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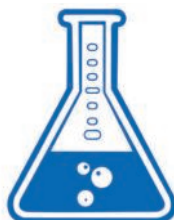
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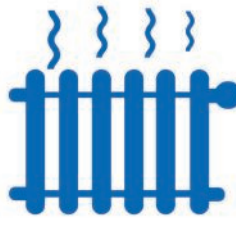
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18

## 18 Cover Story: The best of both worlds

The increasing use of UAVs is forcing many to rethink the rules and bridge the gap between helicopter flight and fixed-wing aircraft. So what innovations are coming to the fore? Justin Cunningham finds out.

## 22 Interview: Chris Aylett

What does motorsport have to offer the rest of industry? An enormous amount, as Paul Fanning finds out when he talks to the Motorsport Industry Association's chief executive.

## 25 Beating the 'cold snap'

Engineering at extremely cold temperatures has a dramatic effect on the materials used and consequently affects design. So what are the limitations of 'cold engineering' and are they being overcome? Justin Cunningham investigates.

## 29 Software drives automotive innovation

Cutting edge software is helping iconic British brand Aston Martin blend design techniques of the past with those of the present. Laura Hopperton reports.

## 33 Direct modelling sparks interest

Direct modelling software SpaceClaim has taken a new direction, this time collaborating with electronic components supplier RS Components to produce 3D design software for non-CAD experts. Paul Fanning reports.

## 35 Fighting the Faraday Cage

A hard and fast, apparently insurmountable rule of physics for more than 150 years, the Faraday Cage effect may finally have been overcome, as Paul Fanning reports.

## 36 QTC drills into new application

Peratech's revolutionary Quantum Tunnelling Composite has found a new sensing application. Paul Fanning reports.

## 41 Linear gives some straight answers

Linear motion is often not well understood, but has a wide range of uses. Here, Paul Fanning looks at some examples of this technology and its application.

## 47 Hydraulics harness wave power

The 2013 winner of the UK Dyson Award is a highly novel system that employs hydraulics to generate renewable power from the ocean waves. Paul Fanning reports.

## 5 Comment

Greater expectations

## 6 News

Industry flocks to Engineering Design Show

Patent Box set to boost UK innovation

Bloodhound steering wheel design finalised

WildCat robot can sprint at 16mph

JLR to open £100m R&D centre in UK

## 9 Technology briefs

Schaeffler extends ballscrew drives

High-power servo motors up to 140 kW from B&R

Fasteners for thin metal

Rolling bearings keep motors running

Sick launches Flexi Loop

Viscoelastic solution for enclosure bonding

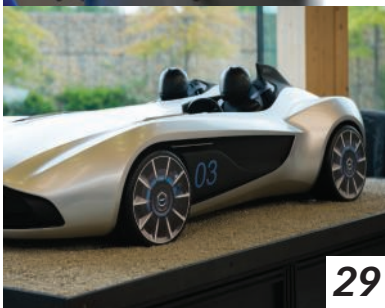
High-performance sensors for medical industry

## 50 Coffee Time Challenge

This month's challenge is to find an effective way to prevent metal theft from the railways.



25



29



47



# EXTREME PRECISION



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# Greater expectations



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

In the music industry, there is a widely-recognised phenomenon called 'the difficult second album'. Put simply, this describes the all-too-common plight of a band or recording artist that has enjoyed great success with their first album, only to struggle to match that success with their second.

The reasons behind this malaise are numerous, but they boil down to two key factors. The band's first effort may have felt like a breath of fresh air, but by the time the second album comes along, they no longer have the advantage of novelty. At the same time, their success has raised expectations among their fans to a level that it can be difficult to meet. After all, being good once is one thing, but staying good and getting even better is quite another.

All this can lead critics and fans to conclude (often hastily) that the recording artist was just a flash in the pan and can be consigned to 'one-hit wonder' status.

This difficulty of meeting heightened expectations is certainly one that resonates with those of us who were involved in the organisation of the recently-held Engineering Design Show. Such was the success of the 2012 show that it may have been difficult for some to escape the nagging fear that 'difficult second album' syndrome might apply this year.

I am delighted to report, however, that any such fears were unfounded. When the three halls of the Ricoh Arena were buzzing with activity; when certain sessions of the Conference programme were standing room only; and as exhibitor after exhibitor gave extremely positive feedback about how busy they were, there was a palpable sense of relief and happiness from those of us who had been involved with it from the start. We had not only avoided 'difficult second album' syndrome, we had raised expectations even further.

Of course, we had been pretty certain we would. The exhibitors, conference and workshops were all of excellent quality, while the features and the Innovation Zone were bound to attract interest. Equally, the success of 2012's Show told us that design engineers would attend a show designed specifically for them. Even so, it was good to have our confidence validated.

Those of you who were there know how well the Show worked and those of you who weren't have the opportunity to find out at next year's event.

We look forward to seeing you there.

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## Industry flocks to Engineering Design Show

The second Engineering Design Show has proved even more popular than the first, attracting 3,155 visitors to the Ricoh Arena, Coventry over the 2nd and 3rd October – almost double the number who attended last year.

The Show, which this year was colocated with the inaugural Electronics Design Show and featured Engineering Materials Live, hosted more than 170 exhibitors, more than 60% of whom have already rebooked to take part in next year's event.

Ed Tranter, executive director of organiser Findlay Media, said of the Show: "It has been great to watch the Engineering Design Show



build on last year's success to grow into something even bigger and better. It's also been great to receive so much

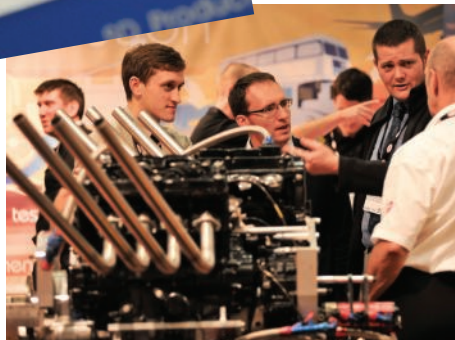
positive feedback from visitors and exhibitors alike."

Alongside the exhibitions, there was also a high-level conference programme, which featured speakers from such illustrious companies as Dyson, Jaguar Land Rover, Messier-Bugatti-Dowty, RSL Steeper and Surrey Satellite Technology Limited.

In addition, a packed Workshop programme attracted many visitors keen to get hands-on, practical advice on technology and industry issues.

Next year's Show will take place at the Ricoh Arena on the 22nd and 23rd October. Says Tranter: "It will be a challenge to improve on this year's Show, but we will. We can't wait."

[www.engineering-design-show.co.uk](http://www.engineering-design-show.co.uk)



## Patent Box set to boost UK innovation

The government's new Patent Box scheme could provide a big boost to UK innovation, according to report launched today by Cambridge Design Partnership (CPD).

The report outlines how the reform should encourage big businesses to remain in the UK, but also warns that the government must do more to help SMEs with incentives to encourage innovation.

Traditionally, numbers of patent applications in the UK have been lower than in other developed countries. The Patent Box scheme was launched in April this year to address this shortfall and reward R&D by offering companies lower tax rates on profits made from products with qualifying patents covering them.

HMRC predicts that the scheme will provide £1.1billion in tax relief by 2019.

The research was carried out in partnership with international patent and trade mark attorney firm Marks & Clerk.

The full report 'Patent Box: An industry report on incentivising UK innovation' is available to download for free at [www.cambridge-design.co.uk/patent-box](http://www.cambridge-design.co.uk/patent-box).

## Bloodhound steering wheel design finalised

The final steering wheel design for the Bloodhound SSC has been delivered to driver Andy Green by UK-based design consultancy Cambridge Design Partnership (CDP).

Early concepts of the wheel were developed in clay from Green's hand imprints in the triple layer fireproof gloves he will wear for the record attempt.

CPD took these initial designs and focused on optimising for a range of considerations, including ergonomics, usability and aesthetics.

The final design was then rapid prototyped at CPD and delivered to the Bloodhound team in Bristol for testing and approval.

Karl Hewson, usability and design engineer, CPD, said: "We retained the original geometry derived from the clay model of the grip area and repositioned the forward facing button locations to fit within Andy's thumb pivot points.

"The new layout now allows a single fluid rotation movement of the thumb to transition from the power grip used when driving into an activation grip required to press buttons. This revised position could save between 0.5 and 3 football pitches of distance during the deceleration phase of each run; time which is vital when preparing the car for its return run."

The final steering wheel will be manufactured using the latest titanium additive manufacturing technology, ahead of the Bloodhound SSC's official land speed record attempt in South Africa next year. [www.bloodhoundssc.com](http://www.bloodhoundssc.com)





## Jaguar Land Rover to open £100m R&D centre in UK



Jaguar Land Rover (JLR) is to establish a multi-million pound technology, innovation and education centre at the University of Warwick.

The £100million National Automotive Innovation Campus (NAIC) is aimed at creating a large scale collaborative research environment, bringing together academics from some of the UK's leading universities with engineers from JLR and its supply chain.

The state of the art centre will feature engineering workshops and laboratories, advanced powertrain facilities and the latest advanced design, visualisation and rapid prototyping technologies.

Construction is due to begin in

September 2014. JLR expects that it will more than double the size of its advanced research team to 500 people by the time the NAIC opens in 2016.

Dr Wolfgang Eppe, Director of Research and Technology for JLR, said: "Investing in collaboration, innovation, research and education is vital if we want to be on a par with our international competitors. Our future sales success, the success of our global business – and the UK economy – lies in the engineering and innovation that will take place in NAIC.

"With a critical mass of research capability we will put the UK at the very centre of the global automotive industry - with the NAIC at its hub."

### WildCat robot can sprint at 16mph

Boston Dynamics has unveiled WildCat, a quadruped robot that can freely bound, turn and gallop along flat terrain at speeds upwards of 16mph with no off-board power supply.

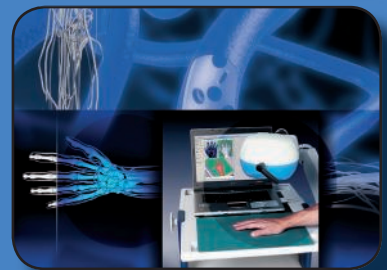
Based on the company's Cheetah robot - the fastest ever four-legged robot - WildCat has been developed for the military with funding from the Defense Advanced Research Projects Agency (DARPA).



Boston Dynamics has yet to release an official statement about the new robot.  
<http://bostondynamics.com>

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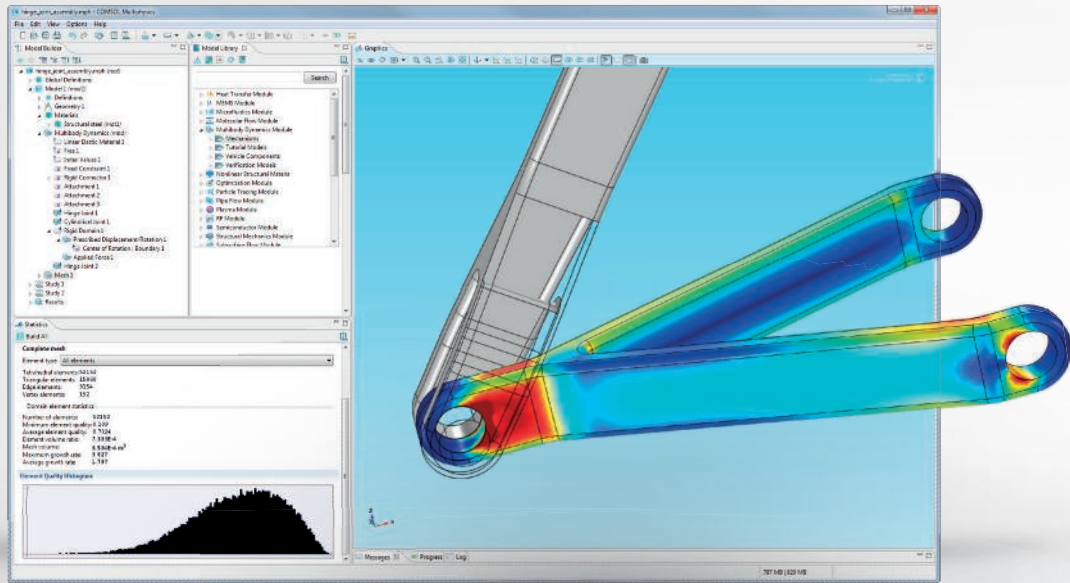
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## Schaeffler extends ballscrew drives

Schaeffler has extended its range of ballscrew drives to include a series of Transportation DIN standard ballscrews. This new series now completes Schaeffler's comprehensive screw drives offering, which now includes ballscrew drives (ground and rolled), planetary screw drives, roller screw drives, as well as a range of ballscrew support bearings.

Screw drives are suitable for a variety of machine building, automation, handling and automotive engineering applications. Screw drives comprise a threaded spindle and threaded nut. Due to the rotation of the spindle, the nut moves in a linear manner along the spindle,



converting the rotary motion of the drive into linear motion. A screw drive is rigidly connected to the adjacent construction, providing axial displacement or positioning of the component. The screw drive can be subjected to high dynamic loads.

Nuts are available in a flanged or cylindrical design and in the form of single or double nuts. Preloaded (double) nuts enable high positional accuracy and rigidity. The thread on the shaft is either rolled or ground. The threaded shaft can be driven by direct or indirect means and is supported on one or both sides – typically by locating/non-locating bearings.

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

## High-power servo motors up to 140 kW from B&R



B&R has expanded its product line to include servo motors with high torque and an extended range of speeds. The highly efficient motors in the 8KS series provide up to 140 kW of power and stall torque up to 555 Nm. Available in two sizes with speeds up to 3,000 rpm, 8KS motors open up new possibilities for applications in a wide range of industries that require high power. In addition, these servo motors are available with either axial or radial fans, water cooling and optional mounting feet.

This motor series is also the perfect complement for implementing high-powered yet energy-efficient servo hydraulic drive solutions together with

B&R's servo pump control. The variant with reinforced bearings, for example, makes it possible to set up high-torque belt feed axes for electric injection molding machines.

The servo motors in this series come equipped with a resolver interface, an optical encoder with EnDat interface and an embedded parameter chip, ensuring seamless compatibility with ACOPOS multi drives and easy integration into B&R's entire system landscape. As a result, 8KS motors can be installed and operated with the same comfort and ease that has come to be expected from all B&R motors.

[www.br-automation.com](http://www.br-automation.com)

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These self-clinching nuts provide strong, durable, and reusable metal threads to accommodate a mating screw, which completes the assembly and eliminates any need for additional attachment hardware. A serrated clinching ring prevents the fastener from rotating after installation. In service these nuts ultimately will not loosen, fall out, or otherwise adversely affect end-product integrity or performance.

