (2003/10/EG), the retrofitting measures are intended to resolve acute problems caused by poor sound-proofing and vibration damping, including problems that occur in hydraulic apparatus already in use.

**The best noise level reductions were achieved using the NRS System.**

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With the NRS System, it was possible to **reduce the total noise** emission level of a cast aluminium bellhousing in critical frequency ranges **by more than 10 dB**. This reduction is clearly audible to the human ear.

Further detail and diagrams available from **[www.jbj.co.uk](http://www.jbj.co.uk)**



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## Servo system comes with new interface

Lenze's tried and tested ECS servo system can now be ordered with a clock-synchronised EtherCAT interface. Combined with the new L-force Controller 3200 C for central control architectures, even the most demanding motion tasks in terms of number of axes and precision required can be solved effectively and economically.

The ECS servo system provides the compact servo drives with high dynamic performance that are necessary for motion tasks with highest requirements regarding precision and speed. They have been designed specifically for multi-axis applications in central control architectures. The versatile system includes a large selection of axis and

power supply modules that can be connected to form an integrated unit. The ECS drives are perfectly matched to the highly dynamic motors in the MCS.

The L-force Controller 3200 C has been designed for use in the control cabinet and is based on the energy-efficient Intel Atom® processor. The integrated 48 MBit/s backplane bus allows I/O modules from the I/O system 1000 to be directly side-mounted to the controller. A short cycle time and minimum jitter in combination with a time stamp guarantee that the motion system also complies with the strictest speed and synchronism requirements.

[www.lenze.co.uk](http://www.lenze.co.uk)



## Drive cuts cost of large-format gripping

Festo has launched an electric bi-parting drive that provides a highly cost-effective and adaptable means of securing simultaneous movement of two carriages – in opposite directions – on the same linear axis.

The new ELGG bi-parting drive has a pair of bearing guides supporting two identical carriages, driven by a toothed belt attached to the top of one carriage and the bottom of the other. This arrangement causes the carriages to move simultaneously, either away from or towards the centre line of the axis.

The ELGG follows the innovative cost-optimised design concept of another popular low-cost Festo electric actuator, by dispensing with the type of full length profile used by conventional toothed belt axes. Instead, it relies on the rigidity of steel bearing guides to ensure straight line movement of the carriages. The bearing guides are supported at either end. T

[www.festo.co.uk](http://www.festo.co.uk)

## Z-axis, in-line linear actuator



Designed with Z-axis movement in mind, the new HepcoMotion SDM Screw Driven Module brings important performance benefits to this role. As well as providing the necessary rigidity, the in-line SDM linear actuator reduces the danger of back driving when matched to a suitable geared motor. Typical applications are gantry systems and pick & place mechanisms.

HepcoMotion® has long held the view that the most reliable and cost-effective X-Y-Z systems comprise elements which take into account

the specific technical needs of the given axis. The SDM module has therefore been developed for both single and the Z-axis movements to complement other products in the HepcoMotion® linear actuator range that are optimally suited for X and Y axis operation.

This new product is based on the HepcoMotion SBD - sealed belt drive - linear actuators whose streamlined design and suitability for high loads and demanding duty cycles have resulted in their wide popularity. The SDM design differs in that it incorporates a ballscrew that provides greater stiffness and precision.

[www.hepcotion.com](http://www.hepcotion.com)

## ACT series linear actuators provide an alternative

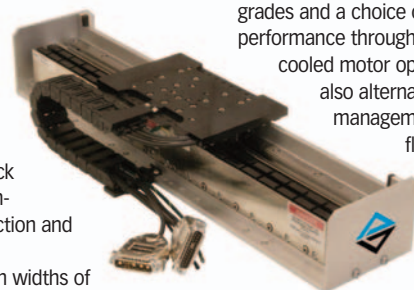
Aerotech's new ACT series linear actuators are based on a cost-effective uncomplicated design featuring ultra smooth brushless linear servomotors, sub micron level encoder feedback and heavy duty linear guide bearings in demanding high throughput / high accuracy positioning applications for parts handling, assembly, dispensing, pick and place, non-contact inspection and scanning.

Available in widths of 115 mm, 140 mm and 165 mm, and with travel range from 100 mm to 1.5m, the modular ACT series provides the capability for higher production throughput and improved accuracy in comparison to ball-screw and belt driven alternatives with maximum

speed to 5 m/s and acceleration to 5 g. Furthermore, a wide and flexible choice of options allow users to select a complete positioning system with price and performance matched to requirements. These include uncertified, certified or HALAR interferometer calibrated accuracy grades and a choice of power performance through a forced air cooled motor option. There are also alternative cable management systems and flexible

mechanical interfacing options ranging from single and X-Y axis configurations through to multi axis systems with dual parallel axes in gantry positioning styles as well as Z and theta axes selected from other Aerotech positioning stage lines.

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# Micrometrology of difficult surfaces

**Obtaining accurate 3D metrology from rough surfaces has been a problem – until now. Paul Fanning reports.**

The ability to obtain accurate 3D metrology images from rough surfaces is offered by an innovative optical instrument developed by Zeta Instruments of San Jose, California, USA and could have implications in a number of industries.

This delivers 3D metrology images from even the very lowest contrast samples with extreme polished surfaces. The Zeta-20 (and Zeta-200) can handle surfaces with very high roughness and/or with high reflectivity variation. The instrument is being used to relieve metrology workloads on AFMs and SEMs at a much lower cost-of-ownership as compared with other optical and stylus profilers.

Ian Holton, scientific director of UK company Acutance, which is the UK distributor for this equipment, says of its potential applications: "It's been bought so far for surfaces that are very difficult optically, so microfluidics channels, solar cell polycrystals – metrology of those is very difficult with any other technique. Anywhere where there is micromachining for micro marks that actually need to be measured non-contact

optically. This can do it where no other technique can."

Some sample types such as microfluidic channels that can be measured with a Zeta cannot be measured with any other type of instrument.

Says Holton: "It's good for highly reflective surfaces with very low contrast. Likewise, the solar cell polycrystals are of extremely low reflectivity and very low contrast. With any other device that claims to do extended focus, the instrument tries to estimate where the height is and then decides which pixels are in focus and which are not – that's all very well if you have high sample contrast, but if there is very low sample contrast as in silicon nitride in solar cells, then the algorithm finds it very difficult to decide which is the correct

height for any given pixel and puts in a number that is very likely wrong. So basically you get metrology with errors."

