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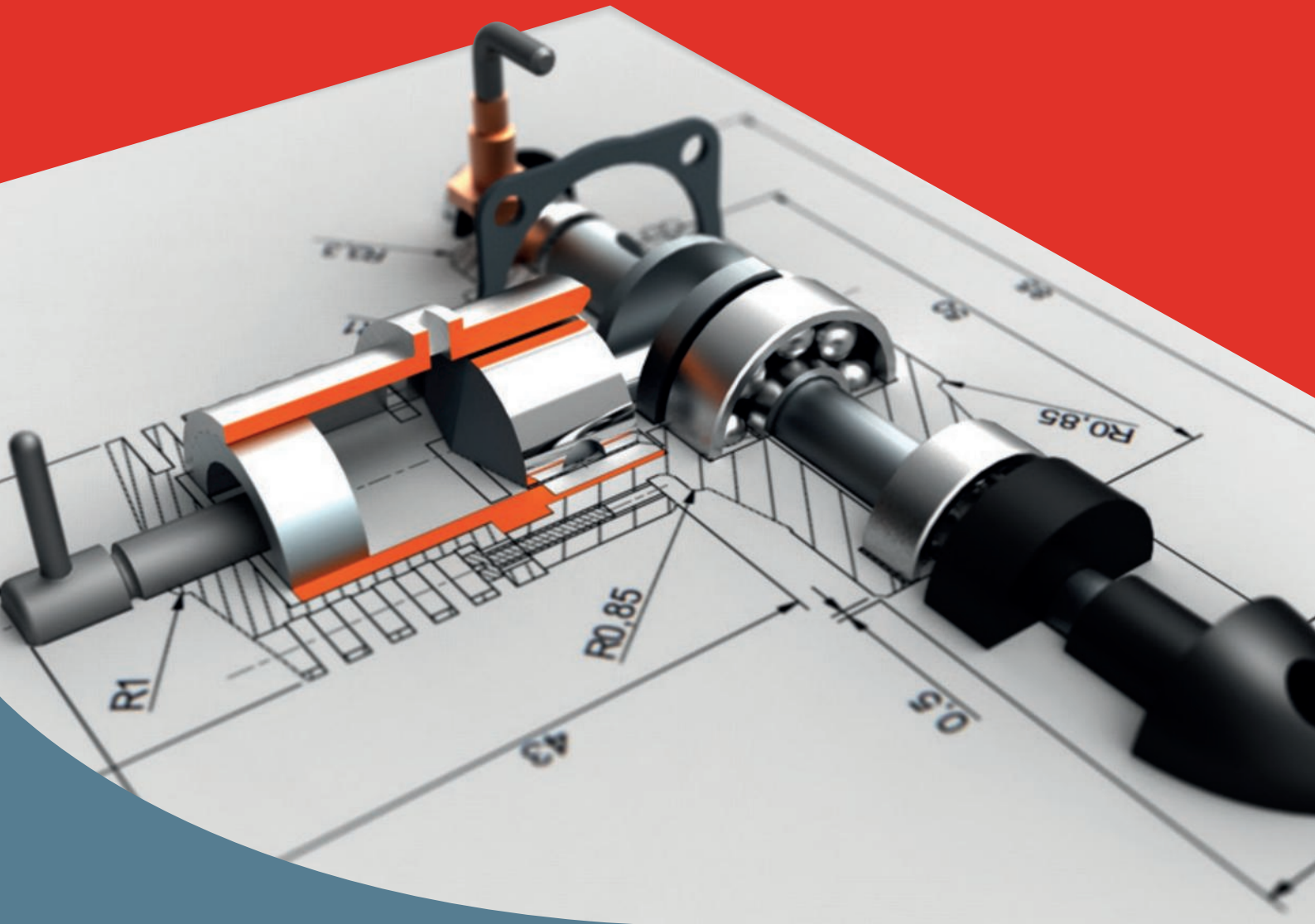
THE MAGAZINE FOR ENGINEERING DESIGN

In this issue: Rapid prototyping • Mini motors • Sensor selection • Efficient hydraulic design

Out of this world

BEEAs winner starting up in space





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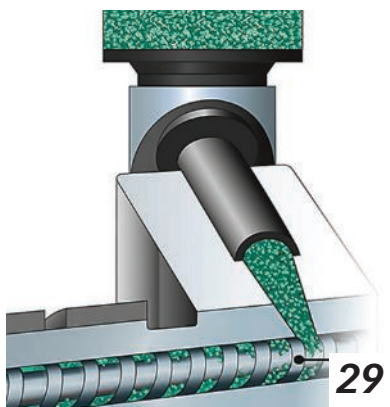


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The winners of the British Engineering Excellence Awards' Grand Prix prize were 'out of this world' - in fact pioneers in the growing space sector. Here are more details of them and all the other winners of the 2015 BEEAs.

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The AM evolution - additive manufacturing has turned prototyping on its head, but it will have to evolve further if it is to become more than just a prototyping tool.

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A new platform is bringing some of the advantages - most notably the cost - of injection moulding to additive manufacturing.

33 New spin on perfect sound

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If you are designing a plant, product or process that requires some knowledge of temperature there may be more than one solution. This article looks at the options.

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Having a single fastening technology to deal with every material from metal to composites sounds like joined up thinking.

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A well designed plant is only as efficient as its weakest link, right down to the hose couplings. This article looks at the common pitfalls of specification and why solid connections hold the key to true system efficiency.

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Sounds give positional awareness, but explosions can damage hearing - so how can we safely communicate with soldiers in the battlefield?

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Difficult to manage?



Tim Fryer, Editor (tfryer@findlay.co.uk)

Are good engineers good managers? I was struck by how many are, or at least the difference it makes if they are, at the recent Engineering Design Show, where I had the pleasure of hosting the conference. A recurring theme throughout the presentations was the sense of direction and communication within the design teams, whatever sector they were involved in – automotive, sport, medical, aerospace. Perhaps it is easier to motivate a team if there is a clear objective, like winning a race or launching an airship, but – and perhaps professional football teams are a good parallel – the best teams do seem to have the best managers.

Our survey earlier in the year showed that the engineers who read Eureka spend a considerable amount of time doing various management duties. Further to their basic role as engineering designers, in a typical week 78% were involved in internal meetings, 42% in external ones, 69% in project management, 52% in general office management – there was even 27% who regularly took care of health and safety issues. It is a mixed bag and often engineers who are good at engineering get promoted, quite reasonably, to positions of management. But it doesn't mean that they are naturally adept at the variety of management, particularly man-management, functions this involves. Some are obviously good and they are the ones that may win races or launch aircraft, while others in less glamorous industries can keep their company's technology roadmap in place and on track.

For the majority though the skills of managing and inspiring a team are less instinctive but they can be developed over time and they can be taught. I think the moral of the story here, looking at both our conference presenters and at the winners of this year's BEEAs (see page 16), is that many of these award-winning companies invest in developing the complete skill set of an individual, not just the technical skill set of the engineer.

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ISSN-0261-2097 (Print)
ISSN 2049-2324 (Online)

Eureka (incorporating Engineering Materials and Design and Design News) is free to individuals who fulfil the publisher's criteria. Annual subscriptions are £81 UK (£118 overseas or £153 airmail).

If you change jobs or your company moves to a new location, please contact circulation@findlay.co.uk to continue receiving your free copy of Eureka.

Origination
CC Media Group
Printed in UK by
Pensord Press Ltd

©2015 Findlay Media Ltd

Published by
Findlay Media, Hawley Mill, Hawley Road,
Dartford, Kent, DA2 7TJ
Tel: 01322 221144



Findlay Media is a member of the Periodical Publishers' Association



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CBI calls for innovation spending

The Confederation of British Industry (CBI) is pressing the Government to prioritise innovation and science funding in the forthcoming Comprehensive Spending Review.

The CBI says that raising total research and development spending to 3% of GDP will help achieve this, supported by a dedicated and long-term industrial strategy.

The CBI is calling on ministers to double the budget for Innovate UK after new research revealed that the Government spends just 0.49% of GDP on R&D – the lowest among all G8 countries.

John Cridland (pictured), CBI director-general, said: "Our research shows that innovation investment has never been more important, given its effect on enhancing productivity. While our economy is doing well, we must not be complacent, as we cannot afford to rest on our laurels while our peers pace ahead. Instead we need to build on our research excellence by fuelling the UK's innovation ecosystem with investment, fresh ideas and skills."

The CBI is also asking the Government to deliver a package on business rates reform that make the regime simpler, fairer and more competitive. The measures include fixing the funding ladder for medium-sized businesses to ensure they can grow; ring-fence revenue from the apprenticeships levy; introduce an independent 'Levy Board' to set the rate based on sound economic evidence; avoid further restrictions on skilled migration; and continue cross-Government efforts to promote exports.



Events

10 - 11 November 2015 TRAM UK 2015 Aerospace Conference

Rotherham
Conference and table top exhibition focused on transferring advanced manufacturing technologies to business leaders, managers and engineers

17 November 2015 Industry Entrepreneurship Summit 2015

London
Summit for industrial entrepreneurs and investors.

17 - 20 November 2015 Formnext conference

Frankfurt, Germany
Exhibition and conference for additive technologies.

17 - 18 November 2015 PTC LiveWorx Europe

Stuttgart, Germany
PTC technology event.

18 November 2015 IET innovation awards 2015

The Brewery, London
The annual IET Innovation Awards showcasing innovations in science, engineering and technology.

19 November 2015 Geometry manipulation in the automotive industry

Webinar
A look at how SpaceClaim direct modeller can help.

24 November 2015 Instant Adhesives

Webinar
Understanding the benefits of instant adhesives.

24 November 2015 IoT in focus

Seminar - Reading
Hardware and software requirements of the Internet of Things
For more event details go to
www.eurekamagazine.co.uk

Designing for the unexpected

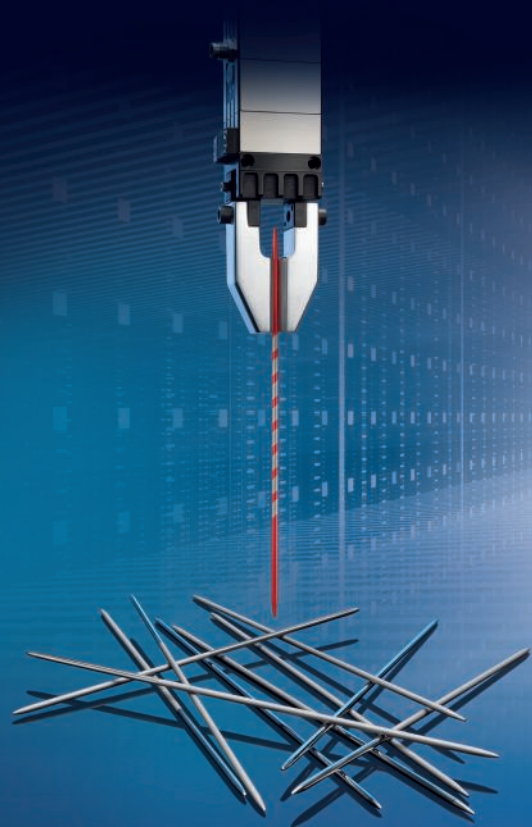
The Lloyd's Register Foundation has launched its Foresight review of resilience engineering. Resilience describes how systems withstand, respond and adapt to disruptive events, such as storms, earthquakes

and conflicts, or more long term and predictable trends.

The foresight review explores how engineering could enhance the safety of life and property through improved resilience of structures, systems, organisations and communities around the world.

The Foundation will issue an international call for expressions of interest to establish a programme to build the resilience of critical infrastructure sectors.

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Actuators deliver sub-nanometre repeatability
108629

Festo extends Optimised Motion Series
108594

Carbon fibre linear guide is lightest in the world
108554

A lightweight alternative to corrugated tubes
108454

World's first IO-Link controlled servo drive
108455

High precision vibration measurement
108491

NEWS

Education not keeping up with technology

The 2015 'Skills and Demand in Industry report' has stated that demand for engineers continues to rise, but 53% of employers are struggling to recruit suitably skilled staff. Published by the Institution of Engineering and Technology (IET), the report reveals that 61% of employers are least satisfied with skills among graduates – and that 66% are concerned that the education system will struggle to keep up with the skills required for technological change.



The report also highlights that while over half of employers say they are recruiting engineering staff this year, 64% claim a shortage of engineers in the UK is a threat to their business.

Nigel Fine (pictured), IET chief executive, said: "Stronger and deeper collaboration between employers and academic institutions is needed to agree practical steps to ensure that young people are suitably prepared both academically and practically before they start work. Supporting and encouraging teachers and academics to spend time in industry – and employers to visit schools, colleges and universities – would also be hugely beneficial."

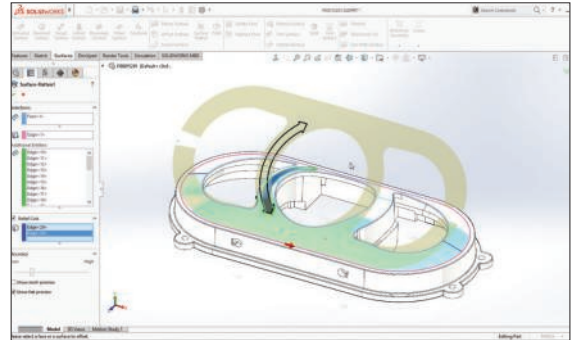
Women account for only 9% of the UK engineering workforce – and yet 57% of employers do not have gender diversity initiatives in place.

Fine added: "Employers also need to recognise the need for workforce diversity and do more to attract recruits from a wider talent pool. This might include looking at other professions, such as medicine and accountancy that have been more successful at attracting a diverse workforce."

"It also means working with parents and teachers to promote engineering as a creative, rewarding and exciting profession for girls, as well as boys."

TECH BRIEF

Solid solutions for productive work



The annual SolidWorks update has been released and includes over 230 new features, many of them aimed at providing increased functionality and improved productivity.

Gian Paolo Bassi, CEO of SolidWorks, said: "More than 90% of the enhancements directly resulted from our community's valued feedback, including their need to work faster and easier."

Included in these customer-led improvements are: Curvature Continuous Edge Fillets — quickly creating smooth blends or 'curvature continuous' fillets for all fillet types, including asymmetric and variable sizes. Also the Thread Wizard accurately models standard and custom defined threads with one quick and easy-to-use command.

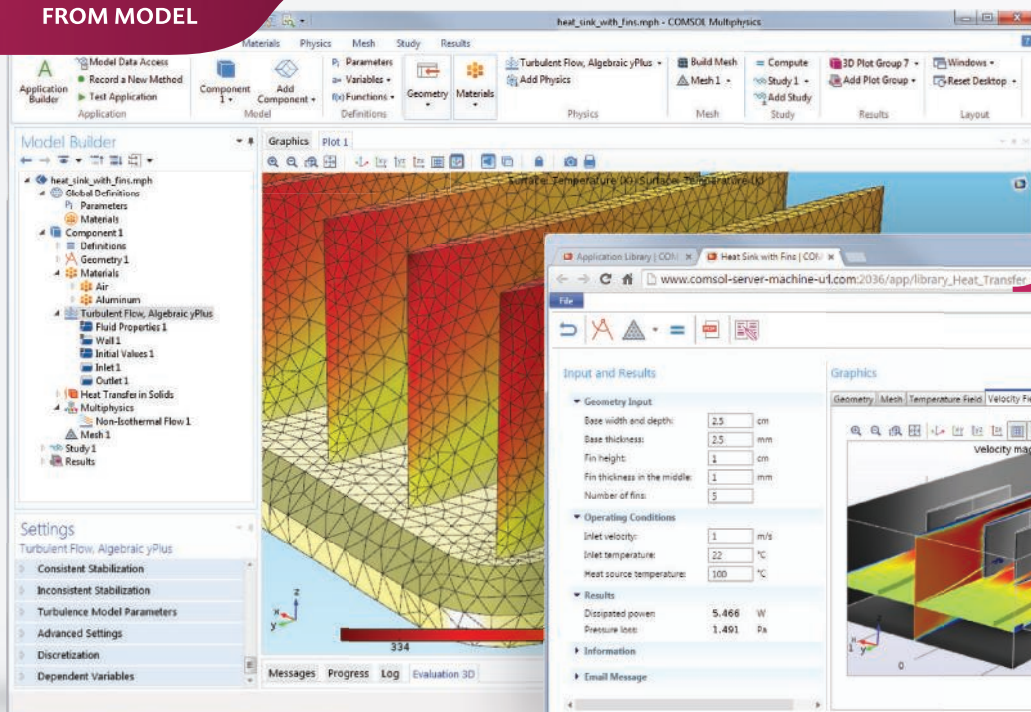
Another interesting feature is called 'Flatten Everything' and allows complex geometry to be flattened for manufacturing. It identifies strains induced when forming shapes back onto 3D surfaces, and introduces relief cuts for the flat pattern to alleviate excessive stretch or compression in the actual material.

