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**Electric**



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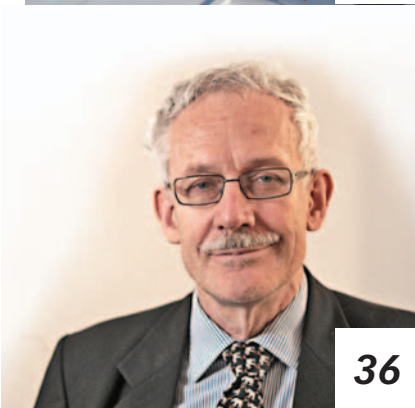
This month's challenge is to devise a means whereby boats can be quickly and easily be got into and out of the water.



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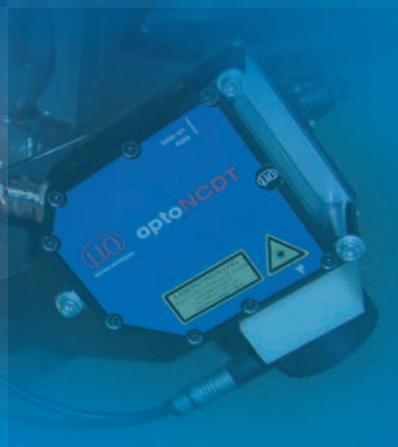
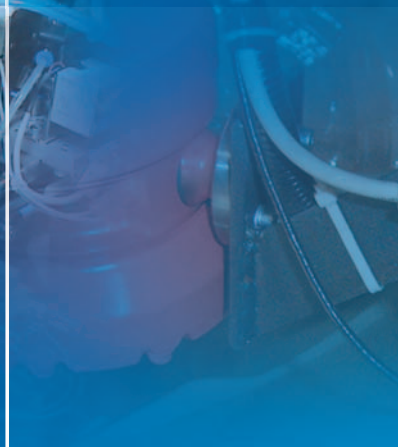
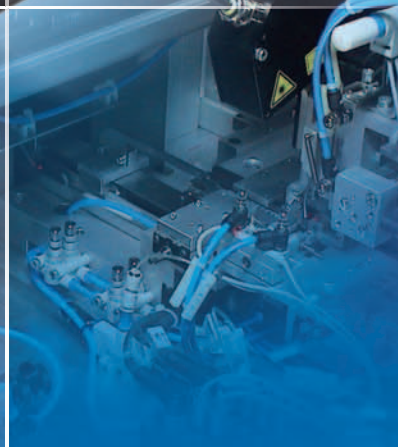


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# An idea whose time has come



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

A common complaint from manufacturers relates to the difficulty in obtaining finance to fund innovation, research and development. The complaint alleges that – even prior to the financial crisis – banks were simply not interested in lending to manufacturers, preferring to lend to more glamorous, high-risk, high-return sectors.

The figures bear this allegation out. Lord Turner, the head of the Financial Services Authority, has pointed out that lending by the UK financial system roughly trebled in the decade before the crisis, but total lending to manufacturing companies was actually slightly lower in 2007 than it was in 1997.

The financial crisis has done little to improve matters, with banks even more wary of lending. Not unreasonably in light of political commitments to 'rebalance the economy', this situation has led to calls for a bank specifically devoted to support for manufacturing and able to respond to the needs of manufacturers.

The fact is, however, that despite calls for this to happen and despite the state ownership of certain banks making it eminently feasible, there has as yet been no meaningful progress on this matter. Since access to finance is critical to any hope of a UK manufacturing recovery, we must hope that this remains a meaningful possibility.

*\* This will be the last issue in which Tom Shelley will appear as Group Technical Editor of Eureka. After 26 years with the magazine, Tom has retired to pursue a variety of other interests (some of which you can read about on page 36).*

*While Tom will continue to write articles for Eureka, I would like to take this opportunity to thank him for his work for Eureka over the years and to wish him a long and happy retirement.*

## Briefs

### GREEN INVESTMENT FUND FROM CARBON TRUST AND SIEMENS OPENS

UK businesses can now apply for green equipment finance from Carbon Trust and Siemens. Worth up to £550 million over the next three years, the dedicated low carbon finance scheme is the first of its kind and will enable UK businesses to invest in cost effective energy efficiency equipment and other low carbon technologies, such as new efficient lighting and biomass heating.

Siemens Financial Services UK Ltd will provide the financial backing and manage the provision of funding, whilst Carbon Trust Implementation Services Limited (a subsidiary of the Carbon Trust) will use its expertise in carbon saving from energy efficient technologies to independently assess the carbon, energy and cost savings of any project. This should enable the financing to pay for itself through energy savings.

### STUDENTS SET FOR MOTORSPORT EVENT

A team of students from the University of Strathclyde are approaching completion of the build of a single seat racing car in preparation for the prestigious 'Formula Student' event.

Considered a breeding ground for world class engineers, the event challenges university students from around the world to design and build a single-seat racing car, which is then put to the test on Europe's top racing venues.

The Strathclyde Motorsport Team will fly the flag for Scotland at the UK event, at the Silverstone Circuit, home to the Formula 1 British Grand Prix, in July after leading the way in recent trials. And the team will be the country's only representative for the German version of the event at Hockenheim, in August.

## Cambridge Consultants receives Queen's Award for Enterprise

Cambridge Consultants has been awarded a second Queen's Award for Enterprise, this time in the Innovation category, for its ground breaking through-wall radar, Prism 200. The award follows on from the Queen's Award for International Trade in 2009.

Prism 200 received the award due to its revolutionary handheld through-wall radar technology, which has been designed to be used by police, special forces or the emergency services. It provides quick and covert intelligence on the movement and location of people in a room or building - without the need for invasive sensors. This compact, portable and durable product uses advanced signal processing to highlight moving people and objects in cluttered environments, through doors or brick, block and concrete walls. Prism 200 has been designed for situations where a high degree of insight is essential for success, and has been deployed in over 67 countries around the world.

Commenting on the award, Dr. Brian Moon, CEO of Cambridge Consultants, said: "We are delighted to have been bestowed with this prestigious award not once, but twice. Innovation is what drives this company and has been paramount to our success over the last 50 years. I firmly believe that in times of austerity, innovation is what will give companies the edge over their competitors, and I am delighted the team here at Cambridge Consultants has been



recognised as being at the forefront of it. I look forward to unveiling further groundbreaking initiatives in the future".

Cambridge Consultants has a history of success with the Queen's Award. In 2009, it was awarded one in the International Trade category in recognition of the strong growth of its export business. This is in addition to three of its spin-out companies - Cambridge Silicon Radio, Inca Digital and Xaar - also being honoured with Queen's Awards.

## Secretary of State appoints Semta as Issuing Authority for apprenticeships

Sector Skills Council, Semta has today announced its new role as the Issuing Authority for Apprenticeships in the science, engineering and manufacturing technology sectors. The appointment, made by the Secretary of State, gives Semta sole responsibility for issuing Apprenticeship frameworks in England.

Apprenticeship frameworks outline the statutory requirements of individual apprenticeship programmes in England and Wales. Used by colleges,

employers and training providers alike, frameworks ensure all programmes, wherever they take place, are consistent in content and high quality in their delivery.

Philip Whiteman, chief executive of Semta said: "Semta is really proud to have been awarded this new responsibility. We know that apprenticeships can deliver enormous benefit to businesses in our sectors, but it is important that they meet the needs of employers. We are already working closely with industry to develop apprenticeship

frameworks that meet these needs, and this new appointment will allow us to support employers even further, understanding demand and helping develop the right solution."

Semta research shows that 32,000 new employees will be needed across its sectors each year between now and 2016. A third of these need higher skills highlighting the importance of apprenticeships in stemming the outflow of talent caused by retirements in a workforce where nearly a third is aged over 45.



## BARA's campaign spurs on UK manufacturers

A recent series of breakfast meetings, attended by leading UK manufacturers have successfully launched BARA's Automating Manufacturing Campaign to stimulate interest in automation among the UK manufacturing community; a quest which has received Government support following an industry study Application of Automation in UK Manufacturing 27 Sept 2010.

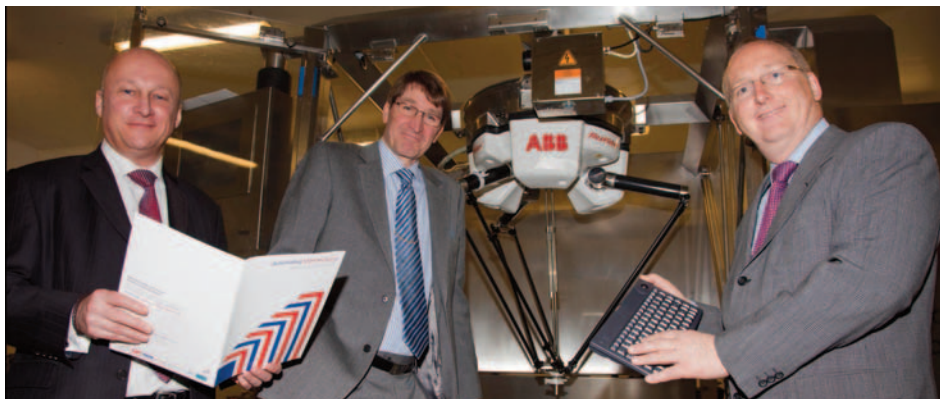
Numerous manufacturers across all sectors including food and beverage, automotive and electrical industries attended the meetings which were supported by the Manufacturing Advisory Service and held at leading automation advocates Lander Automotive Ltd (Birmingham), Harwin PLC (Portsmouth), and the National Centre for Food Manufacturing (Holbeach) where Graham Thomas of Greencore talked about his experiences of introducing automation.

The events, which form part of a larger two year BARA campaign to raise manufacturers' awareness of the benefits of automation, gave attendees the opportunity to have one-to-one discussions with industry experts, learn from users of automation of their experiences, and review the automation in use at the host facility: "It's great to know that there's funding available for automation and to find out what other companies are doing. Although I already had an idea of what I wanted to achieve, seeing real-life examples of automation in action was very useful," said Martin Miller, Chief Engineer (Manufacturing) at supermarket Morrisons.

Speaker Mike Wilson, President of BARA, the British Automation and Robot Association (pictured below, left), outlined the benefits to be gained from automating at the events: "UK companies invest far less in automation than their European counterparts and this campaign gives us an opportunity to show them what they're missing. An automated machine consistently produces a high quality product and operates reliably for every hour of every day for many years, allowing staff to be utilised where their skills are more effective. Manufacturers benefit from greater productivity and improved customer response and service, such that it increases a firm's competitive edge and reduces its costs."

Neale Ryan, National Network Manager of the Manufacturing Advisory Service comments: "As the recent BARA events have shown robotics and automation can play a strong role helping businesses achieve growth and success, something that we feel extremely passionate about. MAS continues to be dedicated to improving productivity, competitiveness and making a real difference to manufacturers' bottom line and we look forward to working more closely with BARA in the future."

For Premier Foods' Manufacturing Manager, Peter Davies, the event was an ideal marketplace to kick-start a project: "It was a fantastic taster of the benefits to be gained from automating. And the format, a short, sharp breakfast session, packed with information and no hard sell, was perfect. I'm now looking to follow up conversations I had at the meeting and begin work on an automation project in the near future."



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“ The PROFIBUS Group is delighted to support Sensors+Systems 2011. We have enjoyed a long and rewarding relationship with Trident Exhibitions and look forward to participating in the first of the new style events. What better location - a venue renowned for innovation and showcasing the latest developments in aerospace and now industrial technology. ” Bob Squirrell, Profibus Group

“ The Institute of Measurement & Control is pleased to support this southern focussed event. Even with times of economic hardship the Institute has seen an increase in local section activity. Farnborough is ideally positioned to serve three of our biggest sections and this event is a welcome addition within a very active measurement and control community. ” Robert Knothe, InstMC Business Development Manager

“ The Electronics, Sensors, Photonics Knowledge Transfer Network (ESP KTN) is pleased to announce its support for Sensors+Systems for Control & Instrumentation. This new regional show complements the aims of the ESP KTN, which carries out a wide range of knowledge transfer activities to underpin Electronics, Sensors, Photonics, Instrumentation and Control Systems technologies in the UK. The show also provides a valuable opportunity for the ESP KTN to increase its visibility and outreach to new members through the seminars it will be running during the event. ” Phil Cooper, Director, ESP KTN

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## In-line linear actuator available

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

HepcoMotion has long held the view that the most reliable and cost-effective X-Y-Z systems comprise elements which take into account the specific technical needs of the given axis. The SDM module has therefore been developed for both single and the Z-axis movements to complement other products in the HepcoMotion linear actuator range that are optimally suited for X and Y axis operation. [www.hepcotion.com](http://www.hepcotion.com)

## Fast lead times on linear recirculating roller guides

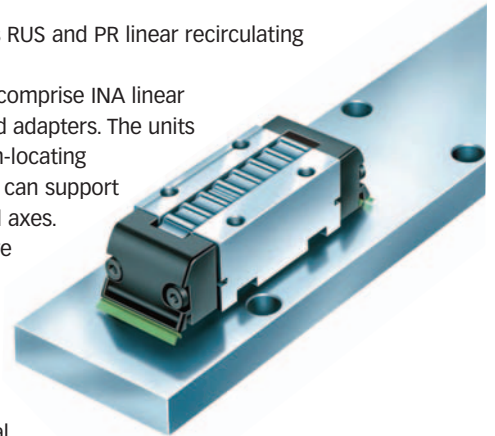
Schaeffler (UK) is now offering UK customers its RUS and PR linear recirculating roller guidance systems on fast lead times.

