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EUREKA

THE MAGAZINE FOR ENGINEERING DESIGN

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So far, so good... but keep going

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

This issue features an interview with John Hayes MP, Minister of State for Further Education, Skills and Lifelong Learning in the Department for Business, Innovation and Skills *(see page 16)*. During the interview, the Minister was forthright in stressing the determination of the Government to restore manufacturing to its proper place in our society.

Mr Hayes was also realistic in his assessment that the country had a long way still to go before it was able to compete equally as a high-tech, high-skills economy with some of its major competitors. This, he believes, will require a complete reassessment not just of industry itself, but also of the educational system that underpins it. "There is something about the aesthetic of practical learning that has to be recalibrated," he said – a sentiment with which anyone who has examined the root causes of the engineering skills shortage would have to agree.

And there are demonstrable actions to back these words. It is hard to argue with funding for 50,000 new apprenticeships, or with the desire to have more apprenticeships than we've ever had before in Britain, which Mr Hayes also expresses.

These are words industry has wanted to hear for years. And yet we know the realities. The public purse strings are tighter than they have been in a generation or more. Indeed, Mr Hayes' own department is subject to as yet unspecified levels of cuts, which begs the question where is the money going to come from to fulfil these laudable ambitions?

Needless to say, *Eureka* wholeheartedly supports the intentions outlined by Mr Hayes. However, we must fervently hope that these good intentions are not compromised by the need to cut costs. We simply cannot afford to cut investment in our future.

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Stick-on cooking power wins design prize

An idea to make power sources that stick onto the sides of saucepans and heat them by induction has just won its inventor €5000 and a six month paid internship with one of the world's leading makers of domestic appliances.

The 'Snail', conceived by Peter Alwin from the Ahmedabad National Institute of Design in India received first prize in this year's Electrolux Design Lab competition, whose finals and award judging took place at the 100% Design Exhibition at London's Earls Court. The theme of this year's competition was to think of ways of in which 74% of the world's population could live comfortably in cities in 2050, despite limitations on living space and the availability of energy and water. Alwin envisages his concept additionally being powered by biochemical batteries, which would address the problem of power cuts.

The runner up, who received €3,000, was Yuriy Dmitriev from the Chuvash State University in Russia with a 'Bio Robot Refrigerator', which would use heat absorbing microorganisms. Third prize and €2000 went to Matthew Gillbride from the USA for a

concept involving kitchen shelving that would include heated and cooled sections for cooking and refrigeration, as well as providing lighting, thus doing away with the need for conventional appliances. There were 1300 entrants for the competition. The Wall mounted 'Shine' washing machine, designed by Levente Szabo, winner of the 2007 competition, is now a launched product and is on large scale trial in Italy prior to going into full volume production.

400mph motorcycle begins construction

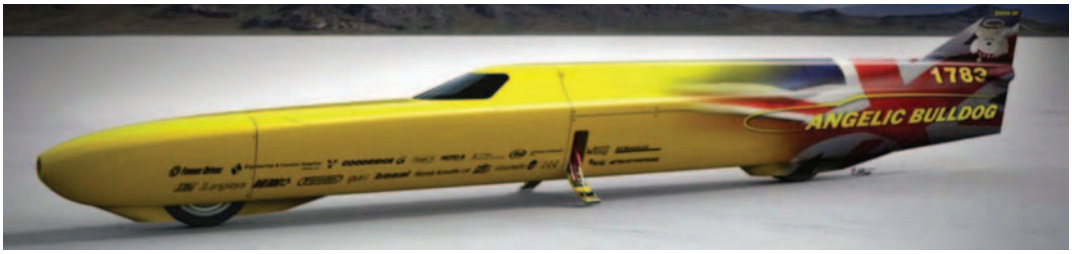
The 400 mph Angelic Bulldog motorcycle, which project leader Gabriel Uttley intends to ride into the record books, has now completed its major design phase and is under construction.

The record, currently held by Dennis Manning's BUB7 at 367.382mph, has not been in British hands since 1937. According to Angelic Bulldog engine designer Dan Dole, the new bike will be powered by two Honda Blackbird engines, placed in a staggered side-by-side arrangement and boosted by superchargers and various other enhancements to produce a net 700 HP.

The two crankshafts from the four cylinder engines are linked by gears from the original gearboxes to produce what Dole describes as a "Dan-Tec 8-23 2.3 litre, square, eight cylinder engine". Power will be delivered through a transaxle gearbox, which is to be made by Elite Racing Transmissions and delivered to the rear wheel through two, water-cooled chain drives running in neoprene tubes.

Uttley said that 50 people are involved in the construction and various sections of the car have now been completed, although the team is looking for an additional £100,000 to complete the project.

Software design is with the aid of SolidWorks, which is one of the sponsors, as it was for the BUB7.



Briefs

BLOODHOUND IS TECHNOLOGY CHAMPION

The Bloodhound supersonic car project has won the British Institute of Technology & E-commerce (BITE)/Rolls Royce 'Championing of Technology' Award.