Home support for women engineers

Hays Engineering and the Institution of Mechanical Engineers recently held a Women in Engineering round table event discussing the 'Diversifying the Talent Pipeline 2015' report. The research highlights the views of engineers (2800 mechanical engineers were surveyed) surrounding encouragement both at school and home for girls to pursue careers in engineering and the need to address the gender balance in the profession. The main reason, cited by 74% of engineers, for the low number of female engineers is that the profession is still seen a 'boys' job'. This perception is perpetuated by a lack of encouragement at school and home, with 63% of engineers saying that engineering is not encouraged as a career option at school, while 60% say it is not encouraged by family. Mike Morgan, director at Hays Engineering said: "Our results show that change can only come if we engage with girls about engineering from a much younger age, and continue to do so throughout the education process. The fact that over two thirds of people think engineering is not being pitched as a viable career option for women is a major factor behind its low take-up."

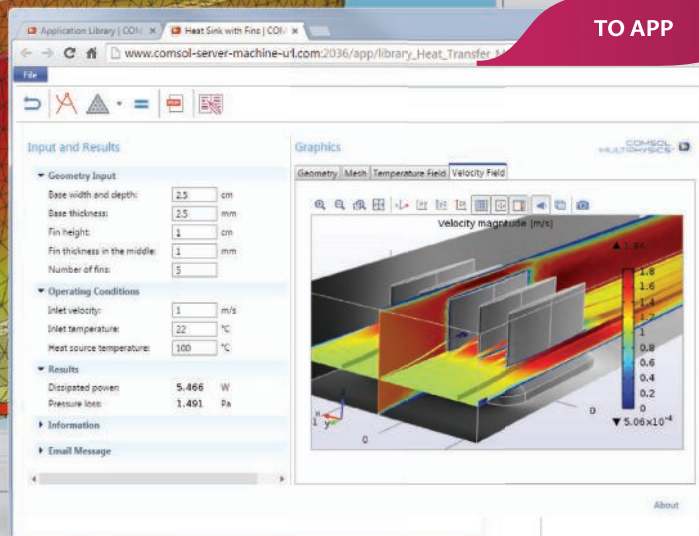


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NEWS

Chinese President visits UK Graphene Institute



President Xi Jinping of the People's Republic of China visited the National Graphene Institute (NGI) at The University of Manchester on the final day of his visit to the UK.

President Xi was welcomed to the University during the first visit of any Chinese President to Manchester, by Professor Nancy Rothwell, president and vice-chancellor of the University, alongside the Chancellor of the Exchequer, George Osborne and other senior Government officials.

The visit took place on the same day that Chinese electronics giant Huawei, China's largest mobile phone manufacturer announced a partnership with the NGI to research graphene and related 2D materials. The NGI currently has over 45 industrial partners who work collaboratively with academics to accelerate the commercialisation of graphene.

Professor Rothwell said: "Our research and innovation spans many areas... and is world leading.

"In each of these we have strong collaborations with leading universities and companies in China."

Solution to last month's Coffee Time Challenge

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Last month we asked you to come up with an idea for London Underground's Circle Line. We were looking at how to make it faster, safer and, more than anything else, a more enjoyable passenger experience. It was a challenge tackled by architectural consultancy NBBJ, whose thought provoking solution was based on the travelators found in many airports.

NBBJ's concept replaces Underground trains with three side-by-side electronic walkways, moving at varying speeds to take commuters around the famous circular tube route.

Each travelator increases in speed from its adjacent walkway. Commuters enter at the slowest speed of 3mph and slowly increase their pace by stepping onto adjacent walkways, up to a top speed of 15mph. When added to an average walking pace of 3mph, pedestrians would actually move faster on foot than today's Circle Line trains, which must stop for boarding at each station. Consequently journeys would be quicker, more enjoyable and healthier.

NBBJ claims this concept will open new possibilities for putting the fun back into travelling on the Underground, for tourists and Londoners alike. But would it be safe enough? Probably a few design revisions would be needed before we could answer that with any confidence!

www.nbbj.com



Shield protects UK manufacturing

Lontra has partnered with Shield Group Engineering in a knowledge-sharing agreement. The partnership will work to refine prototyping and manufacturing techniques to ensure the most competitive component design for the global market place. The first joint project will focus upon the manufacture of an industrial compressor based on Lontra designs to address a global

market worth £22bn.

Chris Shield of Shield Group, said: "Recent reports have focused on UK manufacturers losing out to emerging markets but this is not a foregone conclusion. We have demonstrated that we can outperform emerging markets on price by using smart machining techniques and investing in the latest machining technology."

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With a rapid turnaround many ball screw customers often request that the journal ends of the screws are supplied pre-machined, so that the parts are ready to fit. This eliminates potential scrap rates for the customer, but also ensures that the assemblies are supplied and certified to the accuracy tolerances required.

Precision Rolled

Put simply, the rolling process forms a thread for less cost than a ground one. Ball screws that have been cold rolled formed are ideal for applications that do not require the finite accuracy of the ground ball screw equivalents, but are still required to reliably transmit an axial load with a high degree of accuracy. Using

the traditional recirculation of the balls within the nut housing, a typical ball screw may be 90 percent efficient, versus 50 percent efficiency of a lead screw of equal size. **Precision rolled ball screws achieve accuracies of C7-20 (that's 50 microns per 300mm of cumulative lead accuracy - 20 microns of axial backlash).**

Precision Ground

Ball screws that have been formed by a grinding process are used where acute linear accuracy is paramount within the application. We offer a quality program of diameter and lead combinations with a variety of ball nut styles. **Precision ground ball screws achieve accuracies of C0-0 (that's 0 microns per 300mm of cumulative lead accuracy - 0 microns of axial backlash).**

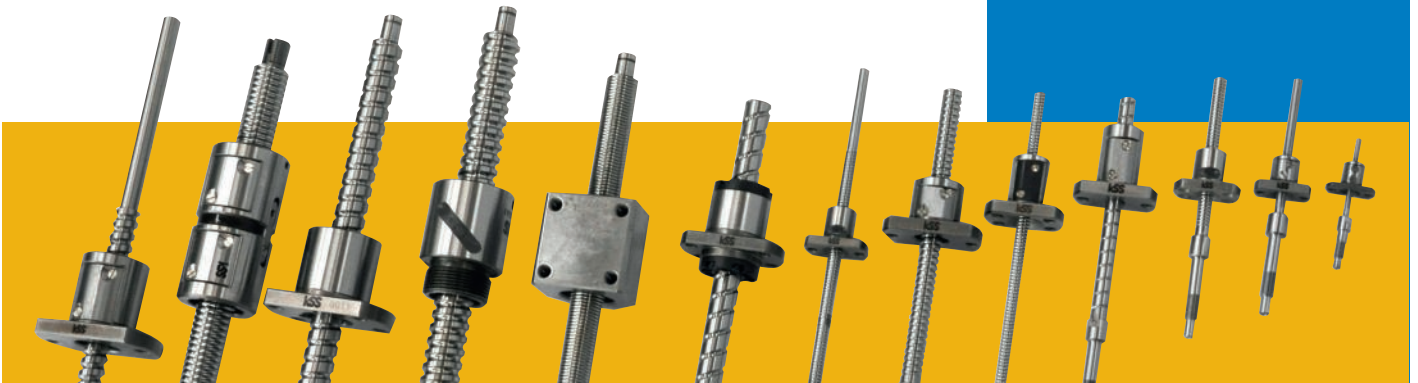
So if you are a user of ball screws give us a call to see how we can make your requirements heard.

NEW



Abssac is now supplying what is believed to be the world's smallest precision ball screw and nut assembly. With an amazing screw diameter of only 1.8mm and lead of 0.5mm, the new miniature ball screw range is ideally suited to the ever-smaller requirements of medical, optical and military application requirements. Using a ground screw format, the hardened steel ball screw can be supplied complete with machined journal ends.

A standard 6mm diameter nut body is used to house the 0.4mm diameter ball bearings, which are captivated in a recirculating ball nut design. Remarkably, the new product range offers a C3-05 accuracy grade (i.e. 0.005mm axial play). Fixing the nut to the application is made simply by a range of pre-drilled nut flange sizes.



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NEWS

Air of positivity from every corner of industry

The Engineering Design Show has proved to be a hit. Tim Fryer reviews the October trade fair.

There was a buzz around the Engineering Design Show that is rarely found in a British trade fair these days. There were many possible reasons for this but probably the most obvious and significant was that a lot of engineers visited the event and spent the full day, or two, there. In fact, over 4000 designers and engineers came along to the event, which was held in Coventry's Ricoh Arena on 21 – 22 October.

An engineer's priority is obviously to gather information that can be filtered back into product development or to find market opportunities, but there was undoubtedly an element of intrigue and excitement around all the cutting edge engineering and technology on display.

This was most evident in the conference programme and in particular the keynotes. On day one Andy Cloughton, Technical Director of Land Rover BAR, described how Ben Ainslie's team were designing a boat that will, hopefully, win the America's Cup in 2017, which would be a first for the UK. The complexities of advanced materials, aerodynamics, control engineering, the simulation and CFD models made a complete and compelling engineering tale.

Day two kicked off in equally fascinating fashion as Ian Cluett, Head of Programmes and Commercial at Williams Advanced Engineering, described how Formula 1 technology has filtered through to other motor sports and the automotive sector in general, but particular emphasis was placed on development of the battery that can be found powering all of the



cars in the new Formula E series.

There were many other highlights in the conference programme, presentations about Hybrid Air Vehicles new airship and Covestro's report on using novel materials for the design of the Solar Impulse aircraft were both particularly well attended and received.

When asked why they came and stayed for the duration, visitors also credited the workshops for which they gained CPD credits, the co-location with the Electronics and Embedded Design Shows, and the scope and expertise of the 210 exhibitors.

"All the feedback has been incredibly positive," said Ed Tranter, executive director at organiser Findlay Media. "There was such an air of positivity this year that we were left in no doubt that we have created an event that is important to all corners of the industry. It was this level of participation and enthusiasm that made 2015 the best EDS to date"

The event has evolved since its inception four years ago and Tranter already has plans for 2016

to make sure this continues. He added: "The critical issue facing our industry is the lack of engineers coming through the education system. We need more going in and more staying with their discipline once they graduate. As we have so much of Britain's finest engineering talent represented at this event, it seemed an obvious opportunity to use it to further engage with the next generation. So new for 2016 will be a major feature called 'Tomorrow's Engineering Designers', which we have committed a substantial new area of the Ricoh Arena to."

Other new features for 2016 will include panel discussions and opportunities to try out the latest design technologies. More details on the 2016 show and its new features will be posted on the website as they become available.

Tranter concluded: "EDS continues to be a huge success and I am sure this is down to our collaborative approach. Exhibitors, visitors, conference speakers, sponsors... everyone plays a crucial part in this partnership and my thanks to all of them for creating such a great show."



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NEWS



BAE invests in air-breathing rockets

BAE Systems has announced it is to invest £20.6million for a 20% stake of Reaction Engines to develop its Synergetic Air-Breathing Rocket Engine (SABRE). The engine combines both jet and rocket technologies and is claimed to have the potential to revolutionise hypersonic flight and the economics of space access.

Nigel Whitehead, group managing director of programmes and support at BAE Systems said: "Our partnership with Reaction Engines is part of our sustained commitment to investing in and developing prospective emerging technologies."

According to Reaction Engines, an aircraft using SABRE would be able to accelerate to speeds of over five times the speed of sound before transitioning to a rocket mode to propel the aircraft to orbital velocity speed 25 times the speed of sound.

Reaction Engines has already designed the SKYLON, an un-piloted, re-usable spaceplane concept intended to carry up to 15 tonnes of cargo into space. It would take off from and return to a runway like a conventional aeroplane, and would make orbit in a single stage, something not currently possible.

Mark Thomas, managing director at Reaction Engines said: "Today's announcement represents an important landmark in the transition of Reaction Engines from a company that has been focused on the research and testing of enabling technologies for the SABRE engine to one that is now focused on the development and testing of the world's first SABRE engine."

The UK Government is also expected to confirm grant funding of £60million to further SABRE's development and to investigate its applications for space access vehicles.

Together with BAE's investment, this funding will not only support the development and testing of SABRE, but will also allow Reaction Engines to expand its workforce of skilled engineers.

Deal rescues North East firm

Altec Engineering has acquired North Shields based Quick Hydraulics within 24 hours of the hydraulic engineering company going into administration. Altec acquired the trade and assets in an undisclosed deal which

safeguards the jobs of two thirds of the workforce.

It is the third acquisition by Altec in less than twelve months, following the acquisitions of Sigma Technologies and Ronco Engineering.

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Stellar achievements!

After several years of re-finding its feet, it is easy to believe that the UK's engineering sector is now finding its swagger! This was evident at the British Engineering Excellence Awards, where world-leading projects were celebrated and rewarded. Graham Pitcher and Tim Fryer report.



There are clearly segments of the engineering industry that are having a hard time at the moment, steel being the obvious one – national and international forces conspiring to make survival a challenge.

In other sectors these global forces are presenting fresh opportunities and the space sector is one of these. Already in the UK there are approximately 34,500 people working directly in a £11.8bn space industry, with a further 72,000 indirect jobs in the supply chain. It is the Government's plan to grow this sector with a further 100,000 jobs by 2030 so that the UK can capture 10% of the world space market, currently worth around £400bn.

There are clearly huge opportunities and one of these space sector pioneers scooped the Grand Prix – the winner of winners – at this year's British Engineering Excellence Awards (BEEAs), announced in London at the end of October.

Oxford Space Systems, conveniently based next door to the Satellite Applications Catapult at Harwell, won Start Up of the Year and was then selected for the overall prize.

The deployable structures it has developed combine interesting technology, the latest materials and a healthy dose of engineering imagination. Deployable structures are essential for satellites as they vastly increase the capacity for such critical components as antennae

and 'solar sails'. The first such solution from OSS is the Astro Tube boom, probably easiest to imagine as a builder's measuring tape made with precision motors and advanced composites. Further down the line will be an expandable aerial, which is being developed with the help of an 'origami professor' from Oxford University.

Beyond the technology, OSS has developed its products to the point of being flight-ready in months, rather than years, as is more typical of the space industry.

According to the judges, the company which is led by serial entrepreneur Mike Lawton, demonstrated everything you could plan and hope for from a start up; a viable range of innovative products and demand for its technology from the global space industry. "It's a huge success story for UK manufacturing plc," they said. And it's an example to other companies of how to identify and exploit a market opportunity - it's estimated that 2000 micro and nano satellites will be launched in the next five years.

OSS says it is succeeding because it has 'genuinely innovative and disruptive technology, strong backing from investors and demand from companies in the US, the UK and Japan. While much space activity is focused on micro and nano satellites, traditional satellite builders are interested in OSS' technology. According to Lawton, all potential customers share a common need to reduce weight, complexity and cost.