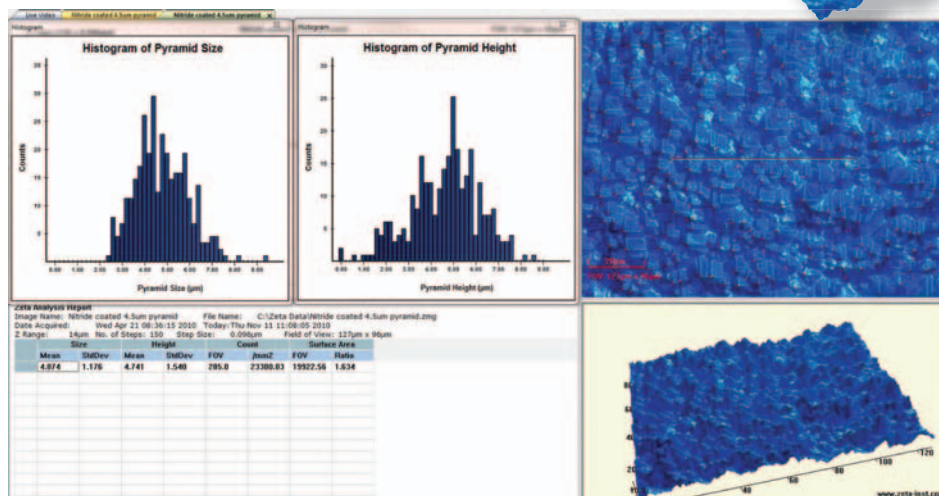
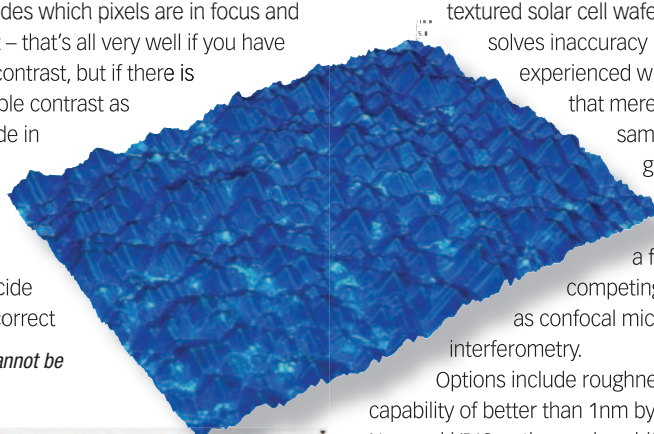
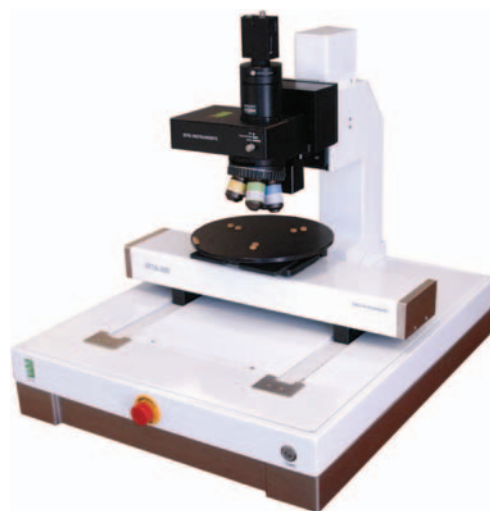
The Zeta equipment gets around all that simply by projecting a very fine light pattern that is in focus at the object plane. Then the software can decide unambiguously where the focus height is for each x/y pixel. Says Holton: "So what you get out are extremely high accuracy 3D maps of surfaces that you can't get in any other way."

Zeta's patented ZDot technique generates contrast from very low contrast samples such as textured solar cell wafers. This method solves inaccuracy problems experienced with instruments that merely use native sample contrast to generate high depth-of-field images, and at a fraction the cost of competing techniques such as confocal microscopy or interferometry.

Options include roughness measurement capability of better than 1nm by use of Nomarski/DIC optics, and a white light reflectometer that enables film thickness measurements. The metrology software is geared for ease-of use, providing height measurements with 70nm accuracy as well as volumetrics.

With a lateral resolution of 0.37 microns, this technique is very complementary to an SEM, allowing researchers to pre-screen samples rapidly and to select the correct sample set for advanced SEM imaging. Because no sample preparation is needed, there are no charging problems and results are delivered in the order of one minute, the Zeta profilers are being used to 'pre-filter' samples for AFM and SEM imaging in areas as diverse as optic-fibre, data-storage and compound semiconductor quality.

[www.acutance.co.uk](http://www.acutance.co.uk)





## Sick launches compact switch

Sick (UK) has added to its industrial instrumentation product portfolio with a new compact optical level sensor switch for aqueous fluids. Designed for robust level monitoring of a range of liquid media, the FDA-compliant MHF15 is ideal for a variety of applications, including tank level monitoring or dry running protection for pumps.

The cost-effective plug-and-play solution, which requires no calibration and minimal maintenance, can be used for overflow protection and low level indication in tanks to monitor the presence or absence of liquids.

Due to its compact design, the MHF15 is ideal for difficult

installations or conditions with limited space. Featuring a robust and highly resistant stainless steel housing and polysulfone apex the switch meets IP67 and IP69K standards, ensuring protection from dust, dirt and water; even during a caustic washdown routine.

Ease of mounting and sealing of the vessel is assured due to use of a standard G1/2" process connection complete with NBR seal.

The MHF15 is the latest addition to SICK's rapidly expanding industrial instrumentation product portfolio which now includes numerous sensor technologies for level, pressure, flow and temperature monitoring.

[www.sick.co.uk](http://www.sick.co.uk)

## New pressure sensor family from Balluff

Balluff has introduced the BSP, a newly developed series of pressure sensors with IP 67 protection for use in gaseous and liquid media. The rugged devices feature a high-quality, long-term stable ceramic load cell and an especially attractive price/performance ratio, simple installation, high operating comfort and high precision. A large, bright and easily visible display ensures immediate status overview. This shows not only the current system pressure in bar, mbar, PSI and MPa, but also features fast and simple configuration of the sensors according to the VDMA standard, using 2 keys

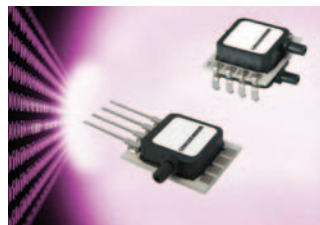
and intuitive menu guidance.

With 11 pressure range versions the BSP sensors cover all the important ranges from -1...0 bar up to 0...600 bar for monitoring process media in factory automation. Typical applications include hydraulics monitoring. The new Balluff pressure sensors, available in the standard model with plastic housing and in the high-end version with stainless steel, offer either two switching points or one switching output plus analogue channel.

[www.balluff.co.uk](http://www.balluff.co.uk)



## New digital miniature pressure sensors



Sensortech's HCLA pressure sensors measure ultra-low gauge or differential pressures from 2.5 mbar Full Scale. The sensors perform precision digital signal conditioning and achieve very high accuracies. The HCLA series provides a digital I<sup>2</sup>C bus interface plus an analog 0.5-4.5 V output signal at the same time. This offers OEM customers increased design flexibility, e.g. in order to build up a redundancy functionality for safety critical applications. The sensors can directly communicate

with microcontrollers without the need for additional A/D converters. Further, digital SPI bus and custom specific outputs are available on request.

HCLA pressure sensors use a special compensation technique to achieve a very high offset stability and virtually no position sensitivity. Together with an optional 3 V supply (standard 5 V) the sensors are therefore ideal for battery powered portable or handheld devices. A wide range of miniature single inline and SMT housing options allows for flexible and space-saving PCB-mounting. All HCLA pressure sensors can be modified according to customer specific requirements, e.g. with respect to pressure range, resolution and internal digital settings.

[www.sensortech.com/hcla](http://www.sensortech.com/hcla)

## Strain gauge technology goes digital

Mantracourt, a leading manufacturer of industrial measurement technologies has announced the availability of its Strain Gauge to USB Converter (DSCUSB), a compact, high performance digital signal conditioner with USB connectivity aimed at applications requiring high accuracy measurement.

The DSCUSB converts a strain gauge sensor input to a digital USB serial output. Having been developed and applied to several specialist applications, Mantracourt's digital strain gauge technology is now available off the shelf, along with a dedicated PC-based data logging software package.

