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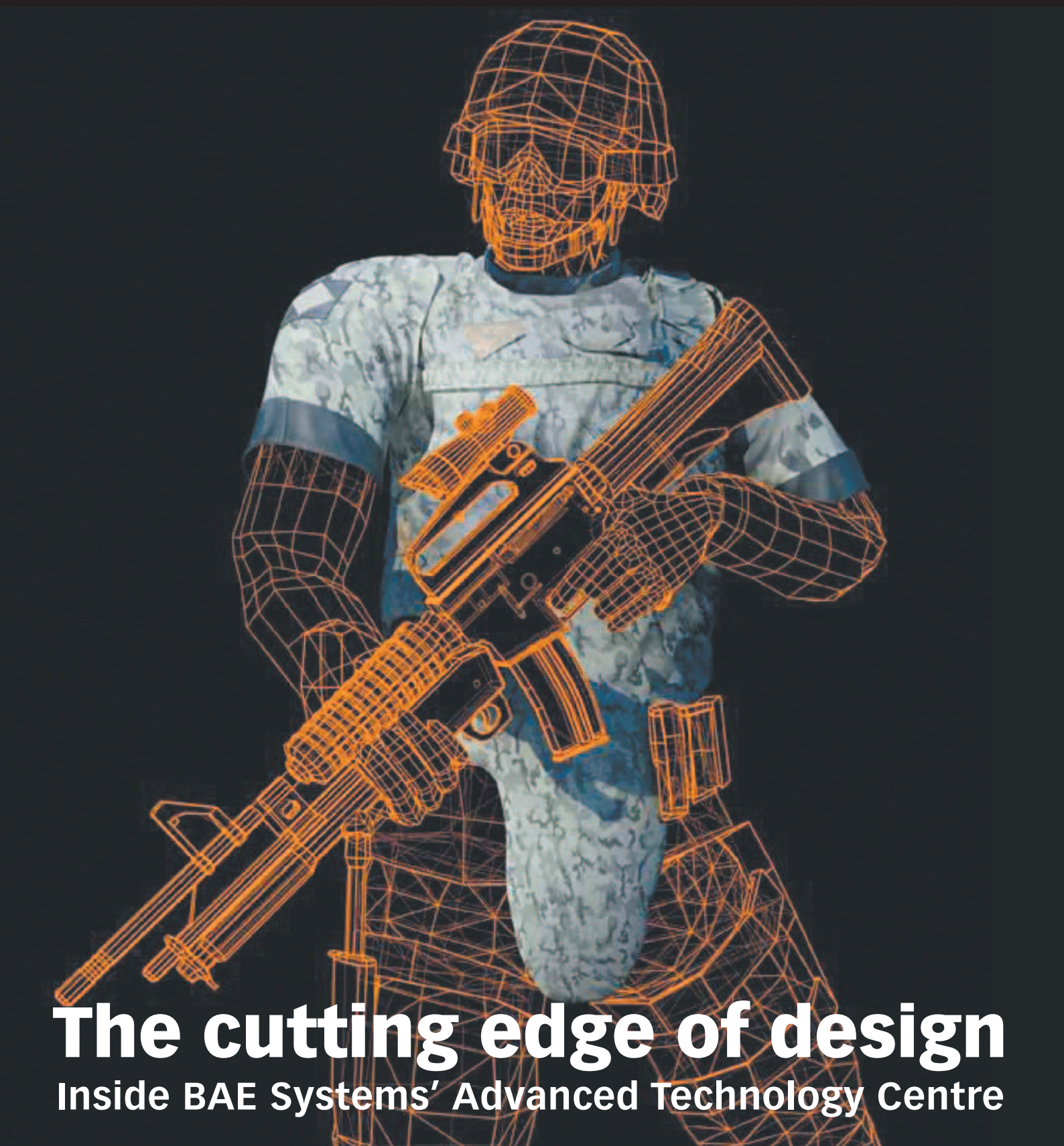
THE MAGAZINE FOR ENGINEERING DESIGN

In this issue: Design Software • Renewables • Sensors, Test & Measurement • Fastening & Adhesives



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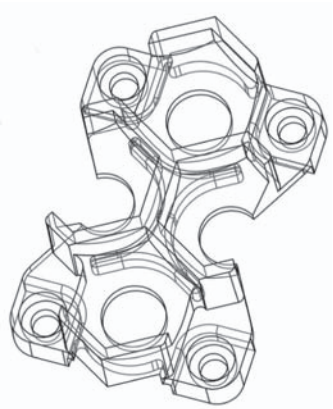

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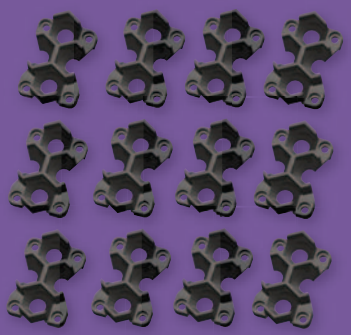

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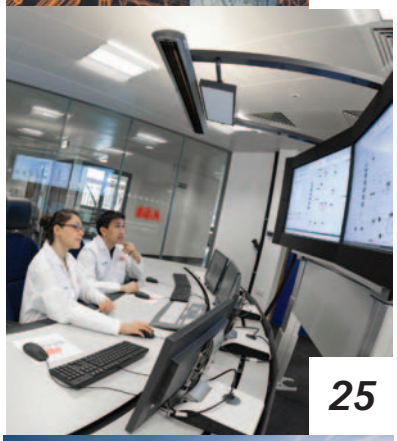

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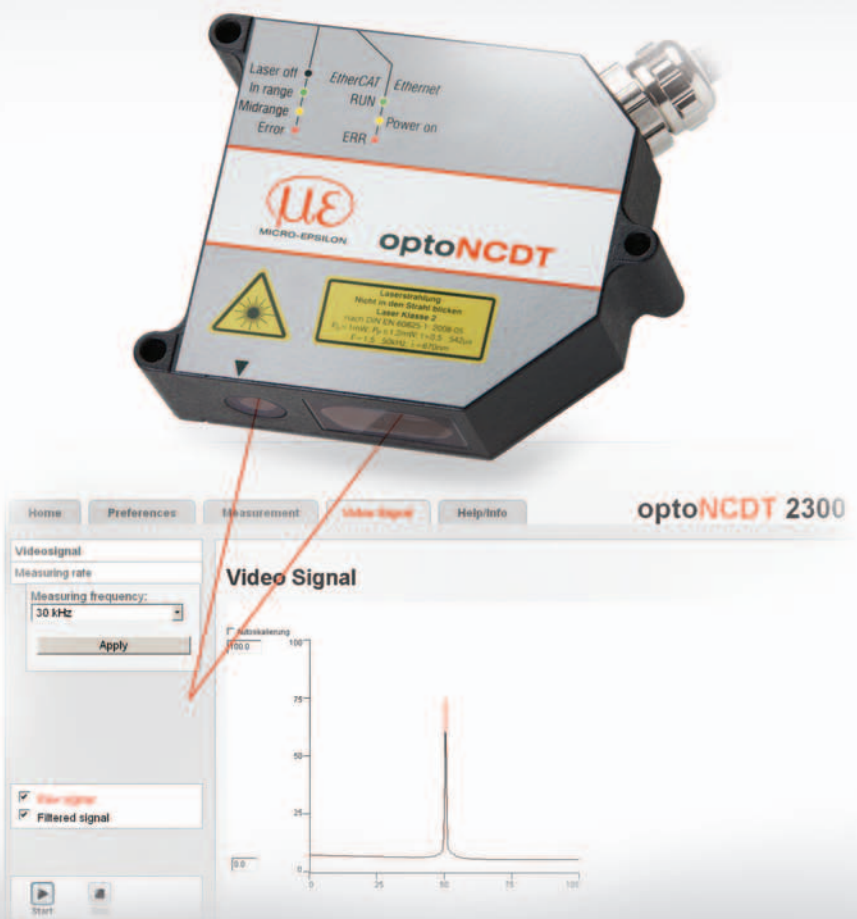

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Welcoming a new arrival

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

When you received this month's issue, you will have noticed an additional publication. That is because this month, *Eureka* and *Eureka Specifier* are joined by our newest stablemate, *Engineering Materials*.

Materials represent one of the fastest-moving and most exciting areas in modern engineering. However, while the advent of new materials and developments in materials processing represent fantastic opportunities in design, they pose almost as many questions as they offer solutions. Is it cost-effective? Is it sustainable? What is its carbon footprint? Is there a large enough supply of it? Can it be manufactured cost-effectively? All these questions represent serious headaches for anyone addressing a new design and can act as strong incentives to stick with the tried and tested rather than adopt new materials or methods.

Engineering Materials' purpose is to help answer these questions and offer readers the information they need to make the right material choice; examining the advantages and implications of those choices in detail and giving readers the information they need to make the right decision. It is our belief that *Engineering Materials* will be a valuable and longstanding part of our editorial offering and we hope you enjoy reading it.

These are exciting times for *Eureka*, of course. In addition to the launch of *Engineering Materials*, we are also now gearing up for the Engineering Design Show on 10-11 October at the Ricoh Arena, Coventry. Registration for this event is now open online at www.engineering-design-show.co.uk. By registering now, you can ensure free entry to this event – the only one of its type designed specifically for design engineers. For that reason among many, we would urge all of *Eureka*'s readers to register now for this exciting show.


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First UK Fraunhofer Centre announced

The first Fraunhofer Centre to be established in the UK will be based at the University of Strathclyde in Glasgow.

Fraunhofer Gesellschaft, Europe's largest organisation for applied research, is creating the new Fraunhofer Centre for Applied Photonics in a strategic collaboration with the University of Strathclyde. The Centre will be a hub for industry-driven laser research and technology for a variety of sectors including healthcare, security, energy and transport.

Fraunhofer will also establish UK headquarters, Fraunhofer UK Research Ltd, at the University, which will be the umbrella organisation for any additional UK-based research centres in the future.

The Fraunhofer Centre will be based in the University's world-class Technology and Innovation Centre, which was launched in March last year and is transforming the way universities, business and industry collaborate to find solutions to global challenges, create jobs and support the economy.

The new Fraunhofer Centre is funded by Fraunhofer and the University, the Scottish Government, Scottish Enterprise and the Scottish Funding Council. The Centre for Applied Photonics is expected to be the model for more Fraunhofer research centres around the UK.

Education Secretary Michael Russell announced the launch of the centre. He said: "Scottish universities are known around the world for their excellence and Glasgow has a global reputation for advanced research and technology. It's great news that this success has helped to attract Fraunhofer to Scotland.

"Building on the links between education and industry is a win-win situation that will benefit our economy. Securing the UK's first Fraunhofer centre is a major achievement for the University of Strathclyde's Technology and Innovation Centre and I look forward to watching this exciting initiative develop." Professor Jim McDonald, Principal of the University of Strathclyde said: "Fraunhofer Centres pride themselves on research that is geared to industry and societal needs – an ethos that closely mirrors our own work at the University of Strathclyde.

www.fraunhofer.de

IDC Models prototypes unique shot glass

IDC Models, the rapid prototyping and model making division of Industrial Design Consultancy (IDC), has produced a prototype for a novel new shot glass.

Quaffer approached IDC Models to produce a prototype of its Pyramid Shot Glass; a double shot glass which gives drinkers a built-in chaser. The product is styled in a pyramid form and allows 1oz of liquor and 2.25oz of chaser to be stored separately until the drink is consumed.

IDC manufactured the prototype using its in-house Viper Stereolithography (SLA) machine, a 3D printer that constructs models by selectively hardening liquid resin. The process involves slicing a CAD model into cross-sections which are traced by high-power laser onto the surface of the resin. The resin cures and hardens where the laser hits, allowing objects to be built up layer by layer.

Peter Pendergast, head of prototyping at IDC Models, explains "IDC's SLA process was able to produce prototypes of the shot glass which were almost water-clear in their finish.

www.idcmodels.com.

Government approves additional UTCs

The Government has approved a further 15 University Technical Colleges (UTCs) to open across the country over the next two years, bringing the total number of UTCs to 34.

For the past four years, the Baker Dearing Educational Trust (BDT) has been working with the Department for Education, local employers, universities and further education colleges to develop a national network of UTCs.

Lord Kenneth Baker, Chairman of BDT, said: "The Coalition Government continues to show its commitment to these new colleges for 14-19 year olds by expanding the national network. I am delighted that it has all party support and so many people right across the country want to open UTCs."

The UTC movement is backed by major players from British industry, with employers across all regions pledging their support.

Jenny Ball, HR Director, Ford of Britain supporting the East London UTC said: "Ford very strongly supports the principle of the University Technical College, enabling school children to concentrate on the Engineering and Technical disciplines while achieving their qualifications. We believe this will inspire and enable the next generation into achieving engineering excellence."

Dr Ralf Speth, Chief Executive Officer, Jaguar Land Rover supporting the WMG Academy for Young Engineers (at the University of Warwick) said: "The UTC will help to address very important issues at the beginning of the educational cycle, namely exciting young people about careers in engineering, and developing the pool of talent which we can all rely upon for future generations to come."

However, not all reaction was unreservedly positive. While welcoming the move, Dr Colin Brown, Director of Engineering at the Institution of Mechanical Engineers (above) added: "The great missed opportunity is that the colleges are set up to teach the engineering diploma which this Government has now downgraded."

www.utcolleges.org

REGISTER NOW FOR SOLD-OUT ENGINEERING DESIGN SHOW

Engineering design show
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Registration is now open for Findlay Media's Engineering Design Show.

By registering now for the show, which takes place on the 10-11 October at the Ricoh Arena, Coventry, potential visitors can ensure free entry to the event. Those wishing to register should visit www.engineering-design-show.co.uk

The show, whose headline sponsors include Schaeffler, Heidenhain, Altium and Premier EDA Solutions, is also now completely sold out. It is the only exhibition of its kind catering specifically to the needs of today's design engineers, regardless of the industry in which they work.

Due to take place at the Ricoh Arena in Coventry between 10th and 11th October 2012, it will include a comprehensive conference, exhibition and practical workshop programme.

Since its launch, the Engineering Design Show has been extremely well received amongst trade bodies and institutions with many, including IMechE, the IED, UKEA, ETN, Intellect and Profibus, having pledged their support.

www.engineering-design-show

Siemens to double apprentice intake

For the first time in decades, the number of new apprentices at the firm is now higher than that of graduates. The company says it is now recruiting similar levels of apprentices in the UK compared to Germany, where the company has its global headquarters.

During a factory tour at Siemen's gas turbine plant in Berlin, Deputy Prime Minister Nick Clegg said: "Today's announcement is fantastic news. Apprenticeships give young people an invaluable opportunity to learn on the job and allow employers like Siemens to build a workforce with the practical skills their business needs. It is a telling fact that Sir William Siemens himself, who founded Siemens in the UK 169 years ago, progressed from the shop floor to the top floor, having started his career as an apprentice."

Roland Aurich, Siemens' CEO, added: "Creating industry ready skills and giving the confidence of aspiration to young people from all walks of life is critical to address the serious skills shortage we face in industry. At Siemens we support the UK Government's efforts to rebalance the economy with an increased focus on manufacturing and engineering."

The new intake of apprentices will be based at offices and factories in Scotland, Newcastle, Lincoln, Manchester, Sheffield, Leeds and Poole. More than half will take up roles in the energy sector, while 36 will join Siemens' wind power business.

www.siemens.co.uk

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Objet launches new desktop 3D printer

Objet has launched the new Objet30 Pro, which it claims is the most versatile professional in-house desktop 3D printer available on the market. Unveiled at US additive manufacturing show, RAPID, the 3D printer offers seven different materials, including, for the first time on a desktop system, clear transparent material and high-temperature resistant material.