The OSS team is encouraged to 'think big' and to not be scared of proposing apparently 'wacky' ideas. In Lawton's opinion, there is no such thing as a 'daft idea'. "History," he said, "is littered with so called experts saying that the technology we take for granted was impossible."

And he went on to recognise the springboard that the BEEAs could offer not just OSS but also the sector it operates in. He commented: "We're absolutely delighted to receive the award after being selected from such an impressive list of finalists. It's really satisfying that engineering in the UK space sector be recognised for the challenging and rewarding endeavour it is. There are huge global opportunities for UK engineering to seize in so-called 'new space' and there's no reason why UK industry shouldn't be at the forefront of developing the much needed supply chain."

The Judges said: "Since its launch in 2013 Oxford Space Systems success has been out of this world. Its range of deployable antennas, telescopic booms and composite hinged panels has won support from Innovate UK, the European Space Agency and the UK Space Agency. Successful engineering organisations need successful leaders; Mike Lawton is an inspirational leader with energy and enthusiasm rarely matched in UK industry and his team clearly enjoys working in a fast moving environment developing innovative and disruptive technology."

OSS was not the only class act. Yet again, the entries to the BEEAs highlighted the fact that the UK's manufacturing and design industries are in good shape.

So who won what and why? Here is an overview of the winners in each category.

Consultancy of the Year Sponsored by National Instruments

KINNEIR DUFORT

Standing out amongst shortlisted companies in this category was Kinneir Dufort, a design, innovation and product development consultancy established in 1977.

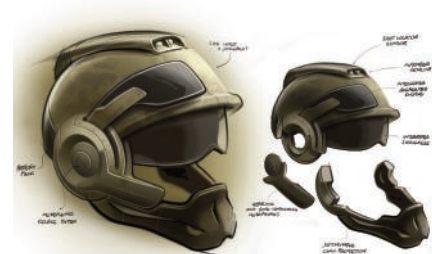
Headquartered in Bristol, it works across markets ranging from consumer goods to defence, with a number of multinational companies as customers.

Over the past five years, headcount has grown to 75 engineers, designers, researchers and software experts – a 26% increase on 2011. During the same period, revenue has grown to £7million, driven by growth across all sectors, with the medical and fast moving consumer goods markets showing particular growth. An example is the design for AGPlus Diagnostics of a point of care diagnostics tool for both medical and veterinary applications.

Whilst the company's heritage is in industrial design – the development of products remains a core activity – it has always looked to combine this with a strong technical capability, so the design delivers performance and manufacturability, as well as ergonomic excellence.

With two sites already in Bristol, Kinneir Dufort recently opened a Medical Device Design Centre of Excellence in Cambridge.

The Judges said: "Kinneir Dufort has demonstrated a real sense of purpose and has delivered fantastic results by following a clear five year plan: it has grown headcount and turnover, and has created excellent design work across hundreds of innovative project solutions."

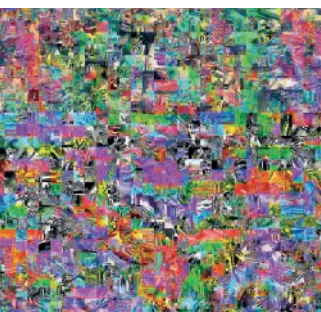


Electronic Product of the Year

Sponsored by Digi-Key Electronics

ARGON STREAMS BY ARGON DESIGN

Argon Streams is a set of encoded video bitstreams that can be used by decoder developers to verify that their



products can handle the latest video standards. The product is targeted at those semiconductor companies who are both designing and manufacturing. It is also of use to IP developers, who license decoder designs to those building hardware products. In both cases, the end products will be used in devices

such as smartphones, tablets and internet streaming systems. The ICs in these products will decode and play video bitstreams.

Because the IC development process requires significant investment, it is crucial that the design is proved to be correct before it is 'signed off' for manufacture.

The Judges said: "Developing decoders for highly compressed video streams is a challenging task. While there might only be a small number of customers for Argon Stream's product, it is of critical importance, helping them to ensure their chips get to market in a timely fashion, on budget and that they work."



Design Engineer of the Year

Sponsored by Danielson (UK)

RICHARD POULTON, NAVTECH RADAR

Richard Poulton joined Navtech in 2008 as the company's sole hardware engineer and has played a

central role in its success. Since then, he has helped to expand the hardware engineering team to eight people, providing their induction and internal training, as well as making a significant contribution to their professional development. In fact, the company says his skills and experience are 'pivotal' to its success.

Although an electronic engineer by training, Poulton has become well practised in all aspects of radar engineering – from design and creation of PCBs to making significant input into software development and mechanical engineering efforts. He is also responsible for legacy designs and dealing with obsolescence issues.

Poulton also takes a personal interest in encouraging young people into engineering and regularly attends events at local schools. This has resulted in students gaining work experience at Navtech. One such placement inspired the student to alter his career path and consider becoming an engineer.

The Judges said: "A driving force in the development of complex, multidisciplinary projects, he is not only developing his engineering staff, but also encouraging the next generation of engineers."

Materials Application of the Year

Sponsored by Engineering Materials magazine

PIPE IN PIPE SPACER BY NYLACAST

Nylacast Pipe in Pipe spacer combines the best properties of different materials to maximise performance.

Pipe in Pipe spacers are a



fundamental element in the oil and gas industry. In subsea applications, the production pipe is housed within an outer pipe, keeping it dry and maintained at a temperature that allows the oil inside to flow. The outer pipe acts as an environmental shield. Pipe in Pipe spacers are used to centralise the inner pipe.

Material choice was key in creating a product that met the design brief. Nylacast selected a custom formulated grade of cast Nylon PA 6, combined with a patented metal coating. The low friction, self lubricated top surface allows the outer pipe to easily sleeve the inner pipe, eliminating damage and the need for greases and lubricants.

Meanwhile, the patented high friction under layer allows the spacer to create a strong grip on the inner pipe, withstanding force during installation and operation. This high friction layer also avoids the spacers 'bundling up', which could unbalance the inner pipeline and potentially result in damage.

The Judges said: "Nylacast's Pipe-in-Pipe spacer was the stand out winner because it clearly met and solved real world application demands. The system uses the company's custom polymers, with low friction on one surface and a patented ferrous metal underside where high grip was required. This clever application demonstrated a real understanding of an industry's needs."



Mechanical Product of the Year

Sponsored by the Institution of Mechanical Engineers

BEBIONIC SMALL BY STEEPER

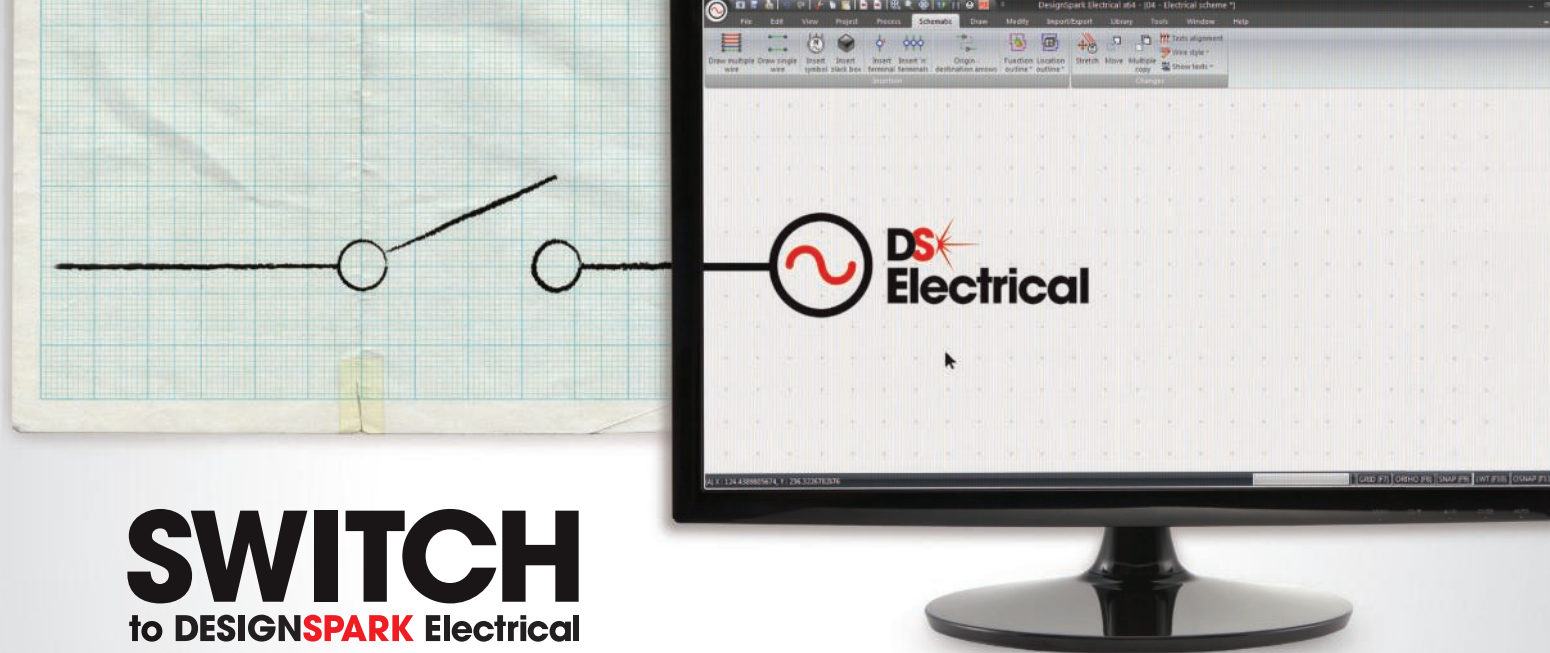
Until recently, there was no helpful prosthetic device which could provide people who had lost use of their hands with some degree functionality.

A number of designs have appeared in the last couple of years, but almost all have been 'one size fits all' and created with larger people in mind. Steeper's bebionic small is aimed at females, adolescents and those of smaller stature. Such a device has a number of requirements, including: different grip patterns; proportional speed control; wrist options; and soft finger pads.

The device provides a maximum grip force of 140N and this grip opens and closes in less than 0.5s. It can support loads of 25kg per finger and a maximum safe load across the knuckles of 90kg.

Individual rare earth magnet motors allow the user to move the hand and grip objects in a natural way. Motors have been positioned to optimise weight distribution and a patented encoding system monitors the position of each finger for precise control. Movement is controlled via myoelectrical signals collected from the surface of the user's skin.

And, recognising that each user is an individual, bebionic small features software and wireless communications technology within the hand that allows the device to be customised.



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The Judges said: "With significant sales under its belt, the bebionic small robotic hand is an engineering success which is making a positive improvement to the lives of people who have suffered serious upper limb trauma. The device has impressive and elegant packaging of complex mechanical systems and electronic controls."

Small Company of the Year Sponsored by D Young & Co LLP **LG MOTION**

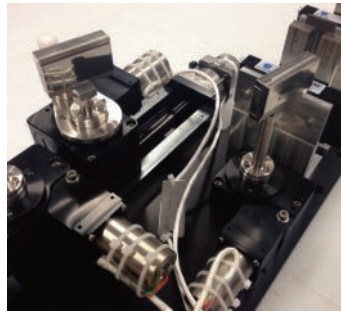
The company provides automation technology to emerging and leading companies across research and high technology industrial markets ranging from laboratory automation and medical equipment to motorsports and film and theatre. Many of these applications are characterised by the design, assembly and supply of customised motion control sub systems.

While some clients know which components they want, others know the end product and need help to integrate the right components into an existing system or even replicate it. Some clients, however, know what they want to achieve, but aren't sure how to get there.

LG says its broad knowledge and experience means it has usually come across similar projects, whether hardware, software or a combination of both.

With its own design, manufacturing and assembly capability, LG Motion can respond quickly on an 'engineer to engineer' level; something which, it says, larger competitors can't offer. Managing director Gary Livingstone noted: "As a lean company with no 'inertia' in our organisation and a short communication chain, we can respond quickly and confidently with a solution."

GWR Fasteners' entry was Highly Commended by the Judges which said: "Operating in many industrial sectors and offering a range of complex integrated engineering solutions, LG Motion has built itself an impressive customer reference list. Continuous investment has led to more success and its focus on people includes employing apprentices to develop its home grown talent."



Start Up of the Year Sponsored by Cambridge Consultants **OXFORD SPACE SYSTEMS**

Founded less than two years ago, Oxford Space Systems is pioneering the development of deployable structures that are lighter, less complex and less expensive than those currently

available. According to OSS, more than \$9billion is spent each year on designing and building satellites. And it believes that it can address a \$1bn slice of this market.

Mike Lawton, OSS' founder, identified the opportunity from the large number of small satellites which companies plan to launch. OSS says each will need lighter, less complex deployable structures.

Even though OSS is still in an R&D phase, its technology is gaining global attention. At the heart of its technology is AstroTube, a rolled composite material that unfurls like a tape measure. Requiring a fraction of the volume needed by a conventional system, the approach not only saves weight, but also reduces complexity.

It has exceeded its first year business plan by signing five significant collaborative development contracts and will see its boom technology flying next year – less than three years after the company was launched and much quicker than a typical development cycle.

OSS says it is succeeding because it has genuinely disruptive technology and is meeting a declared need.

The Judges said: "Oxford Space Systems has demonstrated everything you could plan and hope for from a start up: with an initial grant from Innovate UK, it has developed a viable range of innovative, deployable structures and created a demand among the global space industry. It's a huge success story for UK manufacturing plc."

Design Team of the Year Sponsored by Premier EDA **NAVTECH RADAR'S CLEARWAY TEAM**

Without teamwork, Navtech's innovative ClearWay product – the first radar based traffic monitoring system – would not have been delivered on schedule. In fact, the company says the project would not have been possible.

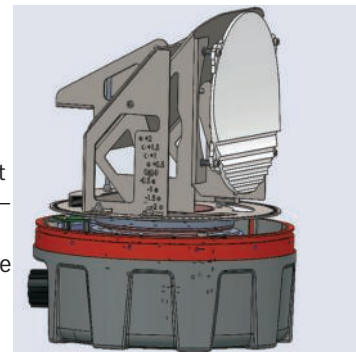
It cites as one of the reasons the many different areas of expertise that were required; ranging from code writing to mechanics and radar engineering to circuitry creation.

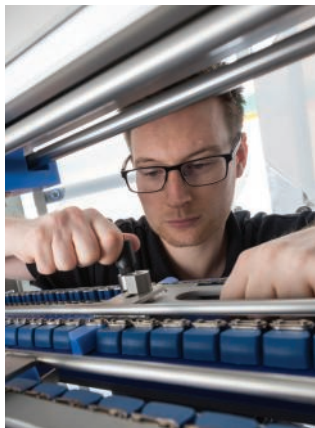
One of the key milestones – and something that required input from each of the six members of the hardware team – was the development of a radar prototype that not only met the size specifications of a roadside sensor, but also at a cost that made the product commercially viable. This meant designing a radar half the size and half the cost of Navtech's existing radars.

ClearWay, the first radar based traffic monitoring system, has a response time of less than 10s and each unit scans up to 1km of road surface, detecting vehicles at 500m and people at 350m.

The Judges said: "In a fiercely contested category, the Navtech team provided clear evidence that its multidisciplinary team was fast and efficient and delivering new technology to new areas across multiple markets.

"Its design solutions were inspired and innovative and the team clearly has huge potential: it has all the parts required to solve complex design puzzles in-house."





Young Design Engineer of the Year

Sponsored by RS Components

DAN STAMP, KLIKLOK INTERNATIONAL

Dan Stamp joined Kliklok as an assistant engineer in August 2011 having graduated from Bournemouth University with a Masters in Engineering. During his four years with the company, he has established himself as a trusted and key member of the

engineering team, acting as project engineer for smaller designs and taking on elements of larger projects, in association with senior engineers.