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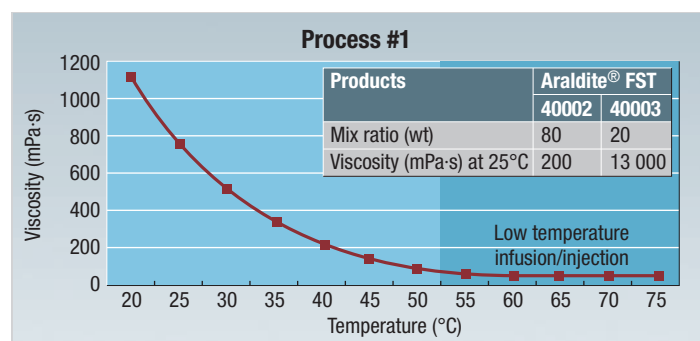
[www.pemnet.com](http://www.pemnet.com)

### FST thermoset solution for lightweight composite

Huntsman Advanced Materials has launched an entirely new high-performance and inherently flame resistant solution for RTM and infusion processing which offers greater strength whilst answering continued demand for weight reduction in interior aerospace designs.

Araldite® FST 40002 / 40003 is a radically different development that provides a unique combination of high mechanical, fire, smoke and toxicity (FST) performance alongside high quality, user-friendly composites processing conditions enabling efficient production of interior carbon and glass composites parts with maximised weight savings. FST 40002 / 40003 has a low reaction energy of about 220 J/g which eliminates bulk exothermic safety issues and enables large thickness composite part production.

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



### Solution to last month's Coffee Time Challenge

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The solution to September's Coffee Time Challenge of how to track packages in transit comes in the form of the DropTag from Cambridge Consultants, an innovative device designed to keep track of dropped and damaged parcels.

The sensor system combines a battery, a low energy Bluetooth transmitter, an accelerometer and a memory chip.

Stuck on a parcel as it leaves a warehouse, DropTag logs any g-forces above a set risky shock level that it experiences.

Once the courier drops the parcel off, the person receiving it can turn on their Bluetooth on a smartphone running a DropTag app and

scan it before they sign for it.

If the graph shows the parcel has been neglected during transit, delivery can be refused.

Tom Lawrie-Fussey, business development manager at Cambridge Consultants, said: "By minimising the complexity of the electronics in DropTag, we've calculated that DropTag could analyse and log crucial events for many weeks using just a single coin cell battery, and could even perhaps be reused.

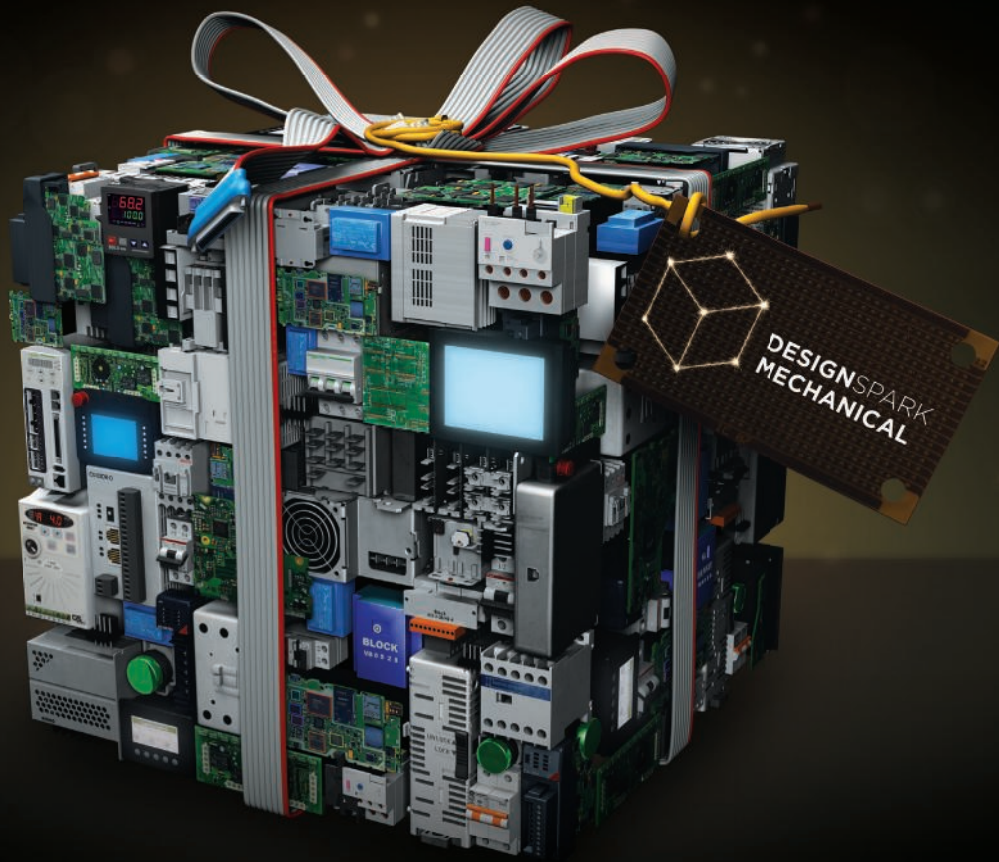
"And, by keeping it simple, we're confident that the bill of material cost would be less than \$2 – making it a very affordable solution."

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## Sick launches Flexi Loop

The launch of the innovative Sick Flexi Loop marks a major step forward for machine safety with a simple connectivity solution for safety and plant design engineers to meet recent regulatory changes.

The Sick Flexi Loop offers new dimensions of scalability, diagnostic insight and I/O connection capacity within a compact space and at a very competitive cost. It is ideal when upgrading automation, robotics and modern manufacturing processes.

With a capacity to cascade up to 32 safety sensors/switches on one loop and to create up to eight separate loops, the IP67-rated Sick Flexi Loop will provide up to 256 sensors on eight dual channel inputs, reducing the clutter of traditional connections. The Flexi Loop is simple to install as a fully-cascadable system, using standard cable with M12/5-pin connectors. No special connections or shielded cables are required.

The Sick Flexi Loop provides intelligent built-in diagnostics without the need for a field bus or complex network addressing, resulting in a decentralised cost-effective solution to monitoring the status of each safety sensor / switch connected to it. As well as indicating

which device has switched and why, LED indicators on each node give live status information and avoid referring back to a desk-based control point.

[www.sick.com/flexisoft](http://www.sick.com/flexisoft)



## Viscoelastic solution for enclosure bonding

tesa claims to be taking the chemistry involved in adhesive tape production forward a generation with tesa ACXplus, an entirely new and radically different range of tapes that are particularly well suited to enclosure applications.

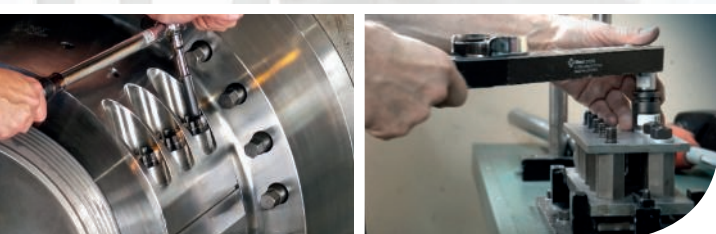
The new patented technology in tesa ACXplus is based on high-capacity acrylates which have been developed for long-term, constructive bonding on both indoor and outdoor applications.

By comparison with traditional bonding methods, this offers many advantages including clear full-surface bonding, extreme load capacity, stress dissipation, corrosion prevention and resistance to both weather and temperature.

tesa ACXplus unique and specially balanced elastic and viscous properties enable the dissipation of extreme physical stress in compensating for different rates of thermal expansion and contraction.

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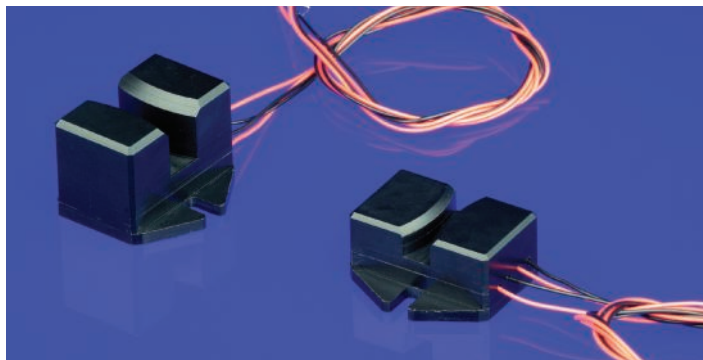
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## High-performance sensors for medical industry



Morgan Advanced Materials, a leading manufacturer of highly-engineered products for the medical industry, has launched a new range of high-performance air in-line and occlusion sensors for the medical sector.

Capable of delivering non-invasive air bubble detection and accurately measuring pressure changes in tubes leading into the body, the new range provides a highly precise means of monitoring safety-critical events in medical products such as infusion pumps, enteral feeding pumps, dialysis equipment and other fluid-handling applications.

The latest air in-line sensor technology has been developed in response to the large variation in tube sizes and materials used in the medical market for drug delivery and fluid management. Morgan now offers three standard designs accommodating a large range of tube sizes.

Key features of the new air in-line sensors include optional digital electronics, which can be programmed to detect air bubbles of different sizes depending on requirement and provide an output reading of air bubbles detected. The technology is available in an established flat surface option and an innovative curved design, which offers enhanced performance and greater sensitivity across a larger range of tube sizes. It does not require external clamping, while its highly-engineered shape delivers reduced signal settling time, enabling faster set-up for operators and improved stability signal over time.

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

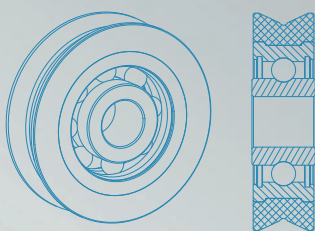
## Innovative siasphere abrasive technology

Master Abrasives' premier coated material supplier and partner, sia Abrasives, has launched an innovative, structured, high-tech abrasive, siasphere.

Innovation for the Swiss company's new siasphere comes from the abrasive structure, which differs greatly from conventional systems. With conventional systems, the roughness of the surface is reduced with increased use and wear. This effect is minimised with siasphere, which results in a consistent cut over the much extended life of the product. Thanks to the special surface structure of the abrasive a defined contact point is created between the workpiece and the abrasive, which is reflected in the exceptional performance and consistent quality.

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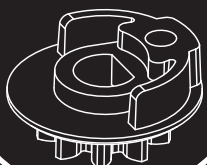


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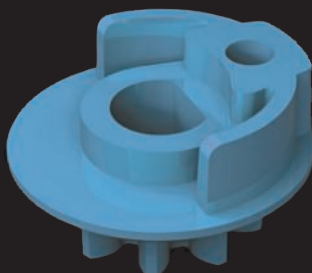


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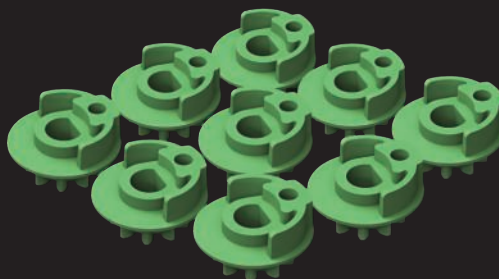
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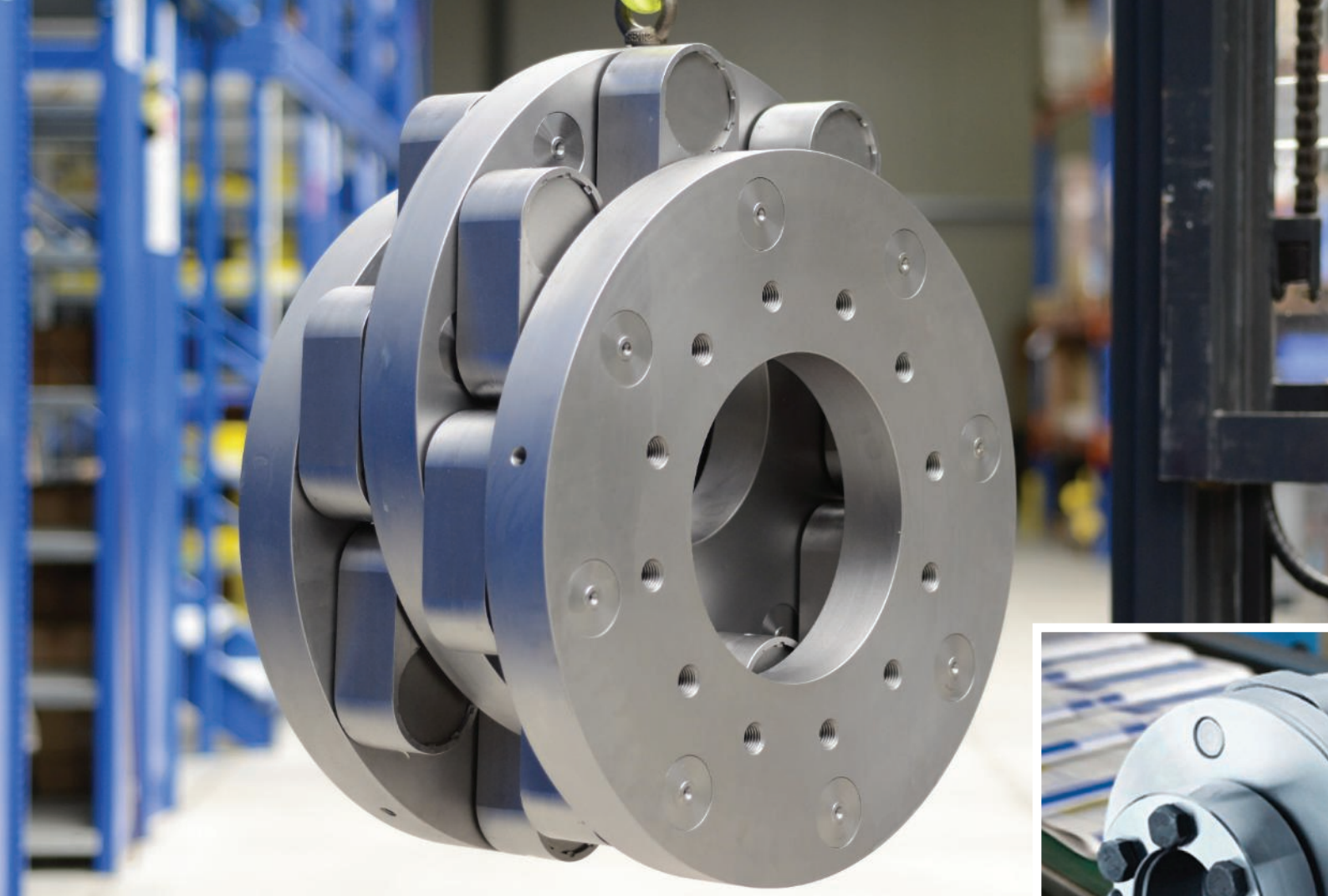
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# Coupling makes offsetting efficient

**Delivering resistance-free parallel offsetting in a compact space, the Schmidt-Kupplung range may be just what you're looking for.**

Wherever driven equipment is required to be axially displaced during operation, problems tend to arise. This is usually because the displacement can be disproportionate to the distance between shaft ends (DBSE). The consequence of this is often that, using conventional shaft couplings, it becomes impossible to transmit loads through a large parallel shaft offset without increasing the distance between shaft ends.

Clearly, this has the effect of increasing the machine's footprint, which is not an acceptable outcome in most instances. In addition, other coupling designs may suffer from a degradation of torque capacity and increased backlash during operation when required to accommodate

such a high degree of parallel offset.