The Objet30 Pro is positioned as the ultimate rapid prototyping solution for designers and engineers, ranging from industries such as consumer goods and consumer electronics to medical devices and design consultancies.

The Objet30 Pro takes its place as the new top-of-the-line addition to Objet's existing desktop 3D printer line which starts at $19,900. With a small footprint, professional 28µm print quality and wide ranging material versatility, the Objet30 Pro produces high quality prototypes with a choice of seven different materials and functional properties, offering designers and engineers possibilities such as: Objet clear transparent material (Objet VeroClear) for simulating PMMA/glass; Objet high temperature material for heat-resistant static functional testing; Objet polypropylene-like material (Objet DurusWhite) for simulating snap-fit parts; and four rigid, opaque materials for standard plastic simulation (Objet Vero Family in black, white, gray, and blue).

www.objet.com

Medical elastomers eliminate pre-drying

A series of thermoplastic vulcanisate (TPV) elastomers spanning a wide range of hardness levels, exhibiting high purity and resilience for replacing rubber in medical applications and providing performance advantages over other thermoplastic elastomers (TPEs) is available from Teknor Apex Company.

The Medalist MD-200 Series elastomer range from ultra-soft 15 Shore A compounds to 80 Shore A grades and avoid the need for pre-drying because they are non-hygroscopic, and have a light natural colour that permits efficient use of colorants. All grades have been certified to pass ISO 10993-5 and are Drug Master File listed with the U.S. Food and Drug Administration. The compounds contain none of the extractable heavy metals commonly used in the curing of thermoset rubber. As they exhibit lower oxygen absorption than non-vulcanisate TPEs, they afford greater protection of pharmaceutical contents.

Used commercially as a replacement for thermoset rubber in syringe stoppers, Medalist MD-200 compounds have been shown to meet the requirements of ISO 7886 for single-use hypodermic syringes and exhibit a low coefficient of friction for consistent travel force in glass and polypropylene barrels.

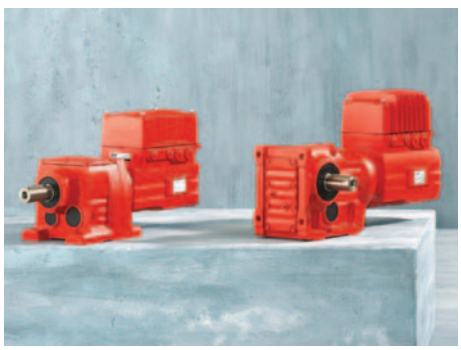
www.medalistmd.com

New IE4 motor halves energy consumption

SEW Eurodrive has launched a new super premium efficiency motor in the IE4 class that can cut energy consumption by up to 50% over conventional designs. The DRC permanent-field synchronous motor contains integrated drive electronics in an enclosed housing and is designed for flexibility so that it can be directly mounted to various gears including helical, parallel-shaft helical and helical-bevel via a flange and pinion shaft.

The motor compliments Movigear, the company's mechatronic drive system, by making its phenomenal energy saving technology available to users of standard gearboxes. It can be supplied with new products or it can be used as a retrofit on applications with existing geared motors driven by traditional motor technologies.

The DRC motor is available in two sizes, 1.5kw and 0.55kw, supplementing the company's product portfolio of mechatronic drive systems. The motor has a nominal speed of 2000rpm, with IP65 and IP66 degrees of protection and a 250% overload capacity. It fits onto standard SEW gearboxes from the R, F, K and W ranges, and can be supplied on its own with an IEC shaft and flange.



The flexibility of the DRC motor makes it perfect for use in a wide range of applications including logistics, airport logistics, automotive manufacture, food and drinks manufacturing, and construction equipment. It is the optimal, energy efficient solution for belt, chain and link-belt conveyors and by adding an optional brake it is suitable for use with inclining tracks and hoists.

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Regal makes its UK entrance

One of the world's largest and fastest growing electric motor manufacturers chose this year's Drives and Controls show for the UK unveiling of its new group structure and product portfolio. Regal Beloit will be highlighting its local support, huge EU stock and modification facility, alongside an enhanced premium range of Rotor brand motors and the official launch of the Marathon motor range to the UK, one of the world's most popular brands of electric motor. This is designed to underline all the competitive benefits of being part of a dynamic organisation with a truly global reach.

Regal Beloit UK exhibited a range of complementary motor brands, including Marathon Electric, Leeson, and Rotor nl, plus highlight the organisation's commitment to efficiency and responsible sourcing.

The Regal Beloit group operates its own manufacturing base. Because they're not reliant on joint ventures or third parties, the company can ensure complete quality control and responsible sourcing of raw materials, and can also focus on increasing efficiency and reducing wastage across the entire route to market, from the production process through to distribution and final delivery.

Recent investment in the company's Netherlands facility has seen Regal Beloit open the doors this year to what is believed to be the largest stock and motor modification facility in Europe, providing direct support and availability to the UK market. With the huge facility being just a few hours' drive away from the UK, local UK stock is being supported by an unparalleled level of motor availability. From fractional kilowatt motors to Megawatt machines, they can all be ordered and despatched for delivery – same day, something which the company believes no other brand can achieve in the UK with the same ease and convenience, most asking a large price premium or, several weeks' delivery at best.

Regal Beloit UK brings together the Marathon Electric, Leeson, and Rotor nl brands, providing a range of single phase and three-phase motors including motors for unconventional or challenging environments such as ATEX explosion-proof motors, marine motors, and vibrator motors.

www.regalbeloit.co.uk

PROJET 7000 3D PRINTER LAUNCHED

3D Systems's new ProJet 7000 production 3D printer is designed to extend the benefits of the company's 'crossover' technology further. The ProJet 7000 combines pushbutton simplicity with SLA printability to deliver the highest quality, most accurate parts and patterns available. Its large build volume and fast build speed provides up to four times the production capacity of other printers in its class. The ProJet 7000 comes in three models: the SD for affordable high-definition parts, the HD for ultra-high definition precision part manufacturing and the MP for dental and medical manufacturing applications. The ProJet 7000 prints the finest feature details resulting in the most accurate prototypes, parts and master patterns.

www.3dsystems.com

Solution to last month's Coffee Time Challenge

The solution to last month's Coffee Time Challenge about how to remotely supply power to medical implants comes from researchers at the Fraunhofer Institute for Ceramic Technologies and Systems in Germany.

The transmitter created by the team consists of an external transmitter module and a mobile generator. The device has a range of about 50cm, can be worn anywhere on the user's body and is capable of transmitting power through an array of materials.

According to researcher Dr Holger Lausch, an electric motor in the transmitter causes a magnet to rotate inside the device, generating a magnetic rotary field. This can harmlessly travel through human tissue, along with virtually any other non-magnetic material. The generator contains a magnetic pellet, which is set in rotation in response to the transmitter's magnetic field. Its spinning movements generate electricity from within the module itself, which in turn powers the implant.

Along with providing power to medical implants and medication dosing systems, the researchers believe scaled-up versions of the system could be used to power hermetically-sealed sensors inside walls or bridges, or wirelessly deliver power to unreachable electronic devices.

www.fraunhofer.de

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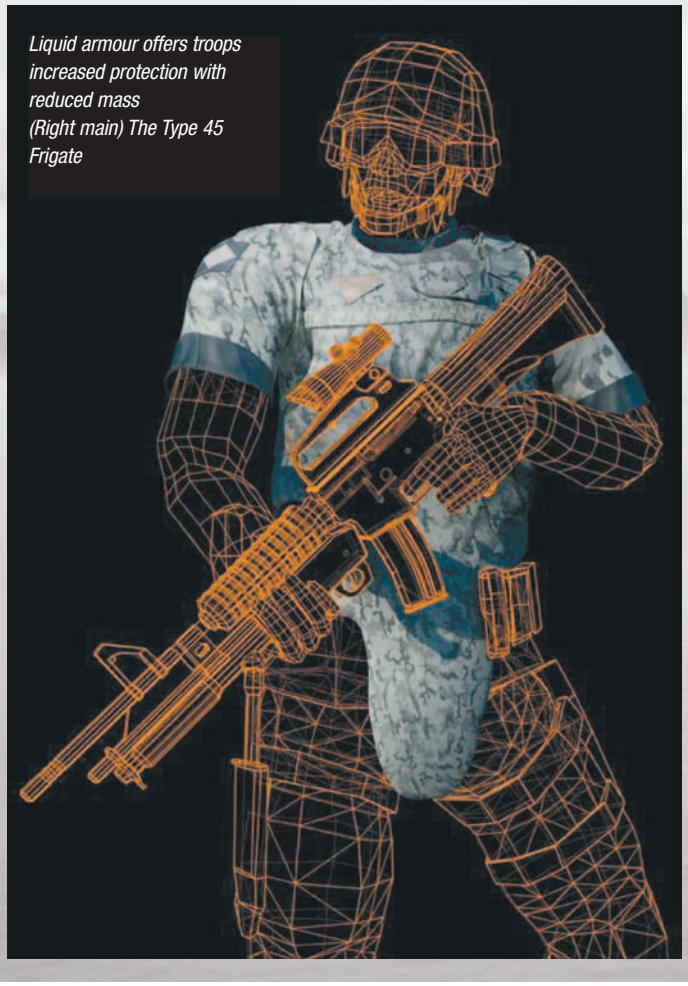
Honing the cutting e

As its name suggests, BAE Systems' Advanced Technology Centre is at the cutting edge of engineering design in this country. Many of the UK's most outstandingly innovative technologies start life in this unassuming building on the outskirts of Chelmsford, Essex. From its past as the research arm of Marconi up to the present day, it has long been at the forefront of innovation in the defence sector.

This history is something the Centre's managing director James Baker feels strongly and one he feels proud to continue. He says: "I often use the term 'pride' and we have people here who are genuinely world experts in their field – be it antennae, Radar, materials or whatever. The excitement and challenge of what they can do here drives a lot of people who work here. There are people here who thrive on solving highly challenging problems."



Liquid armour offers troops increased protection with reduced mass (Right main) The Type 45 Frigate

The results of this have been some of the most eye-catching ideas to have emerged in recent years. From lightweight, 'liquid armour' that harnesses the unique properties of shear thickening fluids that 'lock' together when subjected to a force, to autonomous vehicles and the world-class Type 45 Frigate, many of them owe their origins and capabilities to the ATC.

However, with defence budgets having been slashed both in the UK and worldwide, times are harder for the defence industry than they used to be; with R&D funding having borne the brunt of cuts. According to the ATC's technology executive Dr John Bagshaw: "Figures have radically changed. If you go back 15 years and look at the defence R&D budget, it was about £660m, which is worth about £1.2bn by modern standards. Now the defence R&D budget is about £350m. So you're trying to cover the same degree of technology with less than a third of the funding."

Says James Baker: "Defence used to be a 'favoured child' to some extent. It doesn't feel like a favoured child at the moment. You have all the press around automotive creating jobs, but there isn't the same amount of press around retaining jobs in defence. And that's a worry, because we're losing high-quality scientists and high-skill jobs from defence."

Inevitably enough, this less hospitable climate has led to a change of approach by BAE Systems. This has meant adopting a philosophy of 'open innovation' that encourages collaboration with external companies in order to commercialise products and make better use of the Intellectual Property created within the ATC.

Says Baker: "The business model is key for us because, in my words, defence is bust. So we've had to adapt in terms of what we do. In the old days we'd do a bit of low TRL [Technology Readiness Level] work. So in the past, we'd be doing TRL 1, 2 or 3. Now, we tend to leave that more to the university sector, while we do TRLs 4,5,6 and then work with others to get that final product. The 'Valley of Death' has tended to apply in the past, where we've had some fantastic ideas that we've never successfully pulled through to exploitation."

Impressive results

This approach has yielded some impressive results. One high-profile example of this has been in the development of 'structural batteries'. This came about as a result of consultation with combat troops about the weight of their kit. Rucksacks can weigh up to 76kg and Baker recounts one soldier showing him that he had deliberately snapped the handle off his toothbrush just to save a couple of grams on pack weight.

One of the items troops are most burdened with are

edge

How does one of this country's leading innovators stay ahead in difficult times? Paul Fanning visits BAE Systems' Advanced Technology Centre to find out.

"DEFENCE USED TO BE A 'FAVOURED CHILD' TO SOME EXTENT. IT DOESN'T FEEL LIKE A FAVOURED CHILD AT THE MOMENT."
JAMES BAKER

batteries used to power the huge array of electrical equipment they are required to carry. Thus, BAE Systems developed structural batteries to store the electrical energy within the physical structure of devices, thereby reducing or eliminate the need for traditional batteries, which create weight and bulk, as well as the burden and cost of carrying spares. Says Baker: "It's basically a structure – be it in a vehicle or in body armour – and you make that structure hold battery charge, meaning that you can charge up the suit at night and put it on in the morning and your suit's fully charged."

To develop this technology, scientists at BAE Systems merged battery chemistries into composite materials that can be moulded into complex 3D shapes and so form the structure of the device itself. It can then be plugged in when it needs recharging or utilise renewable power sources, such as solar energy.

Crossing the 'Valley of Death'

The process makes use of nickel-based battery chemistries, which are commonly used in defence technology. Future developments, it is believed, will allow integration of Li-ion and Li-Polymer chemistries found in consumer electronic products such as mobile phones, MP3 players, laptops and tablets.

Having developed the product to the extent that it could power a torch, BAE Systems took it to the Ministry of Defence, which could not afford to invest the money in developing it, but expressed an interest if a finished product could be developed. Says Baker: "In the old days, that would have been a classic 'Valley of Death' scenario. However, the changes we had made to our business model allowed us to talk to Lola."

This resulted in Lola incorporating the structural battery into its all-electric prototype racing car. The wing of the car

will be able to power a lot of the onboard electronics. Says Baker: "It's a great way from our point of view to prove our technology and then spin it back into a defence platform. And all because we had the right partner with the right technology and positioned correctly."

This more open development model has also brought benefits in terms of the speed with which the project has moved on, as Baker explains. "It's still early days," he says, "but if we'd done that traditionally, it would have taken years (if it went anywhere at all). It will still probably be in the timescale of a year or more, but between June and October last year, we were able to take that from the lab to a product in place on a working prototype. They've got it up to the space of a standard car battery in that short space of time from nothing."

Another example of the way BAE is collaborating to develop new projects is the Wildcat Robotic Vehicle. Originally devised as a research platform into autonomous resupply 'mules' for carrying equipment in combat zones such as Afghanistan, the Wildcat was originally developed with rallying specialist Bowler. However, Baker claims the real breakthrough came two years ago when BAE Systems decided to open the project out to others to develop ideas that improve the platform.

Through the Engineering and Physical Sciences Research Council, BAE worked with Oxford University and a Professor Paul Newman, who was head of computer science. Says Baker: "We effectively gifted them in kind one of these vehicles. This meant that he and his people could then take this autonomous platform – which they could never have contemplated doing from scratch due to not having the engineering capability – and play around with different sensors on the architecture."

The result, it is believed, will be faster technological advances than would otherwise have been possible. Says Baker: "We get access to [Professor Newman's] research and the ways in which that might

Stopping power

Referred to as 'custard' body armour due to its (and greatly to the chagrin of its developer, apparently), BAE's 'liquid armour' uses a counterintuitive, non-Newtonian liquid which hardens when struck. It has been developed by BAE Systems as part of a project to create future body armour offering soldiers greater ballistics protection and ease of movement.

The technology harnesses the unique properties of shear thickening fluids, which 'lock' together when subjected to a force, enhancing the existing energy absorbing properties of material structures like Kevlar.