The award was presented to project director, Richard Noble at the World Hi-Tech Forum Gala dinner at the Science Museum. BITE director, Dr Muhammad Farmer said: "The development of the Bloodhound supersonic car, capable of reaching 1000mph, is a world class project which will inspire a new generation to tackle technologically advanced projects and set new records."

www.bite.ac.uk

METALS CENTRE LAUNCHED

Brunel University has launched a £9million metals engineering centre in a bid to rejuvenate the UK's manufacturing sector. The Manufacturing Research Centre aims to make a significant contribution to the £17billion a year metals industry through the development of advanced technologies for reuse, remanufacture and recycling of secondary metals. The centre is funded by the Engineering and Physical Sciences Research Council (EPSRC).

www.brunel.ac.uk

£10MILLION INVESTED IN SATELLITE FACILITY

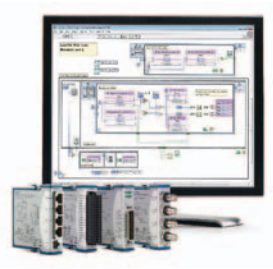
Surrey Satellite Technology (SSTL) is investing £10million in a 3700m^2 technical facility which it says will play a 'crucial role' in its development.

The facility is opposite its headquarters building in Guildford and will enable SSTL to work on a broader range of satellites and provide the capacity to integrate and test more satellites in parallel.

www.sstl.co.uk

Performance Measurements Are Within Your Control

As industrial systems increase in complexity, optimising your system with advanced measurements and control is critical. The open NI LabVIEW graphical development environment and NI CompactRIO hardware can help reduce costs with precision measurements, machine vision, motion control and the ability to connect to existing automation equipment through industrial communication.



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Automation assists switch-offs

Profienergy is an energy management system based on Profinet that automates shutting down and starting up operations to save energy, without risking malfunctions that might arise from incorrect shutdown and startup procedures.

It came out of a request by AIDA, the Association of German Automotive Manufacturers, which asked Profinet International to develop a way of intelligently managing the power usage of robot cells, especially when they are not being used. In some cases, these were known to be drawing up to 60% of their normal power consumption.

System shut downs that need to be accommodated can be summarised as: brief pauses, typically up to one hour; longer pauses from hours to days and unscheduled pauses caused by equipment failures. The first version of the Profienergy profile focuses on electrical energy, but other energy-consuming factors such as gas, steam, water and compressed air may be added.

www.profibus.com

ifm plugs a gap

The TP temperature plug from ifm replaces cumbersome, leaky outmoded boxes with the latest in electronics and connector technology, requiring a lot less space, performing better and costing less into the bargain.

ifm electronic already supplies type TT or TS Pt 100 and Pt1000 temperature pickups with an integral M12 connector not only for ease of connection, but also a seal of at least IP67 and a robust mechanical link. That probe can now be plugged directly into the TP, which will send the resulting measurement as a 4-20mA signal back to the panel, via another M12 sealed connector. Further, using M12 connectors all round means that the transmitter can actually be mounted anywhere between the probe and the panel.

The TP is a fraction of the size of a head transmitter, more robust, and itself sealed to IP67. It can be scaled from a PC using a USB interface, as the in-built communication protocol is the latest IO-Link; this is also means in future scaling instructions can be sent via other non-proprietary systems.

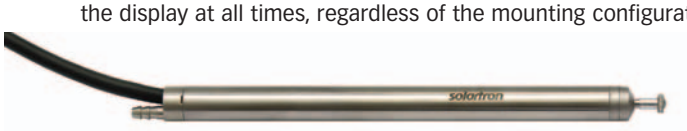
www.ifm.com/uk

Compact digital pressure gauges launch

A range of low cost, battery-powered digital pressure gauges has been launched, which offers customers a direct, cost effective replacement for their existing mechanical gauges.

The DM 10 range of battery-powered digital pressure gauges is available through Impress Sensors & Systems Ltd, a sensor and instrumentation specialist. The gauges are targeted at a wide range of applications, including hydraulics & pneumatics, process engineering, R&D/laboratory work, and mobile pressure monitoring, including mobile construction vehicles, tractors, pumps, compressors and filters. The gauges have a ceramic diaphragm and so are also suitable for environments in which aggressive chemicals are present.

The DM 10 is designed to be mounted easily and quickly in-situ. The 4.5 digit, 7-segment LC display can be rotated independently of the housing, providing the engineer with clear sight of the display at all times, regardless of the mounting configuration. The housing itself rotates 270 degrees about the horizontal axis.



www.impress-sensors.co.uk

DC MOTORS EXPAND MINIATURE RANGE

Rotalink has launched a new line of miniature brushless motors for nominal output torques to over 250 mNm at maximum efficiency and maximum power ratings to 270 W.

The BL motor range is available in both 12 and 24 VDC versions, complete with three phase hall effect commutation for smooth and precise speed and/or position control. The highly efficient brushless design has an inherently low electrical noise factor and unlike brushed DC motors is not prone to commutation sparking; so the motor is ideally suited to EMC sensitive and safe environment use. In addition, the non contacting characteristics will suit applications where long life and high reliability are of prime concern. The BL range includes five frame sizes with nominal diameters of 29 mm, 32 mm, 45 mm, 57mm and 65 mm.

www.rotalink.co.uk

ULTRA-LOW CONTACT FORCE TOUCH PROBES

Solartron Metrology has introduced a new range of ultra-low contact force touch probes. Based on the company's existing Feather Touch probes, which already have a low tip force of 0.18N, the new Ultra Feather Touch models exert a probing force as low as 0.03N.