What is needed, therefore, is something that can accommodate a large parallel or radial offset without resistance to offsetting. Any other coupling – gear, disc, membrane, u-joint elastomeric – has an inbuilt resistance to offsetting in parallel. Traditionally, there are many types of flexible couplings that can accommodate a parallel offset, but they all involve there being a considerable distance between the driven and the driver, meaning a great deal of space is taken up.

Fortunately, a viable alternative to this problem does exist in the form of the Schmidt-Kupplung range of shaft couplings offered by Absac. This product has no resistance to offsetting at all – which is a great benefit to the user. At the same time, however, it also has the ability to transmit an extremely high amount of torque.

The Schmidt-Kupplung allows for exceptional radial movement while reliably transmitting backlash-free torque. Torque is transmitted via compression and tension of the coupling lever links. This well-balanced system transmits torque without adding side loads to the drive.





Moreover, the Schmidt-Kupplung will not transmit radial vibration from the drive to the driven shaft.

Most importantly, the Schmidt-Kupplung delivers all these advantages in an extremely compact design. For example it is possible to have a parallel shaft offset of 275mm in an overall length of 284mm.

A classic design for extreme parallel offset, the Schmidt-Kupplung is a compact, torsionally stiff performance shaft coupling that compensates for variable parallel shaft offset during operation. The Schmidt-Kupplung is the ideal precision component for shaft connection in confined spaces. Through its modular construction both torque transmission and radial offset capacity can be optimised for each application.

The well-balanced design means that the Schmidt-Kupplung is used in many applications, in fact the design can be used in any transmission design where high torque, high shaft offset and small DBSE is present. The precision coupling transmits torque under constant velocity at all possible offsets and can transmit torque ranges from 35 Nm to 6610 Nm.

The couplings are able to transmit huge amounts of torque because the central disc is always defined.

Indeed, it is a

mechanical guarantee is that the centre disc finds its location and is always in the same place when the device is offset.

Many engineers may not realise that such a large parallel offset can be achieved by a shaft coupling. And, in one sense, this is not surprising, since there aren't any other couplings in the world that handle close shaft coupling and large parallel offset.

Crucially, these couplings are also customisable. The links can be longer, meaning you can start to customise their higher torque capacity and thereby extend the amount of parallel offset it is possible to accommodate.

Typical applications for the Schmidt-Kupplung range include printing machines, roll



forming machines, laminating machines and corrugated paper and papermaking machines. Of these, however, printing makes up the largest area of application. One reason for this is that shaft couplings for the printing industry are required to work with absolute precision to guarantee a register pressure and therefore ensure a high print quality.

The high precision requirement starts in the actual printing mechanism and continues through the refinement process to quality assurance on the final product. To maintain the precision movement, the

Schmidt-Kupplung range of shaft couplings are found in many areas of the printing processes. For example, in the drives for printing mechanisms the couplings can be found driving ink rollers and duct rollers or in the drives for rotary die cutting machines and cutting rollers they can be found where guaranteed precise stamping or cutting processes are performed.

A particular advantage of the Schmidt-Kupplung is that during the printing operation, individual rollers may also need to be adjusted, replaced or even removed from the machine. Ease of connection and the unique properties of the Schmidt Kupplung design allow for the axial displacement of roller holders up and away from the press so that maintenance or roller change can be carried out. Crucially, this means that there is no need to stop the printing machines during this period.

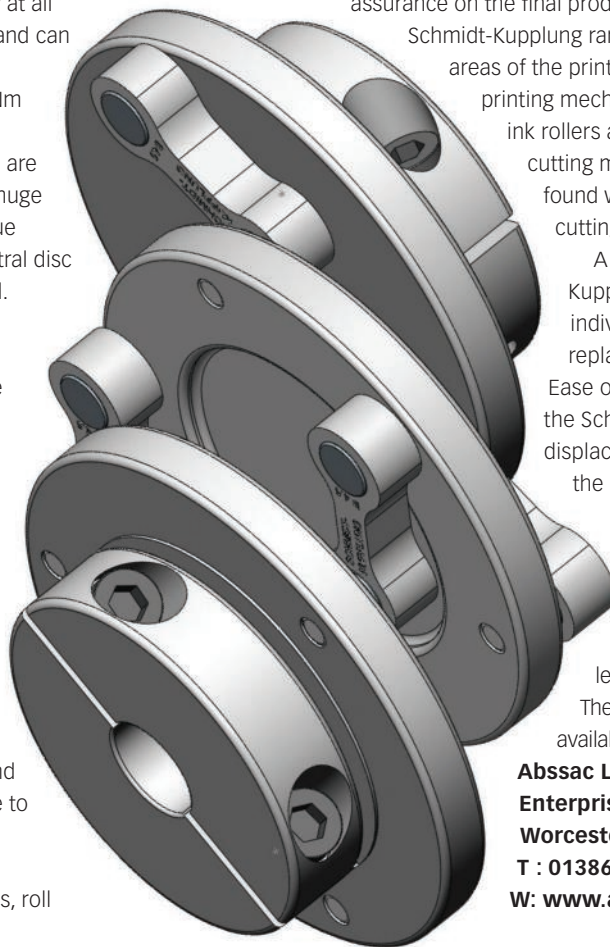
The Schmidt-Kupplung is available in three basic series for various performance levels (Standard; Power Plus and Offset Plus).

There are three different shaft-hub connections available: a taper lock, standard bore or flange mount.

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# The next *magnificent flying machines*

**The increasing use of UAVs is forcing many to rethink the rules and bridge the gap between helicopter flight and fixed wing aircraft. So what innovations are coming to the fore? Justin Cunningham finds out.**

**T**he advent of unmanned aerial vehicles (UAVs) is having an interesting impact on the way engineers think about aircraft. In many cases the rulebook has been thrown out with nothing off limits and ingenuity key. Removing people has removed much of the risk associated with failure in the air allowing much more radical aerodynamic concepts to be trialled.

One example is ornithopters, the idea of mimicking nature by flapping wings to produce lift and thrust. These are increasingly seeing use in small and micro UAVs designed for everything from covert military use to children's toys. A relatively recent example comes from Israel Aerospace Industries that has unveiled a prototype of its 'Butterfly', a micro-UAV for covert reconnaissance missions.

Another example is the DEMON demonstrator aircraft that has been developed by BAE Systems with a consortium of UK universities. DEMON does away with using conventional flaps and instead the aircraft uses air blown over the trailing edges of its wings to manoeuvre. The aircraft, which weighs 90kg and has a wingspan of 2.5m, undertook the first 'flapless' flight ever in the UK in 2010. As it is designed to fly without conventional flight controls such as elevators and ailerons, it requires far fewer moving parts. The aim is to make the aircraft much more reliable

as well as easier to maintain and repair.

UAVs are getting increasing performance demands placed on them in terms of very short – if not vertical – takeoff and landing, the ability to be highly manoeuvrable, need for low maintenance while having good range and speed. This means that many traditional helicopter and aeroplane layouts and architectures are being rethought and redeveloped.

It was this train of thought that originally set the ball rolling for D-Dalus, a cyclogyro rotorcraft that is being developed by Austrian aerospace firm, IAT 21. The company was set up after inventor Meinhard Schwaiger became intrigued with the shortcomings of helicopters.

"I was on a business trip when a television programme came on about helicopter crashes," he says. "It was clear why they crashed, they were unstable and the pilot was not able to control them. I wondered, why didn't they build them in a different way and make them more stable?"

Schwaiger's background is in mechanical engineering and plastic processing and although he has a fascination with flying, he did not have experience in aeronautics. Despite this, he came up with a truly intriguing concept that perhaps borrows from pump design and a more classical mechanical viewpoint.

"I came up with the idea almost straight away, but thought as it was late in the evening it was stupid and told myself to forget it," he says. "The next day I thought actually it was not such a bad idea so I began to look in to it, did some research and quite quickly came up with a concept and wrote a patent."

Schwaiger carried out some initial work to establish the kind of





*The D-Dalus uses four cyclogyros to bridge the gap between aircraft efficiency and helicopters' manoeuvrability*

performance and lift that could be expected against power. Once he concluded that this type of propulsion system could be used for an aircraft, he founded IAT 21 in 2006.

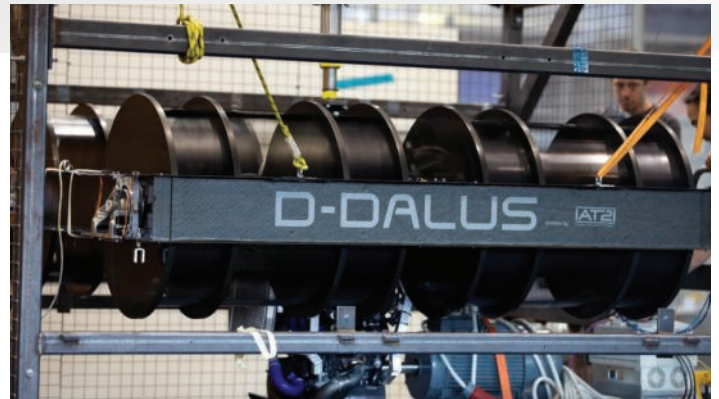
At the heart of D-Dalus are four cyclogyro rotor assemblies that are contra-rotating. The rotors are akin to those used on old paddle steamer riverboats. However, the individual blades can have their angle of attack altered via a mechanical linkage.

Though the aerodynamic body structure of D-Dalus is no doubt impressive, it is the propulsion system that really sets it apart, offering some unique characteristics over more conventional aircraft and helicopters in terms of its manoeuvrability and efficiency.

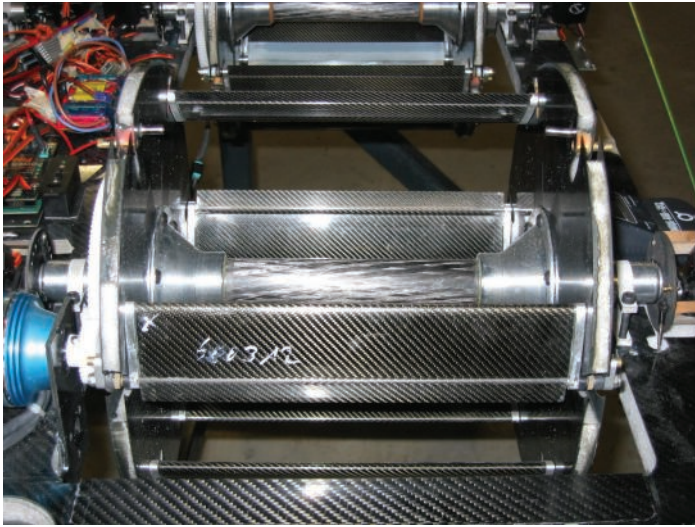
"If the centre point is exactly on the rotation axle you create no lift as the rotor blades are in a neutral position, so there is zero net thrust," says Schwaiger. "However, if you move out of that centre position you can vector the thrust around 360°."

D-Dalus can take off and land vertically as well as hover in the same way as a helicopter but it can also roll, flip or rotate very quickly around the same point. However, the real advantage comes in forward flight. It is the hover and vertical take offs and landings that is its most inefficient phase of flight – approximately 20% worse than a typical helicopter. However, this is usually only a small part of an overall mission.

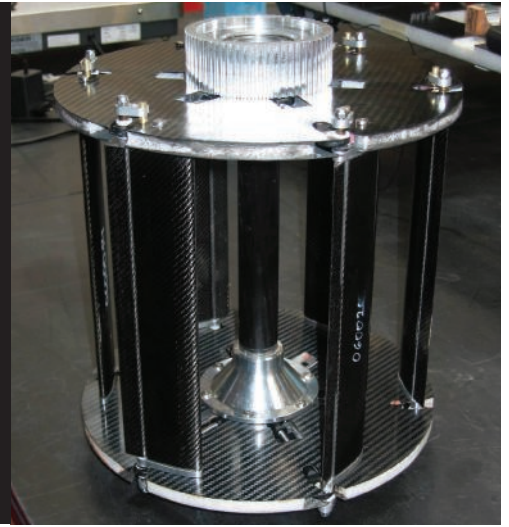
"At a certain speed all the lift is generated from the wing and a 100%







*Each cyclogyro can independently vector thrust around 360° on the z-axis to allow vertical takeoff and landing and hover capabilities, as well as efficient forward flight. The blades/aerofoils that make up the cyclogyros have their angle of attack controlled mechanically to make the system as simple as possible to maintain and operate*



of thrust is used for the forward speed," says Schwaiger. "That is a big difference over helicopters and we are a lot more economical in forward flight. So we can fly from A to B faster, higher and more economically than a helicopter. We can also touch against solid objects like buildings, trees or mountainsides as we have nothing rotating outside the structure."

Perhaps the biggest rival to this kind of propulsion system, particularly when it comes to UAVs, is quadcopters. These have been getting increasingly put to use as small UAVs in both the military and civil arena.

"Quadcopters weigh 10kg and can carry a 20kg payload while D-Dalus weighs 20kg and can take a 10kg payload," says Vice President for defence and leader of the D-Dalus project, Brigadier David Wills. "They can carry more but we can fly further, faster and more efficiently so that is the trade off."

Another key design feature for the D-Dalus team was the desire to make the propulsion systems as low maintenance as possible. The aircraft already does away with traditional flaps relying completely on vectored thrust to manoeuvre.

"Our chef engineer was a trained BMW motorcycle mechanic," says Brigadier Wills. "If there is something we ask him to do that he can't, we have to redesign it. The aim is that it will need a one-hour service every year."

The main structure and much of the rotating components of the D-Dalus are made from a lightweight carbon fibre, allowing various powerplant options to be considered. There are several possible methods of powering the four cyclogyros: it could potentially be achieved using electric batteries or an internal combustion engine. In the case of a diesel engine, it is placed in the middle of the aircraft and a gearbox is used to transmit the power to each rotor. An electric version uses batteries and each cyclogyro would have its own electric motor. Last year IAT 21 conducted a successful test flight using an engine from a racing ski-doo with around 145-150hp.

Numerous innovative concepts have been developed and applied along the development process so far. As the rotors run at over 2000rpm the forces generated at the circumference can be more than 1000g. This means that any mechanical linkage to the rotating blades to alter the angle of attack needs to operate at this extreme. The team struggled to

find a bearing that would do the job needed so they decided to develop their own patented ultra-low friction swivel bearings. These allow microsecond changes giving D-Dalus its unique combination of manoeuvrability, performance and efficiency.

IAT 21 are also examining other novel concepts and technologies to further increase these attributes. Amongst them is a revolutionary way to improve the aerodynamic performance through its rotors. The team is also examining a technique to electrically generate a plasma boundary layer that influences the airflow over the rotor blades using a Plasma Enhanced Cycloidal Thruster (PECyT).

"It is an electromagnetic plasma and is not hot," says Schwaiger. "The current is induced through the centre and there is a wire through the composite air blade. It is a pulsing electromagnetic field that is only a few microns across the surface thickness but it immediately influences the friction of the airflow and you can direct it precisely. So that allows almost pure laminar flow over the wing."

Furthermore, due to its manoeuvrable nature, the D-Dalus is also highly suited to swarming. At moment with air traffic the further apart aircraft are, the safer they are considered. However air traffic is going to triple in the next 20 to 30 years with countless more unmanned aircraft likely to be utilised for all sorts of applications.