Ceramic-based armour plates used in current body armour systems to cover large areas of the torso are heavy and bulky, restricting movement and contributing to fatigue, particularly in harsh environments like Afghanistan.

Liquid armour has been designed to address a requirement for materials which can offers troops increased protection with reduced mass, wider area cover, greater manoeuvrability and easy integration with other systems. The technology can be integrated into standard Kevlar body armour to offer superior, freedom of motion and a reduction in overall thickness of up to 45%.

Stewart Penney, head of business development for design and materials technologies at BAE Systems, says: "The technology is best explained by the example of stirring water with a spoon. In water you feel little resistance to the spoon. Whereas with 'liquid armour', you would feel significant resistance as the elements in the fluid lock together. The faster you stir, the harder it gets, so when a projectile impacts the material at speed, it hardens very quickly and absorbs the impact energy."

When integrated with Kevlar, the reduced flow of the fluids in the liquid armour restricts the motion of the fabric yarns in relation to each other, resulting in an increase in area over which the impact energy is dispersed. As a result, the material is also far less likely to distort than standard body armour, which generally bends inwards when a bullet strikes, causing considerable pain.

An illustration of the differing impacts of a bullet on traditional armour (top) and BAE Systems' Liquid Armour (bottom).

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impact defence, while he gets access to the system and the chance to exploit that in the commercial market. If he uses our background IP, then that gives us some value rather than it just sitting on the shelf doing nothing. And if they develop something that has real value for defence, then we can work with them to do that. In that instance, they get something, because it's their IP. We are effectively exposing our capability, giving it to a third party and saying 'go away and play with that'."

The straitened circumstances of the defence sector has also prompted a change in the approach to designing defence platforms themselves. As an example, Baker raises the state-of-the-art Type 45 frigate, which he points out, comes with certain commercial limitations, as he makes clear: "The Type 45 Frigate is in my view, the most capable frigate in the world, but it's difficult to then go on and sell that to other people precisely because it's so capable and there are export constraints and things we need to keep to ourselves."

This is a model that has changed with the new Type 26 Global Combat Ships. Says Baker: "The Type 26 Frigate is a next-generation warship that we're looking at designing around that sort of open architecture that allows it to be exported. This export-inspired approach means that, if we can design a more 'generic' ship, the UK will have the fancy Radar and the weapons systems that it wants, but we'll be able to sell it to – for instance – the Brazilians, who can then fit their own Radar or whateve, which might not be as sophisticated. You've thus got a platform you can sell to more than one nation."

Naturally, this need to keep certain technologies under wraps is an obstacle to an open innovation model, but by no means

insurmountable, according to Baker. He says: "We do have constraints around what we can and can't do in terms of open innovation, but opening that box does bring huge benefits. In the old days, much of what we're doing would have been top secret, money would have been thrown at it and the first you might have seen of it would have been at Farnborough in 10 years' time. Now, to develop the technology behind a project, we have to be much more open because we probably wouldn't get there otherwise. Our job is to develop the technology that makes that more realistic. How you then integrate it and pull it together into a capability then becomes the 'black' bit, not the raw ingredients because otherwise you'd never get there in today's environment. It's a very different philosophy.

www.baesystems.com

A sporting chance

A recent, high-profile project in which BAE Systems' Advanced Technology Centre was intimately involved was in using its expertise to help UK Sport.

The partnership began in 2009. According to James Baker: "This started off with some personal relationships with certain sportspeople – in this instance the UK Cycling team. They recognised that aerodynamics were a key factor in terms of cycling speed and they looked at what affects aerodynamics – the helmet, the formation, etc.

So we did some early work with them around that time with wind tunnels prior to this agreement. We decided to sign a partnership whereby BAE gave £1.5m of effort in kind to UK Sport."

The most notable success so far has been the success of Skeleton bobsleigh competitor Amy Williams in winning gold at the 2010 Winter Olympics. Says Baker: "Basically, we helped design and manufacture her skeleton bobsleigh, 'Arthur'. We came with a different attitude, looking at the problems from a defence/aerospace perspective. So Amy sat down with our scientists and some of the academics from Southampton, Bath and Sheffield. She wasn't actually the top athlete at that stage, she was the up-and-comer. But, because of that, she was perhaps prepared to put in more time with our scientists."

In return for its investment, BAE Systems has received a number of benefits, including increased interest from potential recruits. Equally, there is also hope that the technology will feed back into the company's business. "What you get from working with athletes," says Baker, "is systems being tested under really extreme performance levels. So from that, we're now getting some spinoff back into soldier systems. A good example is in body armour, where we're able to funnel knowledge from shinpads for BMX riders or helmets, as well as things like the use of liquid protection in helmets to absorb impact."

www.uksport.gov.uk

Taking flight

Alan Bond is well remembered for his work on HOTOL, the horizontal takeoff and landing space shuttle designed in the 1980s. When the program was cancelled he decided to set up Reaction Engines, of which he is managing director, to solve the problems that dogged the project, and continue developing the revolutionary hybrid propulsion system originally proposed.

The Rocket Man

Will commercially available space flight be a possibility in the foreseeable future? Justin Cunningham talks to a man who believes we are closer than we might think.

Here's a challenge: cool the airflow entering a compressor. No problem? It becomes less straightforward, however, if the incoming air is 1000°C and you need to cool it to about -140°C in just 0.01s. This is the perplexing challenge that aerospace engineer Alan Bond has been facing for 20 years now.

The dream of developing a spacecraft that offers affordable and reliable transport to orbit is something that fascinates Bond, who is managing director of Reaction Engines. The difference, however, is that he believes he is close to having the technology to deliver such a system – a system that can take off and land in the same way as an aircraft, does not have to jettison rocket stages or extra propellant tanks and is fully reusable.

There is, however, the obstacle of developing a heat exchanger capable of the performance outlined above. That is the key enabling technology of his hybrid air-breathing rocket engine, SABRE, the Synergistic Air-Breathing Rocket Engine.

"As you get around Mach 3 the air gets very hot and when you compress it, it gets even hotter," says Bond. "A jet engine reaches its limit at about Mach 2.8. By fitting by-passers like the SR-71 you can coax it up to about Mach 3.25, but you run out of steam very rapidly in that regime."

The pre-cooler being developed by Bond and his team will cool air flowing into the engines to allow a lot of compression, even at hypersonic speeds. It will also help keep the intakes cool, doing away with the need for heavy and more exotic metals being used to withstand the high temperatures.

"In the lower part of the atmosphere, you would push air through the engines and combust it with liquid hydrogen," he says. "Then later on, when you have run out of air, you can turn that supply off and go to liquid oxygen in the same engine enabling flight like an aeroplane all the way into orbit."

While Pratt & Whitney pursues the scramjet in its quest for advanced propulsion, Bond is confident the SABRE engine offers many more advantages. "The seductive simplicity of the scramjet on paper is that it has no moving parts," he says. "The reality is it does have moving parts, as you have to change the geometry the further it goes up the Mach number range.

"The other problem is that it can't go from a standing start, so you typically need a turbojet followed by a ramjet followed by the scramjet. But then you have still got to have a rocket to take it into orbit. As some people say, the scramjet turns in to a flying engine museum as you need examples of almost every engine we have ever built."

With the exception of these advanced heat exchangers, SABRE largely uses technologies that are well understood and developed. The pre-cooler, though well understood, still requires miniaturisation. Instead of having good 1¼" tubes with 2mm walls, the tubes are less than a 1mm diameter with walls just 20µm thick.

"It is just a case of getting surface area in there," says Bond. "Each pre-cooler has 2000km of tube. We are very much like the computer revolution in that we are miniaturising heat transfer technology."

Bond's enthusiasm stems from the 'golden age' of aviation, when aircraft continually pushed the boundaries of both speed and altitude. However, he says this era was cut short by the development and proliferation of ballistic missiles.

"It has taken us down a blind alley," he says. "It doesn't lead to a major step forward by further evolution of the technology. So we have got to retrace our steps and that is what we have been doing."

"We are very much like the computer revolution... we are miniaturising heat transfer technology"

The retirement of the space shuttle has seen NASA return to capsules and expendable rockets for space access. The planned heavy lift system is very reminiscent of the Saturn 5 and none of it really represents any forward thinking technology. So could the immerging space tourism industry help to hail a new era of renewable spacecraft?

"It's the entertainment end of the market, but they have a good business case and there is no reason not to do it, provided it is done safely," says Bond. "Many years ago, it is claimed Henry Ford reckoned that aviation would never succeed unless you got the average person flying. Today that is clearly true. There are many people that feel that spaceflight will not really arrive until everyone knows somebody that has been into orbit. To some extent this is probably true, but I don't think that situation will be with us until 2040 or 2050."

Reaction Engines is coming close to the end of its current technology programme and hopes to move to a three-year, Phase III programme, whereby it will further demonstrate the technology – possibly even to the extent of including a flight test vehicle. After that, Phase IV would develop the airframe, Skylon, and integrate the SABRE engines with a view to try and get a vehicle in to commercial service around 2022.

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Why we need to automate – **now**

Brian Holliday, Divisional Director at Siemens Industry Automation, says the time has arrived for the manufacturing sector to cast off its traditional reluctance to automate and invest in new thinking and technology. This topic will be under discussion at Answers for Industry (www.siemens.co.uk/afi), a major conference and exhibition hosted by Siemens on 4 and 5 July at Manchester Central Convention Complex.

Brian Holliday, Divisional Director at Siemens Industry Automation

It has been widely publicised that the Coalition intends to aid the rebalancing of the economy given the now common view of our over reliance on the financial and service sectors before the downturn. Government policy is therefore more supportive and aligned with public opinion that Great Britain should be known once again for 'making things'.

The manufacturing sector has actually performed well given the challenging economic conditions over the past couple of years. But if it is to reverse the general fortunes of the past two decades, the time has come for the sector to commit to a long-term plant and equipment investment strategy.

Statistics suggest the UK lies well behind continental Europe in the application of automation and robotic systems in manufacturing. A study conducted by The Engineering and Machinery Alliance (EAMA), found that Germany has an installed base of 144,800 industrial robots – the UK stands at just 15,000. This proportionate difference also reflects the market size for Programmable Logic Controllers (PLCs), a technology at the core of most industrial machines and processes.

There are clearly sector strengths in Germany, such as automotive, that explain some of the difference. However, it is evident that a significant proportion of automation technology investment in Germany stems from widespread, proven experience that it delivers real competitive advantage in the form of production quality, productivity gains and overall output.

Along with the clear installed base disparity, investment responses to the downturn in the two countries have been notably different. In 2010, €167.4bn was invested in plant and equipment in Germany – a startling figure that was a 9% increase on the previous year despite it being a period of reduced confidence. Meanwhile UK investment levels, which are dwarfed by Germany's, declined by an adjusted 5.1% over the same period, which in turn was 21% down on 2008, suggesting quite distinct attitudes to investment and productivity.

The benefits of automation technology are numerous, but primarily it drives improvement in productivity. The British Automation Robotics Association (BARA) summarised their view in the document 'Automated Manufacturing': "When applied appropriately, automation of the manufacturing process not only drives costs down, it improves quality, reduces waste and optimises energy use" – a scenario manufacturers of all sizes can relate to positively.

For the UK to attain aspired levels of manufacturing output in high-value niche manufacturing and to protect present domestic capability, we need to build on our strengths invest in areas such as low-carbon, material technology, aerospace & defence and automotive manufacturing, while also getting better at planning and executing domestic strategies for British-designed goods. Automation technology and its link to the digital design environment features in the approach of the new MTC (Manufacturing Technology Centre) and this is arguably key to developing our capability in high value manufacturing - linking world-class digital design capability with digital factories.

This approach must be central to our progress in commercialising new ideas, and enabling domestic and foreign-owned companies to see the UK as the right manufacturing location for higher value, customised goods. Our manufacturing sector needs to address the challenge of applying technology to mass customisation, creating flexible automated manufacturing processes.

Automation technology can make a real difference to the British manufacturing landscape – an area increasingly vital for our future economic health. To date, it is clear this is an aspect of industry that has been under-exploited. It is imperative we now invest in the next generation of technology to shape and develop our manufacturing base, to protect current strengths and realise targeted future growth.

Control technology drives carbon capture plant

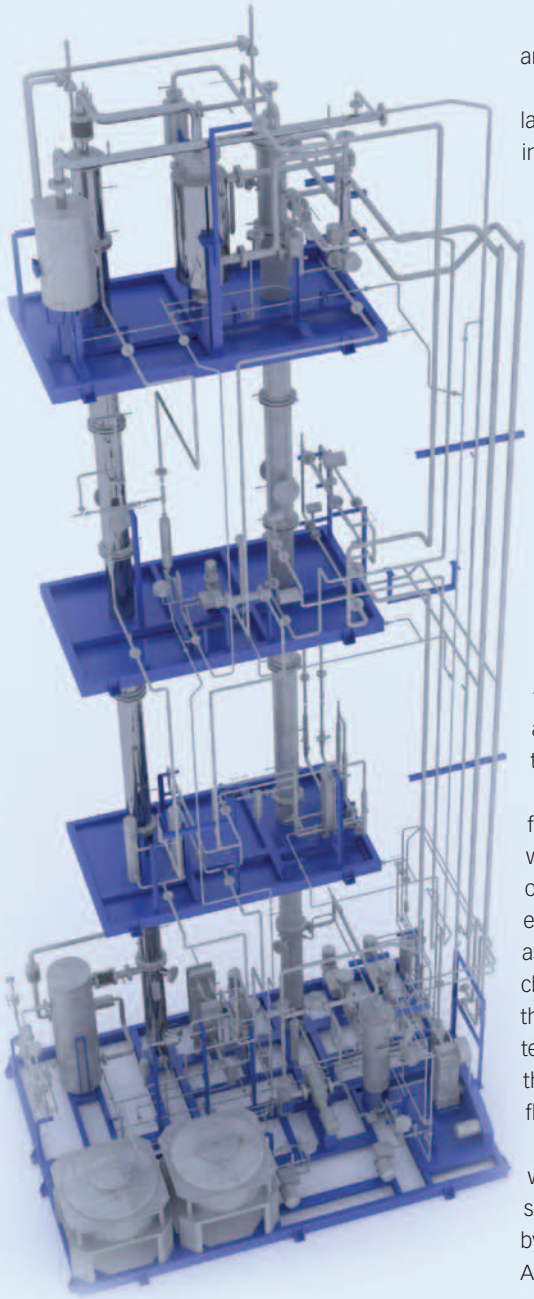
Paul Fanning visits Imperial College London, to see how innovation in control and instrumentation is bringing through tomorrow's engineers.

A new carbon capture pilot plant is using some of the most advanced and up-to-date control and instrumentation equipment thanks to co-operation between a leading manufacturer and academia.

ABB has invested close to £1 million and signed a 10-year agreement with Imperial College London to support its carbon capture pilot plant teaching facility located at the University's central London campus. Using a combination of ABB's instrumentation, drives, motors and process automation equipment, the control room provides students with hands-on experience of pilot-scale industrial plant operations and is the only facility of its kind in an academic institution in the world. The pilot plant will be used in undergraduate teaching with the aim of equipping students with the practical skills needed for a career in industry.

The pilot scale carbon capture plant was commissioned in February 2012 and has a capacity for 50 kg/hour capture of carbon dioxide (CO2). The plant is part of the College's £8.9 million ChemEngSpace Project and will be used for undergraduate teaching, with over 300 Imperial College chemical engineering students having access to it each year. It will also be part of the Department's new international summer school for chemical engineering education.