With their innovative spring balance design and lower moving mass, the high performance pneumatic probes have been developed for gauging delicate materials such as glass or plastic, which require very low tip forces to avoid deforming the component and contact tip materials that do not leave a mark.

Air vented through the shroud at the front of the probe continuously cleans the bearings. This ensures long probe life in automated systems where dust contamination may be present.

www.solartron.com

Control standard finds new applications and certifications

The open automation control standard Open Safety has now been implemented for systems based on EtherNet/IP, Modbus TCP/IP, Powerlink and Sercos III, and was demonstrated running on the first three at this year's Hannover Fair.

Originally invented by B&R Automation and a consortium of other companies, it consists of a safety stack of software applications and standards on hardware design and is certified by TÜV to SIL3 IEC 61508. has been available since 2008 and is managed by EPSG - the Ethernet Powerlink Standardisation Group in Berlin and is maintained and improved by the community of its users. It is now additionally approved by the IEC as standard IEC 61784-3.

An OpenSafety network may contain up to 1023 safety domains, with 1023 nodes or devices permitted within each of these. Safety domains can extend over different and inhomogeneous networks, and can integrate safety nodes that are scattered throughout these into one domain. Safe and unsafe devices can be operated within one domain. Gateways allow for intercommunication between different safety domains.

www.br-automation.com

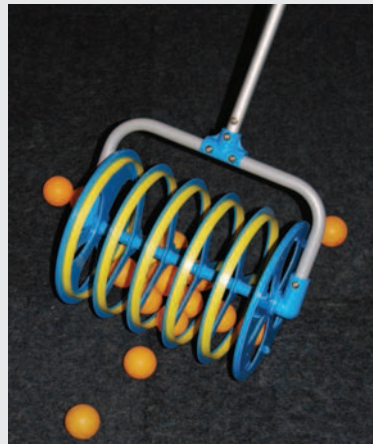
Solution to last month's Coffee Time Challenge

The solution to last month's challenge is a 'Ball collecting device' that is the brainchild of a team led by Dr. Chen, Yu-Gang at Far East University in Taiwan. This institution specialises in creativity and innovation and has its own Innovation and Creativity Centre, which boasts that, between 2001 and 2007, it filed 632 patents and sold 56 of them.

The ball collecting device consists of an assemblage of plastic rings, each of which is equipped with a rubber rim on one side, extending perpendicular to the ring. Rolling the device through the balls causes them to push past the rubber ring, which then springs back afterwards to trap them inside. The device can be rolled using a handle without having to bend down. When it is full of balls, it may be tipped on when end, whereupon the gathered balls fall into a receptacle. Gathering up balls takes only seconds and absolutely no skill is required to operate the device. It has won medals at two international invention fairs.

Enquiries about licensing the idea should be directed to the Taiwan Invention Association or Dr Chen, Yu Gang directly.

http://en.tia-tw.org
ychen@cc.feu.edu.tw



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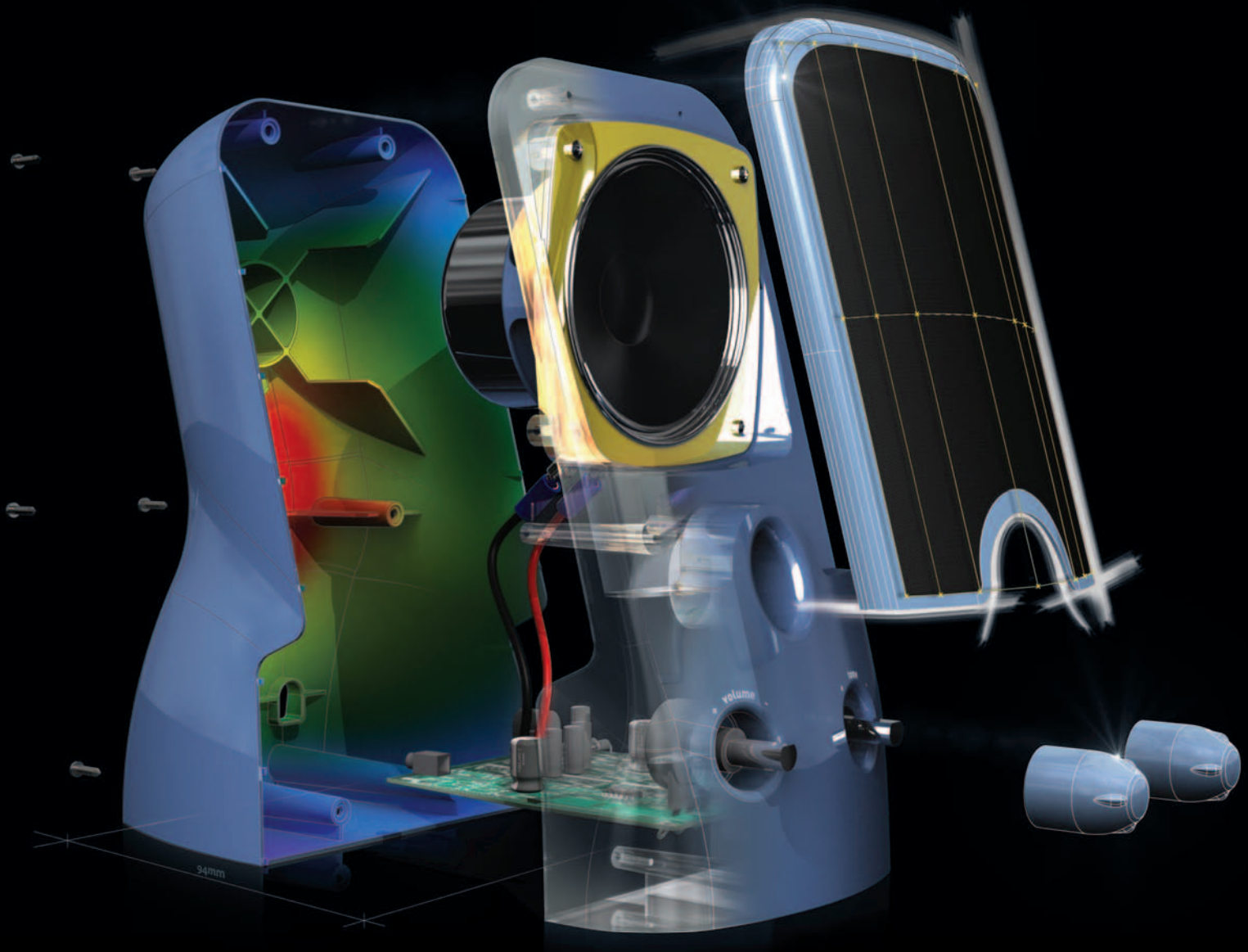