Linear recirculating roller guidance systems comprise INA linear recirculating roller bearings, with guideways and adapters. The units can be used as locating/locating or locating/non-locating bearings. In a closed arrangement, the bearings can support loads from all directions and moments about all axes.

The RUS and PR versions within the range are popular with machine tool retrofitters and machine builders, as these units offer very high load carrying capacities, whilst requiring little installation space. The units also provide extremely high rigidity under preload.

The PR model is a full complement cylindrical roller set and is suitable for high operating temperatures, high speeds and high accelerations. Of all-metal construction, the PR can operate in temperatures from -40 deg C to +120 deg C.

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



## Solution to last month's Coffee Time Challenge



The solution to our April Coffee Time challenge, to provide temporary but effective protection to the feet of visitors to workshops and construction sites comes from Canada.

Called 'Slipp-R' 'Safety Toes', these consist of elastomeric overshoes with steel toes. We came across these at a Health and Safety Exhibition and they are quick to put on, stay on the outside of shoes and are equally quick to pull off. Despite their simple appearance, a fair amount of design expertise and technology has been put into them. The makers say they are acid, oil and animal fat resistant, and will not harden, stiffen or crack even in Canadian weather. They are injection moulded in a material "From the rubber family" without seams, are 100% waterproof and have anti-slip soles. The Ossett based company Paper Life sells them for £21.15 a pair. [www.paperlife.co.uk](http://www.paperlife.co.uk)

## Sick reveals compact code scanner series

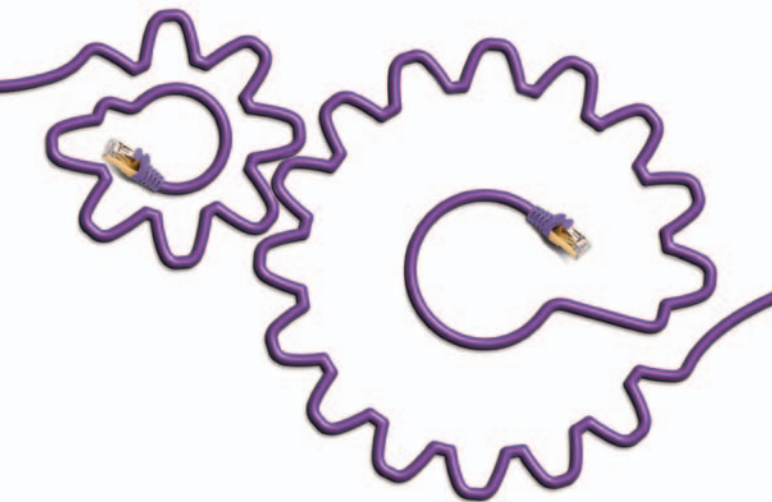
Sick (UK) has launched the Lector 620 code scanner range for reliable 1D, stacked and 2D code identification, traceability and anti-counterfeiting in a compact housing, two-thirds smaller than most 2D code readers.

Sick has developed four versions of the new scanner to meet all market demands. The 'Eco' is the foundation model, while the 'Standard' device is deployed for rapid implementation of universal applications. The 'High Speed' model was developed for activity such as packaging and document handling and the 'DPM' is used for directly applied markings.

The Lector is easy-to-use with parameterisation achieved at the push of a button, while the laser-based alignment assistance reduces training and installation time. The LED illumination also ensures quick analysis of the read-rate performance.

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





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Precision in the Extreme

## New pressure sensor family from Balluff

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



With 11 pressure range versions the BSP sensors cover all the important ranges from -1-0 bar up to 0-600 bar for monitoring process media in factory automation. Typical applications include hydraulics monitoring as well as pneumatics equipment. The new Balluff pressure sensors offer either two switching points or one switching output plus analogue channel.

Thanks to their highly compact design the sensors can be easily located without taking up valuable space. The display with operating panel and electrical connection can be rotated independently of each other by 320° with respect to the flange.

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



## Split roller bearings cut downtime costs

Revolv's SRB SN and SD series of split roller bearings offer direct dimensional interchangeability with standard plumber blocks that house solid bearings. Solid bearings take on average, eight-times longer to replace than split roller bearings; so by replacing trapped solid bearings with Revolve's SRB SN and SD series split bearings when failures occur, users can achieve drastic reductions in downtime costs.



The SRB SN & SD series of split roller bearing units effectively overcome the traditional problem of replacing standard plumber blocks with split roller units: that of the housing base to shaft centreline being higher on a split bearing, necessitating expensive modifications to machinery. They provide a simple bolt-on solution that offers full dimensional interchangeability with conventional plumber blocks, and require no structural changes to adjacent machinery.

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

## New pressure transducer has CANopen

Variohm EuroSensor expands its wide range of pressure transducers with the introduction of the new CANopen enabled SMC series for high accuracy measurement up to 2000 bar in a compact and robust IP67-rated stainless steel design based on the 22 mm hexagonal industry standard. The CANopen protocol ensures straightforward industry standard commissioning with interfacing to CAN 2.0A or optionally CAN 2.0B, and the 1Mbit/s data rate ensures fast update pressure measurement.

The economically priced SMC series is available in over twenty standard measurement range with generous overload and burst pressure ratings that ensure maximum safety.

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# Making the sustainable

**T**he question of which materials are or are not environmentally-sustainable is a vexed one and is not as clear cut as is often thought. For instance, some materials seen as essential for environmentally-friendly products either cannot be extracted economically in sufficient quantities or come at an environmental cost that may make them unacceptable on a very large scale, or.

While these factors may discourage the use of such materials in the course of the technical development of new products, they do mean that thought has to be given to looking for alternatives or finding ways of designing out the need for them.

End user lifetime cost (including cost of disposal) is not a bad way of assessing which material to use, since cost includes the cost of energy to produce and ship, and if the suppliers are responsible – and it is increasingly hard to conceal bad environmental practices in the global village in which we all live – the cost of extracting it or producing it in an environmentally acceptable manner.

Another major problem with the ability to assess the environmental impact of a material derives from the fact that precise and detailed information on the subject is hard to come by. This was one of the motivating factors behind Autodesk's decision to include the Eco Materials Adviser in its Inventor software. The tool uses information from Granta's database of design and environmental information on materials and is intended to allow the designer to make more informed and sustainable material choices at an early stage of the design process before any materials are 'locked in' to the design.

However, while this is clearly a welcome development, it only serves to highlight the paucity of detailed information available on materials. Says Granta's Dr Jamie O'Hare: "This is not intended as a precise cost modelling tool." This becomes clear as one understands that the information on materials is derived from an international average and therefore cannot take into account local factors, alterations in cost, availability and other variables.

Equally, it is not always possible to acquire accurate data

## DESIGN POINTERS

- The vast majority of materials seen to be critical either have alternatives or can be designed out
- The negative environmental impact of obtaining some materials could well outweigh the environmental usefulness of the products to be made from them
- Recycling occurs to a high level where the rewards make it worthwhile but should not be blindly pursued for its own sake
- Technology is moving on at such a rate that materials seen to be crucial today, could well turn out to be of little use in a few years time
- R&D is essential to enable UK manufacturing to keep ahead of the game

from manufacturers and suppliers. Says O'Hare: "There is simply not the level of precision available for environmental data as there is for engineering data. It's simply not possible to get a precise value for a CO2 footprint as it is for, say, tensile strength." Sarah Krasley, Autodesk's product manager for sustainability, also acknowledges the issue, saying: "We're not seeing the same level of precision within the environmental data," she said. "But I would love this to be the start of a push down the supply chain and getting specific eco-indicators."

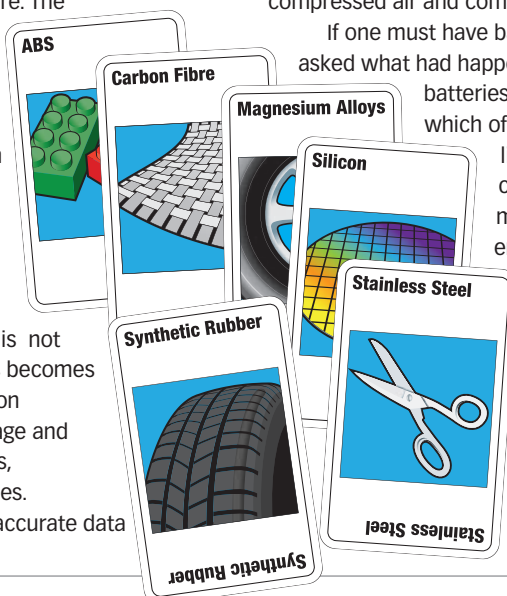
A clear understanding of the available and sustainable alternatives is clearly crucial. However, that is easier said than achieved. A recent Knowledge Transfer Network meeting on 'Materials scarcity and critical materials' looked at materials for electric vehicles and asked whether electric vehicles themselves were as eco-friendly as some would have us believe. For instance, lithium is crucial to

achieving maximum energy storage to weight ratio, but there is limited supply and the extraction process can pollute local water supplies. However, as Dr Colin Johnston, Materials KTN transport sector leader pointed out, there are alternatives. In hybrid vehicles, Formula 1 cars have shown the way to temporarily store braking energy in either flywheels or supercapacitors. It is also possible to store energy as compressed air and compressed nitrogen in hydraulic accumulators.

If one must have batteries for battery electric cars, Dr Johnston asked what had happened to some of the high temperature batteries, relying on systems like sodium sulphur, which offer twice the storage capacity of

lithium ion batteries. The answer, of course, is that, driven on by lower material costs and their higher energy densities, they are still being researched. And this, it would seem, is the key point: most potential material shortages or environmental problems can be engineered round by applying sufficient research and development.

Another example of this can be seen regarding the potential shortage of rare earth metals used in permanent magnets





# material choice

Tom Shelley looks at some of the challenges and questions faced by designers when choosing sustainable materials.

for high efficiency motors. Prices of the most sought after rare earths have gone up by more than 1,000% in the last 12 months. However, permanent magnets are not crucial for electric motors. Most electric motors are induction motors and there are also switched reluctance motors that use no permanent magnets or rare earth metals at all. Starting torque for induction motors is less than for permanent magnet motors, at least at present, but research and development continues.

Technology moves ever onwards changing materials needs. And even wood may come back into its own if the prices of oil derived plastics keep going up. Wood is largely cellulose, a natural polymer, and the German company, Tecnaro also produces a thermoplastic called 'Arborform' from lignin, the other main constituent of wood,

which is discarded during paper making.