In the past year Stamp has worked on a number of machine design projects with international companies. One of these projects – a complete packaging line for a leading toy manufacturer – incorporated a solution that can handle more than 100 different carton sizes in a variety of styles.

Stamp is involved with a number of patent applications, including one for technology used in the toy manufacturer's system. He has been able to discuss how other packaging manufacturers can encourage young people to explore careers in the industry and has looked to capture the imagination of young engineers by discussing the interesting challenges that engineers face.

Stamp is now working on a 3D printing concept, which is exploring the use of 3D printed components in order to provide a quick turnaround of change parts and to improve customer service.

Congratulations to Jenna Allen of A-one+, whose entry was Highly Commended by the Judges.

The Judges said: "Dan Stamp has demonstrated his technical excellence and proven his engineering skills by making innovative contributions to product design, patent applications and through his work inspiring young engineers. He's a brilliant and enthusiastic ambassador for engineering design."

The search for the stars of 2016 starts here...

The BEEAs may reach its climax in the autumn, but the cycle is an annual one. The website (www.beeas.co.uk) will be updated shortly with entry forms, so if you think your design team, company, an individual, or product are among the best of British, now is the time to start thinking about your entry. You could be picking up a British Engineering Excellence Award next year!

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Focal point for AM evolution

Additive manufacturing (AM) has turned prototyping on its head, but if it is to progress beyond the role of a prototyping tool then it will come down to companies like Renishaw to provide the spark.

Tim Fryer spoke to Marc Saunders to find out what the future has in store.



“Additive manufacture is a thrilling arena to be involved with at the moment,” stated Marc Saunders. “It is growing rapidly and is set for some rapid expansion in the next few years. The vision that Renishaw’s got really is about establishing it as a mainstream manufacturing technology.”

Saunders has recently rejoined Renishaw, having just spent three years with E2V, most recently running its space imaging business. The role that has attracted him back to Renishaw is director of the company’s new Global Solutions Centres, which are going to play a crucial role in showcasing some of its latest additive manufacturing (AM) technology.

“A lot of uses thus far have been in rapid prototyping, tooling, direct part replacement, and remanufacture type applications,” explained Saunders. “But we see really big potential in enabling innovative new product designs, made in series production using additive technology. That’s where we really want to take it, and we feel that Renishaw’s capabilities across metrology, machining, finishing processes, and advanced manufacturing generally, put us in a good place to be the right partner for designers and manufacturers looking to do that.”

The company’s technology is being built up around selective laser melting (SLM) machines that have the capability to make dense, intricate parts out of a range of engineering materials, such as titanium and nickel. This makes it suitable for demanding applications in oil and gas, Formula One and aerospace among many others.

“So that’s really what we’re trying to bring to the party, the capability to make high-performance parts for demanding applications, but with the innovative features that additive can bring,” he continued. “Lightweighting, textured materials, topological optimisation... we can do all those sorts of exciting things using

additive processes that you just can’t do using any other conventional technique.”

Apart from producing dental restorations in quantity, the company is not using AM to manufacture parts in significant numbers just yet. However, according to Saunders this is set to change before long.

“In terms of mainstream components in significant numbers going into aircraft and cars, there’s not a lot of that is happening just yet,” he said. “It can get there and the steps we’re taking around the Solution Centres will enable it by providing a pathway towards that.”

Helping make a leap of faith

Companies involved in such activities as medical or aerospace are naturally averse to taking the ‘leap of faith’ – they need to be convinced that the technology has developed to the point where it can be used productively and reliably. While AM technology is still perceived to fall short of the mark, this is where Renishaw’s Global Solution Centres come in.

“What we are looking to do with the Solution Centres is to provide a cost-effective environment in which companies can progressively explore, build confidence and knowledge to the point that they can make a justified investment decision,” explained Saunders. “We are providing an environment where you have access to machines, access to expertise, and access to finishing processes to help go from the conceptual stage all the way through to production, with lots of support to help you along the way.”

There are 10 Centres planned to be opened over the next year, three of which will be in the UK – in Staffordshire, Gloucestershire and South Wales.

Although Renishaw currently only has one AM machine on the market (the AM250) to deploy in these Centres, a new platform – announced as the EVO project in 2014 – is due to be available at the end of this year.

"We are providing an environment where you have access to machines, access to expertise, and access to finishing processes, to help go from the conceptual stage all the way through to production, with lots of support to help you along the way."

**Marc Saunders,
Renishaw**



It is aimed at more industrial applications and as such is not a single machine but a platform solution. Saunders explained: "Production isolation is really what we're focusing on, so being more productive through automation. Reduced handling, reduced manual powder management and so on, making it more suited to extended production runs with less operator intervention than is currently the case."

Despite the excitement around AM, Saunders also sees a role for the Centres in helping temper expectations. "There's definitely scope for wider education as to the benefits," he said. "The freedoms that 3D printing gives, also comes with some limitations. You don't have complete freedom to design absolutely anything, it has to be

makeable. There are a few ground rules that need to be followed and some know-how in the way you can make build more efficiently and in higher quality. So there's definitely a lot of scope for education."

So the Support Centres are more than just demo areas for Renishaw equipment? "Definitely," said Saunders. "The question is really about what will AM do for the customer? It's about them and their products, it's not about our machine. It's about what can they do with the freedom that AM gives them to design things differently? How can you implement it to your product design cycle so it will make your business more successful? That's got to be the thought process to start with."

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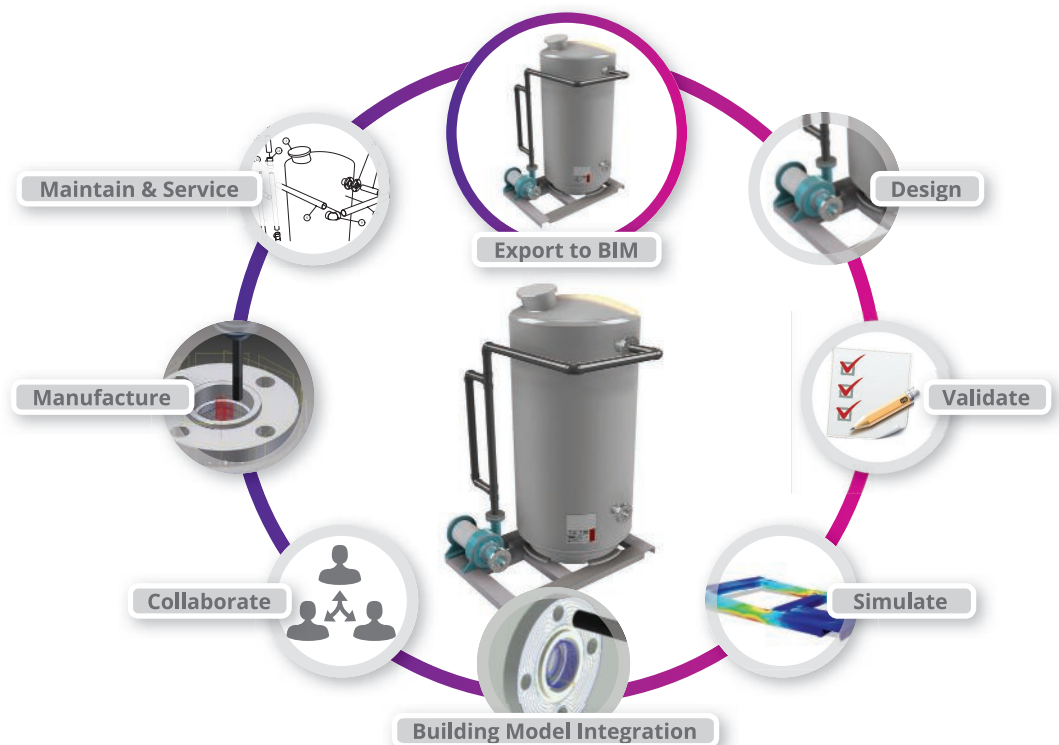
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Seals take **soft option**

Prototype seals are a problem to make as they are generally soft but need to be fully functional. However, a specialised process that can machine rubbers and other soft materials has evolved for just such a purpose, as Thomas Schwarz reports.

Prototyping is a vital process in product development, as it allows everybody involved – especially an external customer – to see what a product will look like, and potentially how it might function. There are many methods of prototyping, ranging from clay models to the very latest techniques such as 3D printing.

However, when it comes to prototyping seals the choice is limited. This is mainly because the physical properties of the seal are vitally important. It is not enough just to look the part, the seal must be equivalent to a production part in every way and capable of withstanding full ‘in field’ testing.

Prototype seals need to be just like the real thing, so they are usually made in the same way as the production process: moulding. However, this is a time-consuming process.

After testing the prototyped moulded seal, a second prototype mould is designed and new prototype seals are made and tested. This can go through five or six iterations before the design and the material properties are right.

Prototype to production

Most polymer components can be made economically using mass production techniques such as injection moulding. The mould itself is a major investment, and only pays for itself once components are running off the line in large numbers. Even a prototype mould is costly, making the normal route of seal development an expensive one.

An alternative process, developed by SKF, called SKF SEAL JET, offers a special prototyping technique for seal development that relies on machining rather than moulding. Although this may sound simple because CNC machining, for example, is a standard industrial process. However, most seals cannot easily be machined because of the relatively soft and highly elastic



Machining working: prototype seals are possible with specially developed equipment

material that is commonly used to allow them to perform their function. This makes cutting a precise and consistent shape extremely difficult, without resorting to multi-stage processes or using highly specialised materials that may not match those used in normal seal production.

Shrinking lead times

SEAL JET was originally developed in 1989, though not as a prototyping technique. Instead, the aim was to make relatively small numbers of seals in order to supply customers at short notice.

The company had noted that aftermarket

demand for seals at that time was high – yet lead times for replacement products were as long as 20 weeks.

SKF realised that an alternative method of producing seals was needed, one that was much faster but guaranteed equality with moulded parts in terms of dimensional tolerances and physical characteristics. In short, the process produced seals that were identical to their moulded equivalents.

At the time, the technique was used to produce relatively short runs of seals, but it eventually came to be used as a vital tool in seal prototyping.

There are three key factors that allow the

process to produce prototype seals so that they combine the properties of actual moulded production seals.

The first is the cutting tool itself. This has been developed with help from industrial partners that are specialists in materials and design. The cutting tool is manufactured from a specially developed hard metal, with precision angled cutting faces to ensure that unwanted material or swarf is cleared efficiently from the cutting area.

Secondly, the process itself has been carefully designed. One critical aspect is the chip removal system, which effectively eliminates the risk of highly elastic chips damaging either the cutting tool or the seal itself.

This is achieved by a suction unit that draws the long, flexible rubber or elastomeric swarf away from the cutting area, with a pair of blades being used to reduce the swarf to small chips; this is effectively a 'catch and cut' process.

Thirdly, the way in which the process is controlled is vital. This is achieved using a special control unit with proprietary software, which offers the option of over 180 pre-programmed designs to simplify the task of making a wide range of prototype seal products.



The control unit also ensures that the speed of the cutting tool is carefully regulated to match the characteristics of the seal material, maintaining a slow, steady and even pressure, especially on softer materials.

The combination of tool design, chip removal system and control technology produces seals of high quality.

For example, tolerances are typically within $\pm 0.25\%$ of the diameter, which is comparable – and in some instances better – to that achieved with high volume seal moulding production systems.

The company has also developed a wide portfolio of material grades, ranging from rubbers and polyurethanes through to PTFE and PEEK. These have been developed in-house, and help to deliver important seal characteristics, such as surface roughness and precise material properties.

The process can be used to make seals in a wide range of sizes, typically up to 600mm outside diameter. It is possible, however, to create seals up to 4000mm in diameter, but these need special knowledge as it is difficult to shape such large billets. A further advantage is the ability to produce seals in non-standard sizes.

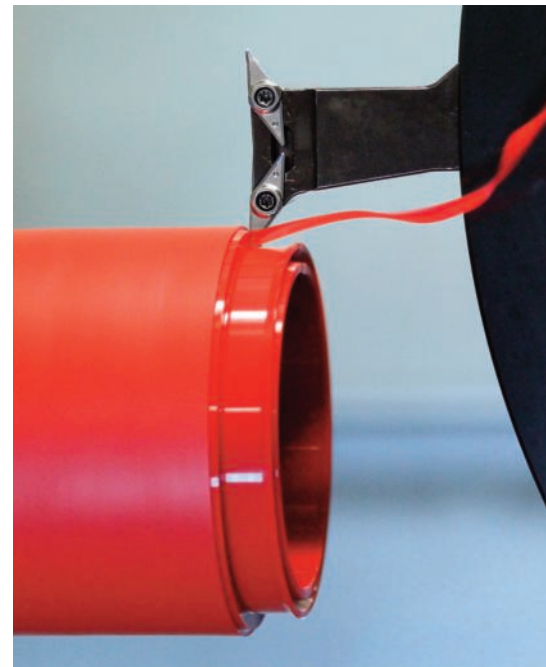
A number of prototyping processes can be used to make 'real' products, but if volumes become too large it makes sense to scale up to a mass-production process.

For SEAL JET, this breakeven point depends very much on the size of the seal, but in general it is viable to use the process for anywhere between 500 and 3000 pieces.

The important point is that unlike other methods, the process uses the same premium grade materials demanded by real-life applications, thereby retaining all of the critical mechanical and chemical properties for optimum seal performance.

What about 3D printing?

Of course, many traditional prototyping techniques have been superseded by 3D printing. This encompasses a variety of techniques, such as selective laser sintering and fused deposition modelling. Most involve building a layer of material, curing it – either by melting a thermoplastic or curing a liquid polymer – and repeating the process until the



part is finished.

While this is a powerful way of making visually appealing parts, their physical properties are relatively poor. At the same time, repeatability and accuracy cannot compete with a technique such as injection moulding.

For these reasons, 3D printing is usually inadequate in the seal development process, especially in terms of dynamic seals.

Working prototypes

As seal prototypes must be 'working' prototypes, they must have all the physical characteristics of a moulded seal. However, it may take another 15 to 20 years until 3D printing can make working seals – which are robust, have high temperature and pressure resistance and can be used in contact with grease and oil. If seal prototyping is not seen as a priority for 3D printing developers, it may never happen.

This means relying on existing methods. While prototype moulds will continue to produce excellent quality seals, a technique such as SEAL JET offers the advantage of making the development process as streamlined and efficient as possible.

Thomas Schwarz is director of Fluid Sealing Systems R&D at SKF.

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Injection moulded 3D printer

Injection moulding machines and 3D printers are often viewed as different ends of the same spectrum. However, one company has managed to combine the properties and processes of both. Tim Fryer reports.

In a departure from existing additive manufacturing techniques, Arburg – a company more associated with injection moulding equipment – has introduced an additive manufacturing platform that is able to produce printed parts using standard plastic granulates. The system is based on the Arburg Plastic Freeforming (AKF) process and answers the call for high-quality one-off items and the personalisation of mass produced parts.

Martin Neff, technology consultant for Freeformer, said: “A key feature is the use of standard granulate polymers at a cost of €3/kg – the incumbent specialist materials can cost as much as €300/kg.”

The Freeformer is the first additive manufacturing machine developed by a plastic injection moulding company. It responds to growing demand for prototypes and customised parts, made of the same materials as higher volume processes. Normally prototypes using injection moulding have high costs associated with them, meaning it has prevented many suppliers from capitalising on this market demand.

Freeforming process

The patented Arburg Plastic Freeforming (APF) process has been developed to be more accessible to companies that use standard plastic part production processes, therefore

bringing injection moulding material costs to 3D printing production flexibility.

As with injection moulding, the granulate is first melted in a plasticising cylinder. A stationary discharge unit with a special nozzle then applies the plastic droplets layer-by-layer onto a movable part carrier using high-frequency piezo technology at a specified duty cycle of 60 to 200Hz. The droplets fuse together on cooling.