Typical applications for the DSCUSB will be those requiring simple sensor connectivity in desk

top settings such as test & measurement, R&D and laboratory environments. For several of our customers it's proving to be a very powerful technology that enables the accurate monitoring, collection and analysis of critical data."

The Strain Gauge to USB Converter is enclosed within a rugged metal case, making the device suitable for all indoor environments. It is a combined miniature precision strain-gauge conditioning amplifier and an analogue-to-digital converter with a USB serial interface. For more advanced use, the device has five-point temperature compensation and seven-point transducer linearisation algorithms, all available via the comm port.

[www.mantracourt.co.uk](http://www.mantracourt.co.uk)



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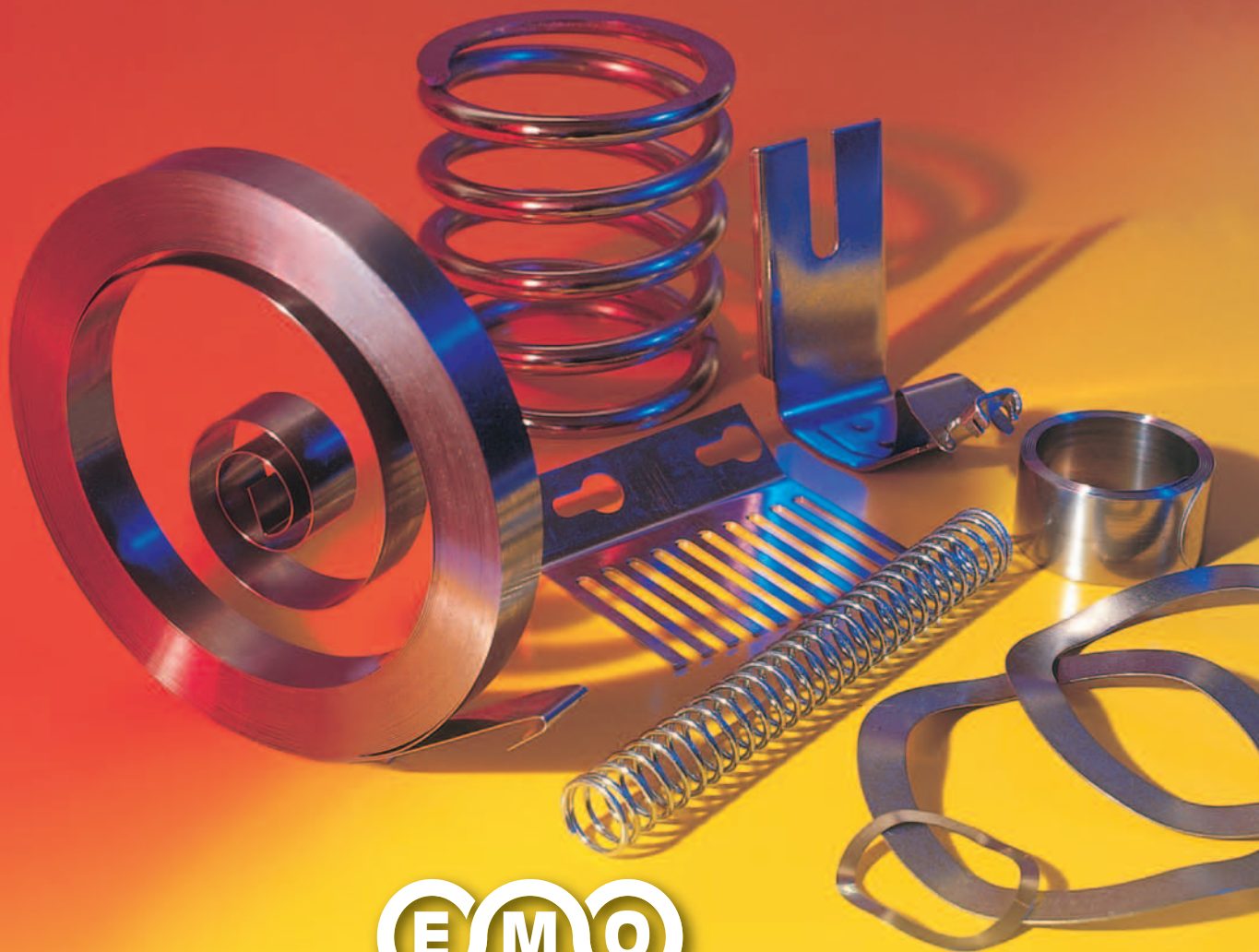
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# Bolts and pins brave tough environments

**Tom Shelley reports on developments in fasteners for wind turbines, construction equipment and other demanding outdoor applications.**

**B**olts and other fasteners in an outdoor environment – particularly when subject to salt spray – are in danger of failing through cracking, but it is now possible to find surface treatments that are at least as good as cadmium, now banned except for use in aerospace, mining, nuclear and offshore. This is despite the fact that the vast majority of cadmium is used not for coating, but in nickel cadmium batteries, which mostly end up in the environment despite all efforts, legislation and good intentions.

Zinc flakes and related sub melting point processes involving aluminium zinc alloys, now seem to be the coatings of choice for really demanding applications. Near shore wind turbines bolts provide a particular challenge.

In addition, special fasteners are constantly being developed for special applications. One of the latest to reach our attention is a special pin for preventing the formation of oval holes.

If corrosion on its own were not enough, bolts pose two additional problems. The first is that the bases of the screw threads offer obvious sites for cracks to start, and provided they have been properly torqued up, are under tension. This makes them prone to two related hazards: stress corrosion cracking and corrosion fatigue. In both cases, the process is accentuated because the



tip of the opening crack becomes a preferred site for corrosion, forming the positive electrode of an galvanic cell, with the rest of the surface forming the negative electrode.

The solution is to have a sacrificial coating which corrodes in preference to iron, and produces corrosion products that will hopefully clog up the galvanic cell and prevent it operating.

Cadmium is perfect, apart from its price, but concerns about its toxicity mean that its use is now strongly discouraged except where nothing else will do, so users have to turn to zinc, or one of its alloys. The traditional way of applying zinc is either to use electroplating dip steel parts in

the molten metal, which has long been the traditional approach for protecting bolts in electricity transmission towers, for example.

The problem with depositing zinc by electroplating is the possibility of hydrogen embrittlement resulting from the acid pickling process that precedes the plating. The problem with hot dip galvanizing, on the other hand, is the formation of brittle zinc-iron intermetallic compounds in the surface layers. There is insufficient time for this process to penetrate deeply into the underlying metal, but it does mean that overall design strength is slightly lower than it would be if no intermetallics were present.

The solution, which is available in different forms from a number of companies is to diffusion bond zinc or zinc alloy flakes or particles to the underlying metal at temperatures below the melting point.

At the Hannover Fair, the German company Dörken was promoting its Delta MKS process, the letters standing for: Mikroschicht Korrosionsschutz System. Licensed all over the world, the process involves the deposition of a base coat and a top coat. Jörn Selent, responsible for marketing told us that the base coat consists of zinc flakes in an inorganic



Standard galvanised



Mechanical galvanised



High temperature galvanised



Greenkote 50 microns



matrix. This can be laid down by spraying, spin coating, dip and spin or dip and drain. Curing is by heating to around 200°C to 240°C for 20 minutes. This contrasts with the 445°C to 470°C required for standard hot dip galvanising and the 530°C to 560°C required for high temperature hot dip galvanising. The base coat may be followed by an organic top coat to give a coloured finish or provide lubrication properties.