Taking the steps to

Renowned product designer Geoff Hollington recently said: "The killer product is something that nobody knows they want, but cannot do without once they have got it." A company or an individual that aspires to manufacture such a product, can have the best technology in the world, but will not succeed unless they clearly identify the market need or opportunity it is going to meet, address the human factors and psychology of the users, and work out how all the people in the supply chain are going to make money so they are prepared to become advocates.

Stephen Knowles, managing director of Industrial Design Consultancy (IDC) asserts that a really successful product is one "that fulfils an unmet market need and executes that need in a very well resolved way", but adds: "Even this does not mean an instant route to riches." Dr Ken Phillips's motorcycle helmet, the subject of Eureka's April 2010 cover story, but originally featured in January 1999 is a case in point. It certainly met a need in that it reduces motorcyclist head injuries, but it has taken much time and effort to get it to market.

Apart from saving lives and reducing injuries, Knowles said that unmet needs could include a need to reduce price, or improving the ease of use of an existing product, and whatever the product, he advised, "It must be satisfying to use, it must be intuitive and it must fit in with existing lifestyles". He then adds: "The best inventions come from people who experience a problem first hand or work in a relevant industry, because they have a good understanding of their market and can see how to address the shortfalls." This certainly applied to Dr. Phillips, who is a doctor, specialising in psychotherapy, so well aware of the effect of brain injuries, who came up with the idea after a discussion with his son, a journalist writing for the motorcycle press.

"A really successful product is one that fulfils an unmet market need and executes that need in a very well resolved way, but even this does not mean an instant route to riches".
Stephen Knowles

The other aspect that inventors and designers need to consider, according to Knowles is, "pricing and the profit everyone in the design chain needs to make. The end retailers, particularly, need to make a good margin, and if they do, they will push the product and make it go."

To assist this process, IDC has just produced an "Inventors Guide", available as a free download from the IDC website, which starts by encouraging inventors to address such questions as: "Has your invention already been thought of? Who would use your product? What are the reasons people will buy your product? What is the potential size of the market? Can you protect your idea? And "What are the risks and difficulties you will face?"

"For future products 'green' has to be the default mode"
Adam Szepanowski

Naturally, external factors such as the economy, the environment and society at large also play a major role in the success or failure of any design. Speaking at the 100% Design event, Electrolux designer Adam Szepanowski explained the importance of assessing and anticipating such factors, saying: "Most designers think design is about aesthetics, but it's really about making products that fit into a user's life."

Szepanowski went on to explain that Electrolux is convinced that by 2050, 74% of the world's population will live in cities and average living space will be only 35.m^2. Furthermore, he believed that almost all plastic then available will be recycled, and that consumers will expect products to be much 'smarter' taking decisions that will result in not only optimum performance but also minimising energy consumption and costs. The consequence for design was, he claimed, that: "Green has to be the default mode."