The process allows uniform material displacement and creates strong, fully functional parts. The construction chamber of the Freeformer offers space for parts with maximum dimensions of 190

x 135 x 250mm. Depending on the nozzle used, the diameter of the plastic droplets generated under pressure is between 0.18 and 0.3mm.

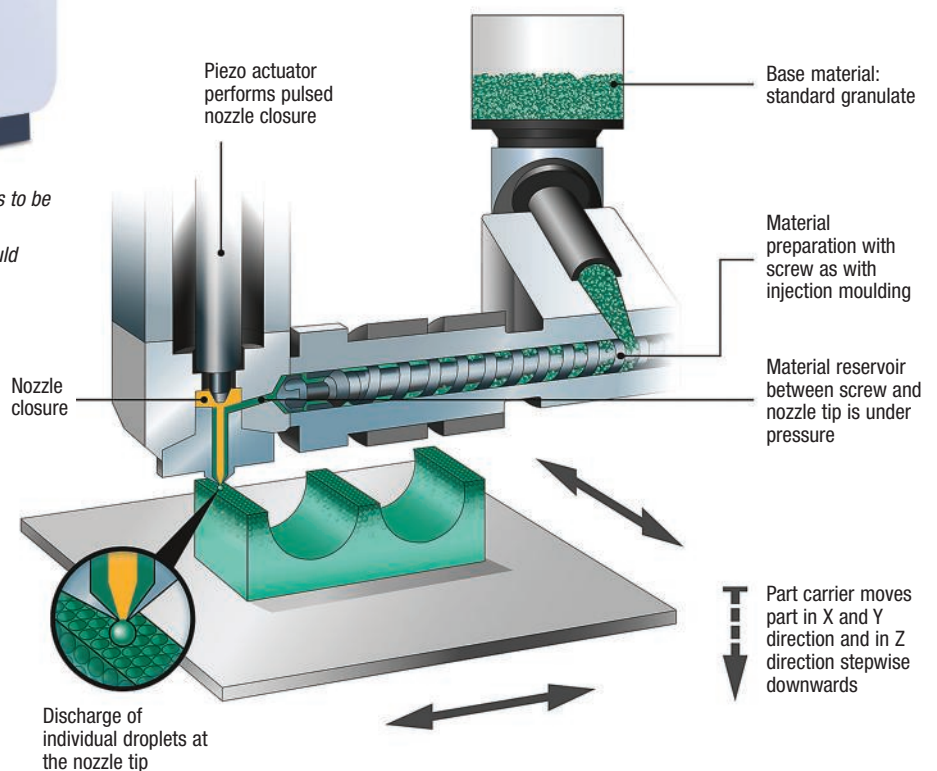
The Freeformer is equipped with a movable 3-axis part carrier and two stationary discharge units as standard. The second discharge unit can be used for an additional component in order to, for example, produce a part in different colours, with special tactile qualities, or as a hard-soft combination.

Unusual geometry

Where necessary, the Freeformer can build up structures from a special support material. This makes it possible to achieve unusual or complex part geometries. The supporting structures are subsequently removed in a water bath.



Freeformer allows functional parts to be produced from qualified standard granulate without requiring a mould





"We have always considered ourselves a technology innovator not a technology adopter."
Colin Tirel, Arburg

Currently unique in additive manufacturing is the combination of a standard elastic thermoplastic polyurethane (TPU) material with reversible supporting structures. Possible applications include bellows, hoses, sleeves, or flexible parts for robotic grippers.

As an alternative, support can be built up in the same material as the part itself. A thinned out intermediate layer with specifically generated predetermined breaking points enables the supporting structure to simply be broken off mechanically at a later stage. This

option is preferred for parts with free-standing structures and clearly defined edges.

The 3D CAD data for the parts being manufactured (STL files) are processed offline using special software to generate the necessary manufacturing data via slicing. No special programming or processing knowledge is required.

"We see the introduction of the Freeformer as a huge technological step for our company," said Arburg's managing director, Colin Tirel. "We have always considered ourselves a technology

innovator, not a technology adopter, and this is a superb example of this philosophy."

Connected solution

The Freeformer is one part of Arburg's latest connected solutions for 'Industry 4.0'. These digital technologies connect machines and products in an 'internet of things' within a Smart Factory. The aim is to permit greater levels of mass customisation of parts in the future.

Bob Cook from Berks based mechanical and electrical engineering consultancy Rotary Motion Technologies, has been applying the technology to his operations. He concluded: "Companies like ours need to respond to this because it is the way technology will go in the future. It is part of a trend to produce parts efficiently, while reducing development costs. At some point cars will be made completely from plastic components, including the engine, so additive manufacturing will have an important role to play, and will have to scale up."

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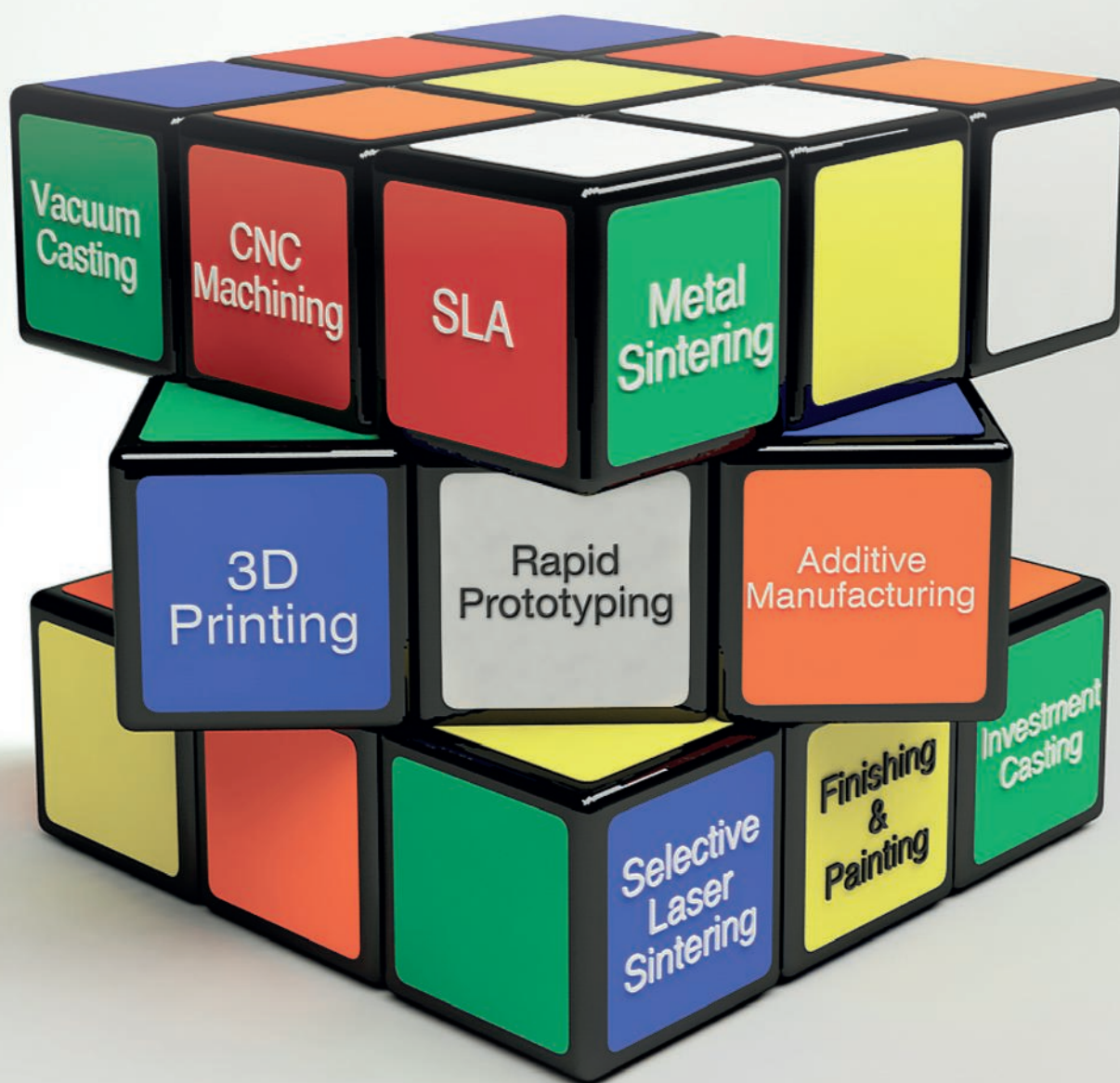
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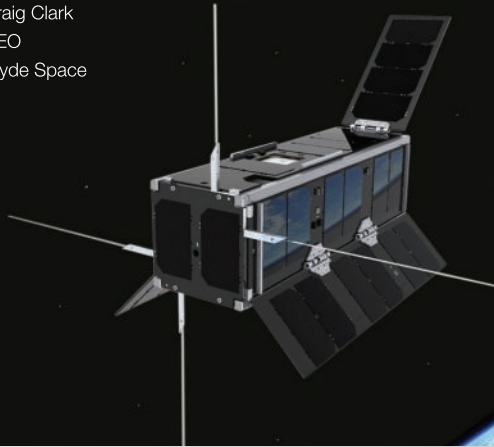
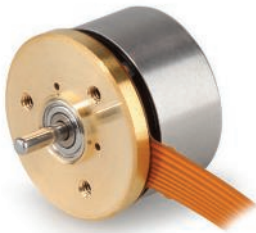
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'The involvement and technical expertise of maxon motor in this project has been fundamental in developing the torque reaction drive. It is refreshing to see a customised off the shelf (COTS) product meet this demanding environment rather than use a bespoke designed motor with the cost implications involved.'

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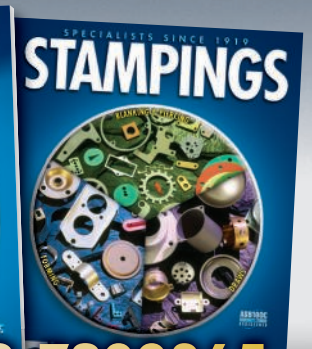
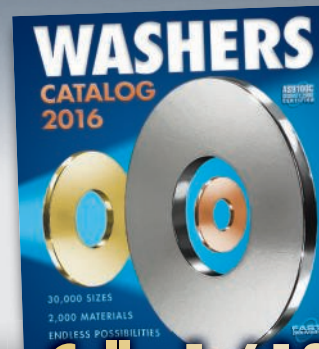
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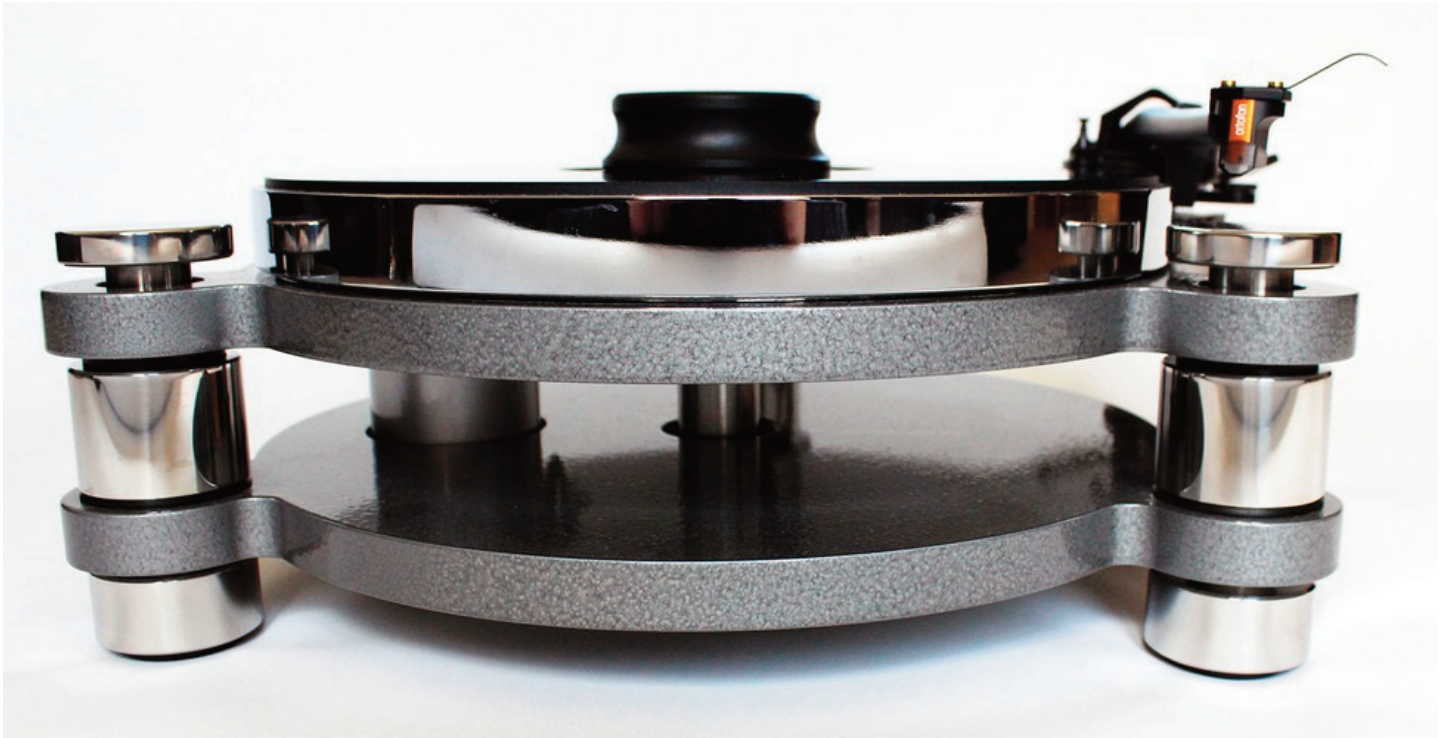


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New **spin** on perfect **sound**

People of a certain age fondly remember the hiss and crackle of playing vinyl records on record players. However, the proverbial fat lady has not started singing, and it turns out that it is not all over for the turntable after all. Tim Fryer looks at the engineering behind the latest addition to this trend.

Music lovers argue that the sound generated by a record player, being based on actual vibrations rather than digital information, had a depth that CDs (and subsequent electronic formats) could never match. For this reason the platform has survived – just – mainly based on premium models that when combined with quality speakers could provide that exceptional musical experience. Such premium models have premium price tags and so have had limited mass market appeal.

The delights of this old technology however are starting to strike a chord once more. Part of this is undoubtedly to do with those people of a certain age discovering boxes of LPs and 45s (aka albums and singles) in their attics and

wanting to give them a spin once more. But that is only part of the equation as records are starting to be released in vinyl once more to meet a new demand. And where there are records there are record players.

Market research company GFK discovered that in the UK in the year up to August 2015, 121,000 turntables had been sold – a £12m market. Although not a like for like comparison, the number for the calendar year 2014 was 94,000. On top of this is the average value per unit in 2013 was £159. In the last 12 months it was £105. A definite indication of market forces taking hold.

Unlike other items of consumer electronics, turntables also have the distinction of, in some

cases, being designed and made in the UK with companies like Avid and Linn offering some budget busting, but high quality products.

One such company is Peak HiFi, set up by Shaun Daniels in 2004 who turned his love of music, and high quality audio equipment, into a part-time retail business, running alongside his full-time engineering job. The company specialises in high quality audio equipment, particularly stereo and analogue equipment, with an enthusiasm for classic turntables. The business flourished and Shaun left his day job to focus on Peak HiFi.

Daniels saw a gap in the market for a completely new record player. He said: “I am a big fan of the Garrard 301 and Garrard 401. These were amongst the very best turntables of the 1950s and 60s and they are exceptional even by today’s standards. Unfortunately the technology around the drive system is complex, and expensive to produce, and they died out in the 70s.