On a neighbouring stand, the French company NOF Metal Coatings Europe was also offering a zinc flake process under the 'Geomet' brand name, which sounded vaguely similar, although we did not manage to elucidate details. In their case, the top coats are black, 'Geoblack' and strongly targeted at the automotive market, although wind turbine bolts are included in their list of applications.

In the UK, TCB - Tension Control Bolts - in Whitchurch, Shropshire, has its own process 'Greenkote' whose ingredients sales engineer Gary Mason described to us as "Aluminium, zinc, and 3% Magic X factor". The process consists of placing bolts and metal powder, plus the secret ingredient, in large rotating retorts at 420°C. It is thus related to the long-established process of Sherardizing, in which articles are heated in the presence of zinc dust. The latter process is normally carried out in a slowly rotating closed container at temperatures ranging from 320°C to 500°C.

Greenkote is more than this, because the coated items do not have to be acid etched prior to being painted, and do not have to be lubricated. Cost is very similar to that of hot dip

*The 'Expander' is used in a variety of arduous environments*



galvanising but the results are a lot better. In salt spray tests, Greenkote coated bolts outperform all other types of hot dip galvanised bolts by a margin.

The bolts themselves are key to a proprietary technology in which the bolt shanks extend past the nuts into a splined section. Nuts are tightened by a special shear wrench which fits over the bolt spline while the outer socket fits over the nut. On pressing the trigger switch, the outer socket rotates clockwise and tightens the nut. When the correct preload is reached, the outer socket stops rotating, the inner socket counter rotates and the spline is sheared off at a break neck. The wrench is stopped and the outer socket pulled off the nut. The spline is retained in the inner socket and may be ejected subsequently.

The problem of pins producing elongated holes in moving joints may be addressed by a Swedish invention that has been used for decades in Scandinavia, but has only just been taken on board by a UK company, Midland Steel Traders in Birtley, County Durham.

Once pivot pins start to become loose, their movement has a strong tendency to increase the hole widening process until it becomes oval,

requiring re-boring of the parts that the pin connects and the fitting of a larger pin, or even the complete replacement of the linked parts. The solution offered by the 'Expander' is to have sleeves which are pressed onto tapered sections of the pin at each end by tightening up a nut and washer arrangement. This eliminates all play in a few moments. The devices typically cost around twice as much as a traditional pin, but users of equipment used in arduous environments reckon they soon recover the additional cost.

The pins are fitted to Volvo loaders and forestry machines and Doosan excavators.

Their main use, however, is in the aftermarket, where repairers in Sweden and elsewhere have long used them to replace traditional pins in worn mountings in excavators and other items of construction equipment and even in lifting bridges. A typical application is by Motala Verkstad in a lifting railway bridge over the Göta Canal in Norsholm, where the pins were used to solve a wear problem in the mountings of the main lift cylinders.

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## DESIGN POINTERS

- Now that cadmium plating is not allowed to be used in many arduous applications, including some subject to salt spray, zinc flakes applied in an inorganic matrix offer a solution. Curing at around 200°C is well below the melting temperature of zinc and avoids possible formation of intermetallics
- A UK process called 'Greenkote' which appears to be developed on from Sherardizing also shows very good results, creating diffusion bonded coatings of zinc - aluminium plus proprietary ingredients that ease painting and provide lubrication
- Swedish expanding pins, long used in Scandinavia but new to the UK offer a solution to worn holes in pivot mountings

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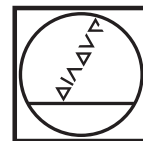
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## A NEW DRIVING PARTNERSHIP in 21<sup>st</sup> CENTURY TRANSMISSION SYSTEMS

The Denis Ferranti Group and KISSsoft AG have formed a new working partnership in the United Kingdom.

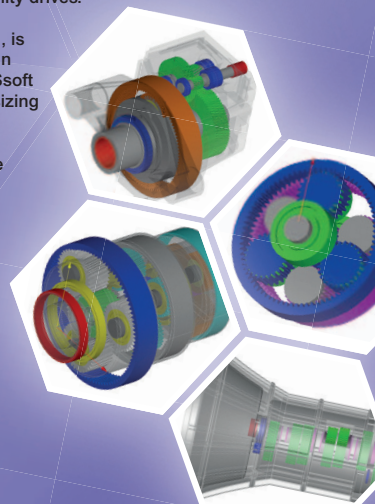
Growing out of the close relationship, developed over a number of joint projects, the Denis Ferranti Group has been appointed agent for all KISSsoft products and services, including training, throughout the UK.

Bangor, North Wales, based Denis Ferranti Group provides design consultancy and manufacturing support for bespoke transmission systems. Challenges faced include aerospace actuation systems, performance automotive gearboxes, wind turbine transmissions, engine gear trains and mobility drives.

KISSsoft AG, headquartered in Switzerland, is a global leader in the development of design software for engineers and designers. KISSsoft software is a high quality modular tool for sizing machine elements, reviewing calculations, determining component strength and documenting safety factors and product life parameters.

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## Plungers offer rapid repositioning

PEM Type PTL2 spring-loaded plunger assemblies allow users to quickly and easily move racks, slides, access panels, and similar equipment to new positions without requiring tools. If necessary, a unique lockout feature keeps the fastener's spring-loaded plunger retracted until the plunger pin drops into final position. A simple quarter-turn of the fastener enables the retracted locking and unlocking actions.

Type PTL2 spring-loaded plunger assemblies install permanently in aluminum or steel sheets as thin as .060" / 1.53mm with hardness of HRB 80 or less or HB 150 or less. Their engineering allows the reverse side

of the sheet to remain flush when the plunger is retracted.

These fasteners install reliably into properly sized mounting holes in a sheet. The fastener is placed into a recessed anvil and then the work piece (punch side) is placed over the fastener's shank. With punch and anvil surfaces parallel, installation is completed by applying squeezing force until the shoulder of the retainer comes into contact with the sheet material.

As a variation of these fasteners, Type PSL2 spring-loaded plunger assemblies are available on special order without the lockout feature. [www.pemnet.com](http://www.pemnet.com)

## Bonding plastics to metal with Intertronics

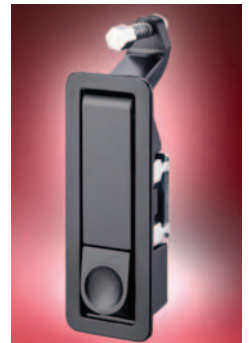


Intertronics has recently introduced the DYMAX BlueWave LED Prime UVA high-intensity spot curing system and specially formulated LED-curable adhesives. These adhesives allow ultra fast cures in seconds for a variety of plastics and metals.

The BlueWave LED system gives the convenience of no bulbs to change, cool cures, no warm-up and constant high intensity. Together with perfectly matched adhesives such as DYMAX 3094, excellent bonding of glass, PC, PVC, polyester, acrylic and metals can be achieved, with a fixture time of 0.2 seconds and tack free cure in less than 30 seconds.