Examples of this approach could be seen from the entries to Electrolux's annual competition for young designers called DesignLab. This year's winner was the 'Snail', a device that could be fastened on the side of a metal cooking vessel and heat it up by induction, thus doing away with the need for a cooker. Conceived by Peter Alwin from the Ahmedabad National Institute of Design, the design was seen to meet all such goals, in addition to minimising space, cost and energy consumption. Runners up included a 'Bio Robot Refrigerator' which would use genetically engineered, heat absorbing micro-organisms in a gel matrix – with food to be kept cool in containers within the gel and a concept involving kitchen shelving that would include heated and cooled sections for cooking and refrigeration. Although such ideas may seem far-fetched, it is worth noting that the 'Shine' wall-mounted, illuminated washing machine designed by Levente Szabo, winner of the 2007 competition, is now on large-scale trial in Italy prior to going into volume production.

David Kester, chief executive of the Design Council, speaking at Venturefest in Oxford, asked the audience which of them used design as a strategic tool in their business and found (as he said he expected) that it was only about 20%. He argued that we as a country have to look to our strengths. He said that since the UK was

success

Tom Shelley reports on the challenges facing anyone seeking to produce innovative and successful products.

Illustration: Oliver Burston, Debutart

"As a country, we have to look to our strengths. The UK is second in the world in terms of scientific and technical papers published and cited and has the largest design sector."
David Kester

"second in the world" in terms of scientific and technical papers published and cited and had the largest design sector in Europe, employing 230,000 people. It therefore follows, he claimed, that these strengths were science and design", and that it was their combination that represented successful innovation.

As a company that had science and technology in spades, but had lacked design, he cited Navetas Energy Mangement, a Suffolk-based company with a technology that allows electricity users to see the energy consumption of individual appliances at a single point. Kester then said, against a slide showing an image of a printed circuit board full of electronics, that, "the cleverness of the project was not coming across". The solution was to produce a visualisation of what the product might look like, which resulted in obtaining venture capital support to fund the development of real products, which are now being field trialled. Kester is also of the opinion that visualisation of product and development strategy is an essential part of internal development processes. "Visualisation is so cost-effective," he declared.

Human psychological factors naturally play a key role in the success or failure of any product. People can be greatly influenced by how something looks or feels. In particular, when products interact with users through electronics, there are a host of additional human psychological factors to interact with that can either make the killer product or totally foul things up. Naturally, such factors will change according to the target market.

Some factors are generational. Different generations look for different things in a product and, equally, one generation may be turned off a product by precisely the same factors that attract another. Pera, for example, has undertaken a lot of development work on intelligent pill boxes that can tell users when they need to take medication. (*Eureka* November 2007 and September 2008). These have yet to take off, however and it is easy to imagine that this might well be because many elderly people who would surely be the key audience for such a product may also have an aversion to high technology, especially technology that produces verbal reminders.

Clearly, this is only one example of the way in which the human factors surrounding a product might adversely affect the success of an invention with numerous practical benefits. Nonetheless, it serves to illustrate the critical importance of understanding the market for any product in terms of the individuals who may (or may not) buy it. As IDC's 'Inventors Guide' puts it: "Researching and understanding the needs and behaviour of the potential users ensures that people will connect with the product – a key requirement for success in the market. Insights gained in the research stage often lead to new product innovations."

"THE KILLER PRODUCT IS SOMETHING THAT NOBODY KNOWS THEY WANT, BUT CANNOT DO WITHOUT ONCE THEY HAVE GOT IT."

Ultimately, of course, cost is probably the single most important factor in any development process. A proper understanding of the value likely to be attributed to any benefits or innovations inherent to the product is crucial if it is not to fall at the first hurdle. A product may be innovative and have practical benefits, but if achieving those benefits costs more than an end user is likely to pay for them, it is doomed to failure. Realism in any such assessment of the market potential for a product is absolutely essential, while a readiness to halt a project that is unlikely to achieve profitablility should be seen as a positive.

Clearly there is no single, guaranteed formula for successful design. The sheer range and complexity of factors requiring consideration is daunting and, as some of the examples quoted here make clear, the process that from design to production can be extremely lengthy. The sad reality is that most ideas don't make it to become successful products, but what is equally certain is that time spent conducting a thorough assessment of the realities outlined here is the only realistic way of ensuring your idea has the best possible chance.

www.hollington.co.uk
www.idc.uk.com
www.designcouncil.org.uk
www.navetas.com
www.frazerdesigners.com
www.faradayknowledge.com

Recipe for a killer product

- Is there a need in any of the markets that you have personal knowledge of that is not being fulfilled? Can you meet it at an attractive price and make it in a way that people would like to use it?
- Look as your skills and manufacturing expertise and to see if they could be used to make something that people really want. If you are already in manufacturing, go to the Design Council if you cannot think of anything yourself.
- Look at the latest ways in which consumers and customers might interact with it. Look at mobile phones and the latest generation of new interfaces and apps.
- Produce mockups and computer visualisations so that potential customers and/or development partners can quickly grasp what it is going to do and how it is going to look.
- If it is intended to be a branded product, show how it will look with the customer's own branding on it.

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Lower today's emissions with tomorrow's seals

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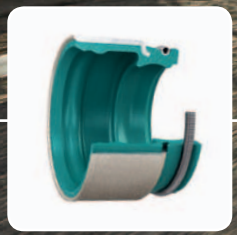
The Power of Knowledge Engineering

New emission standards



High pressure valve stem seal

Lisa Karlsson, SKF

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Government's role in addressing the skills crisis is vital and, according to John Hayes MP, Minister of State for Further Education, Skills and Lifelong Learning in the Department for Business, Innovation and Skills, is one it will not shirk. Paul Fanning reports.