The agreement between ABB and Imperial gives the University access to the most advanced control and instrumentation technology available, as well as lifecycle services and support for the installation. In return, ABB has access to the carbon capture pilot plant for its own use and will use the facility for customer demonstrations and training, staff learning such as inter-divisional training, hands on experience for its apprentices and product testing and software evaluation.



"The pilot plant is a global showcase for the latest and best process control and instrumentation technology in use at one of the world's leading engineering institutions," says Martin Grady, general manager of oil, gas and petrochemical for ABB UK. "We will be able to trial new technology in a low risk, well-managed environment to gather Beta site test data. It also gives ABB a great platform to train its staff and customers on a real pilot plant. Quite simply, there are very few industrial companies that have used all the leading-edge technology that Imperial College is featuring within this pilot plant."

Of course, the nature of the plant is that it has thrown up a number of challenges in terms of control and instrumentation. This has allowed ABB to deploy its equipment in innovative ways that allow the company to field test as much equipment as possible, while also giving the students a rounded introduction to the technologies.

One of these has been the challenge of flowmeter selection, where engineers are faced with a wide choice of flow technologies, each offering distinct advantages and drawbacks. As every type of liquid or gas behaves differently as it flows through a pipeline, it is important to choose the flow technology that can guarantee the best accuracy. It is, of course, important to teach students the various flow technologies, so the solution arrived at by ABB was to use flowmeters in series.

Imperial's pilot plant features three points where different flowmeters are installed in series. Steam flow to the pilot plant is measured by both an ABB OriMaster M flowmeter and an ABB Swirl meter.The OriMaster M is a differential

pressure flowmeter, which measures directly in mass or corrected volume units. It incorporates all of the major components needed for an orifice plate installation into a single assembly, significantly reducing installation costs.

The Swirl meter measures the flow rate based on the frequency of pressure variations formed as steam, gas or fluids meet a fixed spiral obstruction inside the meter body. In comparison to the OriMaster, the Swirl meter requires little straight pipe upstream to get the best accuracy, making it ideal for compact installations.

On the amine chemical feed line to the regenerator column, two ABB meters are used to compare electromagnetic flow measurement against the swirl measurement technique. On the nitrogen gas line the plant uses a Vortex flowmeter in series with a thermal mass flowmeter. Another example of two totally different technologies operating on the same process media.

Another area in which ABB has been able to aid students' understanding of real-world technologies has been in the area of plant-wide communications. To enable the process to be managed from the control room, all equipment on the pilot plant is linked via various forms of communication to the System 800xA control system. The Imperial College installation features examples of all of the leading types of plant-wide communications technologies, enabling students to compare and evaluate each one in an actual operational setting.

Disagreement over a common standard has meant there are many different fieldbus protocols for use in industrial applications. With each type of fieldbus offering its own merits, it is important to be able to understand what needs to be considered when making a choice and the factors that can affect operation. These factors can include data propagation time, suitability for use in hazardous areas, power requirements and ability to integrate with other systems.

In contrast to real-life industrial sites, which are likely to standardise on just one protocol, the Imperial College pilot plant uses a combination of Profibus PA, Profibus DP, Foundation Fieldbus (HSE and H1), HART, Ethernet and WirelessHART technologies. By teaching multiple protocols, it is hoped that students will emerge well-versed in as many protocols as possible.

ABB's involvement in the project is aimed at raising the awareness among chemical engineering graduates of the benefits of a career in control and instrumentation engineering. The investment is seen as a shop window for presenting the opportunities available throughout the ABB organisation. "By investing in the pilot plant and the awards, we are effectively investing in our own future, by making sure that ABB will have ready access to a stream of bright young engineers," says Grady. "One of our biggest problems is finding enough suitably qualified engineers to fill the ever growing range of opportunities we can offer. Obviously if engineering in the UK flourishes, then we flourish too.

"The move by ABB is partly in response to Government initiatives aimed at rebuilding the manufacturing base of the UK and re-establishing the important contribution that engineering makes to people's everyday lives. The UK needs to increase its base of skilled engineers if it is to grow its manufacturing sector towards its potential. We believe that the pilot plant will support education by giving tomorrow's engineers hands-on exposure to real-life technology. This pilot plant really brings the real world into the classroom for the first time."

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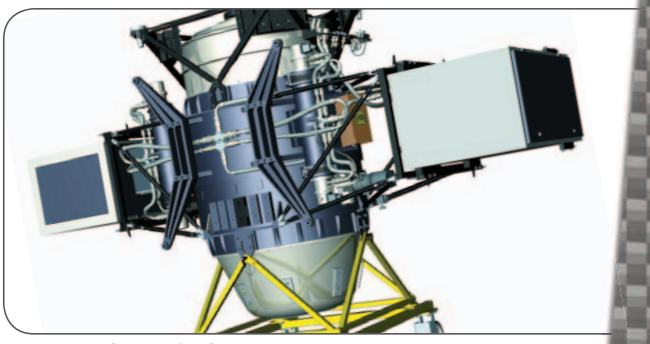

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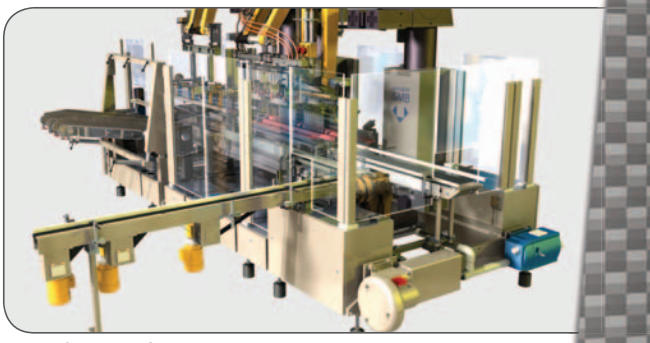

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'Better by Design'

SmartWire-DT smarter than ever

The SmartWire-DT system from Eaton's Electrical Sector, which virtually eliminates the need for conventional control wiring in panels and on machines, is now even more versatile and convenient. This follows the addition of devices with integral SmartWire-DT connectivity to two key product ranges – easy800 control relays and PKE motor-protection circuit breakers.

In many applications, easy800 programmable control relays with SmartWire-DT make it possible to implement sophisticated control systems without the need to use programmable controllers (PLCs), which means big savings in costs and complexity. In addition, Eaton's easySoft-Pro software makes easy800 relays simple to programme, even for users who have no specialist programming knowledge or experience.

The new easy800 relays are suitable for applications with up to 320 I/O and are programmed using straightforward and well-known ladder diagram techniques. The easySoft-Pro programming software now includes SmartWire Assist to configure external devices, allowing control systems that incorporate the new relays to be drawn, configured, programmed and tested using just this one intuitive software package.

www.eaton.com

Ethernet-based smart automation

Drives manufacturer Sprint Electric has introduced a new version of drive.web, an Ethernet-based distributed control system for its wide range of DC drives. The system was demonstrated at the show through an interactive iPad demo. At the demonstration, drive experts from Sprint Electric were controlling a DC motor 6000 miles away using an iPad and watching it live via webcam. Using drive.web, they were able to stop, start, and change the speed and direction of the DC motor and see the changes happen instantly.

The drive.web system includes graphical configuration tools that provide diagnostics and configurability of all drives on the network, either locally or remotely via the Internet. The graphical tools allow the full configuration of the drives, provide service diagnostics, full documentation and an operator interface for local control, all without the need for a PLC or supervisory computer. The graphical tools are part of the Savvy software suite which can be downloaded from Sprint Electric's website.

The Sprint Electric digital range of drives type PLX can become drive.web enabled by simply adding an easy to fit option board. Other drives, even simple analogue ones, can take advantage of the technology by using a separate stand alone DIN rail mounted drive.web module.

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Versatility, power, compactness and low running costs are the main characteristics of this range of vane pumps. All the components subject to wear are contained in a cartridge unit that can be easily removed for inspection and/or replacement without disconnecting the pump from the circuit, drastically reducing expensive machine down time.

All the components subject to wear are contained in a cartridge unit that can be easily removed for inspection and/or replacement without disconnecting the pump from the circuit, drastically reducing expensive machine down time.

The cartridge contains a rotor, vanes and inserts, a cam ring and two covers. During operation the rotor is driven by a splined shaft coupled to the drive unit. As the rotation speed increases, centrifugal forces, in combination with the pressure generated behind the vanes, push the vanes outwards, where they follow the profile of the cam of the ring with a sufficient contact pressure to ensure adequate hydraulic sealing. The two opposed pumping chambers formed by the elliptical profile of the cam cancel out radial loads on the shaft bearings, thereby giving them extremely long lifetimes.

The versatility of this series of pumps enables them to meet the requirements of the most varied industrial applications. In fact, as well as their proven high reliability and excellent volumetric efficiency in all working conditions, they operate with particularly low noise levels. This is made possible by the special profile of the cam ring and the use of a 12 vane rotor that reduces the amplitude of the supply pressure pulses, thereby reducing induced vibrations.

These vane pumps are extremely compact and are supplied with ISO norm mechanical couplings and SAE norm hydraulic fittings. This makes them very easy to install and guarantees their interchangeability with other similar pumps (eg. Vickers, Caterpillar, Denison).

More detailed technical information is available from jbj Techniques Limited.

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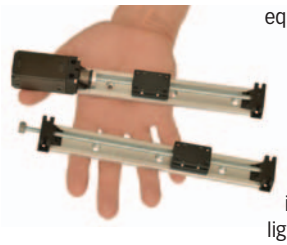
Miniature linear drive suits confined spaces

igus UK has introduced the drylin SLN-27 miniature linear axis with polymer bearings and an optional NEMA 11 certified motor. Developed specifically for simple handling tasks in confined spaces, this high-performance miniature linear drive offers design flexibility for positioning small loads.



The drylin SLN-27 miniature linear axis is based on the proven technology of drylin N27 linear guide system and the linear rail is made of durable anodised aluminium. The plastic module has high wear resistance, is maintenance-free, self-lubricating and corrosion-resistant, providing a 'fit and forget' solution. With compact dimensions of only 22mm high by 28mm wide, it is suitable for low load sensor adjustments and feed mechanisms, as well as lightweight handling tasks such as those found in laboratory equipment.

As almost all of the components used in the drylin SLN-27 linear unit are made of either plastic or aluminium, the system is extremely robust and lightweight. The carriage is driven by a 5mm trapezoidal or high-helix thread leadscrew and is available in a range of pitches from 0.8mm to 5mm. The leadscrew nuts are made of iglidur high-performance polymers optimised for lubricant-free operation over the entire stroke length, which can be a maximum of 250mm.

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Meeting the needs of OEMs, the new L series PLC from Mitsubishi Electric has been designed to provide all the performance, functions and capabilities necessary for today's demanding machine automation requirements in a compact, modular, rack-free package. Bridging the gap between the FX compact PLC and the iQ platform high performance PAC, the new modular controller combines much of the power of a Q series CPU, with the ease of expansion and user-centric design inspired by the FX. This greatly increases the range of functionality traditionally associated with mid-range PLCs.

All the features and functions needed for the most sophisticated of automated machines are built into the CPU as standard, minimising hardware, saving panel space and engineering costs. Every L series CPU provides as standard; 24 points of on board I/O, a 2-channel high speed counter, 2-axes

of positioning, pulse catch and interrupt functions, Ethernet connectivity and built-in data logging. The built-in positioning function has a start time of just 30µs, with a maximum high-speed output of 200k pulses per second, and features such as S-curve acceleration and deceleration, meeting the needs of complex machine positioning applications.

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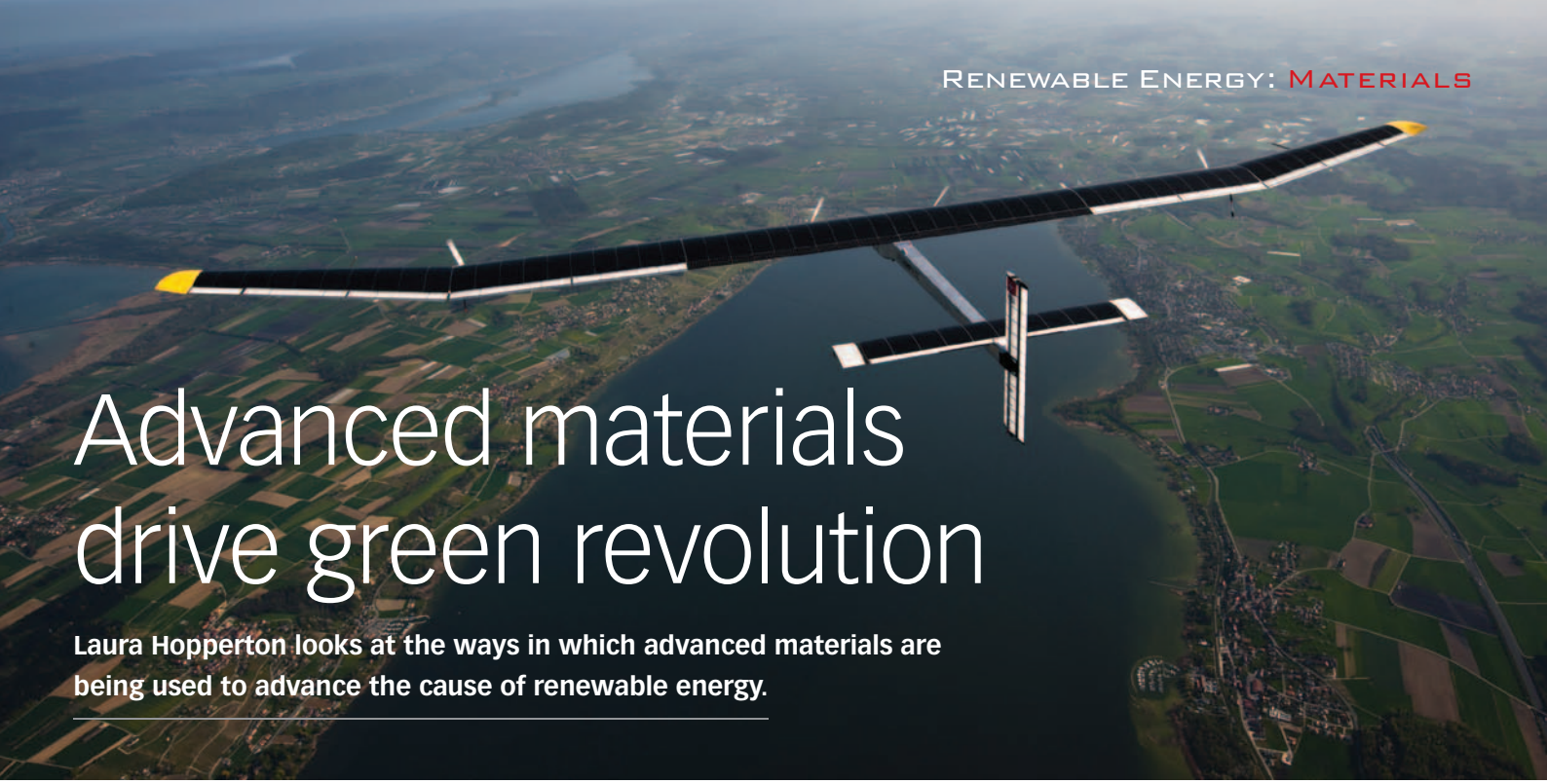


Advanced materials drive green revolution

Laura Hopperton looks at the ways in which advanced materials are being used to advance the cause of renewable energy.

The Government's commitment to generate 20% of the UK's energy from renewable sources by 2020 was reinforced recently by Prime Minister David Cameron during his speech at the International Clean Energy Ministerial summit in London.