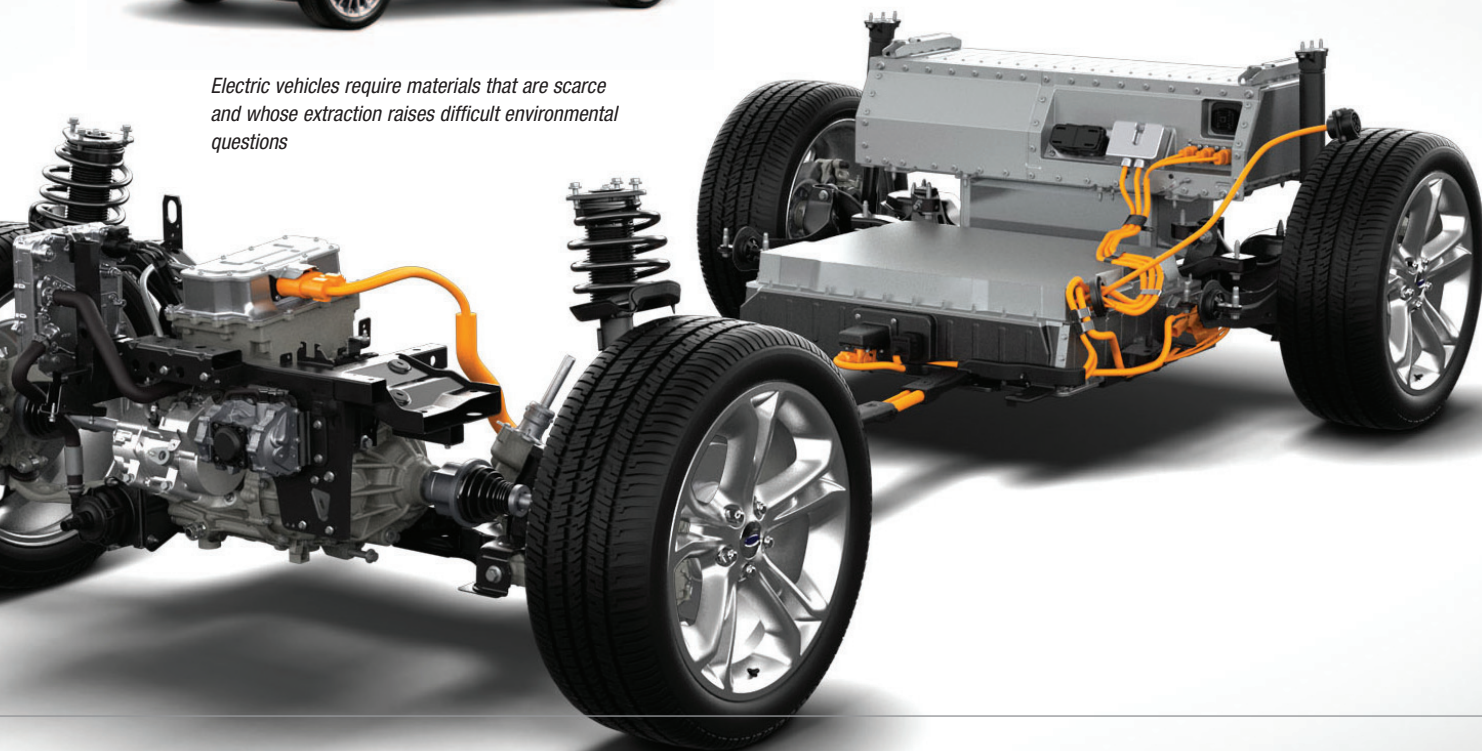
Platinum is and always will be a scarce and valuable metal. It is the best catalyst material known, and as such is the material of choice in exhaust catalysts and fuel cells. There are alternatives but they are not as effective. Being valuable, 98% of production gets recycled, and Johnson Matthey, which is a British company, manages a large proportion of the supply. The remaining 2% not recycled is probably dispersed as dirt on the roads. There is talk of recovering this, too.

Recycling is seen as crucial in conserving strategic materials, but there remain all kinds of practical problems and it is not a viable or eco friendly policy to expend vast amounts of energy and effort to recycle small amounts of material. Suppliers of lithium vehicle batteries take their batteries back and recycle them, but organising the same for batteries in laptop computers and mobile phones is probably not worth the trouble and not likely to happen on a full scale. The situation is even more fraught as regards recycling the tiny amounts of rare earth metals in low-energy and fluorescent lights, and the comment was made that the items that local authorities least want to collect – because they are potentially hazardous – are those that we most need to get back.

Steel does tend to get recycled and so does copper. The reason that



*Electric vehicles require materials that are scarce and whose extraction raises difficult environmental questions*





*Above: British users of composites might experience difficulties resulting from losing control of the production of high quality carbon fibre for composites.*

*Right: The New Cobar open cut copper mine in Australia. The price of copper is continuing to rise as demand outstrips supply.*

the price of copper keeps going up is that demand is exceeding supply. In North America, aluminium was extensively used for domestic wiring between about 1965 and 1973, as an alternative to copper.

Unfortunately, care has to be taken with making connections with it, because when it oxidises, aluminium oxide is a good insulator and connection joints can overheat were responsible for a number of fires. After totally going out of fashion, technical advances have allowed it to be used again, but it is not allowed in the EU. Bars in the rotors of induction motors are normally made of aluminium and current busbars can either be made of aluminium or copper. Aluminium has only 62% of the electrical conductivity of copper but copper weighs three times as much and costs almost four times as much. There is no fundamental shortage of aluminium because when bauxite aluminium ore starts to run out, it can also be extracted from clay.

The recycling of plastics is complicated. We described the production of 'EcoSheet' from mixed waste plastics in our February

edition but most companies making products from waste plastics depend on having a steady and consistent supply of waste plastic of one particular type. For example, Eagley plastics in Chinley extrudes a wide range of products derived from recycled PVC from the building industry. These can be coated with a skin of virgin PVC if required. Similarly, Pipeline and Drainage Systems in Wakefield extrudes ceramic parts, mainly 'Envirokerb' drainage kerbs made from a mixture of LDPE – Low Density PolyEthylene and limestone quarry dust.

There was more concern expressed about possible difficulties that British users of composites might experience resulting from losing control of the production of high quality carbon fibre for composites. Everyone agreed that composites, many of which were originally British inventions, and which are the engineering materials of the future, now depend on supplies from abroad, particularly high modulus carbon fibre, which has to either come from the US and Japan. Adrian Waddams, manufacturing manager for the British Marine Federation is concerned about possible supply problems with resins and fibreglass for boat building. Carbon fibre may represent 60% of the UK composite industry in value terms, but is only a small fraction of the whole in volume terms.

There is no fundamental shortage of carbon, no ecological problems associated with producing it, and big environmental advantages in making use of it to reduce weight, but we have to ask if it is wise to depend on production of a crucial component in two countries which are in many fields, strong business competitors.

The solution, as always, is a need to look after British manufacturing and keep supporting research and development to a point where the UK can secure its supplies of strategic components and be agile enough to develop alternative strategies as and when required.



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# Designing by standard

Tom Shelley reports on how one of the UK's leading industrial designers finds inspiration in a British Standard.

Mike Ayre, the managing director of Crucible Industrial Design is an enthusiast for collaborative working as set out in BS 7000 part 2. He explains: "We are a first and foremost a product design consultancy and became very interested in the standard because it has a lot of common sense guidance, especially about the importance of teamwork. A lot of the companies could do this better."

"Developing new products has never been the most reliable route to guaranteed riches," he says. "Many ideas never see the light of day and of those that do, a significant proportion fail. The reasons for these failures are extremely varied, but often come down to poor understanding of the market and lack of organisation."

In order to remedy this, he believes that "Everybody needs to be involved right from the beginning. Projects tend to be driven either by marketing or technical, but both need to work together. Often we are initially contacted by one or the other, and told the other side will be brought in later. However, if all issues can be hammered out and managed early in the development process, things will go better."

On the question of how much better, he did not specify numbers, but instead cited the example of a recent product development his firm had been involved in where "The whole thing had been managed very efficiently", with the result that the product took only eight weeks to progress from idea to being put on the market. On the other hand, if information had been, "Going back and forth between departments, the same process would probably have taken three or four months".

Ayre is convinced that BS 7000 Part 2, 1997, 'Design management systems. Guide to managing the design of manufactured products' sets this out clearly. "As the preamble says, 'The emphasis of the process is the early, low cost stages where most management decisions are taken and most finance committed.'"

As part of the process, he is convinced that "The same people should come to every meeting, and that these team meetings should be held, typically, about once a fortnight." He believes that particular problems result if management decides to send different people to each meeting, so that everyone has a turn and a chance to find from the 'horse's mouth', what is going on. He says: "[such a policy] is always a mistake, since it means that every meeting has to go over old ground to bring the newcomers up to speed."

"The importance of holding regular design reviews cannot be overstated," he says, "Which is somewhat ironic, as they are often forgotten. We all know the situation – deadlines to meet, finding a time when everyone is available, and the concern that Keith from

production is going to raise a problem that you'd rather not confront. So the reviews don't happen. The problem with this is not that the project will fail – it probably won't – but it will be less successful than it would have been if the regular reviews had taken place, as you will have missed all the opportunities that they would have identified. (Keith actually had a great idea that would have taken half an hour off the assembly time...)"

Given increasing globalisation in design and manufacture, might this process be undertaken online? While Ayres says that online collaboration is, "Extremely useful", he points out that video conferencing has never really caught on despite some companies spending large sums on video conferencing suites. However, he does believe that, with improvement in the relevant technologies, online collaboration is going to be increasingly important. He believes, however, that "Face-to-face contact is still way preferable, because people can check out the body language of those they are meeting with."

*"Face-to-face contact is still preferable, because people can check out body language"*

The other aspect of BS7000-2 that Mike is keen on is prototyping. CAD companies often tell us that there is no need to prototype, except to verify the CAD model. This may work well enough when the new product is not radically different from its predecessor. James Dyson, Ayre observes, believes in lots of prototypes as part of the

development process and the standard defines different types of prototype from 'experimental' through 'test' to 'development' and 'pre-production'.

The standard also stresses the importance of 'Verification and validation'. Ayre says that 'Verification' is the process of checking that the design conforms to the specified requirements, while 'Validation', is about whether the design conforms to customer needs and requirements, or in other words, verification depends on whether or not the product works, while validation is about its suitability to be sold.

To assist in the promotion of these views and to assist others, Mike has written a 1485 word paper, "Tipping the odds in your favour: minimising risk in product development", about making use of the ideas in BS 7000 part 2, available from Crucible Design, free of charge.

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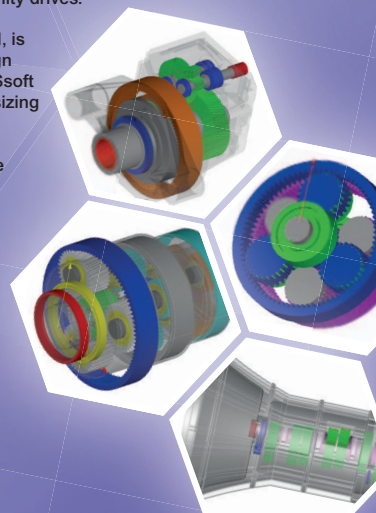
Growing out of the close relationship, developed over a number of joint projects, the Denis Ferranti Group has been appointed agent for all KISSsoft products and services, including training, throughout the UK.

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# New challenges met by gearboxes for larger wind turbines

**Reliability of wind turbine gearboxes is even more crucial when they are very large and offshore. Tom Shelley reports.**

With the latest wind turbines now rated at more than 6MW, and plans to erect such monsters offshore, the challenge of ensuring that their gearboxes as totally reliable has grown even greater than it was before.

It is possible to build wind turbines without gearboxes, but there is a cost penalty because the generators then have to be of sufficient diameter to accommodate a large number of poles.

Close to each other at the Hannover Fair were the stands of RE Power, which has installed three 6.15MW, 126m rotor diameter turbines close to the German-Danish border, and Hansen Transmissions, which supplies the gearboxes. These units have two planetary stages and one helical stage. Both companies are presently majority owned by the Indian Suzlon Energy, which is headquartered in Pune.

Since the plan is to install numbers of these monster machines offshore in the next few months, with all the costs associated with hiring crane barges, should they malfunction, we asked Mario Desmit, Hansen Transmission's marketing communications manager, if they were truly reliable.

He insisted that they were, thanks to accelerated life testing in specially constructed test rigs at the company's production facility in Lommel, Belgium. A dynamic bearing system test



*Hansen Transmissions supplies the gearboxes for RE Power's turbines*

rig has five hydraulic cylinders to apply axial and radial loads of up to 400kN axial force and 1500kN radial force per cylinder. It cost €2.6 million. In addition, the company also has a gearbox test rig which has a nominal power of 13.2MW, a peak power 16.8MW and cost more than €10 million. This incorporates 1,000 tonnes of steel and more than 1,000m<sup>3</sup> of concrete. Hansen has developed what it calls a 'Design Operational Robustness Test' or DORoTe which translates a set of simulated wind loads, as supplied by customers, into a test programme which delivers corresponding rotor torques and speeds to the gearboxes. Two years of operational wind conditions can, the company says, be translated into three months of continuous testing by "Increasing loads within acceptable levels". Start, stop, normal operation with variable loading, run-pause and emergency stops are all included in the test plan.

Multi body computer simulation (MBS) also plays an important part allowing an unlimited number of virtual sensors to be applied to models, as opposed to the limited number that can be applied in reality. Nonetheless, in a validation campaign on gearboxes on the test rig, they are fitted with more than 200 real world sensors in order to measure torque, acceleration, displacement, speed and rotational speeds. This enables validation of the MBS models and their gearbox transfer functions, which can be

incorporated into customer MBS models of overall wind turbines. After the mechanical tests, the gearboxes are completely disassembled and all components inspected.