Skilled operator

First elected to Parliament as the Member for South Holland and The Deepings in 1997, John Hayes served as a member of both the Agriculture and Education Select Committees before joining the Conservative front bench.

He was made Vice Chairman of the Conservative Party in 1999; became Shadow Schools Minister in 2000; and following the 2001 Election, Assistant Opposition Chief Whip. From 2002 to 2003 he was Shadow Minister for Agriculture, Fisheries and Food. From 2003 to 2005 he was Shadow Minister for Housing and Planning, and then Shadow Minister for Transport in 2005.

Hayes was made Shadow Minister for Vocational Education in 2005, and from 2007 to 2010 added higher education to his portfolio.

Joining the new Government in May 2010, he was appointed Minister of State for Further Education, Skills and Lifelong Learning in the Department for Business, Innovation and Skills. In addition, in July 2010 he became a Minister of State in the Department for Education with particular responsibility for apprenticeships, careers guidance and vocational education.

A minister for change?

When John Hayes MP, Minister of State for Further Education, Skills and Lifelong Learning in the Department for Business, Innovation and Skills says: "We need a step change in terms of skills," they are surely words with which many in the manufacturing sector would certainly agree.

However, they could at the same time be forgiven for a certain weary scepticism, given that the manufacturing sector has been warning of a looming skills shortage for two decades, only to see Governments fail to address the issue.

This is a perception that Hayes is seeking to change, starting with a fundamental shift of perceptions about practical skills. "The new government represents a departure in that respect from previous assumptions," he says. "For too long we've assumed that book learning is more important than the work of people's hands."

The economic crisis and the consequent need to support manufacturing has served to crystallise these issues in the mind of Government, something Hayes is quick to acknowledge. "There's a recognition that, coming out of an economic crisis, the only way that Britain can only succeed is as a high-tech, high-skill economy," he says. " So in a sense, what the challenges of the new economy have done is catalysed a new imperative; a new understanding that, unless we improve productivity and competitiveness through building a high-skill, high-tech economy, we won't succeed as a nation."

As a host of engineering organisations and manufacturing companies have made clear of late, the skills shortage in manufacturing is now critical. On this point, Hayes is under no illusions about the scale of the problem. In addition, to his role overseeing Further Education, Skills and Lifelong Learning, in July 2010 he became a Minister of State in the Department for Education with particular responsibility for apprenticeships, careers guidance and vocational education. Accordingly, he claims that the urgency of the situation is not lost on the new Government. He points to the recent redeployment of £150 million of 'Train to Gain' funding into adult apprenticeships to create 50,000, but emphasises that this is only the beginning of the Government's plans.

"Our aim is to create 50,000 more apprenticeships and it's not unreasonable to assume that a very large proportion of those will be in manufacturing and engineering. And that's just the beginning. My ambition is to have more apprenticeships than we've ever had before in Britain... I don't want to anticipate the strategy, but I think I can be fairly certain given the strong priority I put on apprenticeships (and I know the Chancellor and the Prime Minister do, too) that apprenticeships are going to be at the heart of what we do."

Of course, apprenticeships are only of value if there are enough people available to fill them, something that can only be addressed, according to Hayes, by a fundamental re-thinking of the education system. "The challenge begins at school," he says. "Today, [Education Secretary] Michael Gove will be setting out why he thinks we have to entirely rethink our approach to practical learning in schools… looking at how we can in the modern school environment ensure that those with a taste and an aptitude for practical learning, have a route which is as clear, a pathway which is as navigable as those for academic learning."

In his speech to the Edge Foundation, Gove outlined the Government's plans for encouraging vocational education, which included the intention to open at least twelve University Technical Colleges with a minimum of one in each major city.

Creating such 'pathways' is one thing, of course. Getting people to follow them is another. The fact remains that manufacturing and engineering are still not seen by many children as attractive career choices. Hayes believes there is a job to be done in challenging preconceptions in the UK aboutmanufacturing and engineering. He says: "We have to challenge some of the assumptions about practical competence. Other countries have historically done this rather better than us, so we have to detach ourselves from previous bourgeois assumptions about the character of learning... So there is something about the aesthetic of practical learning that has to be recalibrated to make that pathway seductive as well as navigable."

Another factor Hayes believes to be critical in persuading people to follow a vocational route is the quality of guidance available. Here, he believes that industry itself has a crucial role to play, saying: "I think it's about the interface between industry and education. Making sure that what we teach or test is shaped by those in commerce and industry. It's about that interface between the world of work and the world of learning."