"The only way of sensibly doing that is to swarm them," says Brigadier Wills. "So then the air traffic can control the swarm and something like the D-Dalus can go and join a swarm at higher altitude for intercontinental travel and come away from it as needed. That way you can pack a much higher traffic density into the sky."

The idea is establish the technology as a UAV and then explore the possibility of using it as a manned aircraft. That development, of course, will take a lot more time and money and IAT 21 hopes to partner with a bigger aerospace company at some point in the future. In the nearer term, D-Dalus is likely to continue flight trials next year for both military and civilian applications. "It opens the doors of possibility," concludes Schwaiger. "We know there is big interest from the European community and they want to push us."

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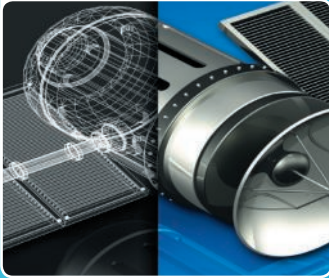


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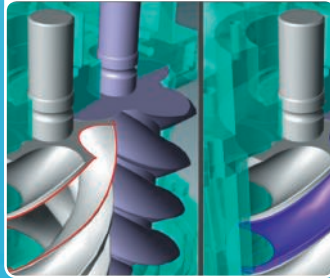
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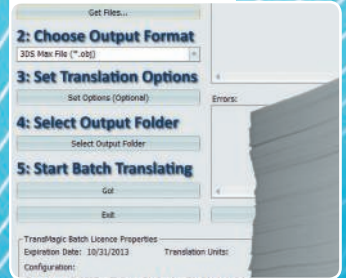
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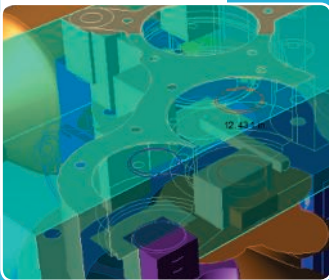
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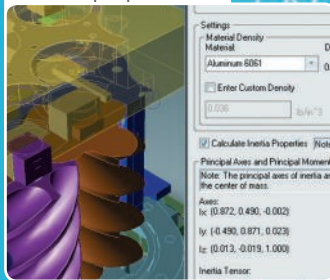
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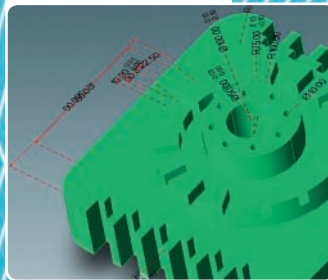
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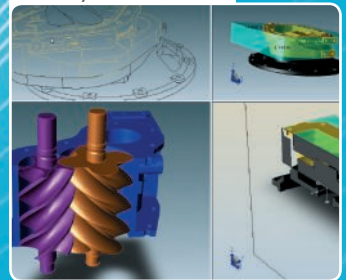
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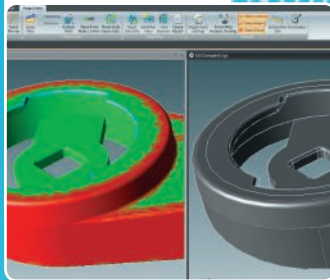
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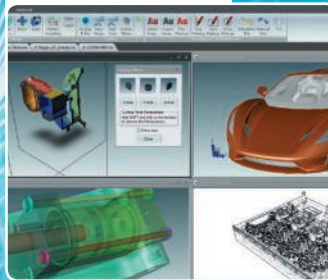
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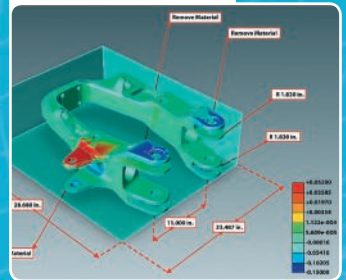
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# An energetic industry

What does motorsport have to offer the rest of industry? An enormous amount, as Paul Fanning finds out when he talks to the Motorsport Industry Association's chief executive.

**T**o some, it may seem odd that those working in a sector as prestigious and high-profile as motorsport would ever need a trade association. After all, aren't trade associations designed to give a voice to those companies who lack the individual clout to get a fair hearing from government? And, given that the Motorsport Industry Association numbers among its members some of the biggest names in Formula One, why do they need this sort of representation?

The answer, according to the MIA's chief executive Chris Aylett, is that his organisation has slightly different goals.

"Traditionally," he says, "trade associations come about because a group finds it advantageous to work together against a common enemy – usually government. However, in this industry, we've traditionally had to fight the sports' governing bodies."

This was the original purpose of the MIA when it was formed in 1994, but as Aylett puts it: "Trade Associations tend to struggle if they only have one issue", so when he joined, he set about being more proactive in the pursuit of greater business development for the MIA's members.

"What we decided," he says, "was that these guys needed to widen their net into other sectors as much as possible. Our members' innovative capabilities had a much wider market than they might previously have realised, so we made it our business to cross sector boundaries and take their innovative capabilities to new sectors."

The MIA, claims Aylett, is "open to anyone who aims to gain a commercial advantage in motorsport", which means that, as well as the engineering aspect of the business, it also represents its logistical, service and media elements. He draws a parallel between motorsport and the film industry in that "it is a glamorous entertainment business at the front end, but is underpinned by logistics and – critically – engineering".

For all his desire for motorsport companies to find new markets, however, Aylett fights shy of the term 'diversify' to describe what the MIA has encouraged. He explains: "'Diversify' is a word that people usually use to describe something they had to do. We didn't have to diversify, we chose to in order to do more business by looking at alternative, adjacent markets."

Clearly, the most adjacent market is automotive. And here, claims Aylett, there is no shortage of companies who can and have used the expertise that motorsport companies have garnered over the years.

The fundamental capability that the sector has to offer, says Aylett, is energy efficiency. "Since the first race," he says. "It's been the person who used their energy source most efficiently who has won. From the 1900s onwards, the most efficient use of energy has won races and so that is where motorsport companies have become expert – and that has encompassed everything from low-carbon vehicles to lightweight materials."

This expertise has been gathered over many years, of course, but it is only relatively recently that it has become a valuable commodity.

Says Aylett: "So energy efficiency was the absolute heart of what motorsport companies did, but they didn't really think they had anything to sell because, until recently, nobody was that interested. However, when energy costs started to appreciate sufficiently, they suddenly found the world beating a path to their door."

One of the reasons why motorsport has been able to become pre-eminent in terms of rapid technological development, says Aylett, is that the process is ingrained in what the companies involved do. "Motorsport is essentially a process of constant development," he says. "We race and rally prototypes, basically. The car you see on the grid on a Sunday afternoon is not a finished product, it is simply the latest iteration in a

constant process of prototyping.

"This makes the businesses within motorsport highly flexible and able to meet what in military terms would be described as 'urgent operational requirements' very quickly."

This process, he says, has meant that the businesses has been able to perform what in other sectors would be considered technological miracles. For examples, Aylett points to the development of KERS [Kinetic Energy Recovery Systems] and hybrid engines within 24 months of the announcement that they would be required. "It took an additional £20m in sponsorship, but it happened," says Aylett. "Why? Because there is a unique level of speed, adaptability and energy in this sector."

[www.the-mia.com](http://www.the-mia.com)

*"From the 1900s onwards, the most efficient use of energy has won races and so that is where motorsport companies have become expert – and that has encompassed everything from low-carbon vehicles to lightweight materials."*





## Driven to succeed

A former Roosevelt Scholar, Aylett began his career as a sportscar driver, eventually becoming a team owner and race promotor; while also building an international sporting goods distribution group.

Having served as president of the Sports Industries Federation, Aylett became chief executive of the Motorsport Industries Association in 1998. In 2000, he initiated a UK government review for energy efficient motorsport; three years later, he launched the world's first international Low Carbon Motorsport conference.



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# Beating the 'cold snap'



**Engineering at extremely cold temperatures has a dramatic effect on the materials used and consequently affects design. So what are the limitations of 'cold engineering' and are they being overcome? Justin Cunningham investigates.**

Engineering at cryogenic temperatures has seen many new applications in recent years. Traditionally these have been small-scale developments for niche applications.

While still considered specialised, cryogenics is being put to use in more mainstream applications such as in hospital magnetic resonance imaging (MRI) scanners, forward looking infrared (FLIR) thermal imaging cameras as well as in the mass shipments of liquefied natural gas (LNG). LNG for example has seen significant investment to stop dependency on any one natural resource from any one country.

The result of all of this is that cryogenic engineering and the associated materials have been the focus of much development. Operating at such low temperatures places a very particular set of demands on the materials used.

Experience with brittle fracture of steel ships operating in the Arctic during World War II demonstrated that, while many metals have

good properties and characteristics at room-temperature, they sometimes do not perform adequately at much lower temperatures.

For example, ferritic, martensitic and duplex stainless steels tend to become brittle as temperature is reduced and can fracture. These failures can occur without any visual warning of deformation of stretching or bulging. This has meant that austenitic stainless steels have predominately been used, as these retain most of their properties at cryogenic temperatures. These have commonly been used in Arctic locations and in the handling and storage of liquid gases like nitrogen at temperatures as low as  $-196^{\circ}\text{C}$ .

As a rule of thumb, the lower the operating temperature, the higher the alloying contents needed – particularly nickel. Austenitic steels have been most commonly applied to extremely cold environments, but are not without compromise. The metals have low yield strength that is frequently subject to the risk of early deformation. To overcome the issue, parts

and components made from castings are usually designed with much thicker walls than would normally be required.

This was the starting point for a low-temperature steel developed by German specialist steel and steel casting manufacturer, Schmolz + Bickenbach Guss. It wanted to use a martensitic based steel that could be developed to offer high strength and toughness at cryogenic temperatures to allow design engineers to specify thinner walls of cast components and save both weight and cost.

Martensitic steel materials are excellent for tempering and also display significantly higher yield strength than austenitic steels. However, particular demands are placed not only on the strength, but also on the toughness. The prerequisite for high strength at low temperatures is primarily a low content of selected trace elements. Otherwise, the segregations caused can result in embrittlement within the casting.

Dr Petra Becker, head of research and



development at Schmolz + Bickenbach Guss, says: "For us, the challenge lay in achieving reliable manufacture of the castings with a focus on optimised structure and therefore adequate strength – without cracks appearing in the casting volume."

The result was the production of the martensitic low temperature stainless steel, Dux Cryo, which Schmolz + Bickenbach Guss has recently started using in replacement of the more traditional austenitic steels.

#### Extensive development work

The starting point for the research was the nickel alloy steel X8Ni9, which is commonly used as a standard sheet or forging material for cryogenic applications. However, due to the high cracking sensitivity of its coarse-grained primary structure, no casting version of the material existed.

The aim was to modify a X8Ni9 alloy to make it suitable for casting processes by combining findings from analytics, metallurgy and heat treatment. Extensive materials research, development and testing was combined with external expertise to see if it was possible.

One of the early key findings identified a number of key requirements, including the importance of purity to any input substance, its melting point and the shaping technology applied. Additionally, it found that heat treatment parameters had to be precisely controlled.

Based on these findings, the team set about experimental production to cast the modified nickel alloy from melting and casting through to heat treatment and thorough mechanical testing. The cast test pieces were subjected to extensive visual and colour penetration checks that included ultrasound and X-ray examinations.

This analysis made it possible to demonstrate that the alloying concept together with the selected cooling conditions produced a crack-free casting. Furthermore, a series of heat treatment tests took place that further optimised the new steels mechanical values.

Becker explains: "Because of its chemical composition, the new material is more advantageous than austenite steel [and although it has] a similar nickel content, [Dux Cryo] contains no chromium. The further advantage is it can be mechanically processed with no problem."

Dux Cryo has already found a number of applications, with more being identified. It is generally considered suitable for applications carried out in temperatures between -100°C and -196°C. This temperature range makes it particularly suitable for cryogenics such as dry ice, liquid oxygen and liquid nitrogen.

Another area that has been identified is for air liquefaction and separation systems, where air is separated using a thermal separation processes that extracts nitrogen, oxygen, argon and other noble gases in high-purity



**"Because of its chemical composition, the new material is more advantageous than austenite steel [and although it has] a similar nickel content, [Dux Cryo] contains no chromium.**

**Dr Petra Becker**

concentration in both liquid and gaseous forms.

Another application with a promising future is the liquefaction of natural gas (LNG). Here, the natural gas is cooled to as low as -164°C. The rise of LNG terminals in the UK has seen the demand for cryogenic components substantially rise in recent years.

"This material could also have interesting potential in the areas of soil freezing, industrial refrigeration technology and oil sands extraction," says Dr Becker. "The same applies for all components that are used at low external temperatures such as whether pumps in Alaska or deep-sea offshore applications."

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## Types of Stainless Steel

The three main types of stainless steels are austenitic, ferritic, and martensitic, identified by their microstructure or predominant crystal phase.

Austenitic steels have austenite as their primary phase and alloys contain chromium and nickel, and sometimes manganese and nitrogen. These are not hardenable by heat treatment.

Ferritic steels have ferrite as their main phase and contain iron and chromium. It is

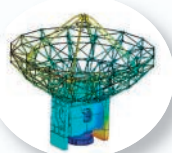
less ductile than austenitic steel and is not hardenable by heat treatment.

Martensitic steels are low carbon steels may be tempered and hardened. Martensite gives steel great hardness, but it also reduces its toughness and makes it brittle, so most are not fully hardened.

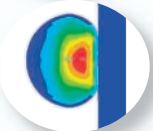
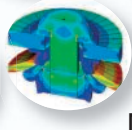
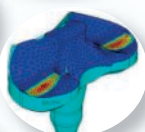
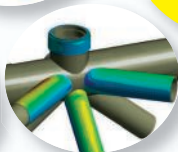
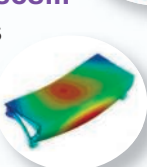
\*There are also other grades of stainless steels, such as precipitation-hardened, duplex, and cast stainless steels.



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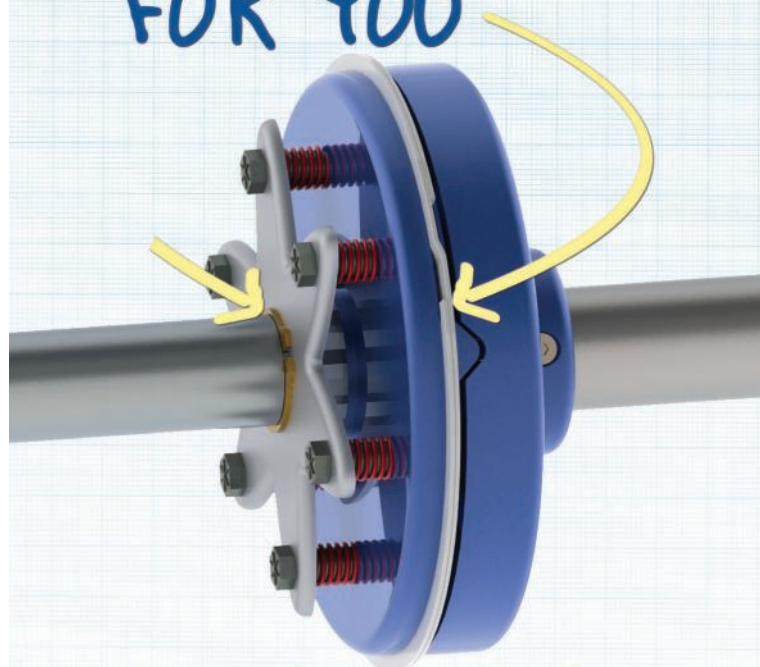


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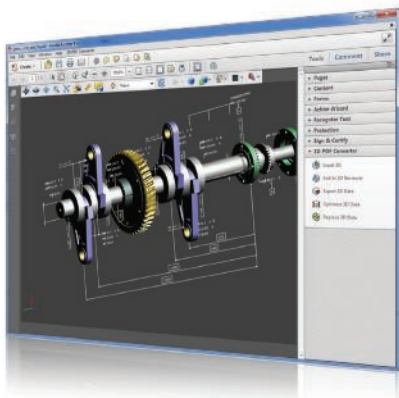
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# Software *drives* automotive innovation

**Cutting edge software is helping iconic British brand Aston Martin blend design techniques of the past with those of the present. Laura Hopperton reports.**

World-renowned for its understated English styling and hand crafted design, Aston Martin has been making cars for the stars, and for a certain secret agent, since the 1960s.