“They also have areas that can be improved, certain limitations in the technology of the day and mass production methods resulted in casting defects, large motors with no speed control, isolation issues and so on. We started to produce upgrade components for these old decks and this is where the vision of a completely new record player came from, one that incorporated the best of the older deck drive systems but addressed the weaknesses

with the engineering of today."

Daniels outlined the requirements he used for developing a new turntable: "You want to retrieve as much information out of the groove as possible, but add nothing. You should aim to introduce no vibration or noise from the mechanics, such as the motor or bearings and reduce airborne and mechanical vibrations from the speakers. Another area vital to performance is pitch stability, the record must rotate at a constant speed and not fluctuate. The drive system must not slow down and speed up, it must have a grip for consistency of speed. This is where the idler drive technology from the turntables of yesteryear, together with a controller, is a vital piece of the device."

For his latest product, the SMD Acoustics V2.0 Turntable, Daniels utilised the latest technology and ultra-precise engineering to produce a record player, with a contemporary design, that built on the qualities of those from the past.

Daniels had heard of maxon products from a colleague within the audio industry and contacted the maxon UK office. "When you are



building someone else's products into your design, you have to have complete confidence in their product and in their support and product availability, for years to come. You don't want to switch and have the expense of finding a new product, possibly changing the design and the knock-on effect to the production timetable. maxon motor have been around for over 50 years and are well known in the record turntable business."

maxon developed a customised solution based on the RE-max 29 brushed DC motor and the ESCON 36/2 DC motor controller, with firmware specially modified for SMD Acoustics. Noise, both mechanical and vibration, are key to

the design in a record deck, any sound from the motor is transmitted directly through to the record deck. The motor uses an ironless rotor construction, with no cogging, giving smooth speed, in addition to low noise and long life.

Speed control comes from the ESCON 36/2 controller that measures the back electromotive force (EMF) from the motor thousands of times a second to make minute speed adjustments to the motor; allowing changes in temperature and load to keep perfect speed and pitch. "The ESCON software is a fantastic tool that offers brilliant potential. For future modifications it just means a software change, which is an easy process," Daniels commented.

After three years in development, the SMD Acoustics Turntable is now ready to go to market. A full description of the technology included in the turntable are on the Peak HiFi website if you require further evidence of why £5K (granite plinth not included) is a sound investment. Then it's time to dust off those Slade albums....

www.peakhifi.co.uk
www.maxonmotor.co.uk
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


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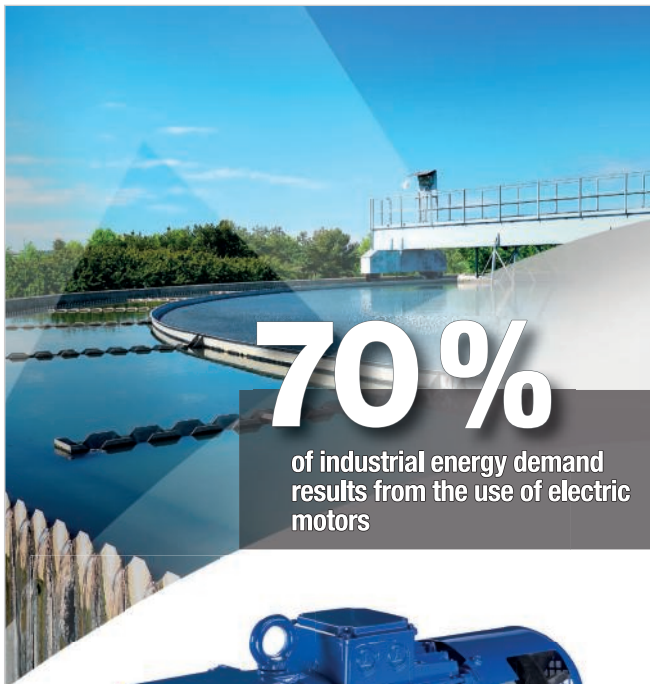
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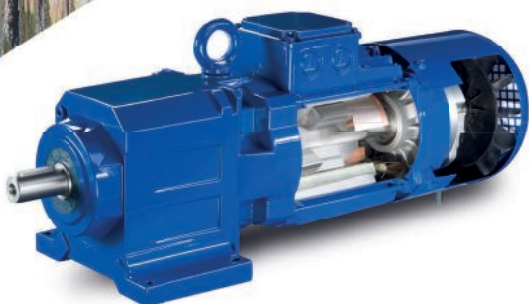


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Get on the fast track

There's more to fast track product development than speed, as Adam Geernaert explains.

Every product starts with an idea, but before you dive headlong into the design process, it's advisable to take a step back and look at the bigger picture. The reason? To make sure that what you think is a good idea can actually make you money.

At Cambridge Consultants, we work with our clients to define the whole product cycle and help them to identify and reduce risk. We are good at it because it's what we do - in every project, in every industry and at every stage in the development. We work across many industry sectors - front end through to manufacturing process design and delivery. The approach to risk is the same - identify the highest risk area that may cause your product to fail, understand it, mitigate it and move on to the next biggest risk. Attack the hard stuff first; it may sound obvious, but perhaps not if you have never developed a new product before.

While it's a situation that Cambridge Consultants is familiar with, it can be challenging for our clients. When someone comes to us with an idea, one of the first things we'll do is ask the company what it knows about the market, how much research it has done and how sure it is that

the product will be successful.

We pride ourselves on delivering market-changing breakthrough products at very high speed. But the assumption that speed to market is the most important thing is wrong. It's a complete waste of time and resources to design the wrong thing, however fast you do it. In fact, it's even worse than that, as it could cause irrecoverable damage to your brand and, in some cases, you might not get a second chance.

It might seem strange to ask a client how well it knows its market, but there's more to it. Sometimes clients are so eager to get on and 'make the product' that they are reluctant to spend time finding answers to questions such as how well they know their competitors, what IP issues they might come up against, and what the market will be like in two years when they plan to launch - but it's a very important part of a successful product development. One of the biggest challenges in product design is trying to predict the future - that's why we have market insight experts who can help with this.

Some clients will have a well-developed specification for their product before they come to



Design expertise wins Red Dot Design Award

Highlighting the world-class expertise of its product design team, Cambridge Consultants has won a prestigious Red Dot Design Award for its KiCoPen smart insulin pen concept. One of the largest design award schemes, the Red Dot Design Concept category attracted nearly 5000 entries from 63 countries.

KiCoPen is intended to make management of diabetes easier and more accurate. It captures the exact dose of insulin delivered and transmits this wirelessly to a smartphone. The batteryless device is powered by the energy generated when the user removes the injector cap.

KiCoPen team leader Vaishali Kamat, head of digital health at Cambridge Consultants, said: "The KiCoPen concept is a fantastic example of how the combination of innovative technology and great design has the potential to change people's lives. The user is always at the heart of our medical device developments - from understanding their unmet needs at the outset through to delivering a user experience that is second to none.

"When it comes to the new generation of digital products, that user-centred design thinking includes working out what information is needed and how it is displayed to make it easy to understand, making apps simple to use and creating solutions that people want to use."





us, but others may still be at the idea stage. It is important that, early in the project, a product requirement specification is created, outlining what the product needs to do – how it will function. From this, develop the technical specifications – how is the product going to deliver those functions? These documents will become the project's sanity check. While they may change as more information becomes available, they will be the documents you always go back to.

One risk to be wary of is 'specification creep'. When innovative people get together, they will often come up with new features or functions which may be very clever, but may add complexity. Changing requirements in the middle of a project is rarely efficient. So take things back to the product requirement specification and ask if the

design is still valid – aim for value, rather than complexity.

Because Cambridge Consultants is a fee-for-service company, we are agnostic about solutions. What drives us is doing the best thing for the client. When a client first comes to us with an idea, we'll be asking such questions as who will use it, how will it make money and how will it be sold? Our job is to ask the right questions and to listen carefully to the answers.

Projects, of course, need a strong project manager, but an excellent technical lead is also very important – someone who understands the product as a whole system. Identifying and addressing risk on a system level is key to developing a successful product.

Let's take the example of a subsea sensor as

part of an oil and gas application. The client might come to us and ask whether we can design that particular sensor. We can do that, but the design of the sensor itself might not be the highest risk area; it might actually be getting the oil or gas to flow correctly past the sensor – and that might not be something which the client has considered.

Of course the 'look and feel' of a product is important, particularly if it is targeted at the consumer or medical markets, and this must be determined early in the process.

Cambridge Consultants has a team of human factors and industrial design specialists who can help clients understand how users will interact with their product. With medical products, for example, this aspect may need to be solved before you address the technical challenges.

Bear in mind that the appearance of industrial products also needs to be considered; often the buyer only sees a catalogue picture at point of purchase. In parallel, you need to start designing the internals. Start identifying the components that will be needed. What is available 'off the shelf' and what needs to be designed? Be cautious in terms of size and shape; your design might work, but be too big or too expensive. The challenge then is cost and size reduction, which means you'll lose time to market and, potentially, money.

And think about how the product will be made. Will it be on an existing production line, for example, or is a new one required? Cambridge Consultants has a very experienced transfer-to-manufacture team who can help identify potential manufacturers early in the project.

In conclusion, remember that all product development should be driven by the end user. It might sound obvious, but it's something that is often overlooked – your product must be driven by a need and the design must follow a well-checked-out process. If you do that, your new product will get to market quicker and with a greatly reduced risk of failure.

Adam Geernaert is a product design engineer who leads the analytical engineering group at Cambridge Consultants.



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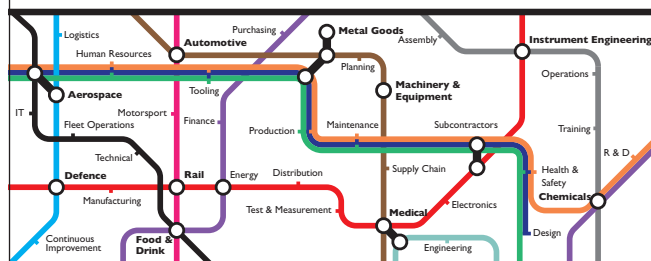
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Hot picks!

If you are designing a plant, process or product that requires knowledge of temperature, there may be more than one solution. Bill Tanner looks at the options available to engineers.

Temperature is the physical variable most often measured in industrial processes.

There are a variety of reasons we need to know the temperature of an object or a process – to prevent product damage, ensure sterilisation, determine biological health, ensure mixture blending, control chemical reactions (including food cooking), or to ensure drying, curing, and out-gassing, to name just a few. Temperature measurement can also be a regulatory requirement; for example in the temperature monitoring of food and drug products.

Selecting the sensor and measurement device to match a specific process is extremely important and knowing the various options is the first step in optimising temperature measurement. For example, temperature measurement sensors play an extremely important role in heat-treatment of metals, for example structural steel used in buildings and metals used in aircrafts. In these cases, a manufacturer must be able to guarantee that the metal was heat-treated in a particular way to ensure the metal has the desired properties. Another example is automobile parts; to be tough enough to withstand wear and tear certain surfaces on some parts must be heat-treated in accordance with a specific ASTM schedule. It is simply not possible to physically look at something (or even conduct X-ray fluorescence) to tell if it is properly heat-treated.

Temperature measurement sensor types

Sensors used in temperature measurement have an electrical property that is sensitive to temperature changes.

The temperature sensor chosen for a particular process depends on its cost, range of operation, sensitivity, response time, repeatability, and its ability to survive its environment. There is usually some measurement range overlap, and more than one

sensor type may be suitable for an application. For example, biological systems can often be monitored with non-contact infrared (IR) detectors, thermistors, or silicon diodes.

Occasionally the only practical way to monitor an internal temperature is to embed a temperature sensor into a product during the manufacturing process. An example is an

electric motor with an embedded resistive temperature detector (RTD), or a thermistor on one of the motor's copper windings.

A thermistor is a type of resistor, generally made of ceramic or polymer, whose resistance varies significantly with temperature. Unfortunately, thermistors require more complicated software to account for their very



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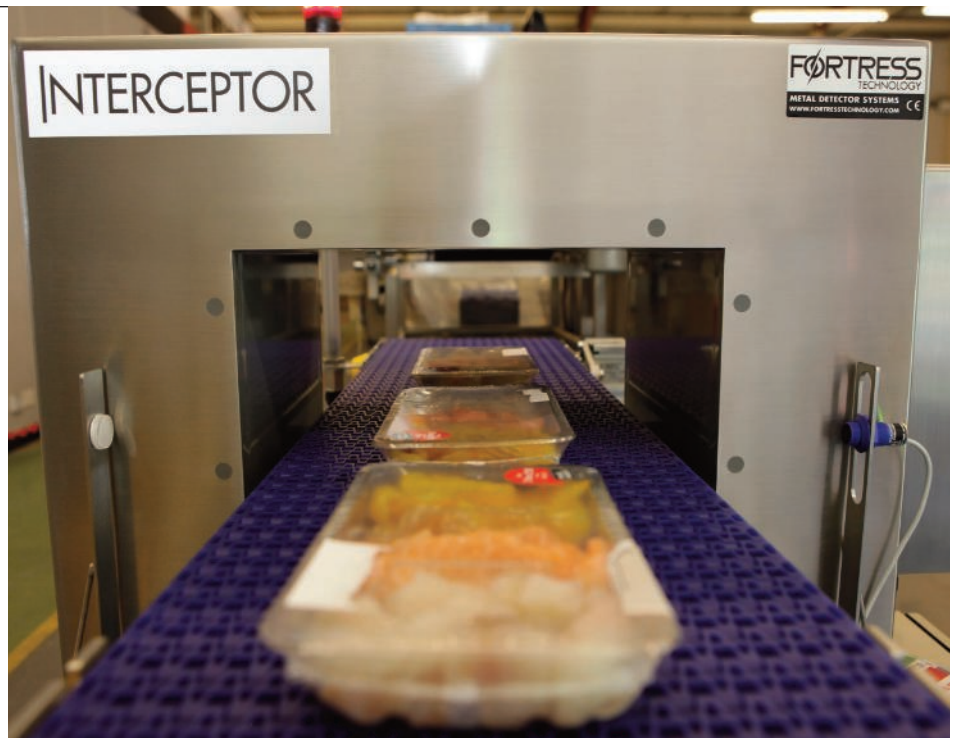
Especially when teamed with the Flexi Soft FX3-MOC Drive Monitor, the DFS60S Pro permits safe working without loss of productivity during routine operations, such as piece part loading, magazine replacement, adjustment on machining centres or splicing of material on reel-fed machinery. Using a single DFS60S Pro, the rotating shaft speed is monitored and output to a safe motion monitor, providing data which can allow PLd / SIL2 safety for the equipment, PLe / SIL3 if two encoders are used.

"DFS60S Pro delivers easily-verified safety for controlled slow operations where production efficiency is key," claimed Darren Pratt, a SICK (UK) encoder specialist. "Using non-certified encoders requires substantial investment in validation and verification of the safety function to ensure compliance with the Machinery Directive. The DFS60S can be fitted to rotating machinery and connected with any suitable safety drive monitor or retrofitted to equipment where the SICK Flexi Soft safety systems have been already installed to operate other safety sensors and switches."

Minute metal detection:

Designing a food production line? Fortress Technology is claiming to have made a breakthrough in food safety inspection. Increasing stainless steel detection by 100% compared to the most recent generations of metal detectors, the Interceptor accurately inspects wet and conductive products and aims to eliminate false rejects.

Specifically designed to tackle the longstanding challenge of high product rejects when using metal detectors to inspect meat, dairy, ready meals, bakery and fortified cereals applications, Fortress's latest technology splits the frequency signals. This means that the machine can clearly differentiate between the signal generated by the product as a result of moisture or mineral content and any metal contaminant, putting a stop to a potential stainless steel signal being 'swamped' by product effect.



non-linear temperature response.