"My ambition is to have more apprenticeships than we've ever had before in Britain"

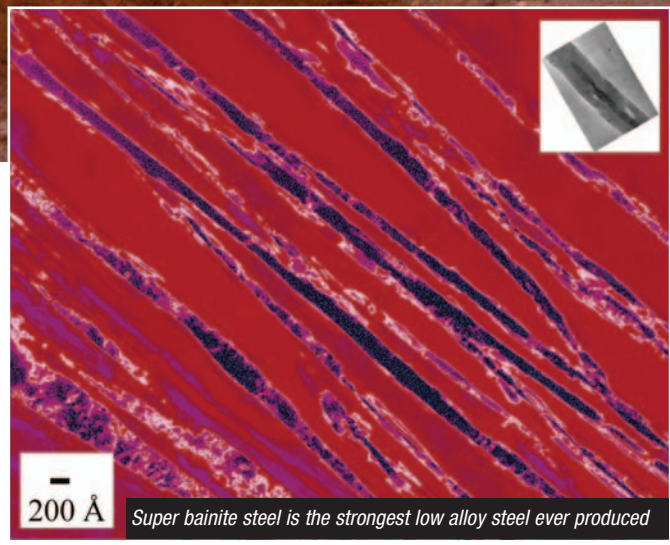
This disparity between the education system and the needs of business is an area where the Minister believes there has been a long-term failure by previous Governments and educational authorities. "As the system became increasingly driven by the preoccupations of public policy makers, it became detached from the real needs of businesses," he says.

"We're looking at how we route the funding for apprenticeships as part of the consultation I'm involved in and are looking at whether we need to route more of the money directly to employers. I'm also looking at how we can make supply side reforms to training to remove some of the cost barriers for employers. I'm also very keen to promote the idea of Group Training Associations so that smaller employers are not faced with impediments in terms of costs."

Hayes is under no illusions as to the scale of the task that still confronts this Government. He says: "We need to move rapidly and a long way to catch up with our competitors. The international data from OECD and others that compares us with France, Germany, the United States at both international and higher level skills shows us that we've got a big hole to plug. But we've made a good and early start."

Steel advances

Tom Shelley reports on some of the dramatic advances now being made in very high strength steels that are low enough in cost to be used in mass market products.



Super bainite steel is the strongest low alloy steel ever produced

Some of the biggest advances being made in metallurgy at the moment are in steels, with TWIP steels and super bainite steels poised to go commercial for automotive applications and armour plate, and many advances being made in stainless steels.

Novel diamond hard coatings on steels have been shown to give a new dimension to stainless steel and have potential applications in putting hard surfaces on other steels and most other kinds of materials, but some of the most striking advances are now being made in China, which currently produces nearly half the world's total output of steel and is putting a major effort into research and development aimed at producing new and improved products.

Corus is heavily involved in developing both TWIP and super bainite steels, which are a British invention, arising from work by Corus and a team led by Professor Harry Bhadeshia at the University of Cambridge Department of Materials Science and Metallurgy. Super bainite steels have an ultimate tensile strength of 2500 MPa, whereas ordinary 'mild' steel comes out around 400 MPa and carbon fibre offers 5650 MPa. They have hardnesses of 600 to 670 HV and a toughness of 30 to 40 MPa m1/2. A typical composition is around 0.8% carbon, 1½% silicon, 2% manganese, 0.25% molybdenum with small amounts of other metals. The steel is solution treated at 920°C for 30 minutes, plunged into a molten salt bath to cool it to a temperature below that at which the iron carbide will separate, but not so cold that the material will form the brittle martensite phase, then placed in an oven at 125° to 250°C for periods that can range from hours to days.

Lower temperatures produce finer structures, but require much longer times, adding to cost. The heat treatment temperatures are so low that carbon cannot diffuse far, so that the resulting plates of iron, separated by carbides of iron and other metals are only 20 to 40nm thick. The current big interest in this material is to make armour plate with holes in it – the idea is that the edges of the holes interfere with incoming projectiles, and DSTL and QinetiQ have been heavily involved in the development, but it potentially has many other applications, since it is not fundamentally very expensive, being potentially about one ninetieth the cost of maraging steels. It has reached the stage of being fabricated in tonnage quantities as plate, rolled strip and bars, although Corus is currently being coy about exactly when it intends to bring it to market on a commercial scale.

Winning Twins

TWIP or Twinning Induced Plasticity steels, are said to be the invention of Professor Georg Frommeyer, head of the Department of Materials Technology at the Max Planck Institute for Iron Research in Dusseldorf. These contain about 20% manganese and small amounts of carbon, aluminium and silicon. The large amount of manganese means that even at room temperature these steels have the face centre cubic structure of austenite – the normal high temperature structure of plain carbon steels. When they are deformed, they harden by forming twins – areas of the crystal structure which form a mirror image to the rest of the structure. Dislocations – imperfections within the crystal structure – have difficulty traversing the boundaries of the twins, making the metal stronger, but not so much difficulty that the material becomes brittle. Metals forming a lot of twins work harden at a high rate, absorbing large amounts of energy as they do so. The big interest is in using them to improve the crash absorption of the structural parts of cars, while reducing weight, or improving crash resistance at the same rate. The only downside is that they also require more energy to form than normal steels, but there are ways round this.

Patrick Kelder, business development manager, Corus Automotive says that the company's current top commercial offering for the automotive market is 'DP800HyPerform', which is a steel with a ferrite-martensite structure and a minimum UTS of 780MPa and an elongation of 20%. This makes the material more formable than is usually the case for steels of this strength, where elongations are in most cases only 14% to 16%. It has a hot dipped, zinc coating and is easily weldable. It is said to be less expensive than TRIP (TRansformation Induced Plasticity) steels.