Now in its centenary year, the company shows no sign of slowing down in its quest for automotive perfection. But how does the iconic brand ensure its designs remain timeless, classy and beautiful?

Like many premium car manufacturers, Aston Martin views the design process as a skill that blurs the line between engineering and art. Much of the process still involves physically sculpting surfaces out of clay, but the company's 50-strong design team has also been on a mission to develop and strengthen its digital capability in recent years.

"We are still very reliant on the physical process at Aston Martin – it's deep within our brand DNA – but we now augment it with a robust digital process," says Neil Lloyd-Sherlock, Digital Surface Manager at Aston Martin. "Earlier

this year, we made the decision to switch to Autodesk Alias for 100% of our digital development – a move which has helped us accelerate the design process, improve efficiencies and increase creativity."

Because the designers work so closely together, and often on each other's models, the decision to standardise to one tool was an easy one, says Lloyd-Sherlock.

"There's always that potential loss of creativity in the process where engineers start interpreting what designers have done. Switching solely to Alias has resulted in a seamless flow of surfaces all the way from the designer's initial sketch to production. There's no room for interpretation when we release to studio engineering because we're giving the same format of data every time. We're all speaking the same language."

Another benefit of the software the design team has found is the time it saves to go from 'art to part'. This is especially true when it comes to wheel design. The process of sculpting by hand used to take up to six months before a one-off wheel design was up to the standard and the geometry could be sent to the engineering department.

Now, the design team only has to draw a segment of the wheel such as a spoke and Alias will mimic that section all the way round the wheel. That data can then be used to produce a photo-realistic visualisation to share with others in the

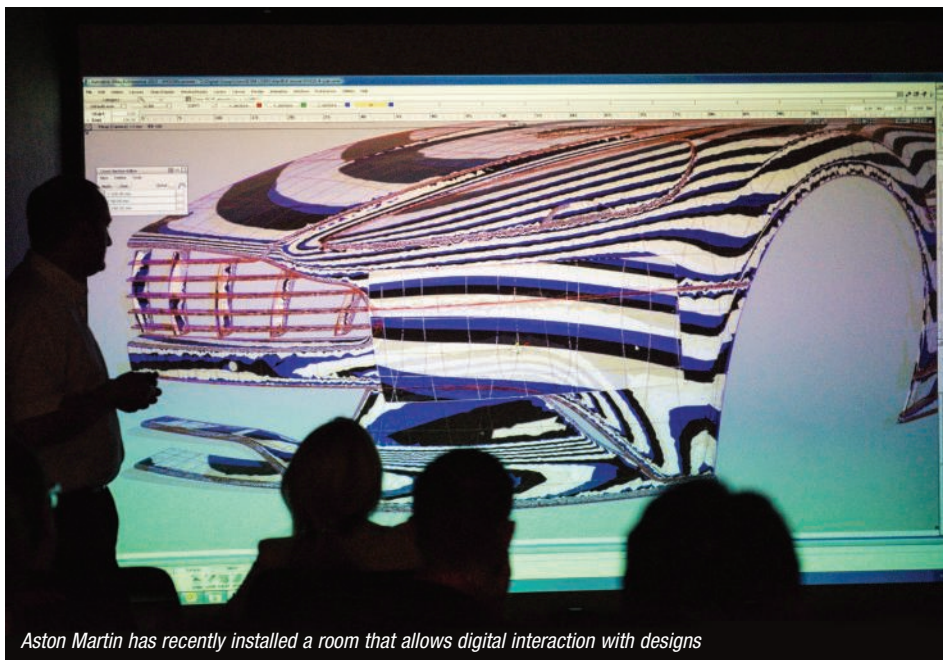


team and can also be sent to a 3D printer to produce a prototype.

"This means that the design can quite literally go from 'art' one day to 'part' the very next," explains Lloyd-Sherlock. "We have a range of rapid prototyping machines in-house that are in use 24 hours a day, seven days a week. The digital team and designer can now get an approximate feel about surface aerodynamic performance based on quick iterations of surface much earlier in the process, prior to handing it over for more in-depth and sometimes timing consuming analysis."

Similarly, the design team recently had to create a new deck lid for one of the cars when the aerodynamics changed following the installation of a new engine. This new deck lid with larger tail flip was designed in Alias and tested aerodynamically in the software before a full-scale part was rapid-prototyped and metallised.

Within just two weeks of releasing the design data, it was then fitted to the car and taken to the



*Aston Martin has recently installed a room that allows digital interaction with designs*

race track to be tested.

"Instead of waiting for a part to be made and tested in a wind tunnel, we want to be able to experiment virtually within the early stages of the design process so we can focus our design effort on it and mature it from that point forward," says Lloyd-Sherlock. "If we can be confident that a design will deliver a certain level of performance before we do hand it over for more in-depth analysis, then that is going to save us time, effort and obviously money in the future."

Aston Martin has recently installed a large-screen, high-definition projector coupled with surround sound into a room where designers, as well as other members in the organisation, can come together and interact digitally with the designs.

Autodesk's flagship real-time rendering product, Showcase Pro, has enabled the design team to showcase the latest automotive models or concept designs quickly and professionally, through photorealistic visualisations and animations, before they reach production.

"We certainly have much more reliance on computer aided simulation to support the verification of prototypes for our products nowadays," Lloyd-Sherlock continues. "The challenge has always been getting the balance right between functionality, speed and aesthetics. Aston Martin is known for creating visual masterpieces, on the inside as well as the outside of its cars, but we also have to ensure parts are strong, lightweight and manufacturable. Alias helps us strike that balance."



*The time taken from 'art to part' is now much reduced*

So what does the future hold for Aston Martin and the way it goes about the design process? Will new technologies such as simulation software slowly overtake more traditional methods like clay modelling altogether?

"We do stick to our core values within design and our core techniques – it's a very much a physical studio – we still like to verify what we do in digital form, but look at things in 3D as well," says Lloyd-Sherlock. "What we're trying to do with new technology is augment the traditional values – adding as much as we can to make the design process more creative, more efficient. We also get more iterations within the process without affecting the overall company's ability to deliver."

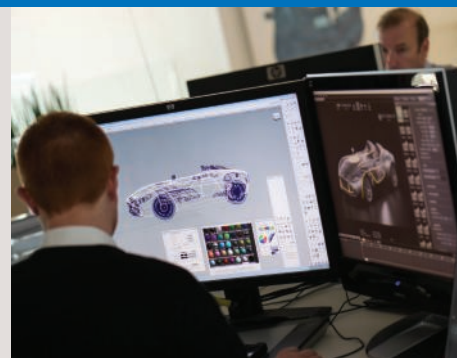
"OEM studios in the past have delivered products based on an almost total virtual design processes. But I think that has been only a limited success and the aesthetics have perhaps often suffered. We are very keen on the physical aspect of the design world and will always acknowledge its importance in our DNA. That's what makes a modern Aston Martin: that very strong bond between the physical and virtual world."

**[www.autodesk.co.uk](http://www.autodesk.co.uk)**

## Designing by numbers

From the first sketch at the start of the design process – produced digitally on a Wacom tablet or imported from paper into Autodesk Alias – through to digital validation on the computer screen and then physical validation with a prototype part, all members of the team play a role in approving the design. This means that any issues can be spotted immediately preventing costly changes further down the line in the tooling and manufacturing stages.

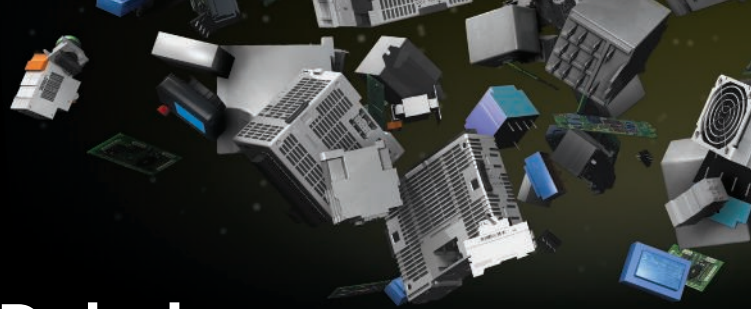
An example of this is the design of a wheel. Previously, it would be sculpted by hand. This process could take up to six months before a one-off wheel design was up to the standard where the geometry could be sent to the engineering department. Today, the designer only has to draw a segment of the wheel on a Wacom tablet and Alias will mimic that section all the way round the wheel.







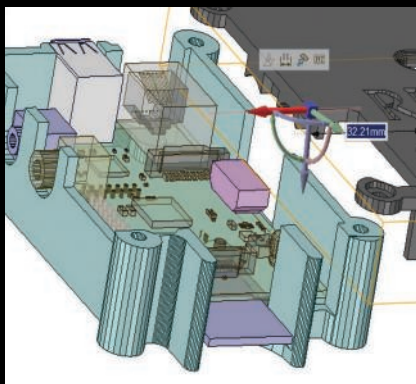
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# Affordable, accessible 3D design in the hands of all engineers

## The time challenge

There is a common and growing challenge among engineers of all disciplines, whether they are involved in electronics or machine design. This challenge is 'time'. Recent studies have found that engineers suffer from a lack of time caused by a higher volume of projects and shorter time-to-market windows. On top of this, a loss of specialisms in ever-decreasing engineering departments has led to difficulties in them keeping abreast of new technologies.



With a 75-year heritage in helping engineers, RS understands very well the issues confronting the engineering community, and how this lack of time is stifling creativity and innovation. This is why, four years ago, the company chose to tackle the problem head-on by creating a centralised online resource, where engineers could not only source and purchase thousands of products quickly and easily from multiple global manufacturers, but also had access to a new phenomenon – free, intuitive online design tools. Today, DesignSpark.com has hundreds of thousands of engineers from all corners of the world regularly visiting the site to download an ever-expanding selection of time saving design tools, at no cost to them. Among these is a library of more than 38,000 3D models in 24 formats, available to download for free – saving engineers days of manual creation.

Even with the aid of downloadable 3D models, the problem still existed that only 5% of the world's engineers had access to powerful 3D modelling tools, either because they were too expensive,

or because the complexity meant that only CAD specialists knew how to use them. Until now, that is.

## Free, intuitive 3D design tool saves time

Working with 3D design company, SpaceClaim, RS has developed a tool that puts 3D design into the hands of every engineer. Called DesignSpark Mechanical, the powerful and intuitive new gesture-based 3D modelling software enables users with little or no experience in 3D design to create complex geometry from scratch. DesignSpark Mechanical's direct modelling technology uses simple gestures that enable real-time editing and instant feedback – very different from traditional feature- or parametric-based 3D CAD software, which requires a steep and long learning curve. All basic designs can be achieved quickly and easily by using the software's four basic tools – Pull, Move, Fill and Combine – as well as familiar Windows keyboard shortcuts such as cut/paste, undo/redo.

The software can remove bottlenecks in the early design process by allowing changes and additions in seconds, rather than having to wait for the CAD department using the traditional 3D tools to rework the design. DesignSpark Mechanical can also be used as a complementary 3D tool in the product development process for the creation of early concept designs, for instance, alongside 3D CAD tools that are already in use today.

The past 15 years has seen a radical change in the way the design process works. Back then virtually every design followed the same flow, starting with the

electronic circuit design followed by the mechanical design of the case, the user interface and connections. Today the process is in many cases steered by the mechanical design, due to spacial and other constraints, resulting in the need for greater collaboration across the engineering disciplines.

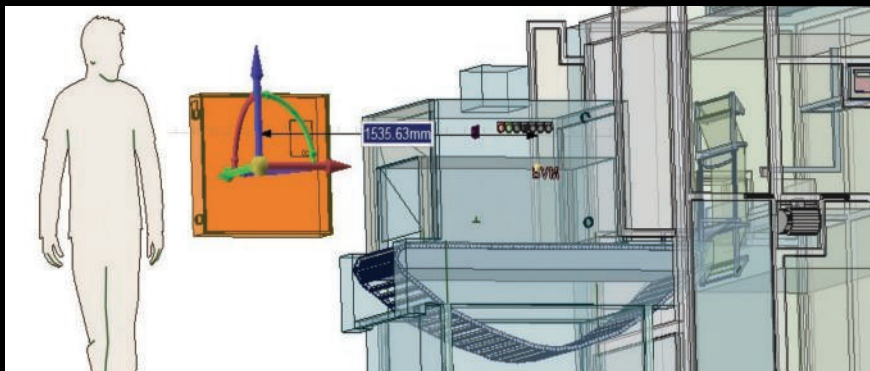
## Electronic and mechanical design worlds merge

DesignSpark Mechanical has been created to bridge the gap between electronic and mechanical design. Circuit layout files can be imported in IDF format from any PCB design tool, including DesignSpark PCB. 3D designs can also be exported in STL, the standard file format to enable rapid prototyping builds and computer-aided manufacturing, with 3D printers now enabling engineers to have functioning prototypes of their designs in their hands almost as soon as they are completed. DesignSpark Mechanical also reads in the purchasing data from parts downloaded from the RS website to automatically create Bill-of-Materials (BOM) quotes.

To add to its proprietary 3D model library, RS has also collaborated with 3D content company TraceParts to provide access to millions of models from the online [tracepartsonline.net](http://tracepartsonline.net) CAD portal in DesignSpark Mechanical format.

DesignSpark Mechanical is available for free download from [www.designspark.com/mechanical](http://www.designspark.com/mechanical).

Support can be found on the DesignSpark community at [www.designspark.com](http://www.designspark.com).