It should be noted at this point that Hansen Industrial Gearboxes, which is based in Antwerp in Belgium and was also exhibiting at the Hannover Fair was acquired by Sumitomo Heavy Industries on March 4th 2011 and is now a separate company. It is currently



*One of the 6.15MW, 126m rotor diameter turbines*

in the process of being rebranded: Hansen Industrial Transmissions as opposed to Hansen Transmissions. Applications for Hansen Industrial gearboxes include: aerators, mixers and agitators, cooling towers, air cooled condensers, conveyors, hoists, mills, kilns, pumps, toasters, pulpers, cable cars, scrapers and screw pumps.

[www.repower.de](http://www.repower.de)

[www.hansen transmissions.com](http://www.hansen transmissions.com)

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

## DESIGN POINTERS

- 'New wind turbines and gearboxes are rated at 6.15MW
- Several are installed onshore and it is planned to install units off shore within the next few months
- The bearings and gearboxes have been subjected to very sophisticated modelling and mechanical testing, and so will hopefully not malfunction

# Hybrid motors find new efficiencies and markets

**Tom Shelley reports on advances in automotive hybrid technology at this year's Hannover Fair.**

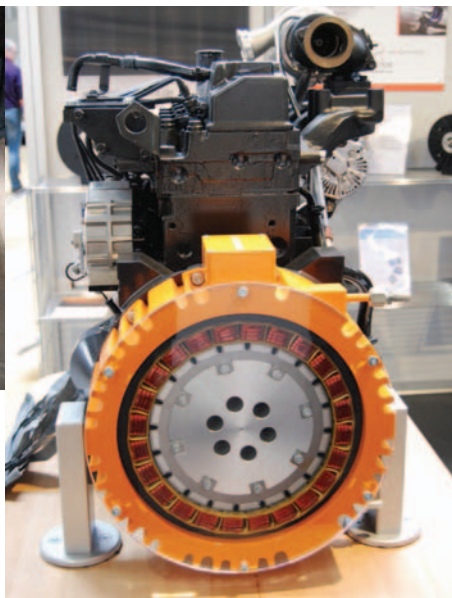


A motor for hybrid transmissions sets a new benchmark in electrical efficiency thanks to improved stator windings.

It also a step forward in a process that is seeing such transmissions diversifying out of conventional cars into small excavators, off road vehicles and trucks.

The Heinzmann Generation 3 hybrid drive motor is the latest development to come from a German Black Forest-based company that has been going since 1897 and has been making electric drives since 1985. At the 2011 Hannover Fair, technical director Frank Böhler showed us how it was more efficient because it used what he called "Concentrated windings" on each stator tooth. He explained that in most motors, there is "Copper without any use, which does not produce magnetic field". There are still resistance losses in these parts of the windings that represents energy that is being consumed for no useful purpose.

In the new design of motor, the ends of the rotor tooth windings are only 5mm from the permanent magnet rotor, whereas in previous designs, Böhler claims the distances were 35mm to 45mm. The change in design also makes the motors more compact. Efficiency improvement in these motors, which are rated at 25kW continuous and 40kW peak, is about 1%, which might not sound a lot, but



represents a more than 10% reduction in heat output, since the motors were already more than 90% efficient.

The company makes motors for electric and hybrid drives that are rated up to 60kW and are used in Atlas wheel loaders, the Mecalac 12 MTX excavator and Ladog multipurpose municipal vehicles.

Böhler favours what he calls, "Mild hybrids", where there is a traditional transmission system, either mechanical or hydraulic, and the motor is switched on during load peaks to provide additional torque. At the same time, the motor functions as a generator during braking and as a starter motor that allows the internal combustion engine to be turned off when the vehicle is stopped and started again in 150 to 300ms. He sees forklift trucks and wheel loaders as ideal applications, because of their frequent stops and starts. However tests with the municipal vehicles, which are not considered to be an ideal use, still showed fuel savings of around 20%.



Also on show in the same hall as the motors were a plethora of battery electric and hybrid cars and vans ranging from electric tricycles to large luxury limousines, the most notable of which came from Mercedes and its MB Tech offshoot. However, outside, was a large hybrid truck which visitors described as looking like a cross between Concorde and a German ICE train. This drive by wire and streamlined juggernaut turned out to have been developed by Professor Gernot Spiegelberg of Siemens, in the context of a Rudolf Diesel industry fellowship at the University of Munich Institute for Advanced Study.

The project has been given the title, "Diesel reloaded". Three post doctoral researchers are engaged in the three principle tasks of: "Electric power train and energy management," "Electronic system architecture of all interconnected functions," and "Development of a novel human-machine interface with side stick controller." Design is being coordinated with the aid of Teamcenter from Siemens PLM. The vehicle is currently fitted up as a mobile exhibition centre.

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

[www.tum-ias.de/current-focus-groups/energy/diesel-reloaded.html](http://www.tum-ias.de/current-focus-groups/energy/diesel-reloaded.html)

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# Grease monitoring lengthens bearing life

**Bearing life is often dependent on the condition of its lubricating grease. Paul Fanning looks at a sensor that allows it to be monitored during operation.**

A grease sensor has been developed that enables the condition of the lubricant to be analysed immediately during bearing operation could ensure that the lubricant is changed long before the bearing sustains any damage.

In conjunction with Freudenberg and lubrication expert Klüber Lubrication, Schaeffler Group Industrial has developed a grease sensor incorporating an electronic evaluation system that enables the condition of grease in bearings to be analysed during operation.

The condition of the grease used to lubricate bearings is often a critical factor in their failure. Indeed, the grease operating life is the decisive value during preventive maintenance if it is shorter than the bearing life. In this case, bearings are usually relubricated halfway through the so-called grease operating life. The great disadvantage of this procedure is that absolutely nothing is known about the condition of the grease. Up to now, users could only receive information about the grease in bearings by taking samples and undertaking costly and time-consuming analyses of these samples in a laboratory.

According to Peter Schuster, Schaeffler Industrial's Director for Advanced Development,

there is no similar grease monitoring sensor currently available. This is due to the way in which the sensor operates. The optical near-infrared reflection method is used here. The process, developed in conjunction with the Fraunhofer Institut for Electronic Nano Systems (ENAS) in Chemnitz, Germany, is based on the infrared process used in laboratories to measure grease quality and was adapted for online measurements in rolling bearings. The know-how involved is not only in the setup of the sensor, rather in particular in the evaluation of the measured signals. The grease undergoes rotationally symmetrical irradiation with certain wavelengths from the sensor. The sensor head is embedded in the lubricant during this procedure. The reflected light is measured perpendicular to the grease. This enables shadow effects and surface

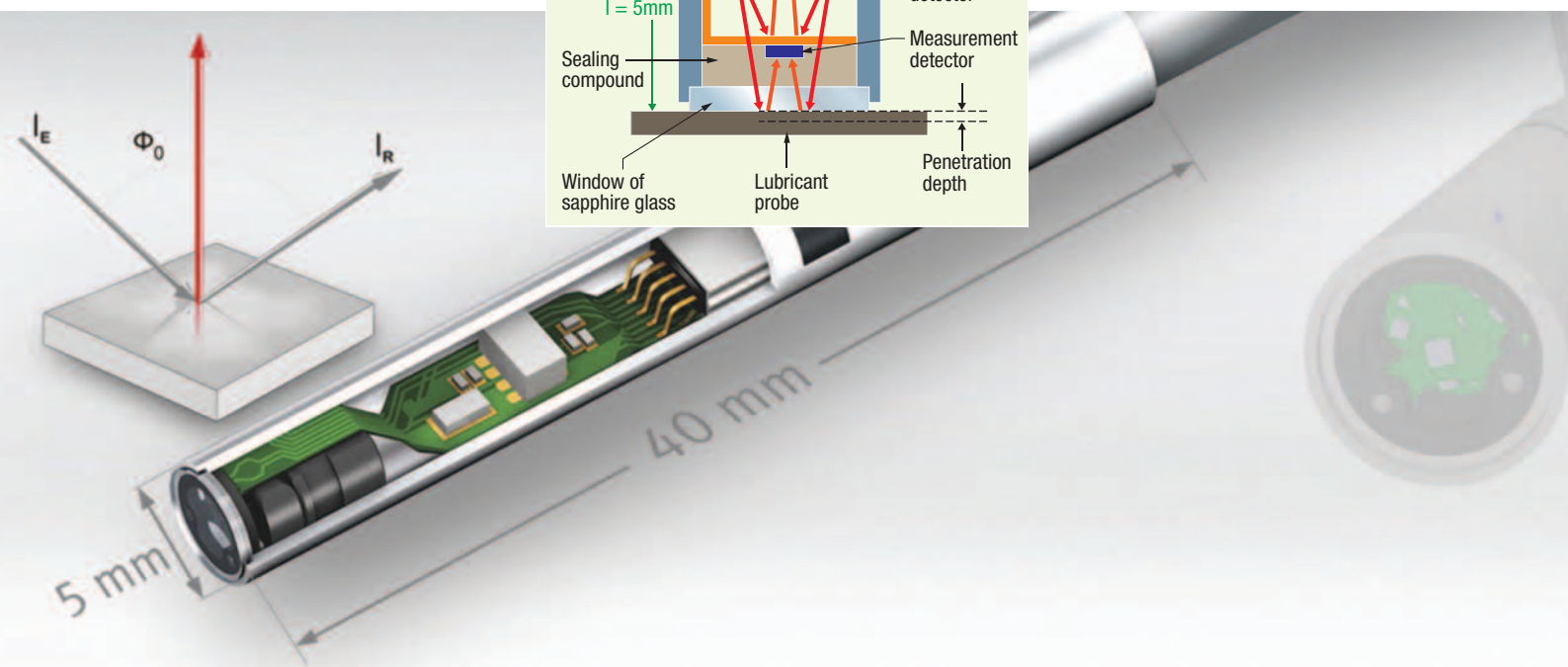
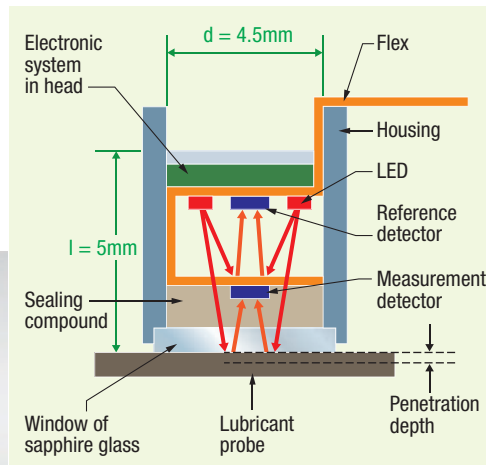
'inhomogeneities' or mismatches to be completely excluded. The reflected light is evaluated in terms of the quality of the grease.

Four grease parameters can be detected using the sensor: Water content, cloudiness, wear (thermal or mechanical wear) and temperature. An analogue signal (4 – 20 mA) is generated from these parameters in the electronic evaluation system, which displays the condition of the grease quickly and simply. A digital signal can be generated that indicates poor/good grease quality by setting a trigger threshold (limit value).

The sensor has to be located in the bearing via a hole put in the position best calculated to monitor the condition of the grease continuously. Currently, no wireless option is available. However, the concept has been proven on test rigs and has been deployed in pilot applications.

Says Herr Schuster: "This will not be a catalogue product. It is designed as a bespoke solution." Currently only in pilot applications, the system will be available by the end of this year.

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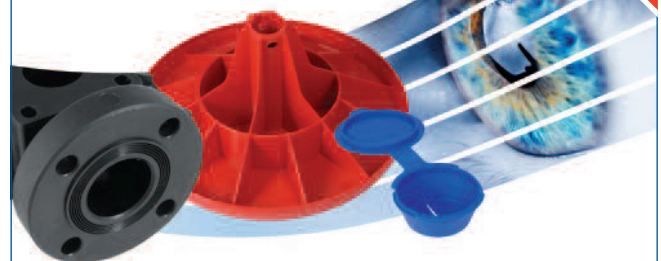
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# Bonds verified in moments

**Tom Shelley reports on a new technology for confirming the quality of adhesive bonds, particularly appropriate for the medical sector.**

A new system applies adhesive, cures it with ultraviolet light, checks whether it has been cured properly, and then if necessary, cures it some more, all within the space of a very few seconds.

The initial application is with an acrylic adhesive specifically developed for bonding disposable medical devices, but the plan is to extend it to other light curable adhesives used in products ranging from aerospace and automotive to consumer durables.