RTDs use such metals as platinum or nickel, and are useful over a large temperature range, while thermistors typically achieve a higher precision within a limited temperature range, typically -90°C to 130°C.

Application examples

Manufacturing plastic products often requires thermocouples due to the high operating temperatures of the machines that make the plastic parts. The sensors are very close to the electric heaters that extrude and form the finished products.

Excessive drying temperatures can cause damage and waste energy, which makes it desirable to control how products, objects, and even people, are dried. For example, streams of hot air drying human hair and hands must be controlled and limited to prevent injury. In the case of food preparation, insufficient drying can cause product damage or allow harmful bacteria to grow. Thermistors often monitor a product's temperature directly or the atmosphere around the product.

The relative humidity of the atmosphere is an important variable related to drying. A thermistor in the humidity sensor of a chilled mirror

hygrometer (CMH) helps measure the dew point, which is related to the moisture content of the nearby atmosphere.

Monitoring outside weather and inside temperatures in heating, ventilating, air conditioning (HVAC) equipment often calls for use of thermistors, RTDs, or silicone diodes, which are low cost, can withstand their environment, and are sensitive to temperature changes. Among these, thermistors have the highest sensitivity. Thermistors are often found in home thermostats because of their high sensitivity and low cost.

Refrigeration systems often use thermocouples due to their ruggedness and low cost. The T-type thermocouple is commonly used because it resists corrosion from moisture better than other thermocouple types, including type K, and J. It is not unusual for there to be moisture condensation on refrigerated surfaces. The T-type has the lowest temperature calibration data of any thermocouple, with data down to -185°C.

The lowest end of the temperature scale is used by researchers to study material properties close to absolute zero, -273.15°C. Sensors in these devices use the dependence of the forward voltage drop in a p-n junction diode biased at a constant current, typically 10 µA.

Some germanium and silicon diodes can get to within fractions of zero degrees Kelvin.

Measuring with thermocouples

A thermocouple is a sensor for measuring temperature that consists of two electrical conductors made from different metal alloys. Typically, the two conductors are built into a cable that has a heat-resistant outer sheath. At one end of the cable, the two conductors are mechanically and electrically connected together by crimping, welding, or other means. This end of the thermocouple (known as the hot junction) is placed at the location that is to be monitored. The other end of the thermocouple (the cold or reference junction) is connected to a thermocouple measurement system. The term 'hot' junction is somewhat of a misnomer, since this junction will be subjected to a temperature below that of the reference junction if relatively cold temperatures are being measured.

Thermocouples generate an open-circuit voltage proportional to the temperature difference between the hot and reference junctions.

It is important to have an accurate cold junction measurement, even when several thermocouples are connected to the same

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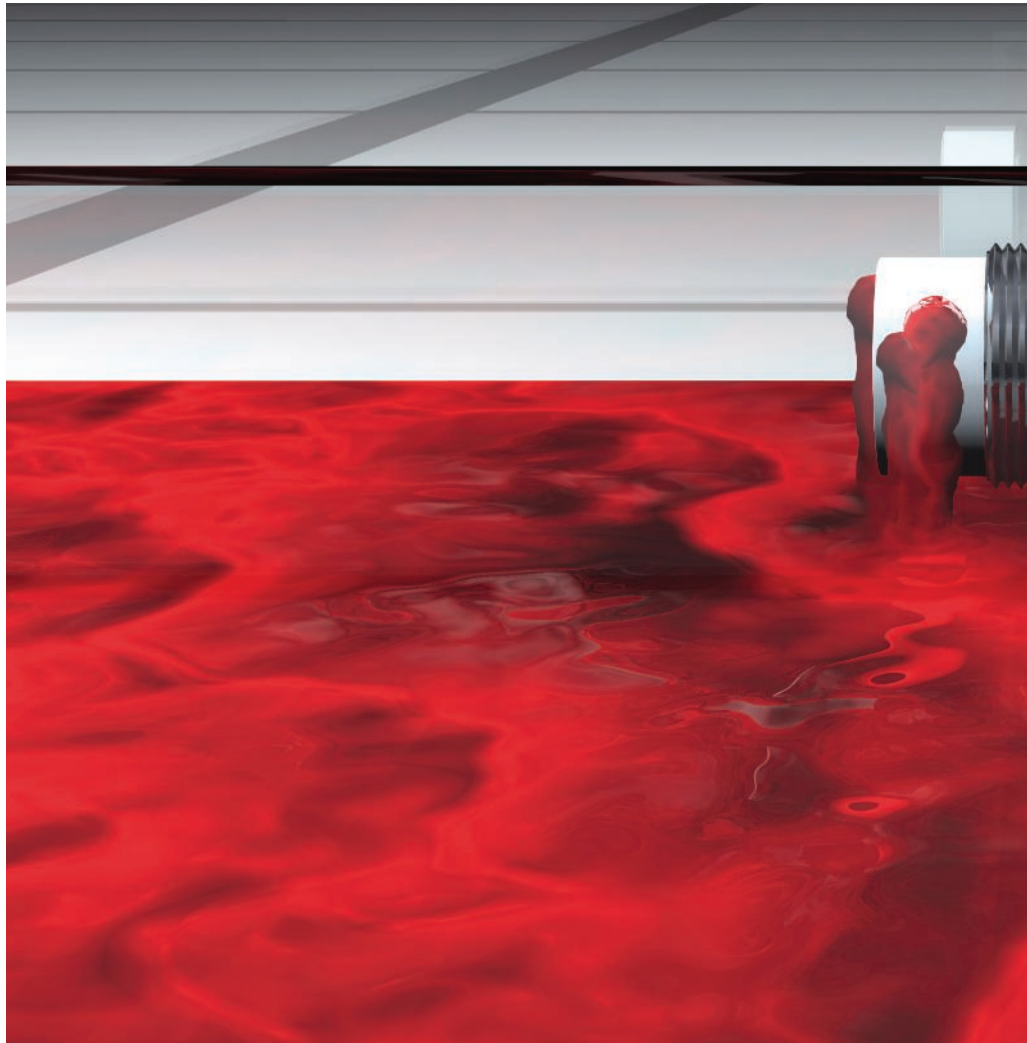


board. If the cold junction sensor is too far away from the thermocouple, there may be a significant measurement error – more than 1° C. To avoid such errors, some measurement systems use eight cold junction sensors to ensure each thermocouple is less than ½-inch from a cold junction sensor.

It is not unusual to attach the hot end of a thermocouple sensor next to an electrical heater or to the machine frame used by high voltage motors. These two conditions often lead to high voltages finding their way onto thermocouple sensors. Thermal cycling of electrical heaters often weakens their electrical insulation, resulting in a high common mode voltage being applied to the millivolt-level thermocouple signal. This condition obscures the temperature signal and in the worst case destroys the measurement electronics. One solution is to isolate the electronics and let them float up to the high common mode voltage of the thermocouple.

Precise industry considerations

Sensors must be chosen to survive their environment and produce repeatable results after repeated exposure to temperature extremes. Thermocouples and RTDs can survive high temperatures but sacrifice resolution; they need more complex circuitry, for example, cold junction measurement (for thermocouples) and a four-wire measurement (for RTDs). The



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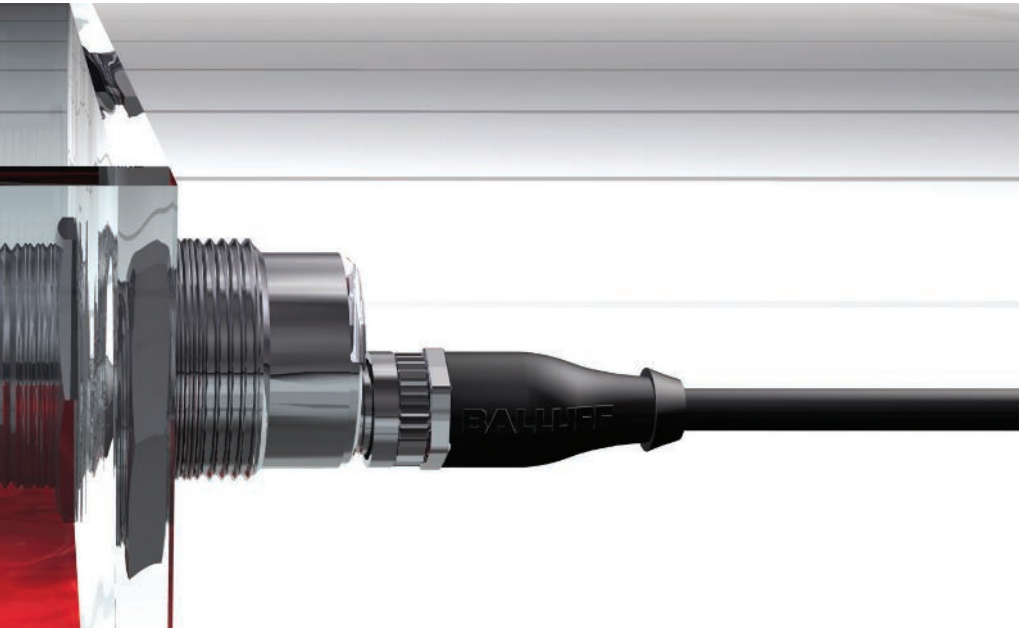


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Keen on mustard:

Liquids such as ketchup, mayonnaise and mustard can be a problem for level sensors as they have a tendency to be adhesive or create extensive amounts of material build-up on the sensors or container walls, other products such as milk can foam during processing. Both these effects can cause standard capacitive sensors to false trigger. Balluff's SMARTLEVEL sensors combat these problems.

The SMARTLEVEL 500+ a stainless steel M30 sensor with a non-flush Teflon sensing surface, reliably detects difficult liquids through plastic or glass containers (up to 20mm thick), or by direct contact with the liquid. Balluff's SMARTLEVEL 500+ can also detect high-conductive acids such as sulphuric or hydrochloric and concentrated cleaning agents, again even through container walls.

millivolt-level signal from thermocouples limits high resolution measurements in noisy industrial environments.

Malfunctioning machinery can add high common mode voltages that obscure the tiny sensor signals and they can destroy measurement circuitry. Isolated measurement circuitry minimises the effects of high common mode voltages while resisting high voltage damage.

Some applications require resolutions of 0.001°C. Thermistors provide this resolution at the expense of a limited temperature range; however, unlike thermocouples and RTDs they cannot survive high temperature environments. Thermistors have the fastest time response to temperature changes. They have the added advantage of being inexpensive and not requiring an additional cold junction measurement.

The reversed biased silicon diode is the least expensive sensor. It has a well-defined voltage versus temperature curve, but does not have the thermistors' high sensitivity – nor can it survive the high temperature environments where thermocouples excel. The reversed biased diode is sometimes built into integrated circuits designed for temperature measurement. The added circuitry makes the diode's non-linearity appear linear.

Bill Tanner is president of Sensoray Company.

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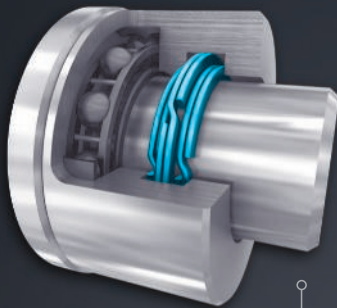
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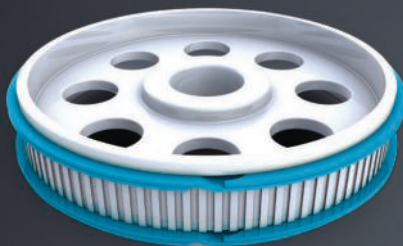
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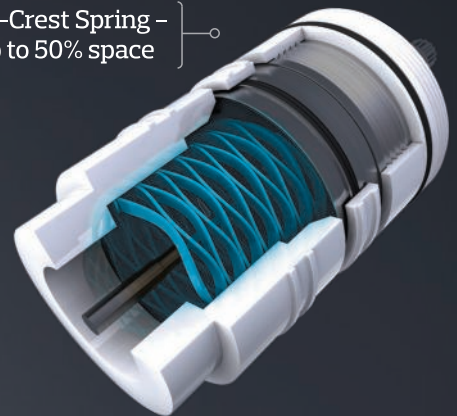
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One fix for the whole mix

Having a single fastening technology to deal with every material from metals to composites sounds like joined up thinking! Tim Fryer spoke to one company who believes it has such a solution

At its most obvious level, lightweighting can be achieved by simply using smaller, lighter component parts. To go a step further and make most use of some of the advanced materials on offer it can mean embracing some new technologies. There is no use, for example, in finding weight reductions from composites if you then lose its structural integrity by drilling holes in it for assembly – the fastening technology needs to be sympathetic to the materials.

PennEngineering's customers, particularly

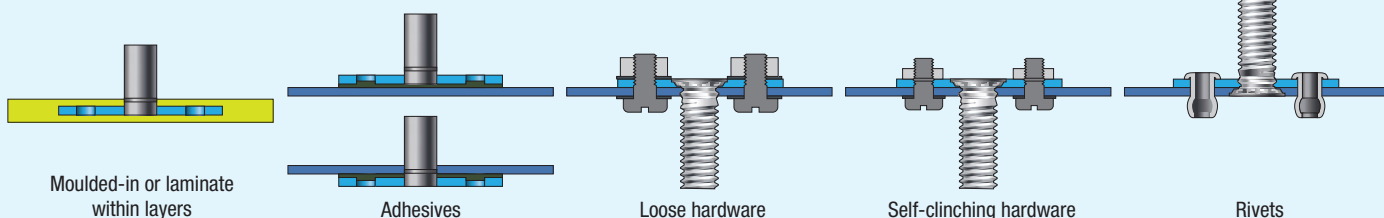
those from the automotive sector, were exploring solutions that were both strong and light, but that also satisfied the demand to be applicable across a range of materials. The company responded by deploying its self-clinching technology in a new format resulting in the VariMount product line.

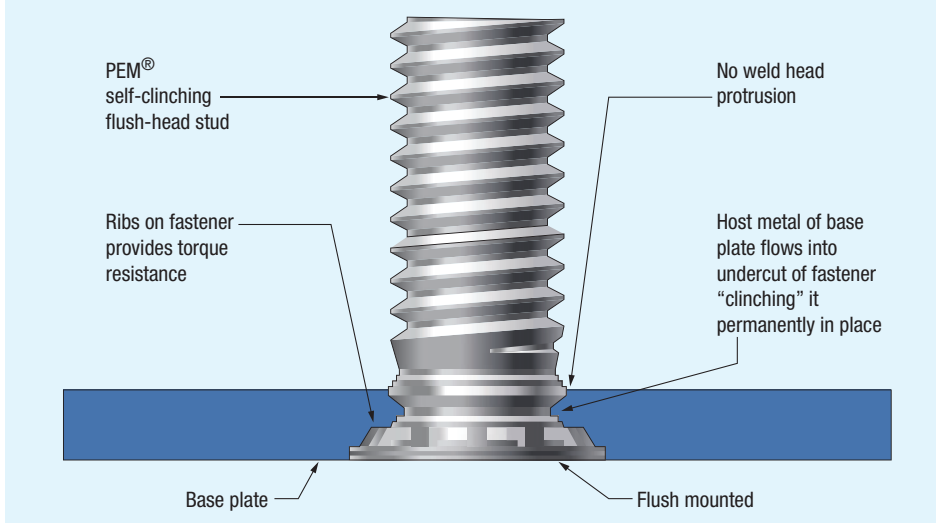
Liam Foy, director of sales and marketing EMEA at Penn, commented: "The technology that's out there today, like welding, is quite unwieldy and quite costly. Self-clinch technology means that the mating component part of the VariMount is a captive part of the plate. In

addition, there are eight various sized holes in the base plate that are designed to accept standard sized other fasteners, like rivets. The idea here is that the customers wanted a different way to mount a fastener. They spoke to us about mounting in terms of adhesives, and then they spoke to us about the different types of mating material that they wanted to mount. Those included things like plastics, laminates, substrates that you couldn't actually pierce."