Describing Britain as being at the forefront of the green energy revolution, the Prime Minister said he was proud of the country's 'world-leading' energy sectors and maintained that renewables would continue to play a crucial part in its energy mix. In particular, he was keen to point out the UK's ongoing commitment to wind power, a sector which has gained considerable popularity in recent years and prompted the more widespread use of advanced composite materials. This in turn has led to growing requirements for innovative new materials and manufacturing methods.

"The trend in increasing turbine size has created the need for bigger rotor blades to broaden the sweep area and ability to capture more energy," says Philippe Christou, director of technology at Hunstman Advanced Materials. "Rotor blades over 50m are now gaining an increasingly larger market share and 60m blades are set to become more commonplace. The development of 70 to 80m blades has started and the 100m is also being considered for offshore applications."

Christou noted that with larger blades come more complex tooling and composite mould designs, longer production times and higher processing costs. "They also create greater stress on the structural, mechanical and gear components of the turbine," he says. "As the industry looks to save time and money and improve efficiencies, fabrication processes for composites have come under the spotlight. The formulation of epoxy-based resin systems that can be used to vacuum infuse dry fibres or pre-forms hold significant structural benefits for producing large, complex composite parts with less than 1% void content and controllable resin-to-fibre ratio. This leads to increased strength as well as predictable performance and integrity of the finished part."

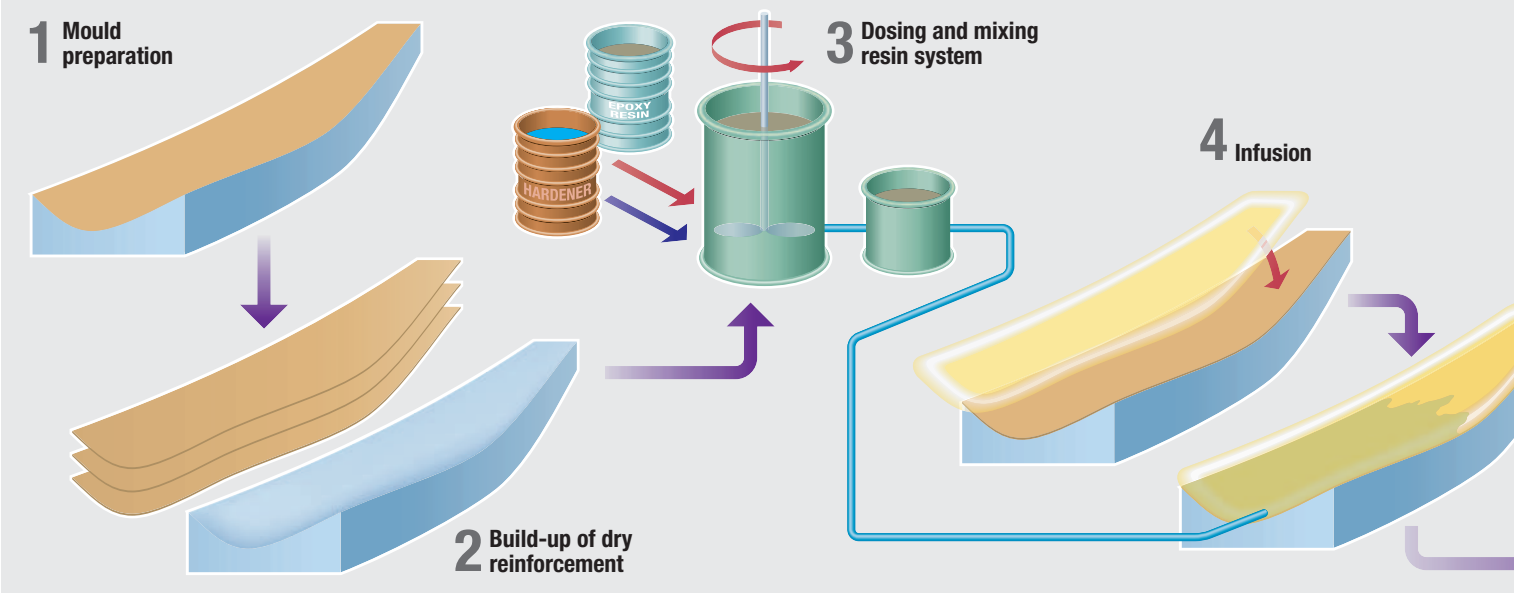
Producing higher performance materials, with an emphasis on lowering toxic risk, is a key area for Huntsman, which has more than ten years' experience operating in this market. The company offers a range of Germanischer Lloyd (GL) approved epoxy resin systems under the Araldite brand name, which are specially formulated to meet the stringent processing and performance requirements for wind blade manufacturing.

According to Christou, the systems are designed with enhanced mechanical and processing properties to improve product quality, lower blade weight, deliver high strength and fatigue properties and enhance impact resistance. The low viscosities of these systems are said to facilitate fast infusion processing and reduced production cycles.

The Araldite LY 1568/Aradur 3489 is an example of the company's latest epoxy based resin infusion system, which is designed to offer more control in the manufacturing process. The combination of its low mix viscosity (200 to 300mPas at 25°C), low exothermic reaction and long pot life (850 to 950 minutes) is said to provide benefits for users when infusing very long or thick composite parts.

In addition, the Araldite LY 8615/Aradur 8615 and Araldite LY 8615/XB 5173 are optimised to provide advantages for high temperature composite blade mould production. Both systems can withstand significantly higher temperatures than the curing temperature of the component production process and can be processed from room temperatures up to 40°C.

The Solar Impulse aircraft made aviation history in July 2011 by flying through the night on solar power alone



They offer heat resistance up to 200°C and are particularly suitable for the production of blades made of high-performance prepregs, which require high post-cure cycles.

As well as developing new materials for wind power, Huntsman also offers a range of products for use in solar energy production, including solar panels that produce electricity and thermal panels that convert the power of the sun into heat. The company has worked in co-operation with a number of industry partners to produce a range of new materials and processing technologies for active temperature controlled photovoltaic (PV) solar cell modules with increased efficiency.

The company's offering includes the Araldite AY 4583/HY 4583 liquid system, which is designed to enable an energy saving encapsulation process at low temperatures and eliminate the critical lamination process with EVA; heat conductive, electrical insulating adhesives that enable improved heat transfer and efficiency; flexible and thermal conductive adhesives which protect the flexibility of solar cells; and the white solder mask Probimer 77 White, which is designed to increase the efficiency of the PV module through higher and multiple reflection.

Huntsman claims the combined technologies have the potential to increase the efficiency of PV modules by more than 50%. In addition, it says that processing can be simplified, costs can be reduced and ageing stability significantly improved.

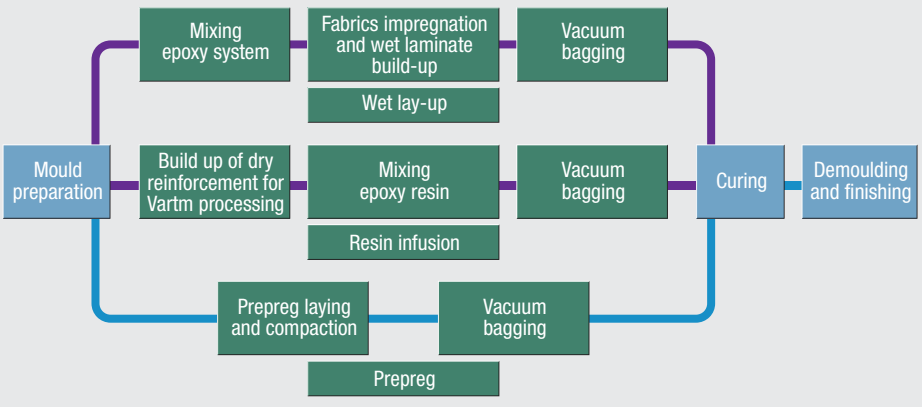
In March this year, researchers at the Massachusetts Institute of Technology (MIT) also made a significant solar cell breakthrough when they found a way to use metamaterials to absorb a wide range of light with extremely high efficiency.

While most thin materials used to fully capture light are limited to a narrow range of wavelengths and angles of incidence, the material's design uses a pattern of wedge-shaped ridges whose widths are precisely tuned to slow and capture light of a wide range of wavelengths and angles of incidence. According to the researchers, these metamaterials can be extremely thin, saving weight and cost. Their actual structure is etched from alternating layers of metal and an insulating material called a dielectric, whose response to polarised light can be varied by changing an electric field applied to it.

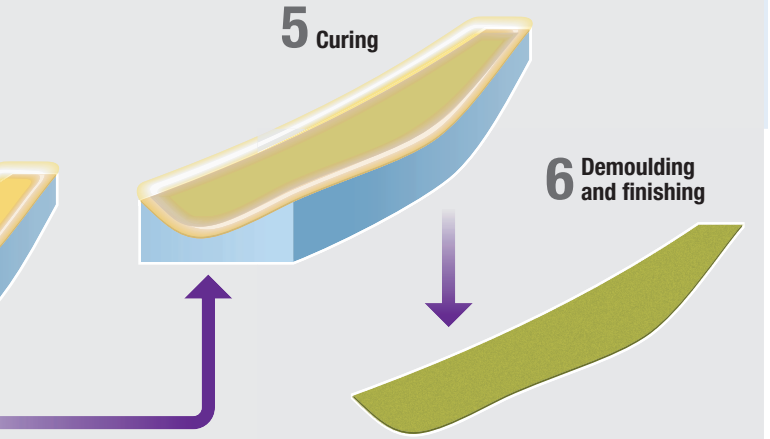
"What we have done is design a multilayer sawtooth structure that can absorb a wide range of frequencies with an efficiency of more than 95%," said postdoctoral researcher Kin Hung Fung. "Previously, such efficiency could only be achieved with materials tuned to a very narrow band of wavelengths. High-efficiency absorption has been achieved before, but this design has an extremely wide window for colours of light."

Fung claims the material can be easily fabricated using equipment that is already standard in conventional photovoltaic cell

Vacuum infusion using Germanischer Lloyd (GL) approved Araldite epoxy resin systems allow the use of "soft" tooling and near to ambient curing to reduce processing cost and energy savings



The six steps involved in composite blade production using a resin infusion system that helps to reduce processing times and subsequent manufacturing costs



manufacturing. Although the initial work was based on computer simulations, the team is now working on lab experiments to confirm their findings.

Meanwhile in Germany, Bayer MaterialScience has teamed up with the Solar Impulse project in a bid to demonstrate the true potential for pollution-free air travel. The Solar Impulse plane, which has the wingspan of a Boeing 747 and weighs the same as the average car, is powered by some 12,000 solar cells mounted on its wings. It made aviation history in July 2011 by flying through the night on solar power alone and is now gearing up to circumnavigate the globe in 2014.

The solar cells on the upper wing surface and the horizontal stabiliser of the plane generate electricity during the day by powering four electric motors and 3.5m diameter, twin-bladed propellers. Surplus energy is stored in 400kg of lithium polymer batteries to allow flight at night, theoretically enabling the single seat plane to stay in the air indefinitely.

As well as nanotube reinforced polymers, Bayer has provided the plane with a number of innovative adhesives, rigid foams and polycarbonate films, including its Makrofol polycarbonate film which has been used in the windows of the cockpit. Novel composites have also been used to provide more stability while reducing weight and ensuring better energy efficiency

www.huntsman.com
www.bayer.com

Surviving the Sun

The scientific satellite destined for the Sun is developing sensors that will show our nearest star in detail as never before. Justin Cunningham reports.

The Sun has always fascinated mankind, so it is perhaps hardly surprising that the European Space Agency (ESA) in conjunction with NASA is to launch a scientific satellite to study it like never before. However, what might be surprising (but perhaps ought not be), is that the satellite is to be largely designed and built in the UK.

European space company, Astrium, has been selected as prime contractor for the £300million Solar Orbiter mission due to launch in 2017. Solar Orbiter will carry a number of highly sophisticated, lightweight instruments, weighing a total of just 180kg. The onboard sensors will measure everything from suprathermal and energetic particles, the Sun's magnetic field, visible and ultraviolet emissions, radio and plasma waves, coronal mass ejections, different wavelengths of light emitted, non-thermal X-ray emission; all in an effort to better understand and predict solar activity.

A high resolution imager and spectrometer will capture the short wavelength, ultraviolet emissions of the Sun's atmosphere. To examine the visible light projected by the surface, and measure local magnetic fields, Solar Orbiter will carry a high-resolution magnetograph.

A vital element in the Solar Orbiter is the development of the Solar Wind Analysis (DWA) suite of sensors lead by UCL and the Mullard Space Science Laboratory. Three separate sensors will characterise electron, proton and gamma particle populations which make up solar winds, and access the abundance of heavy ions.

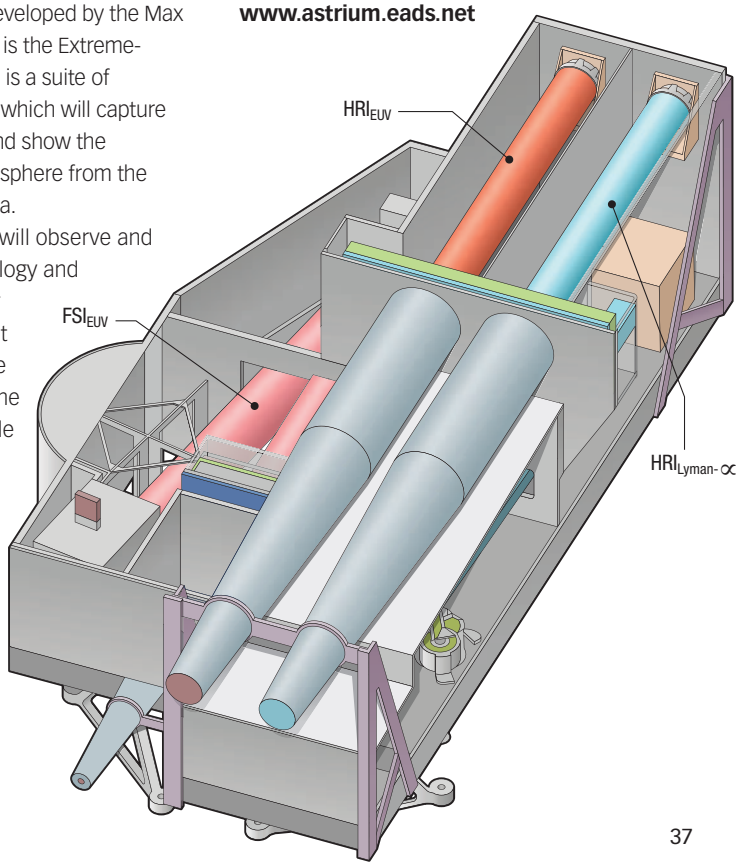
As well as providing overall leadership, UCL will be responsible for the Electron Analyser System (EAS). The EAS will make measure the electron velocity distributions of solar winds, and derive properties such as density, temperature, bulk velocity and heat flux.

Another sensor being developed by the Max Planck Institute in Germany is the Extreme-Ultraviolet Imager (EUI). This is a suite of remote-sensing telescopes which will capture images in high resolution and show the structures in the solar atmosphere from the chromosphere to the corona.

The EUI (pictured right) will observe and analyse the global morphology and local dynamics of the solar atmosphere, in particular at the base of the corona. The full-Sun imager will show the gross structure of the whole Sun at coronal temperatures, while the high-resolution telescopes will show in selected wavelength bands the fine structures that become visible via the close-up views of the Sun obtained during the Solar Orbiter's perihelion phase of the orbit.

The EUV reflectivity of the optical surfaces is obtained with specific EUV multilayer coatings. The spectral selection is complemented with filters that reject the visible and infrared radiation. Only the ultraviolet photons can reach the detectors where they are converted into an electrical signal.

www.astrium.eads.net



Satellites benefit from gaming sensors

Sensor technology transferred from a gaming console could be used to revolutionise the way space assets are built. Paul Fanning reports.