'AssureCure' has been developed by Henkel Loctite in the USA and was demonstrated to us at the recently held MEDTEC exhibition in Birmingham. The curing is initiated when light in the range 200 to 500nm, delivered by an optical fibre, is absorbed by photoinitiator molecules in the adhesive which fragment into free radicals. These free radicals react with the monomers to produce polymerisation. The AssureCure system then sends another pulse of light down the optical fibre and uses FTIR – Fourier Transform Infrared Spectroscopy, to assess whether the photoinitiator has been used up or is still present and able to absorb some of the incident test light at certain wavelengths.

The FTIR spectral response has previously been calibrated against mechanical needle pull tests, so the relationship between spectrum and cure is known empirically, rather than being based on assumptions.

As well as ensuring the mechanical strength of joints, it also ensures that the bonded joints are biochemically inert, reducing cytotoxicity from grade 4 (severe reactivity) to grade 0 (no reactivity).

Alternative methods of verifying adhesive bonds include fluorescence, which can only confirm that adhesive is present and in what locations, and colour changing adhesives, which can only confirm that the adhesive has been exposed to light. Mechanical testing of bonded components is normally destructive and so can



only be applied to a proportion of bonded parts, all of which have to subsequently be discarded as scrap. Ultrasonic testing is appropriate for aerospace, but too slow and expensive for use in mass production.

In practical terms, the AssureCure system is very compact, works with any PC or most PLCs, and sits on a bench top. It is also extremely rapid. The verification typically takes about 20ms. Hence the system is highly compatible with high speed production.

The first and so far the only adhesive it has been applied to is Loctite 3924AC, the AC referring to AssureCure system compatibility. It

is a single component acrylic adhesive of medium viscosity which cures in a few seconds under the action of 365nm ultra violet light. Glass transition temperature of the cured material is 61°C, Shore Hardness, ISO 868 Durometer D is 60. Elongation at break is 280%, tensile strength is 18 MPa and tensile modulus, 283 MPa. The adhesive is compatible with sterilisation using gamma rays, ethylene oxide or autoclaving. It is not, however, recommended to use with pure oxygen, chlorine, or other strong oxidisers. Cooling should be provided for temperature sensitive substrates such as thermoplastics. The uncured adhesive has to be kept in the dark and dispensed using black feed lines.

It has been tested bonding polycarbonate to polycarbonate, polyvinyl chloride to glass, and steel to glass. Test results all seem to refer to cannulas, tubes that can be inserted into the body, often for the delivery or removal of fluid or data. However, one of the other target applications is bonding automotive headlight assemblies.

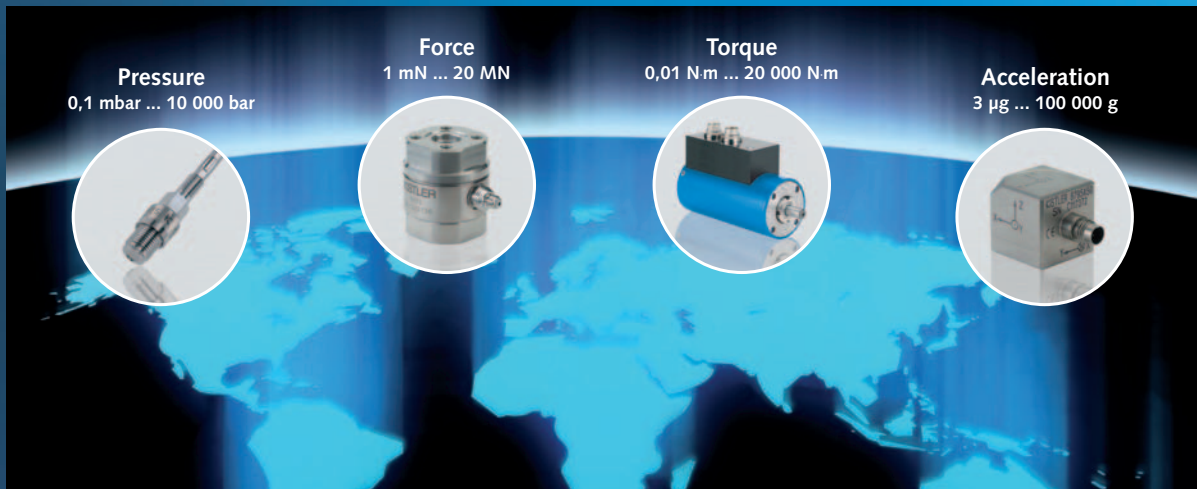
UK marketing manager Colin Chapman says that the plan is to extend the technology to a wide range of the company's other adhesives.

**[www.assurecure.com](http://www.assurecure.com)**

## DESIGN POINTERS

- Testing takes as little as 20ms to establish that cure has been completed.
- Bonded components can be 100% tested without risk of damage to products
- The system is compact enough to sit on a bench top and is used in conjunction with either a PC or PLC.

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# Sensors and systems join through gateways

**Tom Shelley reports on generic gateway modules that are configured to interface automation systems to sensors and other systems using different protocols.**

By coming up with a modular design for gateways, with pairs of units that can be configured for almost any protocol, it is possible to produce interfaces that will transparently connect almost any sensor or other device to almost any control system, without loading them with translation tasks.

This allows modification of existing systems. For instance, adding a weighing facility, barcode reader or vision system, without having to re-engineer everything or worry about whether the new addition is compatible with the rest of the system or will require translation software or special cards, if they can be found and space can be found for them.

The products have been around for a while. Steffan Dahlström, one of the founders of Swedish headquartered HMS Industrial Networks, said that there are an ever growing number of automation protocols and fieldbuses in use, of which about 20% are based on different 'flavours' of Industrial Ethernet. To accommodate this, the company makes interface modules for major automation vendors, which they usually sell under their own brand names, and also a wide range of 'Anybus' 'X-Gateway's and 'Communicator' modules. In addition to models that have been on the market for a while, it has just launched new versions that are lighter, easier to manufacture, use half the electric current of their predecessors and offer new features.

Dahlström commented that it would be, nice for customers if one could just download new software every time a system is changed or upgraded, "But the hardware connectors are

usually different as well, so it is necessary to purchase new interface units", he says.

General manager Björn Franzén said that there were currently about 150 different networks and network protocols in use with wireless adding even more possibilities. Reasons for having to interface to a new protocol could include: production line extensions, factory upgrades and enterprise integrations which require joining factory automation systems to supervisory systems and/or PLCs to PLCs.

'X-Gateways' join networks to networks while 'Communicators' connect networks to sensors and other devices. It is often not

desirable to try to run long cables from devices to PLCs because some interfaces, RS232 for example, have a maximum cable length of around 25m.

The interface modules are not particularly cheap - Franzén said list prices of current models range from €400 to €900 for what he described as, "Odd combinations." However one unit can do quite a lot. A Communicator has a selectable RS-232/422/485, Modbus RTU, DF1, ASCII, CAN or Ethernet TCP/IP interface so that multiple devices - up to 31 in the case of RS 485, can be connected via a single device.

In addition to the existing range of models, which are quite chunky, with the X-Gateways housed in sturdy metal boxes, the new range comes with an SD memory slot, USB configuration ports and downward sloping connectors. They are all housed in the same kind of enclosure and are built around the same



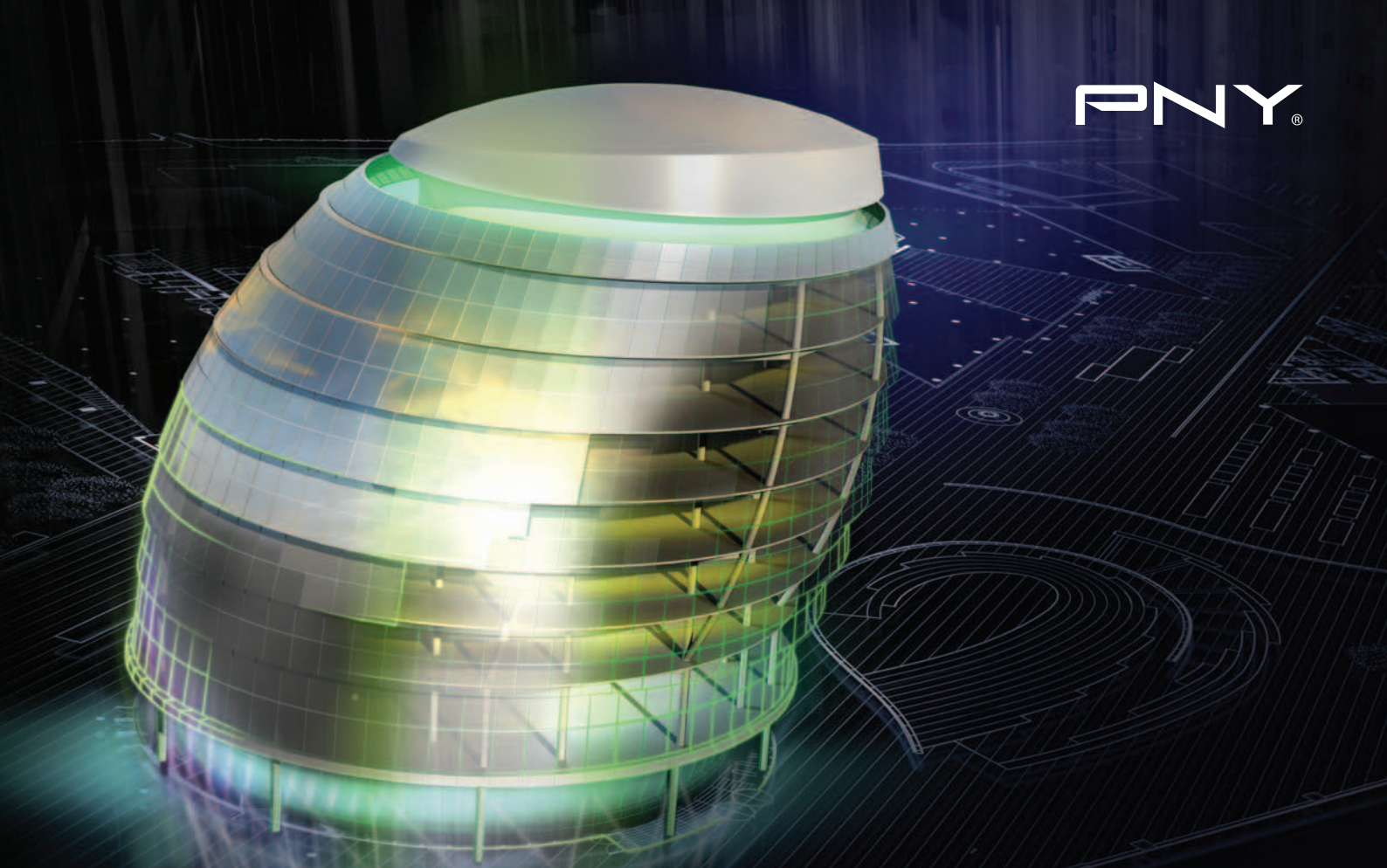
company NP30 proprietary ASIC. They also cost less, with provisional list prices from €290 to €690. Latest Gateway additions are CANopen Master/Slave and Modbus-TCP Client/Server. Latest Communicator additions are CAN and Ethernet TCP/IP protocols. Power consumption is only 150mA from a 24VDC source and operating conditions are from -25°C to +70°C. We are assured that they are all qualified by relevant communications standards organisation as well as having ATEX and Marine certifications. They do need to be housed in a cabinet though, since they are not sealed or otherwise environmentally protected.

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

## DESIGN POINTERS

Modular transparent interface devices use proprietary ASICs and software/hardware modules to suit almost all combination of industrial communication protocols

- 'X-gateways' connect any two industrial networks or PLC systems while 'Communicators' allow sensors and other devices to be connected to fieldbus and industrial Ethernet



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# CAD widens its offerings

**Tom Shelley reports on Autodesk's latest software offerings and user experiences.**

Autodesk has worked hard to integrate its acquired graphical and analytical capabilities with its mainstream products, as well as offering them together in 'suites' which Autodesk's senior vice president Buzz Kross insists are "really wrong to think of as bundles".

AutoCAD Mechanical and Electrical continue to be progressed, even if the company thinks users really should now migrate to their 3D products, and Inventor Fusion, which unites direct and parametric workflows within a single model, is being bundled in with most things, and is still available for free download from Autodesk Labs, at least until June 1st 2011.

Most remarkable, however, are some of the enhancements that the company is not trumpeting, such as the 'Advisers' in Moldflow 2012, which automatically update cost advice, manufacturability considerations and sustainability impact every time a change is

made to a design.