The VariMount solution means the base plate can be mounted on or below a panel, or

Typical mounting methods



Example of a Varimount™ assembly using self-clinching technology

between the layers of it.

"The beauty here is that you can attach any self-clinch fastener to that," continued Foy. "So you can have a stand-off, you can have a blind nut, you can have a female thread, you can have a male thread - as the name suggests, it's a variable mounting fastening system. It really offers the customer a unique solution to a lot of the issues that they face in terms of spreading the load and mounting on different materials."

The core here is the self-clinching technology which revolves around the fastener being harder than the base plate material, which is made of steel or stainless steel. The PEM fasteners, of which there is a variety of types made of harder steels, will be pre-installed - therefore permanently clinched to the base plate without unsightly welds.

Foy commented: "In most cases it's stronger than a weld. With self-clinch the fastener becomes a captive part of the sheet. It becomes locked in on this base plate."

Standard fastener offerings are available in a range of metric and unified thread sizes and lengths include steel and stainless steel nuts, steel blind nuts, steel standoffs, and steel and stainless steel threaded studs. Beyond these standard offerings, other PEM fastener types and sizes can also be supplied pre-installed into base plates to suit particular application requirement.

The first industry that PennEngineering has concentrated on with the system is automotive, mainly because they were the ones starting to use composites. "Typically in automotive those

guys will look at their own material first," stated Foy. "The fastener selection is way down the line. It's very much an afterthought. But we found, especially inside the car, that they were looking for ways in which they can mount fasteners in composites. The key thing about composites is you can't pierce it. The fastener has to be either in the layer or outside of the layer, and this system provides such a solution."

Other likely early adopters will be the aerospace industry where the use of composites is growing and an appropriate fastening solution is required.

Foy said: "The use of metal is reducing as these industries want to reduce weight and so turn to plastics. They want a solution where they

can mount a fastening base plate and a fastener using adhesives to plastics."

Designer awareness

When using with composites, designer awareness is critical. As composites can lose their integrity if they are machined the fastener needs to be part of the material's manufacture and can no longer be an afterthought. This is typically outsourced by automotive manufacturers to composite specialists, which may be performing other functions like putting electrical connections through the composite.

Foy therefore believes VariMount will actually promote the use of composites: "One of the challenges in composites was you couldn't mount a fastener to it. So this actually is in support of a material that's out in the marketplace today that they didn't have a solution for."

Self-clinching fasteners are put together using a press and Penn has a range of equipment designed for use with its own products. But does this pose an obstacle for adoption? Not only does the design engineer need to be convinced it is the best solution but the production engineer also needs to be willing to commit to a new process.

"They are all using competing technologies already and whatever one they are using requires a secondary operation," says Foy. "Now that there is this understanding that any fastening element is an integral part of their overall assembly, I think there's an understanding that you need to take care of the installation as well as the fastener design itself."

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Self clinch goes micro

Lightweighting, with its resultant components becoming harder and stronger, is a major trend, but there is also a continual drive to make things smaller. Particularly with electronic devices the need for smaller fastening devices that are stronger is growing. Here, a full micro range from PennEngineering is challenging the use of traditional fixing methods.

Liam Foy of PennEngineering commented: "If the mobile phone is getting smaller and smaller, and you are using screws that are going to get tinier and tinier - how do you assemble that as a high-volume manufacturer without damaging the screw, and make sure the screw aligns correctly with the mating nut? The applications require a mechanical fixing element. We actually find ourselves competing against some of the more traditional fastening methods like welding, and loose nuts and bolts. And it's really about educating the marketplace. But we've got a fairly strong message to take to those guys, we can say that we can improve the speed of your assembly, we can take out the cost of welding, and ultimately, when you look at nuts and bolts, we can replace two fasteners with one."

The microPEM fastener range have threads down to M1, pin diameters as small as 1mm and clinches into sheets as thin as 0.3mm.

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Correct coupling for efficient hydraulics

A well designed plant is only as efficient as its weakest link, right down to the hose couplings. Here, Andrew Dawes explains how to avoid the common pitfalls of specification and why solid connections hold the key to true system efficiency.

As equipment and technology advances, it has never been more important that modern fluid power systems perform safely and precisely.

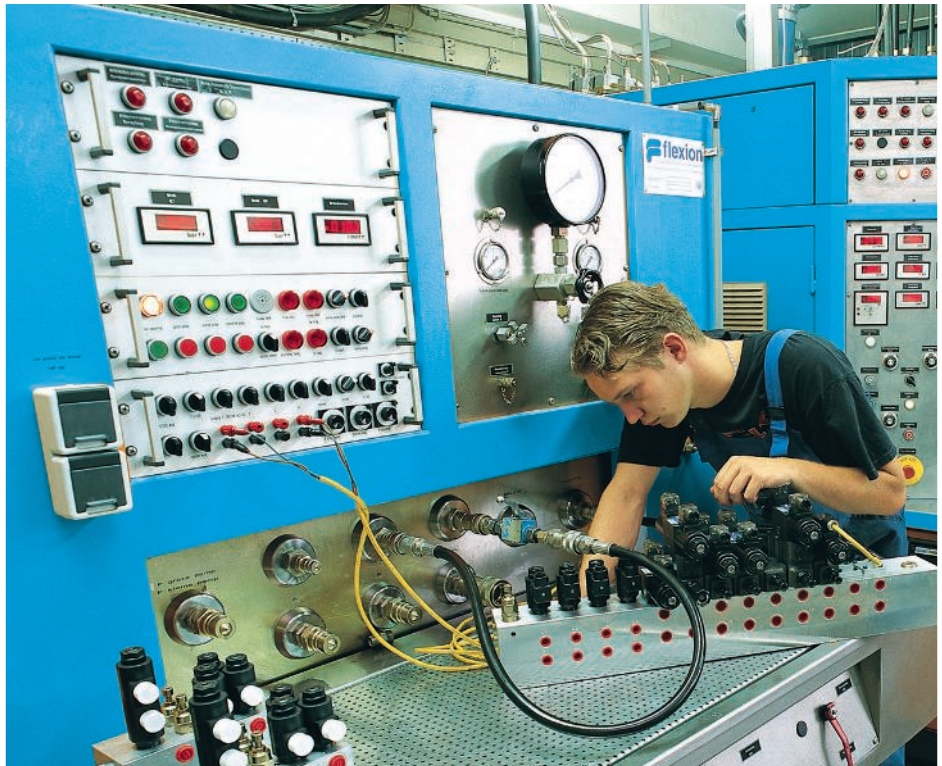
However, partnering one manufacturer's hose with another's coupler can seriously jeopardise this, and the engineer designing the plant must take this into account as much as the engineers that run and maintain it.

It's common knowledge that high-quality hose assembly is essential to the reliability and efficiency of fluid power systems. The flexibility of hoses enables components to be positioned in the most efficient or convenient place, due to the ability to bend around corners, through tight spaces, or across long distances. Yet, there is a misconception within industry that specifying high quality hoses and end connectors (couplings) from separate manufacturers won't have any effect on a systems performance. This couldn't be further from the truth.

The dangers of 'mix and match' design

The amount and type of machinery being imported has grown dramatically, which has led to suppliers offering countless styles and types of hydraulic hoses, couplings and fittings.

This has put engineers under constant pressure to solve challenges quickly, whether getting a newly designed system up and running or avoiding machine downtime on existing equipment. A hose may be matched from one manufacturer, with couplings from another. This 'mix and match' approach, at either design or implementation stage, to hose and coupling specification can have serious repercussions



ranging from minor leaks and major safety hazards, through to unanticipated downtime and increased maintenance costs.

To determine if the correct hydraulic hose and coupler have been selected, it is vital to take a holistic view of the system to ensure maximum efficiency. This should take in to account hose performance characteristics and the demands of the application including meeting temperature requirements and pressure capabilities and crucially the compatibility of system components.

Take size for example, in order to select the

Testing and validation is imperative if the right assembly is to be specified - but strict test parameters must be imposed for it to be useful.

proper hose size for replacement, it is important to measure the inside and, if through confined spaces, the outside hose diameters exactly, as well as the length of the hose. The inside diameter of the hose must be sufficient to keep pressure loss to a minimum and avoid damage to the hose as a result of heat generation and excessive turbulence.

Achieving maximum hose performance and safety requires regular inspections of the hose and components prior to, during and after use.



In fact, the hose must be capable of withstanding the minimum and maximum temperatures of the system application. All hoses are rated with a maximum working temperature ranging from -40°C to 100°C based on the fluid temperature, but exceeding these temperature recommendations, for long periods of time, can reduce hose life by up to 80%.

Needless to say, correct specification at the point of purchase can reap dividends for businesses; ensuring systems are not only safe but also as efficient as they possibly can be.

To understand the core requirements of a system, it is essential to understand the needs of the business and the environment in which the system will be working. This means taking into account every factor of the application, including fluid and ambient temperatures, environmental conditions, the type of equipment, working and surge pressures, minimum bend radius, fluid compatibility and expected service life and beyond. Another key factor to consider is compatibility. It can be all too easy for a system to be specified without properly considering whether the tube compound is compatible with the fluid.

A chemical resistance chart is a good tool, enabling the specifier to select a hose, hose tube, couplings, cover and O-rings that are consistent with the demands of the fluids. Failure to do so can lead to permeation, which will in turn result in loss of fluid within the system.

Compatibility is also a consideration on the braids, fittings and components, yet they are often forgotten during the specification process. However systems exposed to aggressive fluids can result in catastrophic failure and even major health and safety implications.

“It is vital to take a holistic view of a system to ensure maximum efficiency. Take in to account hose performance and demands of the application.”

**Andrew Dawes,
Eriks**

International thread terminations are available in different formats with BSP, Metric, JIC and SAE among the most frequently used. Knowing the equipment's country of origin is a great starting point when selecting what thread end is used. It's important to be aware of these differences and ensure that the system components are compatible and therefore safe for use on site.

Interestingly and unknown amongst much of industry is the testing and validation of the hose and coupling interface under strict testing parameters. There is only a handful of distributors, of which Eriks is one, with the capability to test and validate both its own hose

and coupling combinations as well as bespoke solutions for clients; ensuring efficiencies on site are met and more importantly that the safety of employees working in and around these connections can be assured.

Achieving maximum hose performance and safety requires regular inspections of the hose and components prior to, during and after use. Hoses that have become worn or damaged can present a danger to employees and should be replaced immediately.

While testing and validation is imperative pre-installation, failure to properly maintain hoses can also have serious consequences, such as costly material spills, clean-up, downtime and injury. However, regular scheduled inspections, corrective measures and hose replacements can be far less expensive than replacement or repairs made after a failure.

It's vitally important to be aware of all the factors involved when specifying hose and coupling equipment. Get it wrong and a hose assembly is potentially the weak link in your production process. It can be an entrance point for contamination or leakage and a health and safety risk. Get it right and a high-quality hose assembly will not only maintain a fluid system's efficiency and reliability, but can play a key role in your plant's performance.

Andrew Dawes is hydraulics product manager at Eriks.

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Ownership of inventions

Respondents to our recent IP survey raised some interesting questions regarding how best to mitigate against the potential loss of technology or know-how through staff losses. In consideration of this issue, Anthony Albutt takes a closer look at first ownership rights – asking who has first claim to the IP generated by an innovative UK business.



It is often the case that multiple forms of intellectual property exist in one creative process. In the course of designing a product for example, a combination of copyright, design and patent rights may exist, and multiple rights may protect the same product or design aspect. The statutes that govern ownership of IP rights in the UK are independent, which means that while there may be some common threads between them, the laws on each form of IP are separate, with the potential to cause confusion and complication to those unfamiliar with the law. In this article we will take a look at trade marks copyright, designs and patents.

Trade mark rights

There are no specific statutory provisions governing first ownership of trade marks in the UK, but the first owner will generally be the company that first issues the mark, subject to the mark not already being registered by another party.

Copyright

The author of a literary work (eg, software, manuals) or artistic work (eg, technical drawings) is generally the first owner of any copyright in it, but if the work is made by an employee in the course of employment, the employer is the first owner subject to any agreement to the contrary. Moral rights are the rights of the creator of a copyrighted work to, for example, be named as author. Moral rights are distinct from copyright in that they remain with the creator, even if the creator has assigned copyright rights to someone else.

Registered and unregistered design rights

In the UK, the designer is the first owner of any design right which is not created by

commission or in the course of employment. Where the design has been commissioned it is the person commissioning the design who is the first owner of any design right in it. Where the design is created by an employee in the course of employment, the employer is the first owner of any design right in the design.

Patent rights

For a UK-resident employee inventor, if the invention was made during the course of the employee's normal duties, or during course of duties specifically assigned to the employee, the first owner of an invention made by that employee will be the employer. In addition, UK-resident employee inventors in more senior positions, such as directors, may be considered to have a special obligation to further the interests of their employer. As a consequence, any invention made by such employees in the course of their duties will belong to the employer as the first owner of an invention.

The UK Patents Act also allows non-employed inventors to assign any future patent rights in an invention before an invention is made. For example, a contract may assign to an employer any future patent rights that arise from research work commissioned by a non-employee such as a PhD student.

If the above circumstances do not apply, the first owner of an invention will be the inventor.

IP ownership and contract law

In the UK, contract law is relevant in determining ownership of inventions made outside of employment, eg, by consulting engineers or scientists. It is important that businesses consider contracts with external suppliers and designers carefully and ensure that they include suitable intellectual property clauses. It is very common to require that any

designer or sub-contractor assigns any rights to intellectual property generated through the contract to your business. Failure to comply would then be a breach of contract.

Your first step will be to ensure that the contracts of employment your staff work under include suitable and appropriate restrictive covenants. However, take note that such covenants can be interpreted narrowly by the courts making it difficult to prevent ex-employees continuing to work in your technical field.

A word of caution: having obtained rights from external designers, if you then decide not to register them (for example in the form of a patent) you do not have a monopoly right to prevent others using your technology, including the designers. The same applies to suppliers you may be cooperating with to modify or re-design existing machinery to your specific requirements. Again, make sure your contracts include suitable protective clauses.

Secure your rights with IP protection

Importantly, business owners should seek protection for their innovations. As we have discussed in this article, patent law in the UK clearly states that an invention made in the normal course of employment is the property of the employer. This means you have the right to apply for the monopoly of, say, a patent.

It follows that if you have a granted IP right you can seek to stop a competitor infringing your rights, irrespective of who they employ.

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Hear, here!

This month's Coffee Time Challenge is going to war – onto the battlefield with gunfire and explosions all around. It is an incredibly hostile environment, but not just because there is an enemy trying to do you no good. Those explosions can cause irrevocable damage to hearing and a deaf soldier can be difficult to command.

Ear protection in this environment can therefore be vital, but battle instructions and information still need to get through. Standard earpieces can satisfy both requirements, but they also inhibit the soldier's ability to naturally hear the environment around them. Being able to hear where noises are coming from provides situational awareness which is vital in battle.

The challenge

The Challenge therefore, is to solve the riddle of how to protect the ears without blocking hearing. A practical way of protecting this sense while not impairing it.

Another factor of course is that a soldier's mobility is of upmost importance and every bit of electronics, protective clothing or whatever adds further to the substantial burden the soldier already carries. The solution needs to be light.

We come, as ever, heavily armed with a solution to this conundrum, but if you have an idea that you think will entertain or interest your fellow Eureka readers then send an email to the Editor at tfryer@findlay.co.uk or go to the Coffee Time Challenge section of the web site and leave your idea as a comment.

The answer to last month's Coffee Time Challenge, how to improve the experience for users of London Underground's Circle Line, can be found on p10 of this issue.

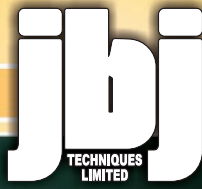


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