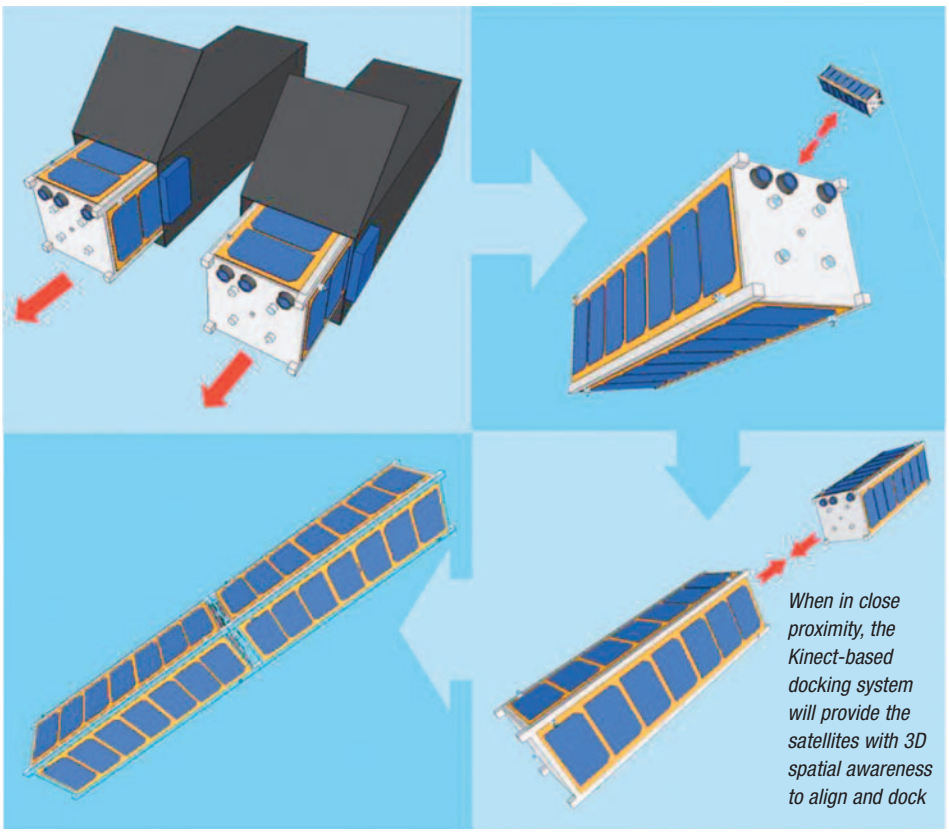
Engineers from the University of Surrey and Surrey Satellite Technology Limited (SSTL) have employed components from a Microsoft XBOX 360 in the development of a new satellite that could change the way space assets are built, maintained and decommissioned.

Shaun Kenyon of SSTL and Dr Chris Bridges of the University of Surrey are the Project Leads developing 'STRaND-2', a twin-satellite mission to test a novel in-orbit docking system. STRaND-2 is the latest mission in the cutting edge STRaND (Surrey Training, Research and Nanosatellite Demonstrator) programme, following on from the smartphone-powered STRaND-1 satellite that is near completion.

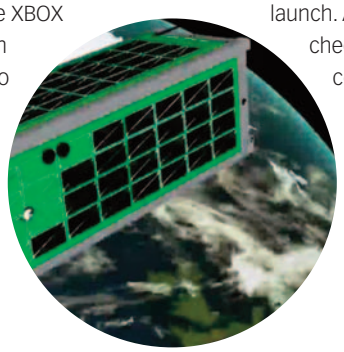
Docking systems have never been employed on such small and low cost missions and are usually reserved for big-budget space missions to the International Space Station (ISS) or historically, the Mir Space Station and the Apollo programme. The STRaND team sees the relatively low cost nanosatellites as intelligent 'space building blocks' that could be stacked together and reconfigured to build larger, modular spacecraft.

What gives STRaND-2 the potential to perform this role is its use of sensors from the Microsoft XBOX Kinect games controller to scan the local area and provide the satellites with spatial awareness on all three axes.

The inspiration for this came from a Massachussets Institute of Technology project funded by both the U.S. Navy and the Army Research offices that used the XBOX Kinect technology to create an autonomous helicopter able to pilot itself in places where GPS is not available. Says Shaun Kenyon: "We were really impressed by what MIT had done flying an autonomous model helicopter that used Kinect and asked ourselves: why has no-one used this in space? Once you can launch low cost nanosatellites that dock together, the possibilities are endless – like space building blocks."



When in close proximity, the Kinect-based docking system will provide the satellites with 3D spatial awareness to align and dock



The STRaND-2 twins will be separated after launch. After the initial phase of system checks, the two satellites will be commanded to perform the docking procedure and, when in close proximity, the Kinect-based docking system will provide the satellites with 3D spatial awareness to align and dock.

Dr Bridges explains: "It may seem far-fetched, but our low-cost nanosatellites could dock to build large and sophisticated modular structures such as space telescopes. Unlike today's big space missions, these could be reconfigured as mission objectives change, and upgraded in orbit with the latest available technologies."

Other possible applications include the safe removal of space debris and spacecraft maintenance, with a low cost, 'snap-on' nanosatellite providing backup power, propulsion or additional on-board computing capability.

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New sensors improve stability

Lion Precision has completed a mechanical redesign of its capacitive displacement sensor probes. The redesign has improved long-term drift and resolution. With the new designs, the highest-resolution models are now able to achieve 0.05 nm resolution.

The displacement resolution demands of the semiconductor, disk-drive, precision bearing and micromachining industries have recently pushed capacitive sensors to their resolution limits. Continuing advances in these industries requires sensor resolution improvements. New, higher resolutions now empower these and other industries to meet the ongoing market demand for increasingly smaller and more precise components.

The new probes are available in diameters of 3, 5, and 8mm and 3/8 inch with axial and radial cable exits. Flat, rectangular packages are also available. The probes work with several models of electronic drivers that can be selected for the best mix of performance, cost, and environmental and mounting considerations.

www.lionprecision.com

Sensors for hydraulic cylinders and actuators

Precision sensor manufacturer Micro-Epsilon has extended its range of robust, pressure-resistant position sensors for hydraulics and pneumatics applications to include a new ultra-compact, 3mm diameter version, which is ideal for miniature hydraulic cylinders and actuators.

Compared to traditional methods of measuring displacement and piston position in hydraulic cylinders and valves (i.e. LVDTs and Magnetostrictive sensors), Micro-Epsilon's EDS series of sensors is much more compact in both its length and diameter. It uses a non-ferrous aluminium outer sleeve as its target, which can be easily integrated into the piston rod. This enables the sensor body to be a solid rod rather than a traditional LVDT style with a hollow sensor body and plunger, making it easier for OEMs to assemble and much more robust and reliable in harsh environments.

The sensors are manufactured from a pressure-resistant stainless steel (up to 450bar) and can withstand extreme vibration and shock levels (up to 300g axial and 100g radial).

www.micro-epsilon.co.uk

Submersible gauging level transmitters for small tanks

A range of submersible tank gauging level transmitters for small tanks and containers is now available in the UK from Impress Sensors and Systems.

The new IMTG range of transmitters are designed for continuous submersion in liquids such as water, oils and fuels. The transmitters are ideally suited to applications in small (0-10m depth) tanks or containers, where conventional mechanical level switches and sensors are not suitable because of reliability issues and a higher degree of level 'control' and measurement is required. WRAS-approved versions of the transmitter are also available for drinking water applications. Typical applications include measurements of static tank level, container or chamber level, and vehicle tank level.

The IMTG transmitters use a piezoresistive, silicon pressure sensing technology and a stainless steel diaphragm, which provide excellent stability, repeatability and resolution. The sensor housing is made from stainless steel, making it ideal for reliable, repeatable hydrostatic level measurement. The sensors are available in nominal pressure ranges from 0.5mWG to 10mWG. An optional self-flushing nose cone is also available.

www.impress-sensors.co.uk

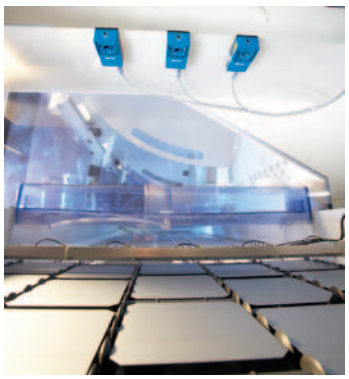
Sick delivers a risk-free vision solution

An 'all-in-one' package to develop, build and install integrated Inspector vision sensors is being launched by Sick UK under its SystemsPlus service group.

Sick Inspector vision solutions already provide cost-savings and improve efficiencies in a wide array of automated inspection and control applications for automotive, food and beverage and logistics companies.

Now with the new Vision@SystemsPlus service, customers can opt for a bespoke solution from Sick UK's expert team who will develop and specify a Sick Inspector vision sensor and associated accessories and then install and commission it to achieve optimum production efficiency. A one-year training and support package is also included.

Sick's skilled SystemsPlus engineering team are highly experienced in installing solutions in the manufacturing, commercial goods and logistics sectors. The Vision@SystemsPlus service includes the design and build of mechanical structure, commissioning the vision sensors, communicating to reject mechanism or to a PLC, testing and training. The systems are controlled and monitored from the Inspector Viewer or a HMI.



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The iconic route

Justin Cunningham finds out why the balance between software and hardware has been a key factor in the procurement of a future icon for London.

Engineering icons are often unplanned. It therefore follows that trying to create this status for a product from the outset is a big ask, especially when you are replacing an existing popular and iconic design.

So when Boris Johnson said he wanted a Routemaster-style bus back on the streets of London in 2008, it was understandably hailed as a tough challenge. The 'New Bus for London' would need to be 40% more fuel efficient and produce 40% less NOx, but critically, it had to be iconic.

David Barnett, development engineering manager at Wrightbus, says: "The brief we were given was that when you walk in to a newsagent in London, you will find postcards of a black taxi, a red phone box, and a Routemaster bus. Fast forward five years and you will see the New Bus for London. This design will define London transport. So no pressure."

The original Routemaster, designed in the early 1950s, has limitations in modern use such as the need for a conductor and limited seats. The new bus would need increased passenger capacity, air-conditioning, a hybrid drive system, and the rear staircase of the original.

"When you look at the original proportions and start to scale those up, you completely ruin the original concept," says Barnett. "The quirkiness of that design is lost altogether."

Wrightbus keeps alive an ethos that is, itself, time served. It says the biggest asset is its skilled manufacturing staff and as a result it's keen to involve them in product development as much as possible. Engineers at the company use Pro Engineer for 3D modelling but get production staff to produce physical mockups to see how things will look in the real world.

"They look at a design in Pro Engineer and mock it up to see how they might build it, what the passenger flow might be like on the staircase, and if is it going to work," says Barnett. "For example, serviceability of the engine, while it fits in Pro Engineer and you can visualise it, how is that going to work when you are in a dirty bus garage at 11pm at night and you have got to get to the air filter? Building mockups in conjunction with 3D models ensures we build a product that not only looks great, but has first-class engineering."

The end design of the New Bus for London uses sweeping glass panels that surround the upper and lower decks, connecting together at the rear staircase. The inside also borrows heavily from the original in its styling. To enable the hybrid drive system and the rear staircase the vehicle length had to be extended. This meant that the entire rear part of the bus is modular, made from composite, and bolted on.

While the use of 3D models has greatly enabled a faster design process, Wrightbus is reticent about buying in to the complete digitisation of the design process. Quite simply, it thinks it doesn't need to, and that it is more about a balance of old and new philosophies.

"Change management and ensuring people are working on the correct version of a design has been a big benefit of using Pro Engineer," says Barnett. "As is the ability to control access, protect out data and share that data out within the company.

"We want to increase the role of it today and move it beyond an engineering tool and drive out all of the non-value added time throughout our process. But, we have got a long way to go and have a lot of hearts and minds to move along the way."

www.ptc.com
www.wrightbus.com
www.tfl.gov.uk

Autodesk products head for the Cloud

Autodesk has announced its 2013 range with an ever-greater emphasis on Cloud-based applications. Paul Fanning reports.

Starting with its 2013 offerings, Autodesk's products for manufacturing and design will be increasingly Cloud-based from here on in.

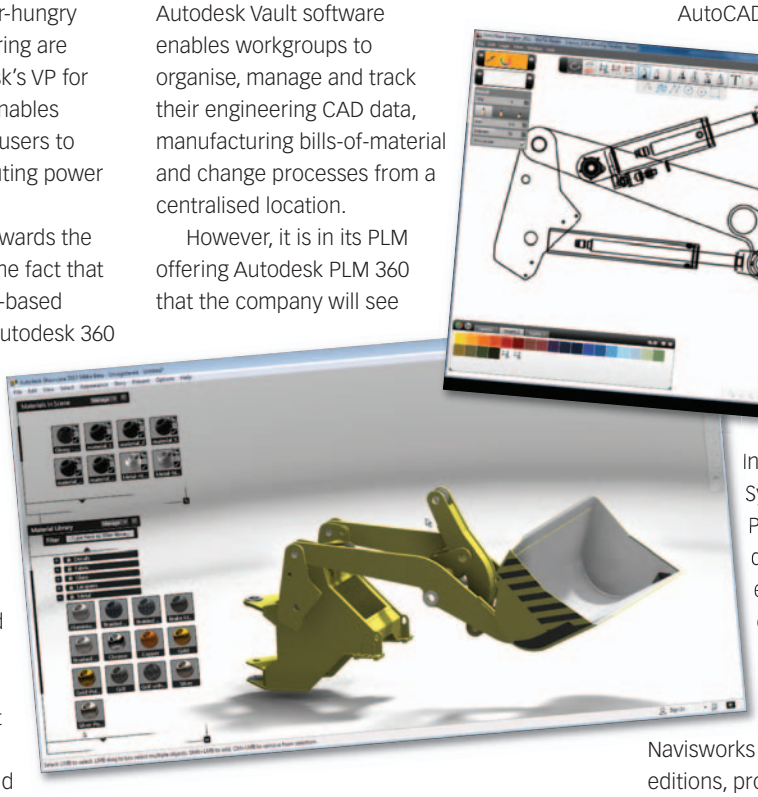
This, of course, is hardly surprising. The apparently infinite resources of the Cloud have made the shift towards it an inevitability - certainly as far as processing power-hungry applications such as 3D CAD rendering are concerned. As Pete Baxter, Autodesk's VP for sales in EMEA, puts it: "The Cloud enables acceleration of analysis and allows users to access an infinite amount of computing power and to run many cycles of design."

Just how significant the move towards the Cloud has been can be seen from the fact that there are already four million Cloud-based users of AutoCAD WS alone while Autodesk 360 has already seen more than 200,000 renders via the Cloud and half a million computing hours. Says Baxter: "The Cloud is best at crunching masses of data and is accessible to everyone from single inventors to huge companies. This allows for many more variations of the same design to be explored and greater design optimisation."

For all this, however, the move towards the Cloud remains just that for the moment. Professional titles like AutoCAD, Autodesk Inventor, and Autodesk 3ds Max will still be available as desktop-installable software packages, but will also include options to exploit Cloud-driven features such as processing a rendering job or solving a simulation scenario using remote servers. Subscription customers will get instant access to these Cloud-hosted features.