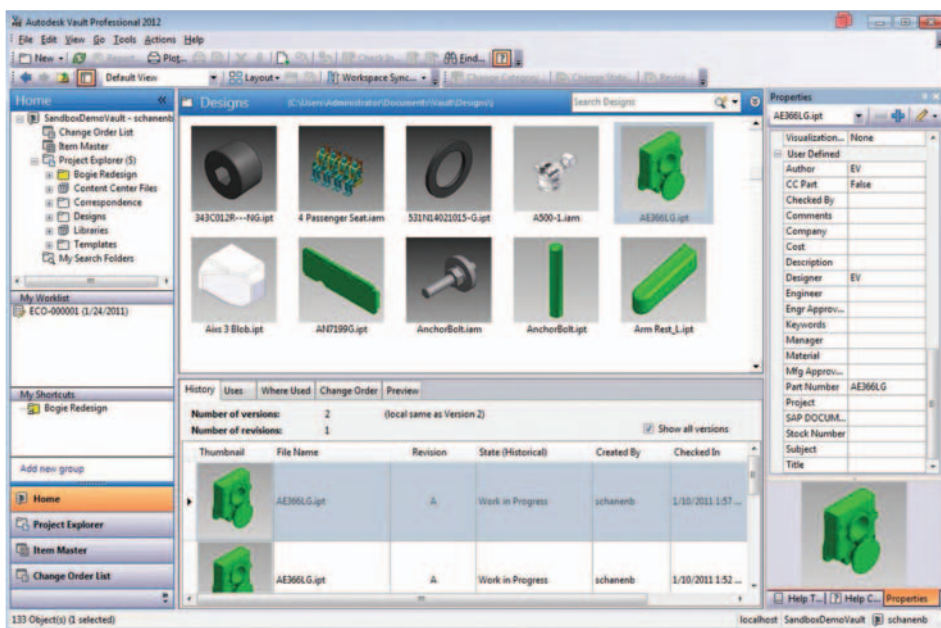
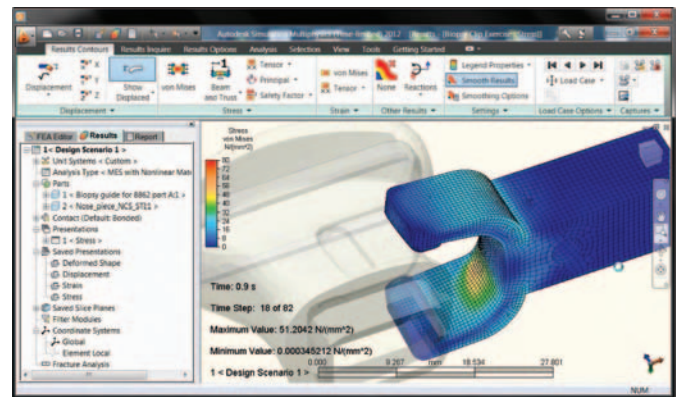
We had an opportunity to find out more about these at a Manufacturing Technology Day held at Lake Oswego in Oregon, which is the home of the company's Manufacturing Solutions Group. Clicking on one of the three Adviser icons on the bottom right of the Moldflow screen at once calls up latest updated information, including a quick simulation of the mould tool being filled, if that is what is wanted. In addition, the software can accurately calculate the orientation of short and long, chopped glass fibres, although continuous fibre reinforcement is not covered at the present time. And, it is possible to determine the temperature variation in an injection mould during an injection cycle, and furthermore, the number of cycles required from production to startup until the mould reaches a stable temperature.

The sustainability tool, called 'Eco Materials Adviser', also comes built into Inventor 2012. The

tool comes from Cambridge, England-based Granta Material Intelligence. Sustainability product manager Sarah Krasley told us that the data is constantly updated, offering figures on such matters as carbon footprint and water usage for different options. What it cannot address, of course, is the way that different companies and institutions have different definitions of what 'sustainability' really is. Nor can it address complexities such as the fact that high water usage to produce natural rubber, for example, may not have a very adverse impact on Malaysia, which has a very high rainfall, but is a serious issue in countries such as North West India and Pakistan, where there are shortages. However, high carbon footprint indicates high energy requirements, and with the rising cost of energy, can be taken as a likely indicator of increasing cost, so is something to pay attention to, if for future cost reasons alone.

Vault, has at the same time been quietly advanced into being a proper data management tool. Allen Gager, a mechanical engineer with KHS USA, which makes packaging machines, said, when we asked what difference using Vault had made, that, "I imagine it was a terribly painful process before". He estimated that because, "We now do a much better job of finding where our data is and re-using it" that it was likely that they had achieved an, "Estimated 60% improvement in efficiency."

The company is based in Sarasota, Florida, and makes machines with thousands of parts each, that Gager described as, "Real cool, complicated stuff." They have 15 seats of Inventor, 2 of Inventor Professional, and 20 seats of Vault. Previously, they had around 75,000 files, "Out in the network", which are now in Vault, plus another 75,000 files expected to be brought in from other sections of the business by Autumn 2011. The company expects to implement Autodesk Publisher by Summer 2011, and to make use of the fact that Vault Professional is to



*Vault has now been developed to become a fully valid data management tool*

be given an SAP interface, which will allow it to communicate with their corporate SAP system. Autodesk personnel added that Vault is to be extended to encompass Showcase data by Autumn 2011, and Sketchbook and 3ds Max data by Winter 2011. Vault already has a link to Microsoft Outlook, allowing mapping of components to specified suppliers.

One of the reasons that Autodesk continues with AutoCAD Mechanical is that many users employ it for intelligent model documentation and detailing. For this reason, it has been made able to import models from Pro/Engineer, Catia, SolidWorks, NX and Rhino. Users of plain AutoCAD cannot directly import Inventor files but they can do so via Fusion, or via specific interface modules that third parties have developed to do this.

Now that tablet computers have at last taken off, Autodesk staff say that the number one request is for Android operating system support, adding that they are working on it now. One of the strengths of AutoCAD has always been its comprehensive libraries of standards, and the software includes updates for ISO, DIN, and JIS (Japan).

What was Algor's FEA software has now been fully integrated and Autodesk badged but Blue Ridge Numerics' cfdesign fluid flow and heat transfer software, although acquired by Autodesk, remains separate.

Alias products, although well integrated into the Autodesk portfolio, and in the form of Alias design are offered alongside Inventor Professional in the Product Design Suite Premium, are also to continue to be offered with

their traditional interfaces, for fear of upsetting their traditional users, we were told. Autodesk SketchBook Designer 2012 is included with the purchase of Autodesk Alias Design 2012 and Autodesk Alias Automotive 2012. One of its particular features is its ability to interpret rough forms done by hand. For example, a roughly drawn loop can be interpreted as an ellipse or circle, if the designer chooses, or left as it is.

Ryan Savenkoff of Weatherhaven, which makes large portable shelters for the military and for use in Antarctica, on the other hand, revealed that it visualises its structures, originally designed using Inventor, in 3ds Max. The Product Design Suite Standard offers this combination. Prototypes often cost around \$100,000 and

## DESIGN POINTERS

- 'Advisers' in Moldflow 2012 automatically update cost advice, manufacturability considerations and sustainability impact every time a change is made to a design.
- Vault Professional is to be given an SAP interface and Vault is to encompass Showcase, Sketchbook and 3ds Max files
- SketchBook Designer 2012 can interpret rough forms done by hand. For example, a roughly drawn loop can be interpreted as an ellipse or circle, if the designer chooses, or left as it is.
- Cost in large-volume quantities is in terms of tens of pounds



Aluminum Curtainwall Systems is dependent on FEA

Savenkoff said that using Inventor ensured that the shelters, which have either steel or aluminium frames usually went together as intended. The products are often required on short notice, and using CAD helps keep lead times down to 8 to 12 weeks. Sevenkoff revealed that much of the company's present R&D is aimed at reducing energy consumption either for heating or cooling. Diesel fuel delivered to remote locations can cost as much as \$300 per litre. Finite element modelling of the fabric walling is not yet possible but Tim Bourdois of ACS – Aluminium Curtainwall Systems, said they depended on finite element analysis of structures and the aluminium and stainless steel components that go into them.

Mechanical tests of parts typically cost \$5000 to \$7000 he said, and take a week or two before results come back. Hence, they want to have to do as few of these as possible. Architects also constantly try to push the frontiers of what is possible and he told us about a building with a glass front, that had to lean out by 15°, and which started to sag. He said that Expensive modifications were quickly required."

Talking of modifications, by using AutoCAD Electrical, Frick Industrial Refrigeration, part of Johnson Controls, has reduced retrofit design times from three weeks to three days. AutoCAD Electrical 2012 now includes Web and mobile access to drawings and new sets of library symbols to comply with both IEEE 315/315A and IEC 60617.

<http://labs.autodesk.com/technologies/fusion>

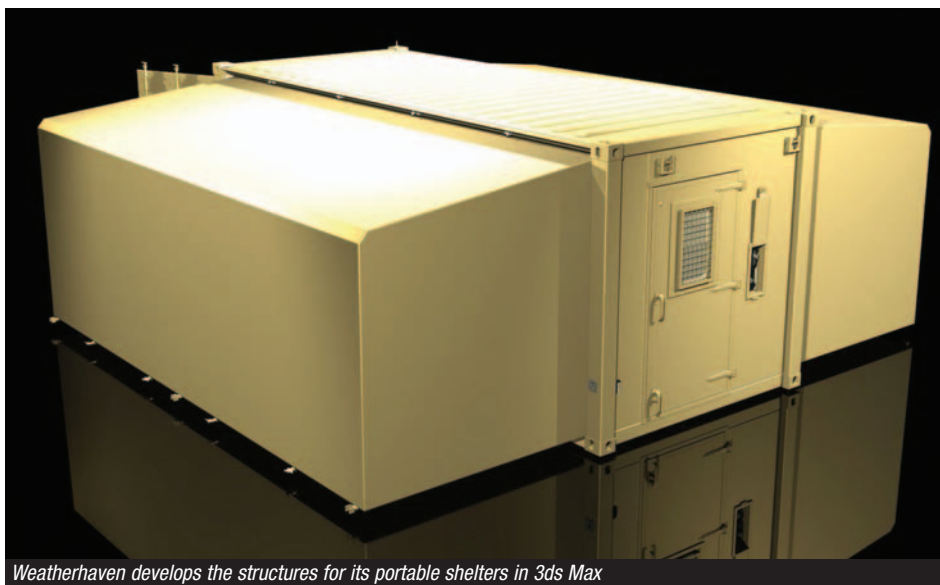
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Weatherhaven develops the structures for its portable shelters in 3ds Max



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# Metals work with composites for aerospace

**Tom Shelley reports on why both metals and composites are crucial in aerospace constructions.**

Carbon fibre composites save weight but they do not conduct electricity very well and damage assessment poses problems. This means that, while carbon fibre composite is forming a much higher proportion of aircraft and rotorcraft construction than hitherto, it appears to be levelling off now and metals continue to have their place.

Using the two types of material in combination means that constructions are more complicated than they have ever been before and the end results are far from cheap. But with energy costs on the rise, and airlines succeeding or failing according to whether their incomes exceed fuel and other operating costs, combined complexity has to be the way forward, and even more advanced materials, such as carbon nanotubes, are likely to be found in the fabric of future designs.

"Don't underestimate metals", suggests Michael Overd, head of structure design and development at Agusta Westland when speaking to a UK Composites Supply Chain Programme Workshop, he commented that while use of composites in aerospace construction had been increasing, "It is now levelling off slightly", with the trend being towards metallic frames with carbon skins, which he called, "Hybrid architecture."

A similar view is held by Airbus, which calls its version of the concept the "Intelligent Airframe". Examples include the metallic strip network within the carbon fibre composite fuselage of the A350 in order to ground electric circuits and electronics, dissipate lightning strikes and reduce EMC problems. Another solution commonly

applied to composites is to incorporate a layer of copper mesh. In addition, the A350 cross beams, which are purely structural, are also found to be best made of aluminium lithium alloy. Nonetheless, carbon fibre composites will account for more than 50% of the total weight of the aircraft, as compared with about a quarter of the total weight of the A380.

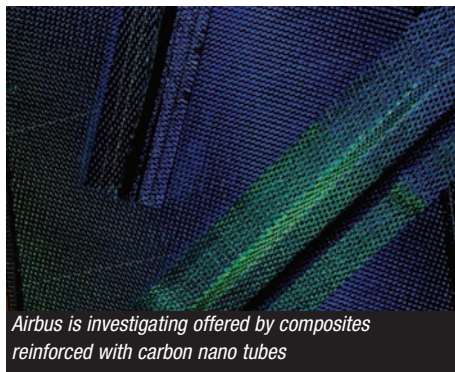
Panels in Agusta Westland's newer helicopters are generally sandwich constructions, according to Overd. He said that monolithic composite constructions are not widely used, citing problems with guaranteeing the quality of bonds, which often leads aviation authorities to demand use of mechanical fasteners.