[www.intertronics.co.uk](http://www.intertronics.co.uk)

## Lever-actuated compression latch



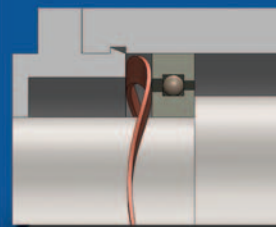
With a minimal protrusion of 6mm the new 6-160 lever compression latch from FDB Panel Fittings provides all the benefits of compression closure with a recessed operating handle. This makes it ideal for cabinets in areas with high levels of pedestrian traffic or narrow corridors such as computer suites, production line control systems or electronic cabinet in server hotels, while its resistance to vibration lends suitability to use on vibration prone applications such as railway carriages and HVAC panels to counter nuisance opening.

The 6-160 features especially easy installation. The complete latch, including the pre-assembled U-shaped fastening bracket, is installed in the cutout from outside. Then by rotating the fastening screw from outside, the U-bracket automatically fastens the complete latch and in the "closed" position the screw cannot be removed. In addition the lever action gives both a soft landing (with cushioning rubber pad) and a comfortable feel for the operator – there is a choice of thumb activated handle release or a key cylinder security option with industry standard key types.

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# 'Unstoppable shifts' solve hardest problems

Developments at the leading edge are helping design engineers. Tom Shelley reports.

Computer aided design of 3D geometry is considered to be more or less a solved problem and major advances are being made in the simulation of the real world performance of virtual products, including composites. On the other hand, data management and ensuring knowledge of all relevant information by the right people remains a nightmare, but progress is being made.

This was the strong message that came out of this year's Dassault UK PLM forum. Philippe Forestier, one of the original founders of Dassault Systèmes spoke of the "Unstoppable shifts" caused by urbanisation and the need to better manage resources and world food supplies and improve global health. He argued that there is a growing gap between companies that are making full use of information technologies to advance their businesses in the face of these pressures, and those that do not, advancing the embracers at the expense of the others.

On the CAD front, Forestier said that Dassault is "Still spending tons of money" to make the tools more user-friendly. The company continues to talk about "Lifelike" experiences and as an example, he showed a walk through up an open staircase on the outside of an oil

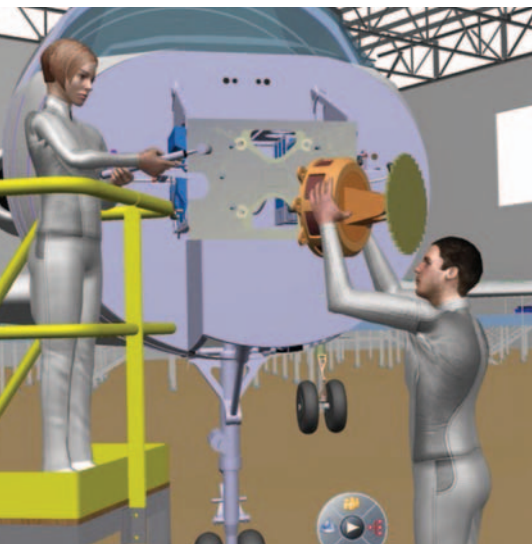
platform, to access some crucial control cabin. We pointed out to Alain Floutier, that to be truly lifelike it should not just simulate of going up the stairs on a nice sunny day above a calm sea, but should be able to reproduce what it might be like to attempt to perform the task in the teeth of a gale above stormy seas. In the light of such considerations, the design team might then decide to reposition the staircase within the main elements of the structure in order that it could be used safely under such circumstances. He responded that the simulation could be made much more realistic, but would require, "More time and effort", which is why his company is spending money to try to make the process of generating simulations easier.

While geometry and visual appearance may be solved problems, designing component parts with optimum properties requires taking their manufacturing method into account. This is especially true of parts made of composite. John Cox from Dassault Systèmes observed that in such cases, "By the time you have designed the part, you have designed the manufacturing process." One of the first companies to realise this was Rolls-Royce, and we were given just some idea of how complicated this process can be by Darren James, design technology leader

for making aero engine fan blades. He described something of the process of designing carbon fibre reinforced organic matrix fan blades with titanium edges for what he described as a new "Trent 500" sized engine. The titanium edges are to improve damage tolerance against bird strike, but the bulk of the blades are carbon fibre because of all the advantages this material gives in terms of reduced weight and out of balance forces, and improved vibration and fatigue resistance and imperviousness to corrosion. The shape is somewhat complex, with double curves and changes in thickness to give optimum performance properties in the engine.

In order to do this, it has to be made of "Quite a few hundred" plies, each of which is of a slightly different size and shape to the one beneath it, and each of which has to be specified in terms of material, direction, rosette and position in the stacking sequence. The design process makes use of Catia V5 and Abaqus and SCO3, bespoke code developed by Rolls Royce, in order to undertake the finite element analysis. These latter codes enable static analysis either 'smeared', looking at bulk properties or ply by ply. In addition, LS-Dyna is used to undertake impact modelling.

The team is currently evaluating Catia V6



because, according to James, "It improves collaborative working."

Finite element analysis capabilities for analysing aircraft type composite structures and computational fluid dynamics continue to be improved, according to Alain Prior of Dassault Systèmes. Problems were encountered during the development of both the Boeing 787 and the Airbus A380, and Prior observed that both companies, "Have realised since that it would have been better to do the advanced analysis up front", instead of subsequent to the failures of physical tests. He said that, "A lot of progress has been made with regard to non-linear

## DESIGN POINTERS

- Modelling using 3D geometric CAD is largely considered to be a solved problem, although there is still much work required to make it quicker and easier to use
- In composite component design, design for manufacture is an integral part of the design process
- Tools for simulating the performance of composites are much improved, and, validated by experiment, they are increasingly being accepted as proof of the integrity of a design
- Managing data, particularly where it concerns access and comprehension of complex standards, regulations and requirements remains a problem, but progress is being made

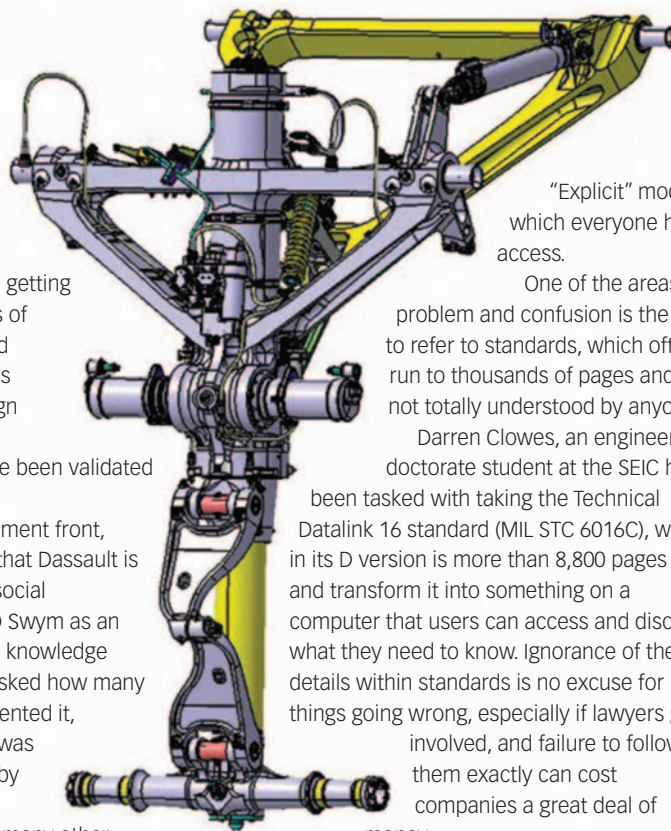
behaviour, damage behaviour and the detection of damage. Physical test results are getting very close to the results of computer modelling and increasingly, modelling is being accepted as design validation, as long as modelling methods have been validated by physical experiment.