Autodesk's 2013 design suites integrate with Autodesk 360 (the branding for the company's cloud offerings) to better enable collaboration. Cloud-based assets promote design sharing and reuse and the suites also offer interoperability with the new 2013 version of Autodesk Vault product data management software and the company's next generation, cloud-based alternative Autodesk PLM 360. Autodesk Vault software enables workgroups to organise, manage and track their engineering CAD data, manufacturing bills-of-material and change processes from a centralised location.

However, it is in its PLM offering Autodesk PLM 360 that the company will see the single biggest move to the Cloud in 2013.



Available in Standard, Premium and Ultimate versions Autodesk Product Design Suite 2013 now includes one-click workflows created to help customers seamlessly move through the engineering design process, advanced Cloud-based services for simulation and the inclusion of additional software allowing customers to realise their end-to-end design process.

Autodesk Product Design Suite 2013 updates include Autodesk Inventor software in the Standard edition, establishing 3D parametric design as the foundation to the engineering design process and providing a solution that delivers powerful 3D design and drafting capabilities.

AutoCAD Electrical software and Autodesk Inventor Routed Systems are also available in the Premium and Ultimate editions, delivering a complete integrated electromechanical system capable of producing an entire product definition, including fully defined tubing, piping and hydraulic systems. Also available is Autodesk Navisworks Simulate in Premium and Ultimate editions, providing integrated electromechanical, markup and visualisation workflows capability.

However, as one would expect with Autodesk, AutoCAD is ever-present. As Pete Baxter puts it: "AutoCAD is front and centre in every single design suite."

This, though, has also been optimised for use in the Cloud and in mobile applications through AutoCAD WS.

www.autodesk.co.uk

Multi-material design drives joining technology

As industry strives for ever greater efficiency, more materials than ever need to be joined. Justin Cunningham reports on recent developments.

With the increased use of composites in many industries, the need to reliably join them with other materials has never been greater.

The automotive industry is a case in point. Rather than shifting from one material to another, it is opting for a multi-materials approach to satisfy increasing constraints from lightweighting and safety design drivers. The result is that materials with radically different properties need to be joined. Management of thermal expansion, electrical conductivity and corrosion are just a few issues that need to be considered when joining exotic materials with the more traditional ones. It is not just about lighter materials, though, but smarter design and using the optimum methods for specific interfaces and materials.

At the recent Global Automotive Lightweight Materials Conference in London, there was much discussion around the various different ways of joining the materials being used to take weight out of a structure.

Speaking at the event was Professor Frank Henning from the Composites Technologies Centre at the Fraunhofer Institute based in Canada. He says: "We are strong believers in a multi-material approach and think each material has its own benefits, so should be used where it makes most sense. And that can change all the time as new technologies are developed.

"If you reduce weight just by replacing the material, then the designer did a bad job as you over engineered it in the first place. There is a lot that can be done in terms of shape optimisation, and the more expensive a material becomes the more we need to integrate functions to make it cost competitive."

Professor Henning is researching methods of joining composite materials with steels and alloys, but in a single, automated, production process. He outlined two fundamental joining techniques to produce what he refers to as 'hybrid' parts: extrinsic and intrinsic.

Huntsman has helped UK-based NRG develop a joining methodology for a magnesium hub and composite wheel, doing away with the need for bonding and finishing

A high performance epoxy was used for EEW's the compound liner clad steel pipes

Extrinsic joints take two distinct parts and assemble them using rivets, adhesives or fasteners. However, new methods are being explored that could act as an alternative such as loop wound joints.

"The loop system is a development that is coming from filament winding," says Professor Henning. "It is connected to a robot and the robot joins tubes with specially designed clenches by winding around the structures, joining them continuously."

Intrinsic 'hybridisation' looks to integrate various different materials in to a single process. The idea, by Fraunhofer, is to integrate metal at the cure or moulding stages of production. "Intrinsic hybridisation in mould assembly might have a metal part mounted in a mould and the mould is then over injected or over pressure moulded," says Henning.

Also at the event was Jaguar Land Rover (JLR) which gave an insight into its material choices on various parts of its vehicles. JLR has been a forerunner in adopting aluminium, and as a result

The Fraunhofer Institute's Composites Technologies Centre is developing methods to integrate various materials into a single automated process

has had to develop, and often pioneer, many new joining methods to ensure joints provide the strength and stiffness needed.

The new Range Rover Evoque features an aluminium roof structure riveted and bonded to the main steel monocoque chassis. There is a further operation in the paint shop which seals the outside of the joint preventing any water getting in and risk of corrosion.

"This saves mass in the area we really want, which is higher up," says Simon Black, senior manager body structures, Jaguar Land Rover. "This lowers the centre of gravity significantly and makes a contribution to improving the dynamic performance."

The materials market is continually evolving and OEMs are placing more pressure on suppliers to develop and deliver new joining methods for their materials.

Material and adhesive innovator Huntsman is focusing a great deal of its effort on producing high-quality, complex, lightweight parts. It continues to develop technologies and processes that strike a balance between increasing throughput, low return on investment and quality.

The company has helped UK-based NRG Wheels produce a composite wheel with a magnesium hub. During the resin transfer moulding process, specially-coated titanium fasteners working within the specially-bonded bushes fastened the hub to the epoxy carbon fibre rim, so no additional component bonding or finishing is required.

The company is well versed in providing adhesives for different substrates. Last year it supported German based Erndtebrücker Eisenwerk (EEW) produce its compound liner clad (CLC) steel pipe.

The company created a composite plate compounded out of a carbon-manganese plate and a corrosion resistance alloy (CRA) sheet, which needs to be bonded together with a high performance epoxy.

The challenge lay in identifying an epoxy adhesive that could enable the cladding of steel plates with all commonly used grades of CRA sheets, prior to forming and welding the heavy composite clad plates into pipes.

After assembling the composites for testing, the adhesives were hardened in a hot press at 180°C and differences in the resistance to shear and tensile forces were observed. For most of the products, disbonding occurred with some of the composite samples showing significant signs of breakage. However, one of the adhesives - Araldite AV 4600 – emerged as a clear winner.

Markus Bockelmann, leader of research and development at EEW, says: "The stress in compound cladding often reaches maximum levels due to bending or shear force, so a bonding solution that helps enhance performance and prevents issues such as inner buckling of the pipe is critical.

"Araldite AV 4600 proved to be ideal for this application in providing the strength needed to withstand both bending in production and the shear and tensile stresses that the pipe would be subject to in application offshore."

The CLC pipes produced show outstanding mechanical and physical properties, making them ideal for high-stress environments such as offshore marine applications. To produce the composite clad plate that forms the CLC pipe, EEW used Araldite AV 4600 to bond the carbon-manganese steel plate and CRA sheet together in combination with additional resistance spot welding. The bond has proven strong enough to form pipe diameters of less than 180mm.

EEW's CLC pipes fulfil the specified requirements for liner pipes, providing more safety against inner buckling and collapse due to the bonding of Araldite AV4600 and the grid of spot welds. They can also be produced in much larger diameters than liner pipes. Indeed, the production process of CLC pipes does not set any limitation to the pipe diameter.

Master Bond is also answering the call for multi-material bonding approaches and has developed a fibreglass adhesive, EP33, which facilitates the reliable bonding of fibreglass to a variety of different substrates.

It has been designed to overcome thermal expansion mismatch complications. Curing at room temperature, it produces durable, high strength, and tough bonds between fibreglass, wood, metals, vulcanised rubbers and many plastics. It maintains strength of 220kg/cm² in shear even after exposure to 235°C.

www.fraunhofer.de
www.jaguarlandrover.com
www.huntsman.com
www.masterbond.com

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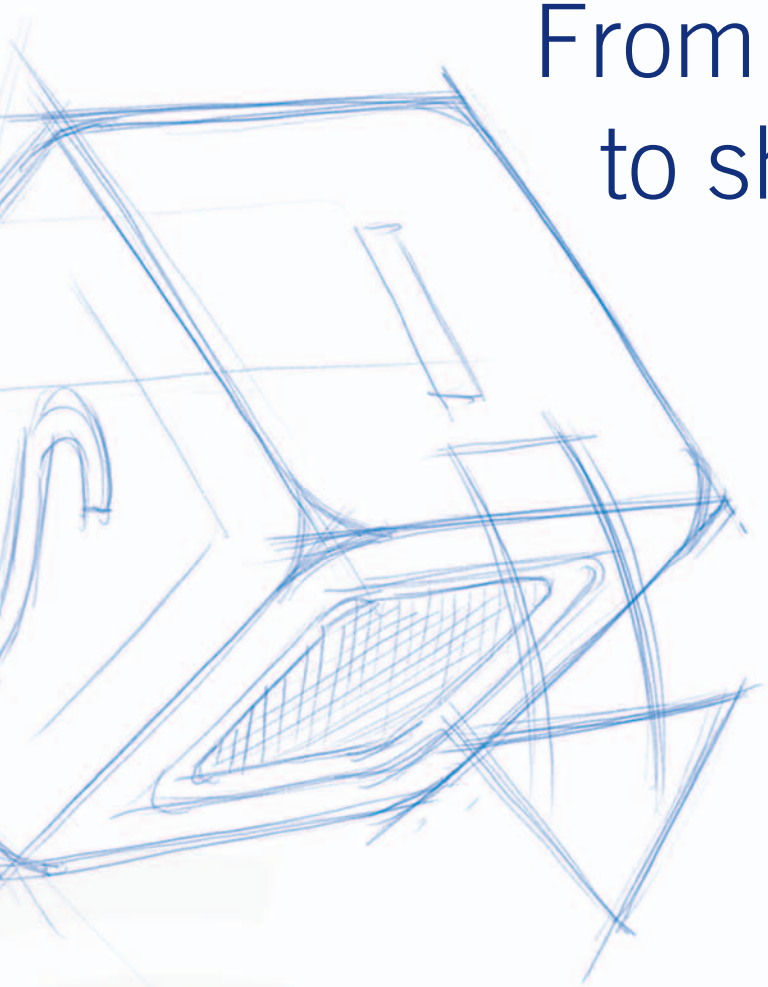
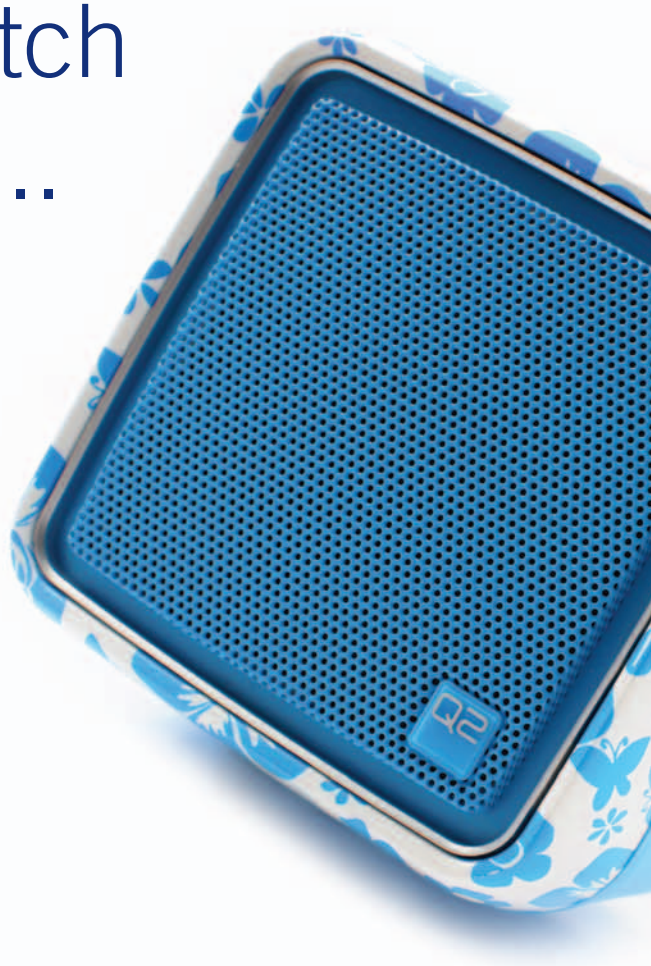
From sketch to shop...





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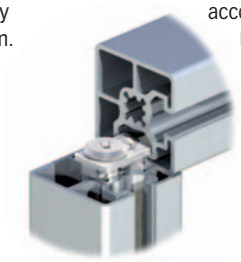
New connector for fast frame assembly

Speedy assembly is now assured thanks to HepcoMotion's introduction of the new RapiLok connector for its MCS aluminium frame and machine construction system. Up to four hours can now be saved on the construction of a typical frame using RapiLok, saving costs while enhancing the versatility of this highly comprehensive system.

RapiLok is designed to secure two profile sections mounted at right angles. The previous fixing method required cross drilling of these profiles but with RapiLok no machining is required. Also only one profile needs to be tapped and there are no other components involved; another cost saving as well as reduced inventory. The result is a joint that is neater, visually more appealing but nonetheless, rigid and reliable.



All that is needed is a single hexagon Allen key to install RapiLok. The process is accomplished in seconds. RapiLok locates against rotation and is therefore suitable for twisting loads. Serrated faces on the underside of the nut grip onto the smooth faces on the MCS profiles, making it ideal for applications where additional loads are applied.

www.hepcomotion.com

Self-clinching studs reduce panel stress

PEM self-clinching studs designed with large-diameter heads provide particularly robust solutions for heavy-duty attachment applications. The enlarged, non-flush stud head distributes the axial tightening force over a large area. The result is improved pull through performance, reduced compressive stress on the panel, and development of full thread strength. All four types of these RoHS-compliant studs offer cost-effective alternatives to weld studs by enabling easier installation with fewer production steps.

Type HFE steel studs install permanently in steel or aluminum sheets as thin as .040" / 1mm with hardness of HRB 85 (or less) and HB 165 (or less). Thread sizes range from #10-32 through 5/16-18 and M5 through M8. Standard stud lengths are available up to 2"/50mm.

www.pemnet.com

New, low-pressure overmoulding system

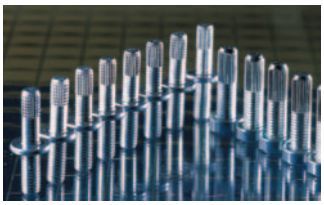
Macromelt is a new, low-pressure overmoulding hotmelt polyamide. The Macromelt range from Henkel is used extensively in Germany but new to the UK.

Henkel provides an extensive range of thermoplastic hotmelt polyamide materials to meet a variety of specific requirements such as cable and strain relief, encapsulation of small PCBs, sensors, switches, terminals, antennae etc.

The key advantages of Macromelt overmoulding, compared to more traditional 2K potting compounds, are its much shorter cycle times (10- 50 seconds) and it is less aggressive on fragile components thereby reducing wastage. In addition, since there is no longer any need for a separately produced housing, there are savings in total production costs to be achieved in most cases.

www.techsil.co.uk

Automotive supplier tests ATP studs



In the future, ATP TriPress fasteners from Arnold Umformtechnik may be used in place of conventional weld-on studs. These press-in studs match the requirements profile of the company, which specialises in the full scope of kinematic subassemblies and hinges in the passenger car seating area.

"The anticipated use of lighter materials, such as magnesium, fibre-reinforced composites such as carbon, or high-strength steel in car construction requires fastener systems that ideally provide better joint quality at lower cost," according to Reinhard Gruber, sales manager of the automotive division of Alpirsbach-based Hetal-Werke. With their triangular shape, Arnold TriPress press-in studs provide the answer to this cost/benefit dilemma. They are polygonal fast-assembly components that can be pressed into plastic and light metal materials.