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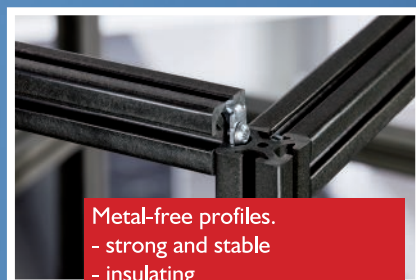
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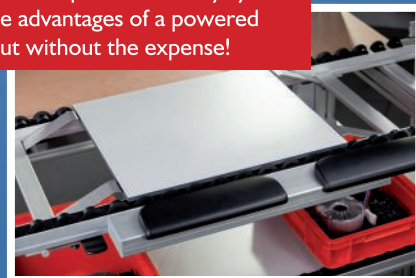
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# Direct modelling sparks interest

**Direct modelling software SpaceClaim has taken a new direction, this time collaborating with electronic components supplier RS Components to produce 3D design software for non-CAD experts. Paul Fanning reports.**

DesignSpark Mechanical, the new 3D design software from RS Components and Allied Electronics, is ideal for engineering and conceptual design, bringing the advantages of 3D design to every engineer across the world. An intuitive and powerful user interface makes DesignSpark Mechanical perfect for CAD novices and experts alike and ideal for those looking to transition from 2D to 3D design.

The software applies a cut-down version of SpaceClaim's 3D Modelling software, which, by employing a direct modelling allows users to simply click, drag and drop geometry within the design to create a design. Says RS Components' head of applications strategy Martin Keenan: "This is a design tool to meet the needs of everyone in the design process. It is highly intuitive with a short learning curve, as well as being free of charge for ultimate accessibility."

Essentially, Design Spark Mechanical is a means to allow engineers to build 3D enclosures around their PCB designs. This is clearly not intended to produce a final, production-ready model, but does allow more accurate prototypes to be created, meaning fewer changes to design are required later on, thus avoiding one of the greatest bottlenecks in the design process.

Clearly Design Spark Mechanical enables rapid creation of highly professional concept designs for product proposals. Equally, the powerful and intuitive gesture-based modelling allows anyone to create geometry and create solid models without the complexity of traditional feature-based CAD. There is therefore no need to be a CAD expert: electronics and industrial engineers can learn to use the tool within minutes and easily



want to put SpaceClaim in front of as many potential users as possible and this collaboration is a very exciting opportunity for everyone...and obviously we're keen to sell as many of those users up to the full package of SpaceClaim Engineer as possible." This, he points out, is clear as – despite being branded as Design Spark Mechanical – no user will be left in any doubt that the engine that underpins it is SpaceClaim's.

collaborate with other disciplines involved in the product specification and design process.

Of course, from RS Components' point of view, this is not merely an altruistic gesture. Design Spark Mechanical allows users to download CAD models of components directly from its library of parts at [www.traceparts.com](http://www.traceparts.com).

This obviously explains where the interest lies from RS Components, but what about SpaceClaim? From SpaceClaim's perspective, of course, this represents an excellent opportunity to put direct 3D modelling in the hands of those who may otherwise never have had access to any form of 3D CAD before.

Chris Randles, SpaceClaim's CEO, is happy to acknowledge this strategy, saying "Of course we

Randles also indicated that this sort of collaborative model of increasing SpaceClaim's reach and popularity is something the company is keen to pursue if the right sector or market becomes apparent.

Obviously, Design Spark Mechanical only represents only a restricted version of SpaceClaim's software and anyone wishing to do anything more complex will need a more sophisticated package, but there can be little doubt that it is another significant step in the democratisation of 3D CAD.

[www.rs-online.com](http://www.rs-online.com)  
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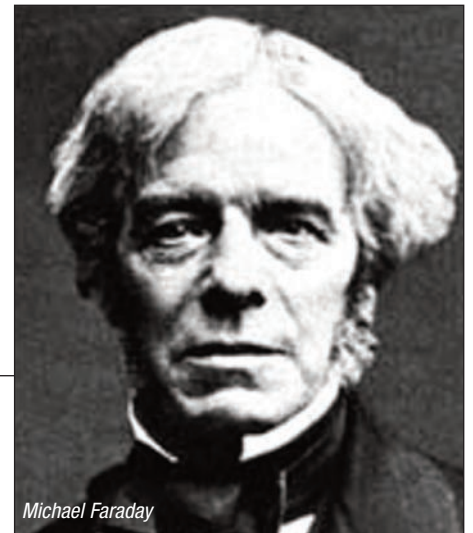
# Fighting the Faraday Cage

**A hard and fast, apparently insurmountable rule of physics for more than 150 years, the Faraday Cage effect may finally have been overcome, as Paul Fanning reports.**

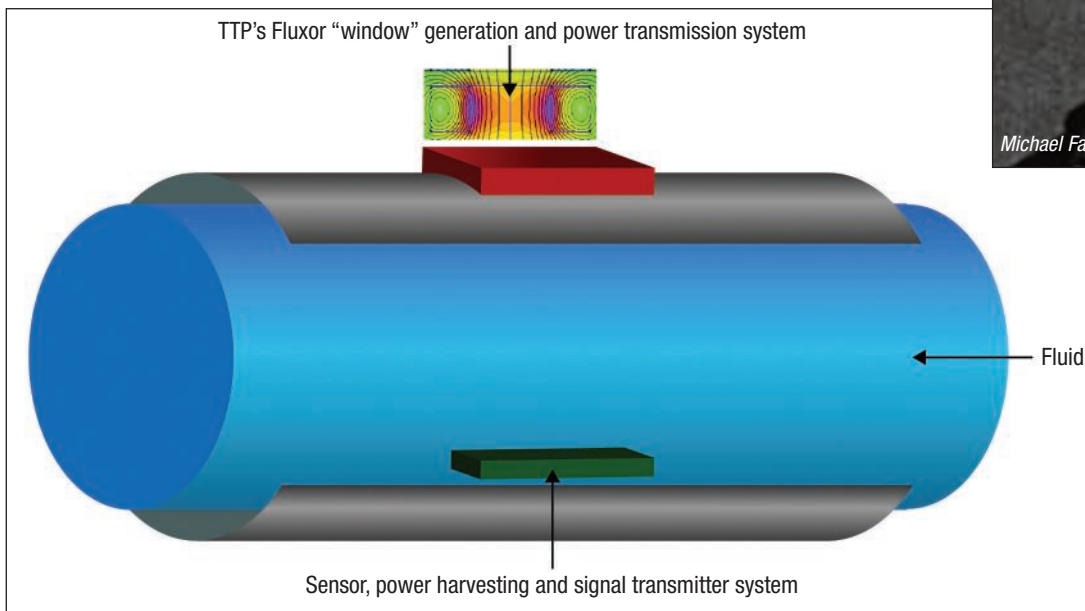
The 'Faraday Cage' effect has long been an apparently insurmountable fact of engineering. The fact that a metallic enclosure prevents the entry or escape of an electromagnetic field has been both a boon and an obstacle to engineers since the effect was first observed in 1836 by the eponymous Sir Michael.

Since that time, the effect has become one of the better known aspects of physics, becoming a staple of science lessons, as well as appearing in

Of course, as previously mentioned, the Faraday Cage effect does have useful applications, from preventing leakage from microwave ovens to lightning strike protection and screening data cables. However TTP's new patent-pending Fluxor technology will have major benefits for power and data transfer through metal shielding. TTP is already using the technology for monitoring fluid levels in steel pipes, taking readings from medical implants and measuring data from inside F1 engines.



Michael Faraday



interrogator unit with a permanent magnet or electromagnet could be placed on top of a fixed sensor through a metal wall. A Fluxor window is opened to transmit power to energise the sensor and transmit a signal back – all without the need for physical openings in the enclosure.

"The ability to overcome the shielding characteristics of a Faraday Cage opens up many exciting opportunities, combined

film plots and other aspects of the media. Today, it is probably most commonly understood as the reason why it is impossible to get a mobile phone signal in a steel lift.

However, engineers at The Technology Partnership (TTP) now appear to have developed a way to break through the Faraday Cage. Part of the TTP Group, 300-strong TTP is a leading product development company based in the Melbourn Science Park in Hertfordshire. The technology the company has developed is called 'Fluxor'.

TTP's Fluxor method creates a 'window' for electromagnetic transmission of power and data by applying a strong DC magnetic field, which lines up the magnetic dipoles in the material to 'saturate' a small area of the metal screen. This reduces the permeability and increases penetration to make it possible to transfer electromagnetic power and signals. Experiments conducted by TTP using steels from 5-15mm thick show that the optimum operating frequency range is in the region of 400-500Hz.

In a typical operating scenario, a portable

with new battery-free, ultra-low power wireless sensor technology also being pioneered at TTP," says Dr Allan Carmichael from TTP. "We see these developments as major enablers for delivering the Internet of Things that will allow billions of devices to communicate and interact with each other. We are currently working with a number of customers on use cases that exploit the Fluxor technology and expect to see practical applications deployed in the next few years."

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

# QTC drills into new application

**Peratech's revolutionary Quantum Tunnelling Composite has found a new sensing application. Paul Fanning reports.**

Peratech has announced that Globalpower has taken a licence for the UK company's Quantum Tunnelling Composite technology. The first product to feature QTC sensors is its new Touch 12V portable electric drill.

QTC technology was first commercialised at the beginning of 2006 and Peratech is currently working with a number of key technology clients who are implementing QTC sensing technology within their own products. Its business is essentially the IP licensing model that has been proven to be rapidly scalable and



**"These new inks enable QTC switches and sensors to be printed using standard printing techniques. This makes them very easy and inexpensive to mass produce."**

David Lussey

highly profitable for the likes of ARM and many others. QTC technology has been on the scene for some time and has received extensive coverage in the pages of both *Eureka* and *Engineering Materials*, while Peratech itself took the Judges' Special Award at the 2011 British Engineering Excellence Awards. However, while the technology has a range of potential applications, the move to becoming a

widely used material solution is rarely fast.

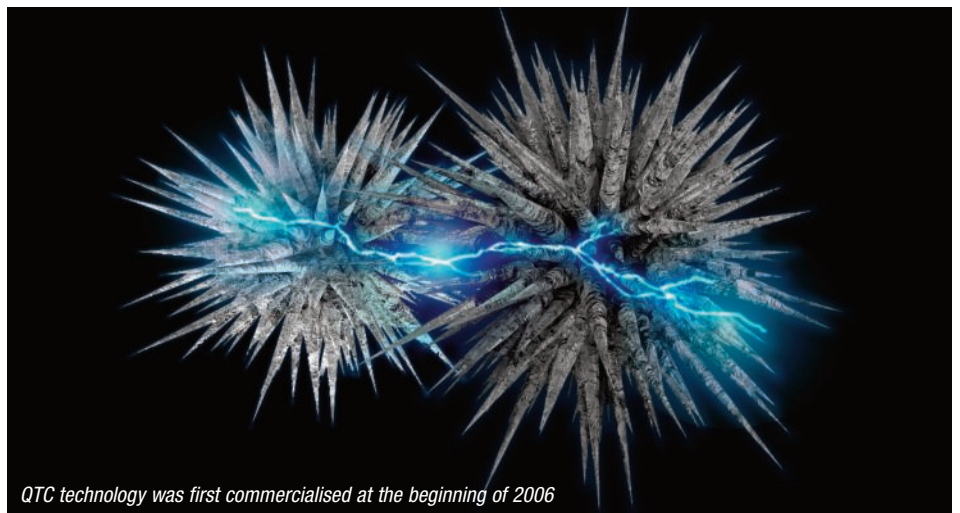
The core of QTC technology is that QTC materials change their resistance when a force such as pressure is applied. This enables pressure sensors to be created that function as on/off switches or with a resistance change proportional to the pressure applied. The sensitivity can be fine-tuned to suit the application right from being so sensitive that QTC materials can sense pressure through glass for touchscreen applications to ultra-rugged designs for military use.

Peter Hosking, head of Globalpower, said, "The look and feel was a critical part of the design. QTC touch technology enabled us to create a really intuitive, touch control interface that is very responsive with the slightest changes in pressure on the sensor, instantly changing the speed of the drill. Peratech's touch technology forms the very core of the design and our marketing of the new Touch drill.

"The drill is also designed to be used in the toughest of conditions with a five-year

warranty, so we needed to have a switch that was ultra-reliable. QTC sensors have no moving parts, so they have a very long operational life and are proof against the dust, dirt and liquids that always go hand-in-hand with drilling."

David Lussey, Peratech's chief technical



*QTC technology was first commercialised at the beginning of 2006*



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officer, adds, "This is start of a new phase for Peratech. We are developing a new range of QTC inks with the assistance of the UK Centre for Process Innovation. These new inks enable QTC switches and sensors to be printed using standard printing techniques. This makes them

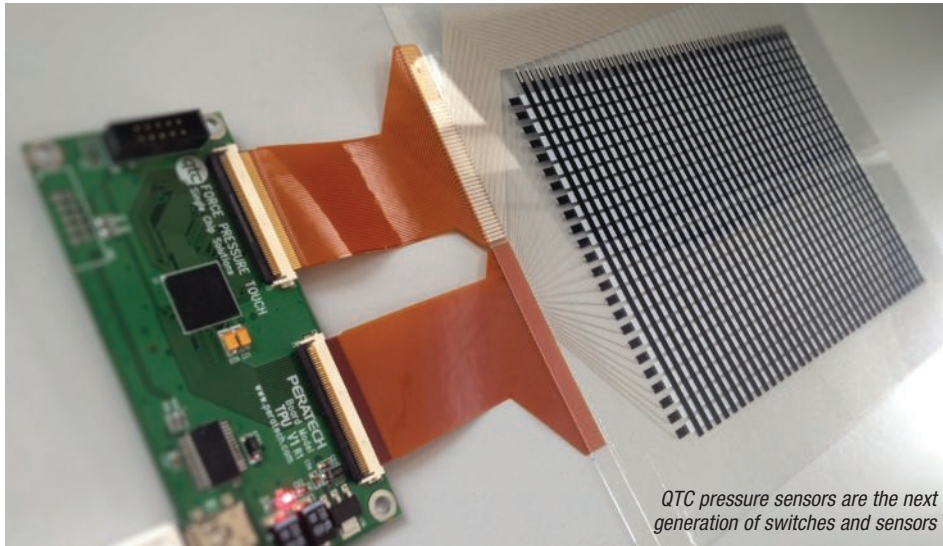
very easy and inexpensive to mass produce plus they can be printed at the same time as other printed electronic components onto plastics, textiles, etc. QTC pressure sensors are the next generation of switch and sensor technology that can be used in a wide variety

of control interface applications ranging from touch screens and white boards to vehicles and household goods. These solid state sensors have no moving parts, nothing to wear out, and no air gap to become contaminated."

Peratech makes extensive use of Government grants to help fund new Research and Development into Quantum Tunnelling Composites. As a result, there are three PhD students working on this area of material science along with two University laboratories.

"This is all done on a commercial basis," explained David Lussey, "and helps Peratech develop the whole area of QTC material science much faster than we could do on our own. Thanks to this government funding, we have doubled the number of patents that we are filing every year. This will really accelerate our presence in the market so that, within ten years, QTC technology could be in almost every electrical and electronic device providing innovative, ultra-reliable, human/machine interfaces."