Apart from improved strength per unit weight, composite constructions improve damping and their stiffnesses can be tailored to suit their applications, but, Overd says: "One has to allow for manufacturing variability." Furthermore, if suppliers make even small changes such as new resin development, the modified design has to be re-qualified.

In helicopters, Overd said that, "The number one technology challenge" is high frequency vibration, which is difficult to computer model, and when this is done, "You have probably got it wrong."

Another challenge is improving crashworthiness. Overd commented that air crashes usually result either from pilot error or maintenance problems. This means that no matter what the technology, there will always be occasional accidents. To accommodate this, helicopter and aircraft structures need to collapse progressively, as in cars, to absorb impact energy and give occupants an improved chance of survival. This, he said is "Difficult" to accomplish with carbon fibre composites alone, but is easier to achieve if composite skins are attached to metal frames. Composites offer clear advantages over metal construction as regards, corrosion, fretting and fatigue and research and development continues.

Overd mentioned research work in Italy on composite manufacture using RTM – Resin Transfer Moulding, and also the growing interest in thermoplastic as opposed to cured composites. Thermoplastic composites have high damage tolerance, because they are not made from bonded layers of pre-preg, and offer high fracture toughness and impact resistance, good fatigue resistance, low storage cost and infinite shelf life. They are hard to bond, but on the other hand, they can be fusion welded. One approach is to use resistance welding, which involves placing a layer of conductive material, such as a metal mesh or carbon strip between two surfaces and applying sufficient electric current to melt the



*Airbus is investigating offered by composites reinforced with carbon nano tubes*



thermoplastic polymer at the weld interface.

A major research project in Europe is TAPAS – the Thermoplastic Affordable Primary Aircraft Structure consortium, which consists of eight Dutch companies and research institutes and Airbus. Airbus already uses ultrasonically spot welded fixed wing leading edges made from Ten Cate's glass/PPS (Polyphenylene Sulphide) for the A380. The flight deck floor of the A400M is also made of thermoplastic composite as are the rudders and elevators of the Gulfstream 650.

TAPAS projects include the development by

Kok and Van Engelen of induction welding technology for components made of large double curved structures made from high performance, unidirectional tape. Another project involves fusing together multiple preforms in a single step to create integrated structures. A Fokker patent pending development improves stiffener to panel joints by incorporating radiused plastic fillets.

In order to be able to produce larger skin panels and achieve high build rates, it will be necessary to automate laying down of thermoplastic unidirectional composite. In a full scale demonstrator, automated layup of a skin panel and stiffener preforms is being developed by Fokker Aerostructures and Airborne

30%. In order to do so, it seeks, "New design principles, arrangement of stiffeners, geometric arrangement of assessment holes for maintenance and assembly methods." Both metallic and composite structural solutions are being explored, and the project is set to conclude at the end of March 2012. Participants are: Airbus Operations in the UK, Alenia Aeronautica, Delfoi in Finland, EADS, the Eidgenössische Technische Hochschule in Zurich, Fokker, Societe Nationale de Construction Aerospatiale Sonaca in Belgium and Stichting Nationaal Lucht – en Ruimtevaartlaboratorium in The Netherlands.

As well as improving the design of aircraft leading edges, Airbus is also very interested in possibilities offered by composites reinforced with carbon nano tubes, which are now becoming commercially available in quite large quantities. Apart from their immense strength, their electrical conductivity is a couple of orders of magnitude higher than that of carbon fibre. However, it is not just a matter of mixing them into resin. They either have to be spun into nanotube fibres, or processed in such a way that they are fully dispersed, oriented in the same direction and well bonded to the matrix. One idea is to use them to stitch conventional carbon fibre pre-preg layers together to reduce the risk of delamination. Other types of nano composites being studied include polymers reinforced with nano metre sized particulates. Nano particles can be silica, silicon carbide, silicon nitride, titanium oxide, zinc oxide, calcium carbonate, barium sulphate and nano clays. Metal matrix nanocomposites also show great promise, as we mentioned in our March 2011 edition.

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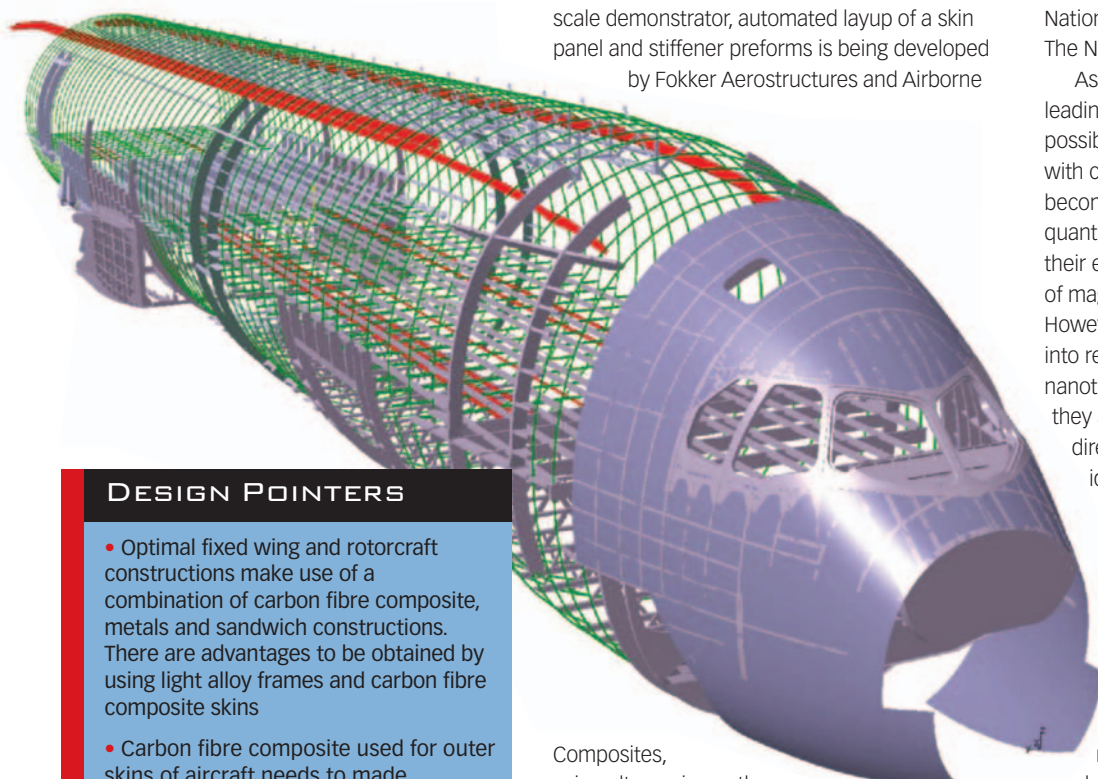
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## DESIGN POINTERS

- Optimal fixed wing and rotorcraft constructions make use of a combination of carbon fibre composite, metals and sandwich constructions. There are advantages to be obtained by using light alloy frames and carbon fibre composite skins
- Carbon fibre composite used for outer skins of aircraft needs to be made electrically conducting
- Thermoplastic composites are already in service in airframes and likely to be more widely used in future
- The next steps forward look likely to be the incorporation of carbon nanotubes in composites and the introduction of nano metal matrix composites.

Composites, using ultrasonics as the heat source. Press forming is being developed at Dutch Thermoplastic Components.

This has led onto a European Union FP7 project, COALESCE2, the letters standing for Cost Efficient Advanced Leading Edge Structure. The project description notes that, "Leading edges of modern commercial aircraft are found to create an overly large part of the total wing costs." The project aims to reduce these costs by more than





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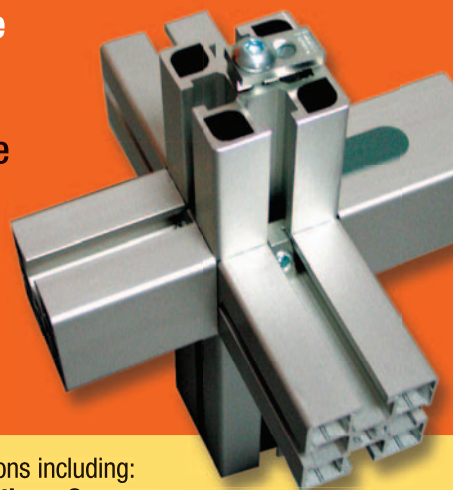
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# 'Mr Eureka' bows out

After 26 years with Eureka, Dr Tom Shelley, *Eureka's* Technical Editor, retired at the end of April. Before he left, he talked to editor Paul Fanning about a career in engineering and journalism that, it transpires, is far from over.

**PF: What first drew you to engineering?**

**TS:** My father would take me on a Saturday morning to Blaw-Knox, where he worked as chief draughtsman to meet all the other engineers and see the machines and go for a ride on the latest piece of construction equipment – something that came to a rather abrupt end when one of the hydraulic leads blew. After that, how can one fail to become an engineer?

I was about nine then, but it probably started even earlier than that with my first Meccano set. I was encouraged to make things from an early age.

I went on from there to Emmanuel College, Cambridge, where I studied Natural Sciences. I was interested in Physics, but I had a very bright supervision partner whose brilliance depressed me thoroughly and I thought I probably wouldn't make it as a physicist.

Having been brought up as an engineer, I found myself drawn to metallurgy, which is a strongly technical, hands-on subject. I specialised in metallurgy and ended up an engineer – to my father's inimitable relief. He didn't feel there was much of a future in physics! 'You need a real job,' he said.

**PF: What was your career path from there?**

**TS:** I invented something while I was doing my Doctorate and my supervisor and I started a company called Arc Electrolysis. It was a process for recovering tin from residues and low-grade ores. It used rather a lot of electricity, so although we took out a patent with the National Research Development Corporation, it never made anyone much money. It was used industrially, but they didn't pay a licence fee!

My attention was then drawn to a job being offered in Iran with what is now called Sharif University, so I went there for a couple of years. From there I was offered a job in the United States. I thought I was going to MIT, but it turned out to be MT – not the Massachusetts Institute of Technology, but Montana Tech! However, I stayed there three years and came up with a process for treating cathodes from aluminium smelters, which I was believed. I also did my first green energy project. Then, I was going to go back to Iran to be an advisor for the Iranian Copper Industries Company. However, they had this

revolution and, after the man I was to work with was shot, I decided I probably wouldn't be going after all. The upshot was that I ended up working for Blaw-Knox as Research Officer to try and bring some new technology into the company. I spent four and half years there fighting middle management, who were of the 'we've always done it this way' persuasion."

**PF: So how did you come to work for Eureka?**

**TS:** There was an advertisement in *The Daily Telegraph* that said: "This Ad Will Change Your Life". And it did. Within 10 days of reading it, I was working here. I was asked to write a trial article. I wrote it, phoned up the editor a few days later and asked if it was any good, to which he said: "I hope so. We're running it in the next issue, so I gathered I was hired!

**PF:** I've become aware just in the last 18 months that working on Eureka gives one a unique and privileged perspective on industry. Having been 'both sides of the fence', is that something you feel as well?

**TS:** Absolutely. It gives one a totally unique perspective.

When you work in a particular branch of industry, you only see your part of it. But when you get here, you get this total overview of the industry, which forces you

to learn new things. We're in a unique position and get a remarkable picture of the industry. And that overview is important. I see one of our main jobs as being to take an idea from one part of industry and introducing it to other parts of industry so other people can make use of it. The problem is that you're often taking ideas from one area where the person understands the technology very well to another where they will be less familiar. So we have to be able to act as translators to some extent.

It's such a fast-moving business. When people say to me 'How do you find enough stories', the only answer is that there is never any shortage of stories. It's always a question of 'What do we use? What do we ignore?' As you know, I've got thick files at home of stories we have never used, which I've always kept just in case

*"I specialised in metallurgy and ended up an engineer – to my father's inevitable relief. He didn't feel there was much of a future in physics! 'You need a real job,' he said."*







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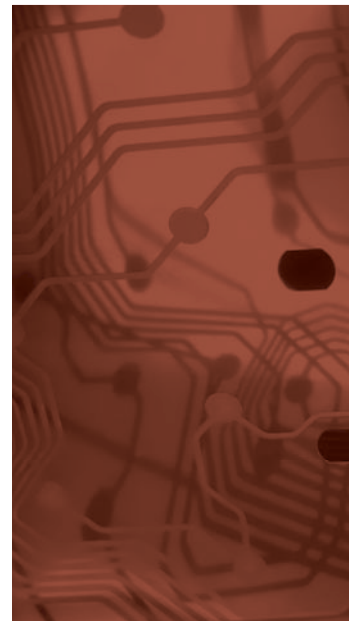
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gearstick image courtesy of eprn:technology



**Tom at the age of two years and today.**



one needs to revisit them. What's interesting is how many of those stories are still live in one form or another.