On the data management front, Forestier made it clear that Dassault is still pushing its secure social networking software 3D Swym as an aid to collaboration and knowledge sharing, but when we asked how many companies had implemented it, Forestier told us that it was still only in serious use by the 9,000 users within Dassault Systèmes, but many other companies were "Interested" including non traditional Dassault Systèmes customers such as in insurance. Furthermore, the company was hoping to sell it for use by, "Communities within the European Union."

The problem of providing easy access to complex bodies of information is, however, being tackled in a different manner by the Systems Engineering Innovation Centre SEIC), which is a collaboration between Loughborough University and BAE Systems.

Steve Hinsley of BAE Systems, seconded to SEIC, explained how he is concerned with not just the mockup model of products but the whole lifecycle management process, now identified as CADMID, standing for, Concept, Analysis, Demonstration, Manufacture, In-Service and Disposal.

If a project is governed by large numbers of documents, regardless of whether these are paper or electronic, this leads, according to Hinsley, to an overall "implicit" project lifecycle model which only exists as a whole in people's minds. Unfortunately, everyone will then have a different version of this model which leads to confusion. There therefore needs to be an

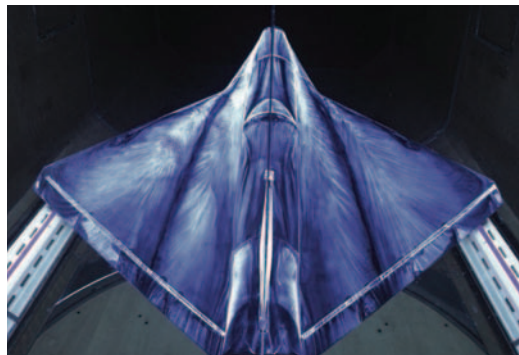


"Explicit" model to which everyone has access.

One of the areas of problem and confusion is the need to refer to standards, which often run to thousands of pages and are not totally understood by anyone.

Darren Clowes, an engineering doctorate student at the SEIC has been tasked with taking the Technical Datalink 16 standard (MIL STC 6016C), which in its D version is more than 8,800 pages long, and transform it into something on a computer that users can access and discover what they need to know. Ignorance of the details within standards is no excuse for things going wrong, especially if lawyers get involved, and failure to follow them exactly can cost companies a great deal of money.

Clowes said that this particular standard is available either as a hard copy document, with "Lots of inconsistencies", such as cross references that lead to dead ends, or a PDF version which at first sight, appears to have blue



colour blue to highlight certain facts. A project started to put this into computer form in 2005, which Clowes joined in 2007. The data has been entered using the Eclipse Modelling Framework,

which is open source, and allows the construction of a web based format which outputs in natural language. Tools started to be rolled out to customers in 2009. When we asked if the same approach could be applied to other vast and difficult to penetrate sets of documentary regulations, such as the Machinery Directive or the 22 volumes of regulations and procedures used by London Underground, Clowes responded positively.

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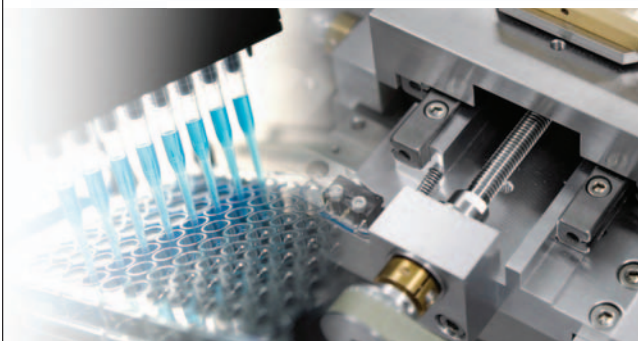
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Engineering excellence - by design

# New thinking key to viable water and wave power

**Tom Shelley reports on simple ideas that give a dramatic improvement to the efficiencies of water based renewable energy sources.**



*A large working model of the water wheel was on display at the Hannover Fair, as was the Romanian wave power generator (below)*

Power can be harnessed from flowing rivers and tidal streams by using a novel German water wheel with greater efficiency than hitherto by allowing the vanes to partially rotate, Romanians have come up with a novel wave to pneumatic generator, which also uses free to rotate vanes and UK ventures press forward with yet more ideas.

The water wheel and Romanian concept were both on show at this year's Hannover Fair, the water wheel in the form of a large, working model, and the wave power generator, in the form of the component parts of a 3.5kW demonstration unit.

The novel water wheel has been developed by consulting engineer,



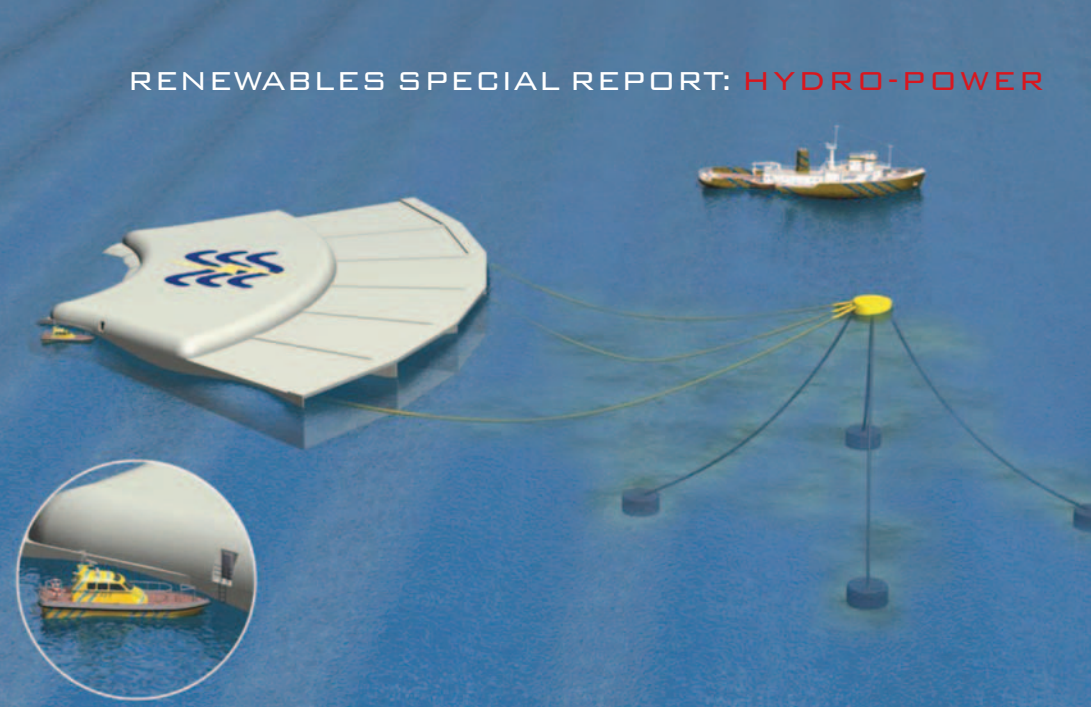
Hartmuth Drews, who is based in Pinneberg, and runs a company that makes water wheels commercially. He calls his new design an, "Energy floater water power plant". His breakthrough ideas are to mount the

water wheel on a pontoon in the flowing river and include a framework, to support the blade against the force of the incoming water flow, but which allows them to freely pivot back when withdrawn.