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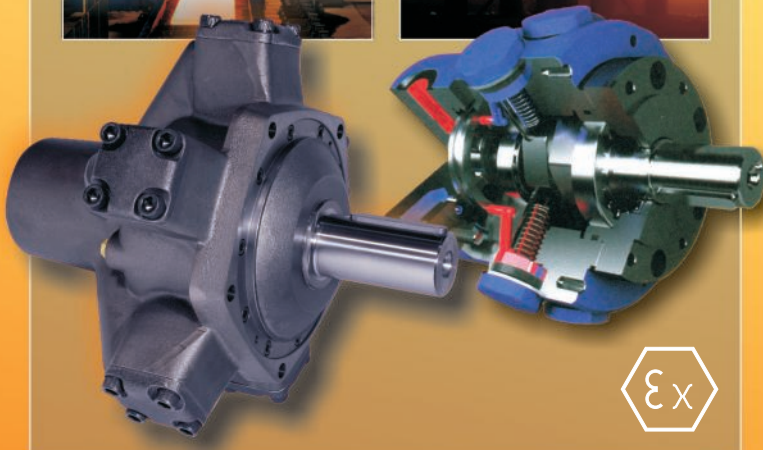
*QTC pressure sensors are the next generation of switches and sensors*



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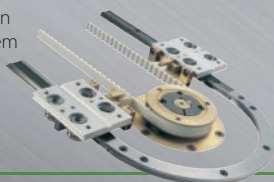
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# Linear gives some straight answers

**Linear motion is often not well understood, but has a wide range of uses. Here, Paul Fanning looks at some examples of this technology and its applications.**

For high-precision motion control of machine tools and other production machinery, design engineers and end users increasingly require ready-to-fit, complete linear motion systems with integrated features such as sealing, lubrication, measuring and braking.

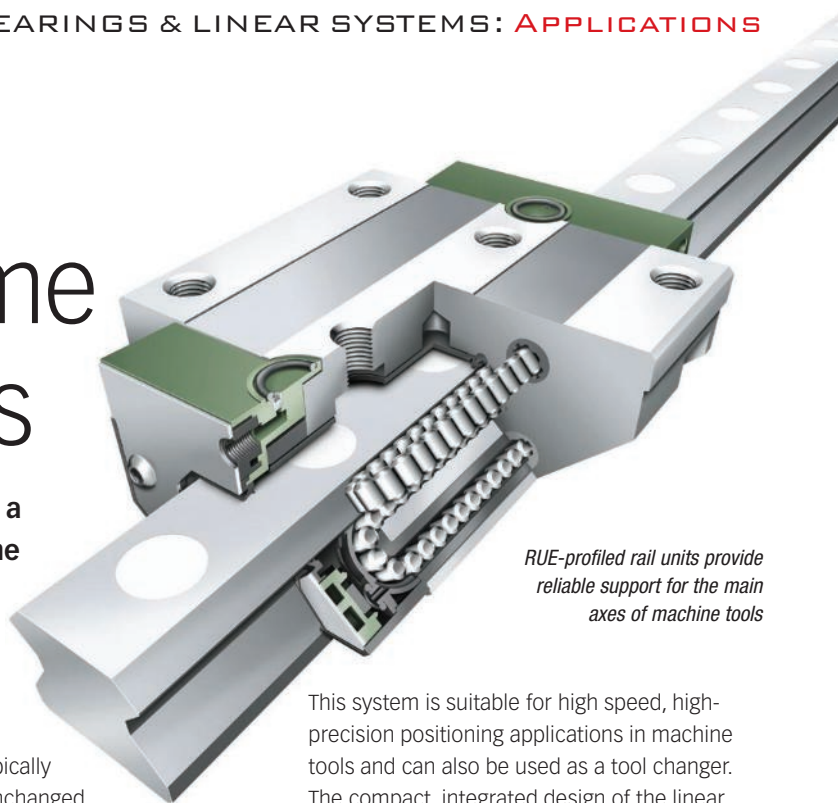
Schaeffler has developed a comprehensive range of standard, ready-to-fit complete linear guidance systems for machine tools, including profiled rail linear guides, linear actuators, shaft guidance systems, linear recirculating roller bearings and guideway assemblies, as well as a range of accessories such as damping carriages, seals, equipment for long term lubrication, clamping and mounting components.

However, manufacturers and design engineers are demanding higher load-carrying capacities, longer term precision, improved dynamics and higher machine availability. In response to these requirements, Schaeffler's premium quality X-life profiled rail linear guidance systems offer improved

performance in terms of higher running speeds (typically 40% higher) with unchanged load carrying capacity and rigidity for highly dynamic machine tools.

Schaeffler's RUE range of roller type profiled rail linear guidance systems have been working reliably for many years in machine tool applications. RUE-profiled rail units provide reliable support for the main axes of machine tools.

For feed and discharge systems, tool changers and handling systems, Schaeffler ready-to-mount linear actuators are the preferred choice. The MKUVS 42 LM, for example, is a linear actuator with a direct drive.



*RUE-profiled rail units provide reliable support for the main axes of machine tools*

This system is suitable for high speed, high-precision positioning applications in machine tools and can also be used as a tool changer. The compact, integrated design of the linear actuator system means it requires less space to install. For extremely high loads that need to be transported in vertical axes, Schaeffler MDKUVE tandem actuator module is ideal.

HepcoMotion's GV3 linear motion system for arduous applications is continuing to develop. Build quality is key to its superior performance and so, too, is its 'V' operating principle.

Continuously developed for more than 50 years, the 'V' concept makes the GV3 linear motion system the perfect choice in tough environments such as offshore engineering. One of the major benefits is the self-cleaning action that eliminates contamination of the slideway.

Also significant is the extent of travel achievable by GV3, fitted with HepcoMotion cap seals, before re-lubrication is required.

For most harsh environment applications GV3 is therefore a fit and forget system.

The inherently low friction of the GV3 system means it positively thrives in high-speed conditions, especially in applications which also require prolonged accuracy. In addition to low noise, low friction also allows the system to run dry, if needed.

Low friction also means low energy consumption and long re-lubrication intervals cut maintenance costs. By comparison a recirculating ball monorail is highly susceptible to dirt ingress in the ball track, causing the block to fail catastrophically and permanently damage the rail.

The need for a replacement bearing is the



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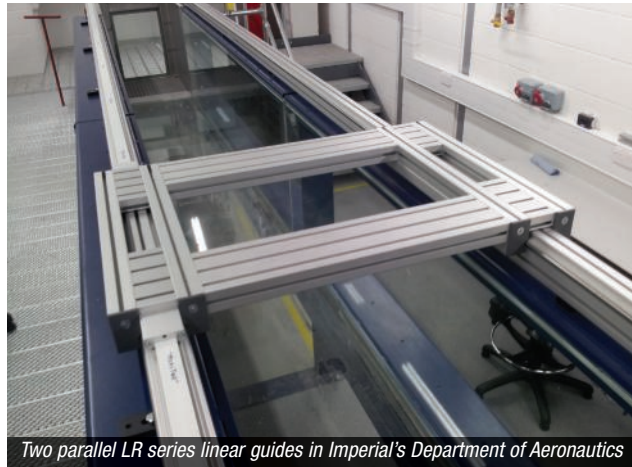


worst that can happen to a GV3 system, a task that can easily be accomplished without affecting the slide. Furthermore, thanks to its adjustable eccentric bearings, GV3 will continue to work even when worn.

If corrosion resistance is needed, the customer can specify the HepcoMotion SL2 range which is directly interchangeable with GV3 and made to the same specifications. Indeed the range offers a choice of materials to achieve the best compromise between corrosion resistance and wearability. Different bearing options complement this flexibility.

Superior surface finish also plays an important part in the longevity of the GV3 system. Quite simply, the better the finish, the less likelihood of surface corrosion and for this purpose HepcoMotion has invested heavily in capital equipment to provide this performance edge.

HepcoMotion harsh environment and



Two parallel LR series linear guides in Imperial's Department of Aeronautics

corrosion resistant products are not just restricted to basic X-Y-Z linear motion. It also provides complete ring and track systems.

Linear motion is often associated with certain industries, but a very atypical application comes from LG Motion. As an addition to its cutting-edge fluid mechanics research facilities, the Department of

Aeronautics at Imperial College London

The servomotor-driven positioner is based on two parallel LR series linear guides from LG Motion's associate MiniTec UK. The mechanical system is configured as parallel mounted belt-driven and non-driven slides on stainless steel precision shafts, supporting a 600mm x 600mm carriage that transports test models with precisely-defined velocity/time waveform profiles at speeds up to three metres per second over an 8m travel range. The complete system comprises the LH series linear slides driven by a powerful brushless servomotor with

resolver feedback and high precision gearhead, plus a cabinet-mounted single axis servo drive and motion controller.

The new 9m water flume has two main modes for fluid mechanics research at the Department of Aeronautics. The first concerns understanding the behaviour of complex structures such as oil platforms in sea state



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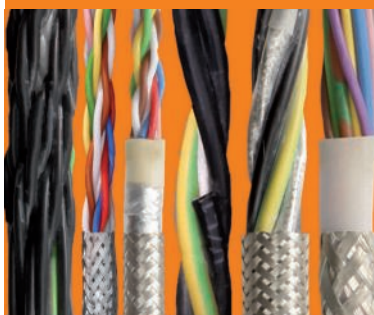
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studies by simulating current and tidal conditions to create vortex induced vibrations through turbulence. In the second mode the water tank is used in similar way to a wind tunnel except that water rather than air is used as the forcing medium. An area being studied in this way is flow-induced behaviour of cylindrical models that may represent surface piercing pipelines or marine-based tower structures such as wind turbines, and how different surface features and coatings may influence their prolonged use.

For both of these modes, the positioning system drives the carriage mounted model to follow a precise waveform profile initiated from an analogue demand signal from the flumes' main controller or, for set-up and other assessment purposes, directly from the motion controller via simple BASIC-like PC programming. The waveform simulates the

required modelling conditions whilst a series of high precision sensors collect the relevant structural behaviour information with the results presented through a dedicated data acquisition system.

For a system with such high-speed and high acceleration capability, safety was a main concern. The linear slide includes a light curtain operating over the full length of its

main working side. Adjustable overtravel limit and datum switches are conveniently mounted on the T-slots of the extruded aluminium profile LH slides. The light guard and limit switches are wired to the cabinet mounted motion controller which includes hardwired and software programmed safety features to ensure safe shutdown under emergency conditions.

LH series linear slides are available for customised travel lengths with belt transmissions and various motor technologies available to suit the application. The addition of double-row angular contact bearings on stainless steel precision shafts increases the load carrying and speed/acceleration performance for the 9m water flume.

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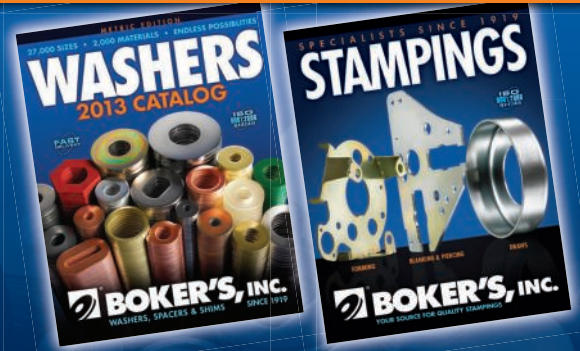
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# Hydraulics harness wave power

**The 2013 winner of the UK Dyson Award is a highly novel system that employs hydraulics to generate renewable power from the ocean waves. Paul Fanning reports.**

The west coast of Scotland is home to some of the most powerful and consistent wave generating potential in the world. Despite 11,800km of coastline and the possibility to produce between 40-70KWh per metre, we do not currently use even 1% of this free, powerful resource.

With the increased demand for energy over the next 50 years, Renewable Wave Power (RWP) is attempting to remedy this situation with a new and efficient power take-off structure. RWP is a semi-submersible multi-axis wave energy converter, specifically designed to run in the Orkneys, Scotland.

The design has the unique ability to absorb the forces from the peaks and troughs of the North Atlantic waves in any given direction. The multi-axis structure's test results highlighted the increased potential and efficiency to convert external movements into hydraulic pressure, compared to conventional linear devices.

Inspiration for the project came from a variety of sources. First, as inventor Samuel Etherington puts it: "[I had a] personal awareness that there simply must be alternative energy generation sources in the mainstream energy production industry if we are to avoid destroying the landscape that we live in."

Secondly, from kitesurfing and sailing off the west coast of Cumbria, he became conscious of the sheer power within waves and the real potential for energy generation. Finally, diving trips in the Orkneys has put the world's wave

and tidal development technology at the European Marine Energy Centre firmly in mind. In addition, he claims, living in the Lake District, it is easy to see why developing renewable energy is vital as he feels the global environmental, social, and political effects will continue to escalate if renewable energy does not play a bigger part in energy production.

RWP has undergone multiple simulations, CAD iterations, and a 40th scale, fully-functional prototype. Testing at Lancaster University's wave tank proved the principles behind the multi-axis structures, while displaying promising

results for energy generation using the new and unique structure. The hydraulic power take-off system is a proven design capable of reacting and changing valve states in respect of the sea state. This variable setup allows the maximum energy to be harvested from the ocean in any given sea condition.

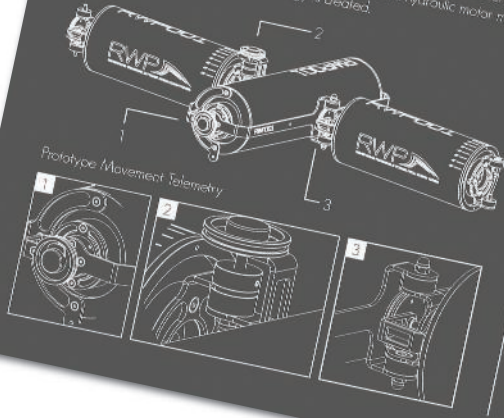
Wave data recorded from a data buoy in the Orkneys was scaled and propagated down the wave tank to provide scaled wave heights and wave lengths in which to test the structure. A further successful round of tests to verify the initial results will see the commission of a





## Renewable Wave Power Structure

The three dimensional nature of a wave front is not to be approached in a two dimensional manner. Any attempt to resist the movements of a wave will after time end up with a stress, leading to a fracture and eventually failure. RWP has to absorb a wave's three dimensional movement. The hydraulic cylinders effectively absorb any movements that the structure encounters, and pressure accumulators contain the pressure and adapt to the sea conditions to modify the pressures in real-time, allowing for optimized performance from the structure. As the high pressure accumulator reaches its variable pre-determined limit, hydraulic fluid is released under pressure through a hydraulic motor mated to a generator and, as a result, energy is created.



scaled hydraulic test rig to develop and refine the hydraulic geometry for the structure. Beyond the hydraulic development, RWP will enroll on the European Marine Energy Centre's Nursery Programme for sea trials.