The cost savings result from the process. The number of manufacturing operations is dramatically reduced compared to the welded-stud option, and cycle times are shortened. The triangular shank and longitudinal knurling provide high resistance to fastener stripping in permanent joints, such as for seat rail adapters.

www.arnold-uk.com

Securing wind power

Joining parts together is one of the most critical steps when delivering a product or a system. Since 1982 the Nord-Lock Group has been focused on solving the toughest bolting challenges and securing the world's most critical applications.

In wind turbine towers bolted joints are particularly exposed to severe vibration and dynamic loads: from foundation bolts to joints keeping different sections of the tower secured and in numerous applications within the turbine itself. Here, the most crucial applications can be found on front and rear main bearings, yaw bearings and bolts on the nacelle frame, as well as bolted joints connecting the main shaft to the hub, and blades to the bearing.

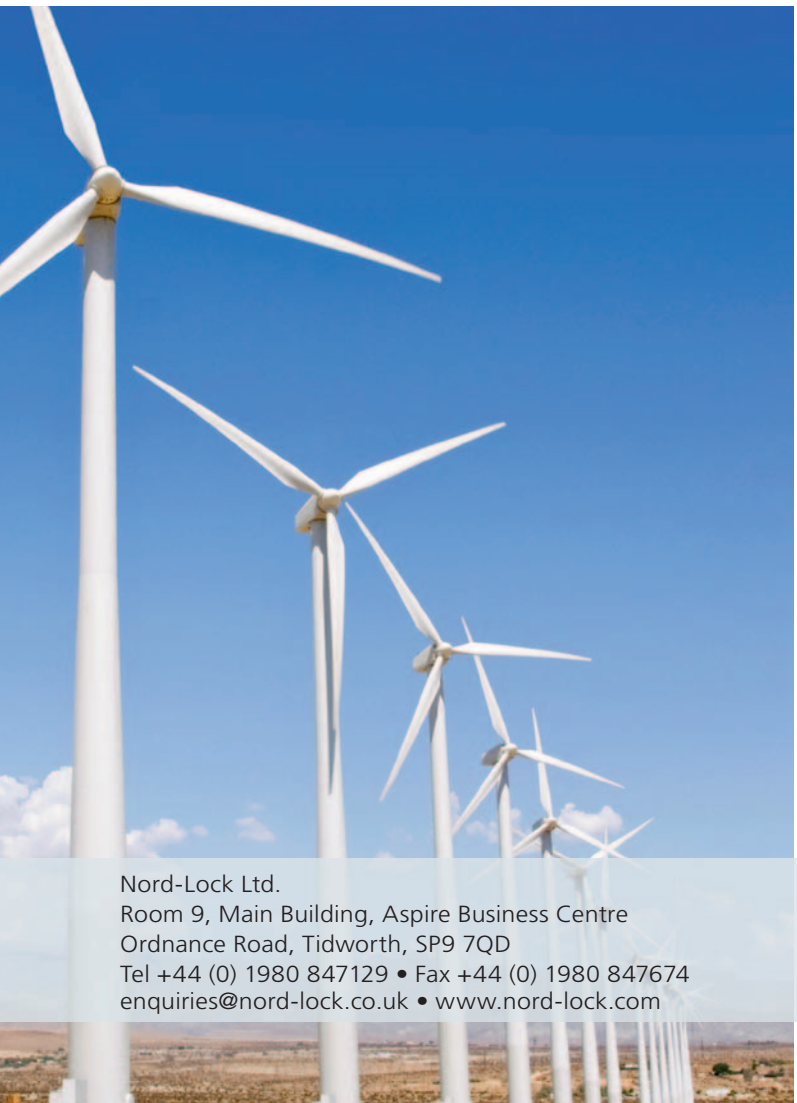
Increase capacity, reduce maintenance interval and improve safety

Nord-Lock offers a unique combination of bolting expertise and a wide product range, including wedge-locking technology and Superbolt tensioners, all designed and developed in-house. Our Production System includes rigorous internal testing and full traceability. Our products hold several certificates from independent institutes including AbP, ABS, DIBt, DNV and TÜV.

With Nord-Lock bolt securing systems, the wind turbine power output can be increased. Safely secured bolted joints mean that you are able to reduce the maintenance frequency and inspection and thereby substantially reduce overall production downtime and maintenance costs. You also decrease the risks of human error associated with conducting this type of maintenance.

Partner up with an expert

We help you identify your needs and ensure successful operations over time with our on-site support and remote product training. Nord-Lock Performance Services is a partnership concept that offers tools to add value throughout a project and ensures that your bolting application pays back many times. **Contact your national Nord-Lock office or visit www.nord-lock.com and learn more about how Nord-Lock can secure your most demanding applications.**



Joining parts together is one of the most critical steps when delivering a product or a system. The Nord-Lock Group is focused on solving the toughest bolting challenges.

We offer a unique combination of bolting expertise and a wide product range, including wedge-locking technology and Superbolt tensioners, all designed and developed in-house.

The Nord-Lock Group looks forward to being your partner in bolt optimization.

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Eureka has partnered with leading intellectual property law firm D Young & Co LLP to offer advice and information to help companies understand, use and protect their IP. Specialising in patents, trade marks, designs and related intellectual property rights, D Young & Co works with companies ranging from start-ups to established multi-nationals. In this issue, we look at the copyright issues associated with computer programs, with the help of Cam Gatta, Solicitor, Dispute Resolution and Legal Group.

The Protection of Computer Programs: Copyright

This is the first of two articles looking at certain aspects of the protection afforded to computer programs by copyright and patents.

Copyright can protect several 'elements' of a computer program and its main advantage is that it is an automatic right in the UK i.e. no registration is required). UK copyright will automatically subsist in a 'work', provided the criteria for protection are satisfied. These include:

(1) originality: this does not mean that the work has to involve creativity or artistic merit, but simply that a work 'originates from its author', i.e. it is the author's own intellectual creation or an expression of his/her 'independent' skill, labour and judgment;

(2) for certain types of work, the requirement to be recorded in a material form; and

(3) the presence of factors connecting the author or the work to the UK (or a country party to international copyright treaties).

While copyright protection is conferred relatively easily, the scope of protection (and consequently the monopoly granted) is narrower if compared with that provided by trade marks or even more so patents. As observed by the Court of Justice of the European Union ('**CJEU**') in relation to computer programs (but it applies to all types of copyright works), '*copyright protection covers only the individual expression of the work and thus leaves other authors the desired latitude to create similar or even identical programs provided that they refrain from copying*' (SAS Institut Inc –v- World Programming Ltd, C-406/10). The rationale is that, doing otherwise, would '*make it possible to monopolise ideas* [as opposed to the expression of ideas], *to the detriment of technological progress and industrial development*'.

Under the Copyright, Designs and Patents Act 1988 (CDPA), computer programs are stated to be a type of literary work in which copyright subsists. However, there is no definition of computer programs in the CDPA or in the relevant EU legislation (Council Directive 2009/24/EC on the legal protection of computer programs, the '**Software Directive**').

In the recent cases of *SAS Institut* (see above) and *Bezpecnostni softwarová asociace - Svaz softwarové ochrany v Ministerstvo kultury* (Case C-393/09), the CJEU concluded that the following are protectable under the Software Directive:

- source code;
- object code; and
- the preparatory design materials (e.g. functional specifications, graphs, flow charts etc.) leading to the development of a computer program (provided that the nature of the preparatory materials is such that a computer program can result from them at a later stage). There is uncertainty as to whether preparatory design materials are considered to be part of the related computer program or a separate copyright work. This point might become relevant when determining issues of ownership (and the right to exploit) the copyright.

Conversely, the following are not protectable as a computer program under the Software Directive:

- The ideas, principles, logic and algorithms underlying the programs;
- Graphical user interfaces, i.e. those parts of a computer program, which enable communication between user and computer;
- Functionality, business logic or functional structure of a computer program. Therefore, it would not be an infringement of the copyright in a computer program to replicate its functionality in another program, provided that one has no access and has not copied the source code and the object code of the former;
- The programming language and data file format. However, if one obtains the source code or object code relating to the programming language and data file format used in a computer program and then creates similar elements in another computer program, that conduct could be an infringement of the copyright in the original source code and object code. Also, this does not rule out the possibility that programming language and data file format might be protected as other types of copyright work; and
- Commands, either individually or as a compilation, and the syntax of the commands.

Next time, we will look at the patentability of software.

Note:

In addition to the protection granted under the Software Directive, other elements of a computer program can be protected by the ordinary law of copyright pursuant to *Directive 2001/29/EC on the harmonisation of certain aspects of copyright and related rights in the information society*. The elements in question are the more 'visible and audible' features of a computer program, e.g.:

- The graphic works appearing on screen, including icons;
- The text(s) displayed on the screen;
- Those components of the graphical user interface(s) which satisfy the originality test (see right) and whose expression is not solely dictated by their technical function.
- The musical works and sound recordings generated by or accompanying the running of a computer program; and
- Any database that may be searched using a computer program.

Next time, we will look more closely at the patentability of software

More information is available at D Young & Co's Knowledgebank at www.dyoung.com. Alternatively, please contact Cam Gatta at cxg@dyoung.co.uk or Anthony Albutt at aja@dyoung.com

D YOUNG & CO INTELLECTUAL PROPERTY

What a mover!

Unless you are phenomenally strong, moving heavy rolls of paper, railway wagons or aircraft by hand is probably unthinkable. So how can it be done?

Usually, heavy rolls of film, paper or cables require some kind of heavy-duty machinery to move them wherever they need to go. These industrial rolls can weigh tons, yet all need to be manoeuvered around warehouses.

This is usually done by forklift or by groups of people all pushing the roll, putting their backs in to it and straining away. This is obviously far from ideal, as it can cause back problems, especially in the long term, and has potential dangers if it rolls away out of control.

And then there are items that are just too heavy; railway carriages, trucks, and even aircraft. Take a maintenance depot that deals with trains and trams. Moving these colossal masses, sometimes over 100tonnes, usually requires the driver. But often engineers need to check wheel integrity, by rolling or lifting up the trains. Drivers are not always around, lifting equipment is large and expensive and powered trains are not always available to move carriages.

Aircraft, of a small to medium size, are also limited in manoeuverability once they are parked and the pilot has gone to the bar. Yet maintenance engineers might need to move the aircraft to a hangar. While machines exist to move these they are again generally large, bulky and heavy.

The Challenge:

The challenge this month is to come up with a handheld device which can be used to roll anything from rolls of paper to train carriages. The device should require no real physical effort from the user and be able to shift up to 100tonnes. It can be powered by any means, but should not be overly complicated. An air hose, hydraulic line or electrical cable is probably going to be your best bet.

This should be a classic problem for mechanical engineers, and first principles can probably guide you most of the way, certainly in terms of the kinds of forces you are dealing with. The device should also be small and light enough that it can be carried around, being highly portable and only needing to be connected to a power source.

High power density is obviously a must have, and for particularly heavy items such as trains, additional methods of finding grip can be added to the design. The solution can involve using high ratio gearing, a clutch system, driven by anything from pedal power to an electric motor. However, strain on an electric motor could cause it to overheat and prematurely fail, so it might not be the ideal solution after all.

The solution we will offer next month, however, uses none of these technologies and keeps its device simple and elegant. Once you see it, you may consider it obvious. In the mean time, see what you can come up with.

The solution to last month's Coffee Time Challenge of how to supply power to medical implants remotely is in the Technology briefs section on page 12

Adhesives

Much more than just a Product Guide

The new 160 page publication from Henkel, the manufacturer of the Loctite®, Bonderite® and Teroson® brands, is so much more than just a product-by-product guide for industrial adhesives, sealants and surface treatment solutions. It is an excellent application reference source for anyone involved in engineering design, build, assembly and repair.

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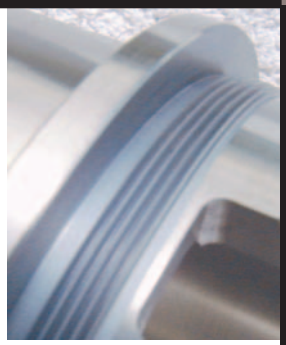
Design Out maintenance problems with WS2!



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Solenoids and Solenoid Valves

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ABS-ESD7 Material from Stratasys can be used to fabricate assembly aids for electronic products

UK Distributor, Laser Lines Ltd, is pleased to announce the introduction of a static dissipative ABS material for items sensitive to electrostatic charge. This new material, called ABS-ESD7, is for use by Fortus additive manufacturing systems - the Fortus 400mc and Fortus 900mc. The material has static dissipative properties for applications where a static charge can damage products, impair performance or cause an explosion.

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www.laserlines.co.uk

For more information on the following jobs enter the reference No. on... **www.totallyengineering.com**

Design Engineer

Location: Mid Glamorgan
Type: Permanent
Salary/Rate: Competitive

General Purpose of Role to include:

- To prepare design concepts for new products
- To perform heat/cool calculations for cabs
- To perform heat exchanger performance calculations
- To produce engineering designs for the new product, using appropriate CAD tools
- To liaise with customer engineering representatives on design issues
- To participate in the engineering aspects of cost reduction programs
- To conduct engineering changes to existing products.

Main Responsibilities to include:

- Creation of conceptual designs to suit customer requirements
- Assisting in the preparation of commercial quotations for the concepts
- Developing the concept through to final design intent
- Liaising with customers' engineering representative
- Detailing the final design intent for manufacturing
- Compiling detailed Bills of Materials for the final design.

For full details online, enter reference: qkCyWPc

Senior Mechanical Design Engineer

Location: Cambridge, Cambridgeshire
Type: Permanent
Salary/Rate: Benefits + relocation allowance

This uniquely diverse £1 billion global consultancy in the Built Environment industry in the UK is looking for a Senior Mechanical Design Engineer to work within a multi-disciplinary team, based in Cambridge within the water sector.

Roles will include preparing outline and detailed mechanical engineering designs, producing technical and commercial specifications, drawings, schedules, working closely with clients and contractor partners, as well as providing technical support to other offices. It is important to have relative experience in water/waste water.

This role will give the opportunity to further develop mechanical and management skills through project work, and provide excellent opportunities for career advancement in the water division.

For full details online, enter reference: qkCy0AG

Mechanical/Project Design Engineer

Location: Chippenham, Wiltshire Type: Permanent
Salary: £27k-£29k per annum DOE

Calling all mechanical engineers! Do you have good 3D CAD skills – and looking for your next step up? If so, this established manufacturer of rotating equipment is looking for a Mechanical/Project Design Engineer to join its team.

You'll be responsible for providing mechanical design and development for new and current valve projects and orders to an agreed criteria, quality and timescale. You'll also co-ordinate and control associated projects.

Some of your duties will include:

- Investigating assigned problems and projects and providing solutions
- Following designs through manufacture to product release
- Formulating the necessary criteria to enable performance testing
- Providing detailed drawings, and appropriately assisting with process and purchase technicalities.

For full details online, enter reference: qkCygGN

Lead Engineer – Airworthiness

Location: Bedfordshire
Type: Permanent
Salary/Rate: £40k-£56k per annum + benefits

Job details:
This leading global manufacturer supplying into the Aerospace sector is seeking an Airworthiness Lead Engineer, responsible for supporting the Office of Airworthiness, and delegated approval process and procedures for airworthiness activities for the design organisation.

Main Responsibilities:

- Support the management and upkeep of the design office handbook
- Maintain process and procedures of the design organisation, specifically the preparation and checking of compliance to Part 21
- Ensure capability and competence of external subcontractors inclusive of test facilities are current and be capable of conducting technical audits.

Knowledge, Skills and Experience Required:

- Technical and operational experience in the Aerospace industry
- A good understanding of Airworthiness regulations and certification for large aircraft
- Proven Part 21 and CS25 capability, with strong compliance and documentation skills.

For full details online, enter reference: qkCygRO

Ethernet

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