He claims that this increases mechanical efficiency by around 40%, rediscovering and adapting an idea made use of by the designers of nineteenth century paddle steamers, who found that efficiency was greatly improved if blades were turned vertically as they entered and left the water.

Having the water wheel float on the river gets round a whole host of problems. Drews water wheels are normally installed in existing old mill sites, but in a new installation, introducing dams for small and large scale hydro installation means dealing with environmental legislation that requires free flow of the main body of water to allow fish to reach their spawning grounds. Hence, new installations requiring a dam across a river from one bank to the other have difficulty obtaining approval, even if they include fish ladders. Furthermore, there is a considerable cost requirement for civil engineering work in order to provide head for a traditional type of installation, whether using water wheels or turbines.

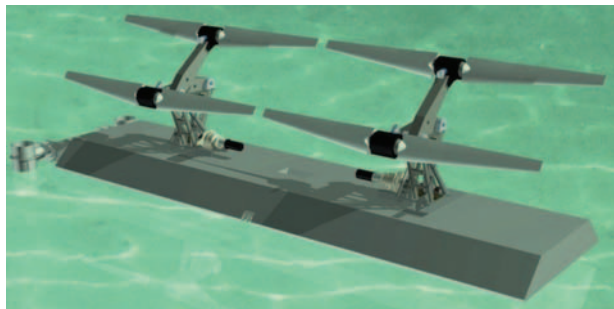
Traditional water wheels rotate slowly, typically 5 to 10 rpm,



producing torques of 8 to 25kNm, and it is necessary to gear them up by 150:1 to 300:1 to turn a generator at 1,500 rpm. Drews observes that while planetary gear trains can transmute such loads and achieve suitable gear ratios with more than 90% efficiency, they are not cost effective for this type of application. For this reason, he proposes that the Energy Floater should be equipped with gear ring segments round the wheel rim that engage directly with a pinion attached to the shaft of the generator.

Much of the untapped hydroelectric power potential in Europe is small scale – “Microhydro”. A Scottish government report, “Employment Potential of Scotland’s Hydro Resource”, published in September 2009 suggested that there could be 1.204 GW of potential new hydro capacity in 7,043 schemes across that part of the UK. 4,419 of these are less than 100kW.

On the stand of the National



*The OWEL converter and the Pulse Tidal device*

Institute for Research and Development in Electrical Engineering ICPE-RA, which is based in Bucharest, we saw a small, submersible generator with a directly connected, four bladed turbine. It is designed to rotate at 350rpm in a water flow of 1.6m/s. While producing only 200W at 11V, it is more than enough to power a remote monitoring system, and if made a little larger, could be made to power a mobile phone base station, the latest designs of which only consume about 500W.

The same laboratory also had on show a 750rpm, 3kW permanent magnet generator optimised for small scale hydroelectric and wind power generation and a hydro-pneumatic converter in which waves compress air in a narrowing chamber and drive a turbine. The problem that has to be overcome with such devices is that the air moves back and forth, but the generator needs to keep rotating in the same direction. One solution is the Wells turbine, but its efficiency is only about 40% to 70%, which is significantly less than for traditional

turbines, which in large units, come in at more than 90%. The Romanian solution is to direct the airflow into a narrow, annular space, and have blades that can pivot. This requires that the blades be short and stubby rather than long and narrow. The experimental unit we were shown seemed robustly made and we were told that it produced a rated power of 3.5kW at 2,000 rpm from a 50m/s air flow.

A suitable way of producing large amounts of compressed air from wave power is John Kemp’s OWEL (Offshore Wave Energy Limited) converter, which has waves compressing air as they move along a narrowing chamber in a free floating vessel. Thanks to £2.5 million from the Technology Strategy Board, OWEL, working with IT Power is now at the design and build stage of a 42m long, 600 tonne, 0.5MW demonstrator. The machine is to be tested at the Wave Hub facility off the north coast of Cornwall. A similar commercial machine deployed in open seas would have a rating of 1MW. IT Power is also the lead company in an EU funded project to develop the Pulse Tidal Device in which oscillating horizontal hydrofoils extract power from tidal or other water flows. The company has begun a year long environmental study ahead of an application to Marine Scotland for a licence to start producing 1.2MW of renewable electricity in 2012 in Kyle Rhea, a narrow, fast flowing strait between the Isle of Skye and the Scottish Mainland.

The company has made extensive use of Autodesk Inventor to simulate the transmission mechanism in the Pulse Tidal Device and the mechanical and structural design of the OWEL.

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## DESIGN POINTERS

- Water wheels can extract power from water flows by being mounted on a floating pontoon. Allowing the blades to pivot as they are lifted out of the water greatly improves efficiency
- In wave power to pneumatic systems, turbine efficiency in a bidirectional turbine can be greatly enhanced by allowing the blades to pivot
- Both the Offshore Wave Energy (OWEL) and Pulse Tidal Devices have reached the large prototype design and build stage



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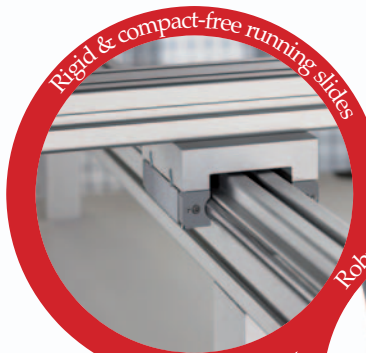
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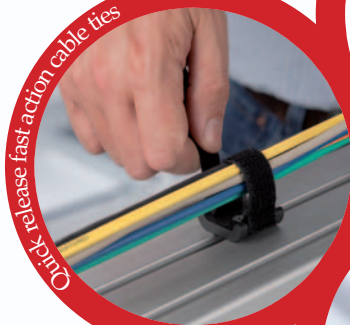
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## READER INTERVIEW

ALAN HAWKINS  
TECHNICAL MANAGER  
PILKINGTON GLASS



**Q How did you get started in manufacturing?**

**A** Well I'm one of those people you'd probably call a technologist rather than an engineer. My background is in academia rather than industry. However, when it came down to it, I probably wasn't quite good enough to become a lecturer, so it was really a case of looking for a role in industry and I found myself here. That was 32 years ago and I'm still here.

**Q What does your role involve?**

**A** I'm technical manager, so that means I have a technical input on pretty much all the products. We do a lot of fire-resistant glass for various applications and a fair amount of explosion-resistant glass as well, so those are always interesting projects, although by their nature, I'm not sure how much I can tell you about them!

**Q What are some of the more interesting projects that you've worked on over the years?**

**A** As I say, there are a lot I can't talk about, but some of the most interesting ones I've been involved in lately would probably be the Olympic Velodrome, which has this amazing glass roof that we've installed. There was also once a project where we installed a lot of fire-resistant glass on a boat – that was interesting. And we also recently were involved in a very interesting project at Edinburgh's Waverley Station.

**Q Has the industry changed a great deal since you joined it?**

**A** The glass industry's funny in that, technically, a lot of the products haven't changed a great deal over the years, but the way in which we make and handle them has. In fact, probably the biggest change I've seen has been in the way the products are handled. We produce glass in five-tonne

batches and, because it's so brittle, the best way to handle that for years was manually lifting it. However, since automated handling has taken over, it's hard to get across just how much it's changed things. I suppose that the easiest way is to point out that, when I joined, there were 145 people working here and now there are just 46. I would say the majority of that is down to automatic handling.