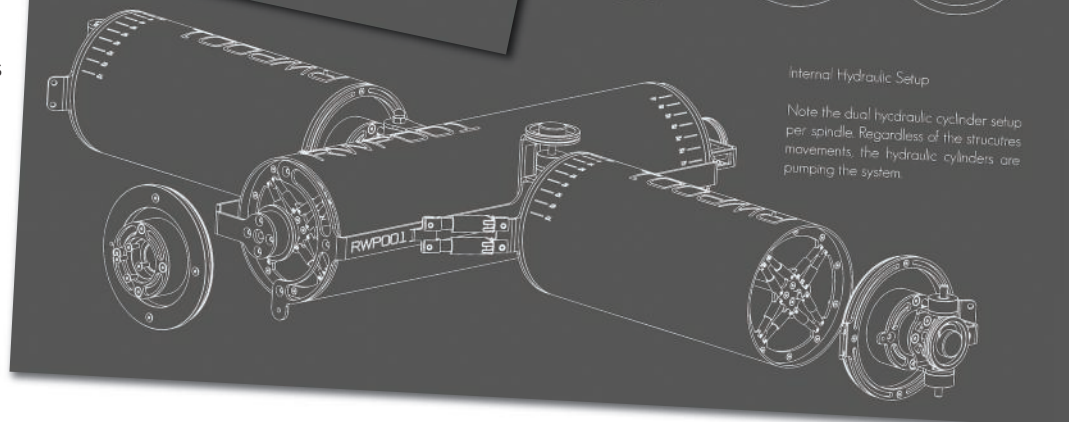
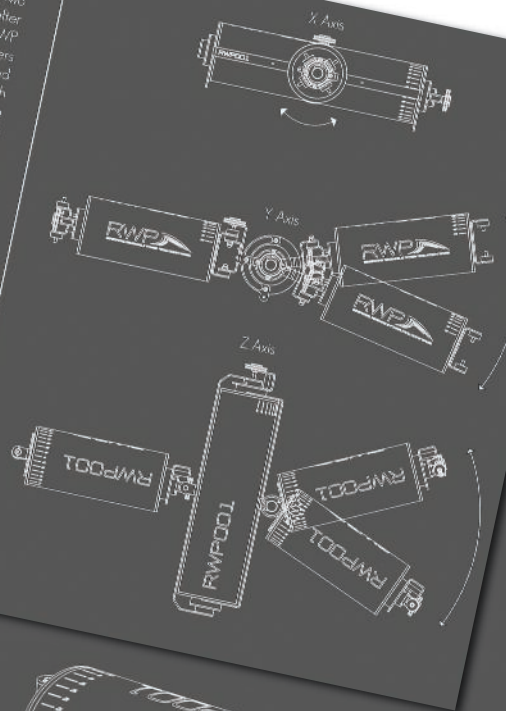
The Renewable Wave Power generator seeks to overcome the limitations of some current wave power technologies. These work best when struck by waves travelling in one direction and are less efficient in more turbulent seas.

So how does it work? A long chain of loosely-linked pistons draw power from the tidal waters that flow unpredictably. Energy is generated as the chain flexes in high and low points of each wave. As part of the project, data was taken from buoys moored in the Orkney Islands and used to make waves in a water tank at Lancaster University.

The 3D nature of a wave front cannot to be approached in a two-dimensional way, since any attempt to resist the movement of a wave will eventually result in a stress, which in turn will lead to a fracture and an eventual failure.

RWP is designed to absorb any movement that the structure encounters and effectively pumps up and pressurises the closed-loop hydraulic system. High pressure accumulators contain the pressure and adapt to the sea conditions to modify the pressures in real-time, allowing for optimum performance from the structure.

As the high-pressure accumulator reaches its variable pre-determined limit, hydraulic fluid is released under pressure through a hydraulic



motor mated to a generator and, as a result, energy is created.

Regardless whether the unit is cresting a wave or sitting in the trough of a wave, the cylinders remain capable of pumping hydraulic fluid around the system. The setup allows rotary motion to be converted via linear hydraulic cylinders into fluid pressure.

The pressure within the system is stored in accumulators that, at a capped pressure, allow fluid to be released through a hydraulic motor. This generates rotary motion on the hydraulic motors' output shaft, which is mated to a generator. The fluid that has travelled through the hydraulic motor is fed into a low-pressure accumulator reservoir. Consequently, redraw of the hydraulic cylinder draws fluid from the low-pressure reservoir and the closed loop cycle continues.

Further tests are planned to demonstrate his

device's efficacy. Commenting on the device's future, Dr. David Forehand of the Institute for Energy Systems, a research institute in the engineering school at the University of Edinburgh, told BBC News that "The real test for a device is its cost of energy".

Scotland is aiming to be the world's leader in wave and tidal power, but it is still largely in the development and commercialisation stage. The Scottish

government has the Saltire Prize, which will award \$15.8 million in 2017 to one of the wave and tidal energy companies competing for the prize. The winner will be the technology that has the greatest volume of electrical output over 100 gigawatt-hours over a two-year period using only the sea.

Renewable Wave Power has many steps before it could compete for an award such as the Saltire Prize, however. Etherington's submission to Dyson noted that he would require further tests to verify the initial results. If those tests were successful, Etherington would commission a scaled-up rig to be tested at the European Marine Energy Centre on Orkney Island, which has a variety of test facilities for wave and tidal powers in various stages of development.

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# Protecting metal

The epidemic of metal theft is plaguing UK infrastructure.

With many questioning how effective changes in law will be, can technology solve the problem?



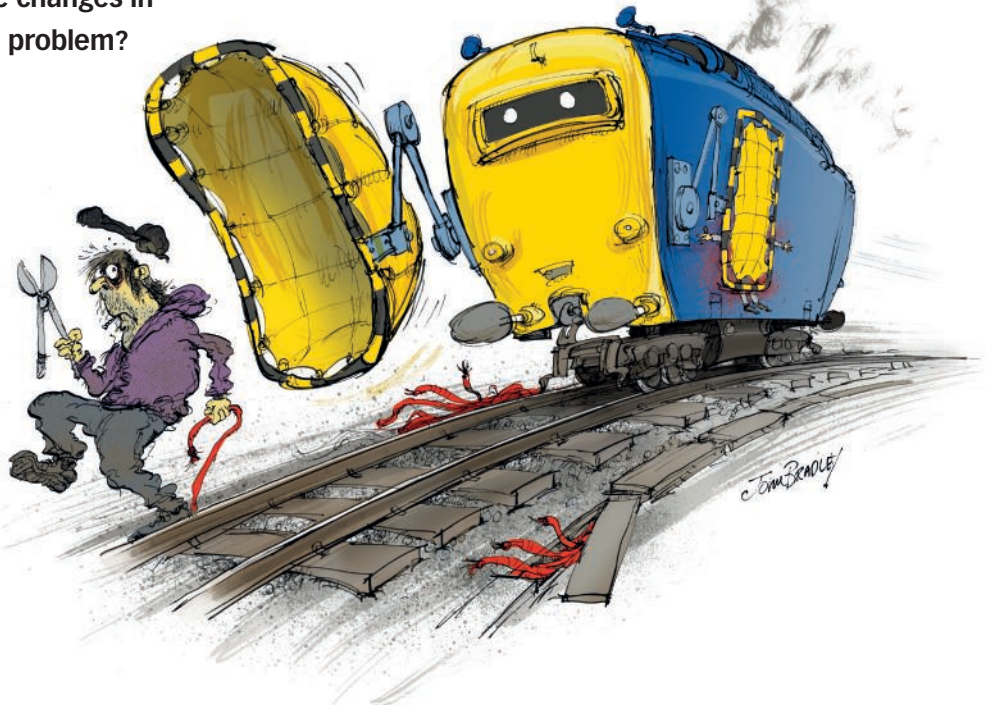
The price of scrap metal has soared in the last few decades sparking a record number of metal related thefts. The crystalline solid loot is then sold on to scrap dealers often for lucrative sums. Despite changes to the law for scrap dealers to be introduced in November, the black market for scrap metal is significant, estimated to cost the UK some £770 million annually.

Everything is a target from manhole covers to road signs to copper wire. Sub stations have been a target as have the car catalytic converters of cars. Even if changes in the law do help to reduce domestic scrap dealers from buying dodgy metals, it is understood that much of the metal is taken overseas for substantial amounts of money.

One area that has been particularly vulnerable is the UK rail system, which has been routinely targeted for its copper cables used for communications and signalling. Theft of these wires causes massive disruption and a significant amount of work is often required in repair. The thefts cause massive delays and disruption, impacting safety and costing millions to replace. Cables have even been stolen as soon as they are replaced.

## The Challenge

The challenge this month is to therefore come up with a method of stopping thieves steal quite so much of the railways copper wires.



One of the biggest issues with this crime is the ease and speed with which thieves are able to disconnect and remove long lengths of copper cable.

The protective measure you come up with should be simple to fit and relatively inexpensive, though due to the cost incurred by the railway the solution need not be 'cheap'. Barricading the lines to make it harder for thieves to access has proved both costly and ineffective in many cases. You could use laser

sensors to line the tracks and detect thieves which will then notify the British Transport Police, but this is still not an ideal solution.

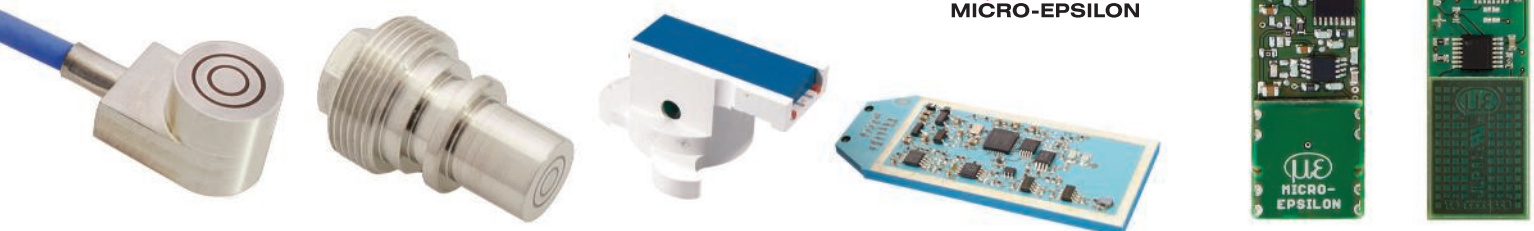
Really, the measures in place need to be fit and forget, and be able to secure the cables to such a degree that thieves will be unable to remove any material quickly. And to do so would require significant force, noise and effort – all of which will hopefully deter any light fingered crook.

The solution we have in mind low-tech but surprisingly elegant and effective. However, there is nothing to say that it is necessarily the best available. We are very keen to see if Eureka's readers can come up with something better.

The answer to last month's Coffee Time Challenge of how to track packages can be found in our Technology Briefs section on page 10.

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## Coatings

### WS2 Stops galling of SS and Titanium

Stainless Steels and Titanium are both prone to galling and seizing. WS2 is a very low friction dry lubricant surface treatment, developed by NASA for use in deep space. It has been shown to provide a very cost effective solution, preventing both problems on threads and other sliding surfaces.

WS2 works well from -273° to 450° C and down to 10-14 Torr. WS2 has been applied to bearings and gears to extend life.

Design Out maintenance problems with WS2!



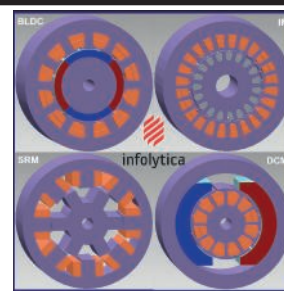
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## Electromagnetic Design Software

### Infolytica state-of-the-art Electromagnetic design software

Infolytica state-of-the-art Electromagnetic design software is used worldwide by Engineers in a wide range of industries including electro-mechanical, non-destructive testing (NDT), induction heating, sensors, industrial transformers. Infolytica also offers a truly innovative design tool – MotorSolve – for IM, SRM, Brushed and Brushless DC motor design. It has built-in thermal analysis including various cooling strategies, and can couple to 3rd party software, for example OPAL-RT for Hardware-In-Loop real time analysis.



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## Inorganic pigments

### Rockwood Companies Jointly Exhibit at K 2013 Hall 8B / Stand Number C48 16 – 23 October, Düsseldorf, Germany

Rockwood Pigments and Holliday Pigments are co-exhibiting at the K Show, the international plastics and rubber trade fair, showcasing their portfolio of inorganic pigments with environmental benefits. Rockwood Pigments is focusing on its Lead-free replacement colors and Holliday Pigments will be launching a new Ultramarine blue pigment, Grade 71, alongside new Ultramarine violets Premier VSB, VSR and Ultramarine pink PX.

#### Rockwood Pigments' eco-friendly pigments

Rockwood Pigments, a leading manufacturer of advanced high performance inorganic pigments, will be exhibiting its Solaplex® range of eco-friendly yellow and orange inorganic pigments, for full or part replacement of traditional heavy metal pigments.



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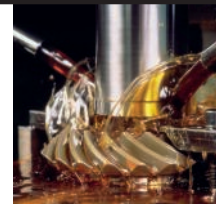
www.rockwoodpigments.com

## Neat Cutting Fluids

### New cost-efficient Q8 Bach AHM neat cutting fluid features powerful EP additive package that's active at all temperatures

Kuwait Petroleum International Lubricants (Q8Oils) has extended its range of neat cutting fluids with the introduction of Q8 Bach AHM, a medium viscosity, heavy-duty machining fluid featuring a powerful active EP package and heavy lubricity agent.

The EP additive package is active at all temperatures, which means that an excellent finish can be achieved through a full range of speeds and feeds – from the heaviest removal of stock, down to finishing with light cuts. In addition, the heavy lubricity agent allows maximum contact of the fluid with the work piece at all times, helping to eliminate chatter and poor finish when using exceptionally large cuts and high feed rates. The highly-regarded Q8 mist-reducing additive package is also incorporated into the formulation.



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www.Q8Oils.co.uk

## Pumps

### Hydra-Cell Mono-Block Pumps Ease Installation & Service

Wanner International has introduced an optional Mono-Block style pump head on its Hydra-Cell G03, G13 and P200 seal-less pump models.

The new Mono-Block pump head combines the traditional valve plate and manifold into a single component, allowing easy access to the cartridge style valve assemblies. The valves are accessed easily without the need to disassemble the pump or disturb the system pipework. Routine maintenance, valve inspection and, if necessary, replacement, can be carried out quickly and efficiently and causes very little downtime while cutting service and maintenance costs. A further benefit of the Hydra-Cell with Mono-Block pump head is its ability to prime quickly at slow speeds. Mono-Block pump heads are available in brass or 316 stainless steel. Diaphragms are available in a range of materials from PTFE and Viton to Buna, Neoprene and EPDM, to suit the requirements of the liquid being pumped.



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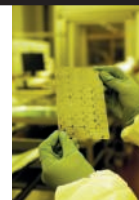
www.hydra-cell.eu

## Resonating biosensors

### Chemical Etching the next generation of resonating biosensors

Highland Biosciences Limited, creator of leading edge diagnostics technologies, has partnered with Precision Micro in the development and manufacture of a miniaturised 'tuning fork' biosensor. The component forms an essential part of HBL's proprietary microviscometer, that is claimed will improve the safety of a number of medical procedures by providing results conveniently at the point of need.

The biosensor design comprises of 3 micro engineered stainless steel tines, which resonate many thousands of times a second, detecting microscopic changes in film thickness, density and viscosity of a liquid sample and converting the presence of bacterial toxins into an electronic signal. With a tight innovation cycle needed, and a reliance on the material properties being unaffected during manufacture, both stamping and laser cutting were ruled out as viable methods of both prototype and serial production. HBL opted instead to use the chemical etching process.



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**YORK**  
21st NOVEMBER

**DURHAM**  
14th NOVEMBER

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### MAIN EVENT

**GAYDON, WARWICKSHIRE**  
**7.11.13**

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### GUEST SPEAKERS



**CHRIS BOARDMAN, MBE**  
GB GOLD MEDALIST



**BERTRAND SICOT**  
CEO SOLIDWORKS

**SOUTHAMPTON**  
24th OCTOBER

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