**PF:** Do you think most people understand how difficult and complex the process whereby something goes from being an idea to being a manufactured product can be – not to mention how long it can take?

**TS:** Probably not. A classic example is the cover story of our very first issue 30 years ago, which is still being developed! Three-Dimensional weaving – it's used to make plastic manhole covers for petrol forecourts, but its original application for aerospace is still at the R&D stage and is still being proven. And it will be some time yet before you see this process being widely used in aerospace – but you will.

Materials are the worst and always take the longest because the whole thing depends on them and, if they go wrong, the whole thing falls apart. Electronics is the quickest.

**PF:** Do the advances in computing represent the single biggest change in engineers' lives, do you think?

**TS:** I've seen CAD come from calculations on a Commodore PET to a highly sophisticated tool that every engineer has on their desktop. The change has been unimaginably fast.

There used to be those who modelled and those who did experiments. In those days, it was a great achievement when the model bore any relation to what was actually happening.

**PF:** Which areas of engineering do you find particularly exciting at the moment?

**TS:** We are at the most exciting period for an automotive designer there has ever been. Automotive design was fairly routine, but now nobody knows which way it's going to go next. You see all these concept cars with completely different transmission systems and gas-powered and petrol-powered and solar-powered and obviously all sorts of hybrid technology. So it's a wonderful time to be an engineer because it's a time of radical change – a time where you really can innovate and everything's up for grabs.

**PF:** So those are the upsides. But what do you see as the big problems facing the industry?

**TS:** The big problem is that the banks have gone from being over-generous to being incredibly difficult to deal with. Every entrepreneur you talk to at the moment says the same thing. They're only too happy to loan you money, but when it comes to financial support, they're incredibly difficult.

**PF:** If you were put in charge of industrial policy, what would you do?

**TS:** I would set up a national investment bank – not staffed by civil servants, preferably, but with people from industry to support those branches of industry that look most promising. It should have an expert staff. Owning Lloyd's TSB, the Government has that chance, but hasn't really taken it so far.

**PF:** Obviously, you'll be keeping your hand in to some extent with *Eureka* following your retirement, but what else are you planning to keep you busy?

**TS:** I have taken on a venture called Blast Absorption Systems Ltd, which is a new company with a start up technology that depends on pre-stress in composites. Pre-stress occurs in composites anyway even if you don't want it to. We put it there deliberately in quite a complex way. The idea is to take weight out of constructions. It was invented by an architect and I'm just there as a technical advisor and expeditor and hold 30% of the company.

**PF:** You talk a lot about the woodland that you own. Will that be playing a part in your retirement?

**TS:** Yes, certainly. It's all to do with green issues. I've always believed in putting my money where my mouth is and we bought this wood outright and put a lot of our own money into this. I don't expect to see much back from it, but that's because we believe in the environment. We've turned it into a very nice nature reserve and we're now going to try and put it into production and write a book encouraging others to do the same. I see wood as a great future resource not just as a source of heat, but as a source of materials, so that will be another thing that will keep me busy.

# Not getting stuck in the mud

This month's challenge is to devise a means whereby boats can be quickly and easily be got into and out of the water.



Boats can either be left moored in the water or hoisted out onto land. However, there are occasions when a boat needs to be swiftly launched into the water and then recovered again. If the need, whether civilian or military is urgent, it is to be expected that conditions are quite likely to be very unfavourable.

**The answer to last month's Coffee Time Challenge of how to protect feet in the workplace can be found in our Technology briefs section on page 9.**

Either the weather will be stormy and the water rough, or the tide will be out. This can be a major problem around parts of the United Kingdom where the sea may be a mile or more away from the land at low tide.

The traditional way of quickly getting a boat in or out of the water is to use a slipway, with a winch to pull the boat back up when it is recovered. These typically cost millions of pounds each, and do nothing to cope with a mile of mud banks.

Small yacht and motor boat owners launch from and recover using a trailer, pushed down a ramp while attached to a motor vehicle, usually a 4x4. Users can sooner or later expect to have problems when they get stuck in the

mud below the ramp doing a launch or recovery when the tide is out. They will then soon realise that the sea and motor vehicles are not at all compatible, and if they manage to recover the vehicle at all, will find that it has suffered much damage.

## The Challenge

The answer for those who really need to do this in difficult circumstances is to use not only a sea compatible trailer, but also a sea compatible tractor.

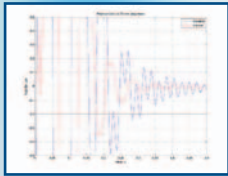
A conventional tractor for land use will not do. Water will get into the electrics or into the air intake and it will at once cease to function. There are many problems to overcome. How does one deal with air cooling of the radiator? Should the driver be in a cab, which may cause the tractor to float away in a rising tide until the cab fills, or should he be in the open and exposed to the elements? Should it have tracks or wheels? Tracks spread the load but it is hard to waterproof all the component parts. And what happens if it gets stuck in the mud with the tide coming in? Do you accept its loss, or do you make it amphibious? In that case, is it cost effective to make the boat amphibious instead? You could, but amphibious craft are not usually compatible with the worst kinds of weather.

There are no simple answers, but the design that we describe in our June edition fulfils all goals and meets all requirements without wasting money. It is the fruition of much experience and a long period of development. It is also, you will have to agree, quintessentially British in its design philosophy, as is its application.

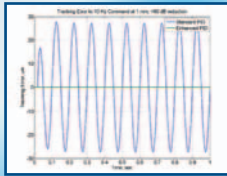
**See if you can come up with anything better.**



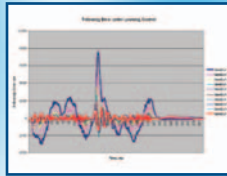
## Solutions for high precision positioning and machine control from Aerotech Increase Throughput with Advanced Controls



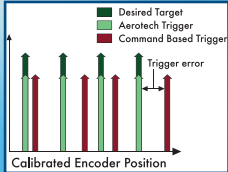
Command Shaping



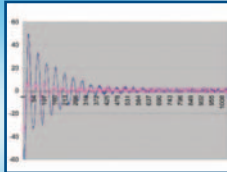
Harmonic Cancellation



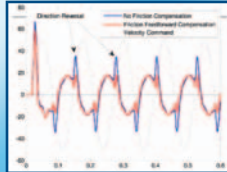
Interactive Learning Control



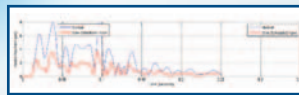
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## 3D Printers

### Aston Martin Racing develops race car in under six months using a 3D Printer

Without the 3D printer, we would not be testing the car today." George Howard-Chappell, Technical Director at Aston Martin Racing.

The Dimension® 3D Printer from Laser Lines Ltd was used to mock up the chassis, driver controls and engine of the race-car. The 3D printer produced prototypes for concept and testing of Aston Martin's new AMR-One, (LMP1 class), to be driven by the Aston Martin Racing works team drivers in the 2011 Intercontinental Le Mans Cup.

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## Cameras

### Stemmer Imaging to Distribute LMI Technologies' 3D Smart Camera in Europe

STEMMER IMAGING and LMI Technologies Inc have signed a distribution agreement that will make LMI's Gocator 2000 series of smart 3D sensors available in Germany, UK, Ireland, France, Austria and Switzerland. Gocator is a new, simple-to use, all-in-one solution that makes 3D measurement and control for factory automation accessible to all levels of users. Gocator 2000 series is an exciting new breed of pre-calibrated sensors that make industrial 3D measurements more affordable and available to a wider range of applications. Ease of use is leveraged by the built-in web server as an effective GUI for rapid setup and control. Users can connect, set up exposure and speeds, visualize profiles, measure dimensions, select communication outputs, and monitor results using Firefox, Internet Explorer, Chrome, or Safari web browsers.

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## Code Scanners

### SICK Reveals Lector®620 Compact Code Scanner Series

SICK (UK) has launched the LECTOR®620 code scanner range for reliable 1D, stacked and 2D code identification, traceability and anti-counterfeiting in a compact housing, two-thirds smaller than most 2D code readers.

Tim Stokes, barcode product manager, SICK (UK), said: "The LECTOR®620 sets a new standard in barcode and direct part marking (DPM) scanner design. The innovative solution, which has been developed in response to customer demand, combines industry-leading technology, into a compact, easy-to-use design."

SICK has developed four versions of the new scanner to meet all market demands. The 'Eco' is the foundation model, while the 'Standard' device is deployed for rapid implementation of universal applications. The 'High Speed' model was developed for activity such as packaging and document handling and the 'DPM' is used for directly applied markings.

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www.sick.co.uk

## Energy Recovery Systems

### Spirax Sarco helps Heinz save 473 tonnes of carbon a year

Heinz is saving 6% of its average steam load per year at its baked bean factory in Wigan by recovering energy from effluent using a system designed and built by Spirax Sarco. Cooking British family favourite Heinz Beanz begins by blanching the raw haricot beans in hot water. Starches and sugars leach from the beans into the water and agricultural residues are washed off. The blanching water must be purged regularly to maintain the necessary quality. Before the new system was installed, the purged hot water was disposed of to drain, but the Spirax Sarco system now intercepts it and uses it to help heat the blanching process. The system recovers around 1,500kW. "It's been in place for 18 months now and we are seeing excellent results from the heat recovery," says Barry Aspey, Environmental Compliance Manager for Heinz.

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## Gearboxes

Davall Stock Gears introduce two ranges of standard gearbox, specifically designed for harsh environments applications.

Constructed with a SMOOTH, FULL STAINLESS STEEL HOUSING (304), fully sealed, lubricated for life and pressure leak tested, and designed to be close coupled to a stainless steel AC motor.

The two styles of gearboxes have a large choice of reduction ratios available, worm series (right angle) from 7:1 up to a nominal 100:1, and helical series (co-axial) from 3:1 up to 60:1, with power ratings up to 4kW.

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## Multi-channel controllers

### Controller offers simultaneous measurement and control of multiple channels

A new compact, multi-channel controller with touch-screen display is now available, which is ideal for the simultaneous measurement and control of a wide variety of process manufacturing applications.

The CMC-99 controller from Impress Sensors & Systems Ltd provides an incredible variety of input and output combinations to suit individual customer requirements. The three card slots on the reverse of the controller each comprise 16 I/O pin options, which enable the user to choose any combination of inputs and outputs to suit the application. For example, up to 48 analogue current or voltage inputs could be used; up to 16 relay/SSR outputs; 24 thermocouple inputs; or 12 RTD inputs; or a combination of these. The unit also incorporates a 24V DC digital input, enabling relays and triggers to be set up.

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## Quick-Disconnects

### Harsh Environment Quick Disconnects speed Engine Test Hook-up

Chell's SQDC pneumatic quick disconnects, designed to speed up gas turbine data acquisition, are fully tested from -50 to 325 degC and for vibration to D0160F. Available in 16 and 19 way circular configurations for 1/16 inch diameter tubulation, SQDC's may be specified with Silicon or Perlast seals, pressure-tight blanks and pipework guides.

Chell also manufacture the Cablerange AS quick-disconnects for the Pressure Systems 9116 pressure scanner and Circlex quick disconnects for 1/16 and 1/8" diameter tubulations for multiple connections up to 30 ways.

Although designed for turbo-machinery testing, Chell quick-disconnects are equally ideal for any test stand application where multiple pressures are being measured.

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## Sensors

### Miniature RH Sensor from Michell provides reliable measurements in high humidities

Many RH instruments installed in high-humidity applications suffer from poor reliability because the electronics are exposed to the harsh, damp environment. The miniature PCmini52 probe from Michell Instruments overcomes this problem with electronics that are encapsulated in a protective resin and so are completely protected from the atmosphere. This gives the instrument an IP65 rating and enables the probe to provide reliable measurements no matter how high the surrounding humidity. The PCmini52 humidity transmitter uses a capacitive thin-film polymer sensor which either absorbs or releases water vapor as the relative humidity of the ambient air rises or drops. These sensors, developed by Michell's Coreci division, offer both a fast response and excellent sensitivity to fluctuations in humidity.

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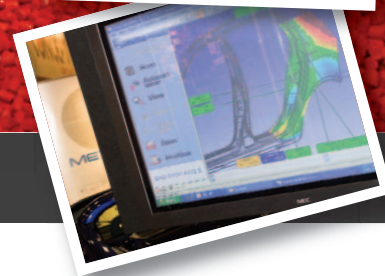


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