**Q What are the big issues facing your industry at the moment?**

**A** Well Government cuts are a big issue for us at the moment, since so much of what we do is for the public sector. However, in a larger sense we, like everyone, are under increasing pressure to be energy efficient and to work in a way that is more environmentally friendly. Obviously, glassmaking is a fairly energy-intensive process, so this is quite a challenge for us.

Going forward, I think the issues will revolve around more efficient and environmentally-friendly products. So, for instance, it would seem inevitable that photovoltaic glass that actually generates energy from the sunlight that passes through it will be a product of the future. I'm not sure if I'll be around to see it, unfortunately, but it's something that seems almost certain to happen.

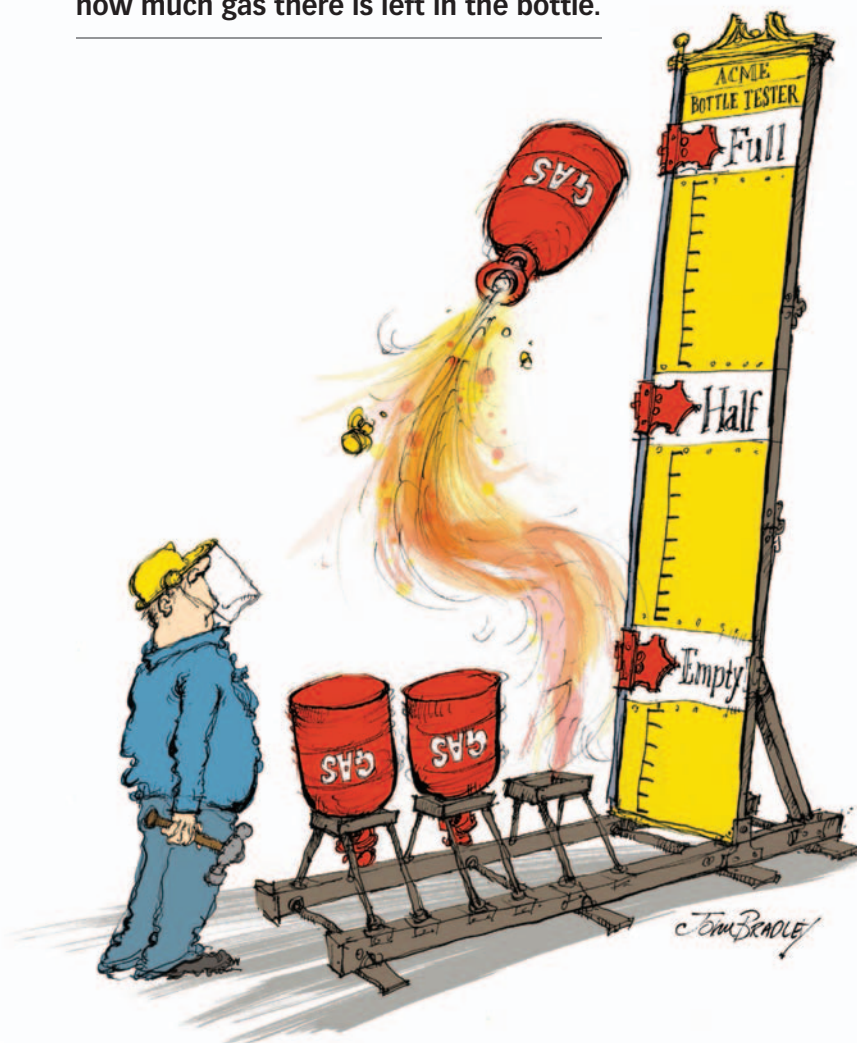
**Q What still excites you about your role?**

**A** I've always liked working in an industry where you get to see the end results of all your hard work. That's always been a very satisfying thing for me.

Unfortunately, I'm 62 now, so I'm getting a bit old to be doing the other part of the job that I love, which is walking about on roofs of buildings or going up on cherry pickers to help advise on projects. It's childish, but being able to get out and about and see the thing you're working on has always appealed to me. It's certainly better than being at a desk in front of a computer screen.

# Getting to finish the barbecue

The problem for all those who cook or heat with bottled gas, is knowing how much gas there is left in the bottle.



The answer to last month's Coffee Time Challenge of how to get boats in and out of the water quickly can be found in our Technology briefs section on page 8.

any difference in note between a full, half full and nearly empty gas cylinder. There seem to be greater acoustic differences between cylinders than are afforded by their being full or empty. Or one could try shaking it (hopefully not with the cooker connected) to detect the inertia of the liquid inside, slopping about.

It would be possible to find the internal level of the remaining liquid gas using ultrasound, but such systems are neither low cost, quick or simple to use, or very compact. One could purchase several filled gas cylinders for the price of a single system and it would be simpler to have a spare gas cylinder than a pair of electronic transducers, cables, and an instrument in a carrying case. In any case, if used only occasionally, the batteries will almost certainly be found to be flat when the instrument is taken out and deployed.

What is needed is something simple. The solution that we offer in next month's edition of 'Eureka' does the job most simply and inexpensively. Once you see it, may consider it obvious, except that nobody seems to have thought of it before, allowing the inventor to patent it. It is commercially available, but not in the UK, despite being a British invention.

See if you can come up with anything better.

Those who depend on bottled gas for their cooking can be relied on to always have a spare, filled bottle. As soon as the bottle attached to the cooker is empty, it is replaced with the filled bottle and a replacement obtained for the empty one.

The problem comes with occasional users of bottled propane or butane, whether this is for a building work or road maintenance, a gas barbecue, a boat, a caravan or to take for camping. Who wants to have to cart two gas bottles up a mountain for a camp? The only way to be sure how much gas is left in a bottle is to weigh

it. Since gas bottles are usually made of steel and quite heavy, it is not easy to tell by picking one up, whether the bottle is full, half full, or almost empty so to do this, the user would need to be in possession of a proper weighing machine.

## The Challenge

Our challenge this month, therefore is to come up with the simplest and most cost-effective way of establishing how much gas remains inside a cylinder of propane or butane gas. The first idea one might try is tapping it, but, personally we can't tell

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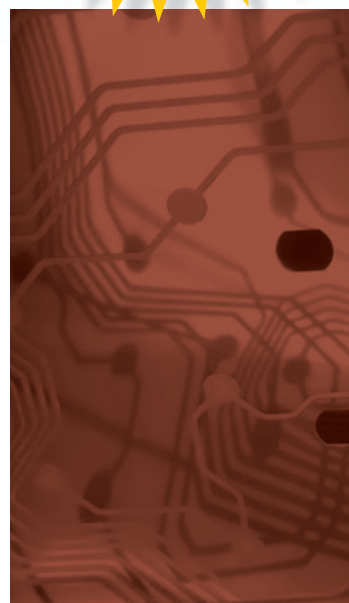
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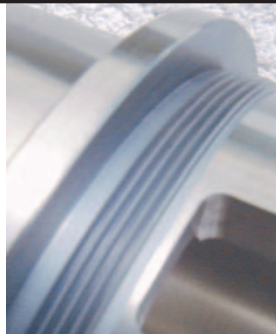
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