Deliberately forming nano-sized twins at an early stage in face centered cubic structured metals has been found to result in dramatically greater strengthening effects according to a Chinese research group. Professor K Lu from the Shenyang National Laboratory for Materials Science was invited to give the Kelly lecture to

the Department of Materials Science at Metallurgy at Cambridge on June 15th 2010, and introduced by Professor Kelly himself, author of the book 'Strong solids' and generally considered to be the father of modern fibre reinforced composites.

Professor Lu described how he and his colleagues had succeeded in making copper more than ten times as strong as it is normally, without adversely affecting its electrical conductivity. He then revealed that he had just succeeded in applying his methods to making AISI 316L stainless steel up to five times stronger, by a commercially viable manufacturing technique.

The trick is to come up with cost-effective methods of producing twins on a 15nm or smaller scale in usable pieces of metal. The team started by using pulsed electrodeposition to produce foils up to 30µm thick. However, they then moved on to producing the effect by dropping a hammer onto copper samples in liquid nitrogen from a height of 7m. The top strength performance achieved so far is a yield stress of more than 600MPa, as compared with 70MPa for conventional annealed conductivity copper, while retaining 97% of the electrical conductivity.

When applied to stainless steel, the low temperature forming process produces nano sized grains as well as nano twins, which make the material brittle, but this problem can be overcome by annealing the metal in such a way that the grains recrystallise to larger size, without making the twins thicken significantly. If this is done, ultimate tensile strength can be raised to 900 to 1400 MPa instead of 260 MPa. His latest work is to apply the same methodology to iron 25% manganese steel, at slightly higher manganese contents than the TWIP steels described earlier.

The leading Chinese steel company is Baosteel, headquartered in Shanghai, which has recently integrated its stainless steel R&D with its sales and market development operations in a new Stainless Steel Technology Centre, adding to and improving the more than 60 grades of stainless that it currently offers. The latest developments are new ferritic grades for automotive exhaust systems and solar water heaters. The company produces more than 30 million tonnes of steel per annum – three times the entire output of the UK – has a partnership with Thyssen Krupp and is fully ISO 4001 and 9001 compliant.

Stainless steel is also the demonstration substrate for extremely hard amorphous sp3 diamond coatings invented by Sergey Aleksandrov, now chief technology officer of Diamond Hard Surfaces in Towcester, which is engaged in commercialising his discoveries. Not only do these give steel and other substrates hardnesses of 4000 HV, they also result in friction coefficients lower than the 0.025 associated with polytetrafluorethylene. The original demonstration coating on stainless steel was only 12µm thick, but coatings 40 to 50µm thick are now produced regularly. Applications abound in the chemical, industrial processing, electronics, medical, aerospace and oil and gas industries, where they are applied to oil drilling mud pumps and drill tools, increasing useful lives from 300h to 1200h, according the company's Chris Walker. Process temperatures are only around 100°C, so the process can be applied to coating infra red optics and suitable plastics.

www.corus.com
www.corusautomotive.com
http://lu-group.imr.ac.cn
www.baosteels.com
www.diamondhardsurfaces.com

Design Pointers

- Super bainite steel is the strongest low alloy steel ever produced, more than six times stronger than mild steel, yet should sell at a very acceptable price when it goes into commercial production. It has currently been produced as slab, bar and strip in tonnage quantities.
- TWIP steels are designed to absorb exceptionally large amounts of deformation energy during vehicle crashes by twinning • Sacrificial graphite cages allow bearings to be routinely used at up to 350°C.
- The best performing high strength steel that is currently available commercially for automotive use has a UTS of 800MPa and an elongation of 20%.
- Deliberately inducing nano-sized twins in copper, stainless steel and steels close to the compositions of TWIP steels has a dramatic effect on strength, increasing that of pure copper for electrical devices by ten times and AISI 316L stainless steel by five times.
- A new low temperature diamond coating process raises surface hardnesses of steels and other materials to 4000V while imparting coefficients of friction of less than 0.025.

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Design software harnesses the wind

Tom Shelley reports on a user who has gained speed benefits from mainstream CAD and the latest enhancements.

The world's major design house for the supporting structures for wind turbines has achieved enormous efficiency and quality improvements by adopting one of the mainstream 3D CAD packages and has substantially improved quality, accuracy and detail.

Rambøll, headquartered in Denmark, but with a substantial design office in London, designs the foundations of most of the world's offshore wind turbines. Far from being just steel tubes, they have to not only support the main structure, but accommodate access from the sea to the mechanical parts of the machine, while resisting the effects of wind, waves and currents as well as the wind load on the turbine. "Every one is different", according to project engineer, Filipe Duarte Matias Ângelo, because the nature of the sea bed, what is to be attached on top, and the local nature of sea waves make each design problem unique. The company previously used a dedicated structural civil engineering package, Tekla Structures, but in 2008, embraced SolidWorks.

Ângelo says that the designs involved "extremely large files", to the point that "simple updates were taking almost a day and it was taking around 30 minutes just to open a file".

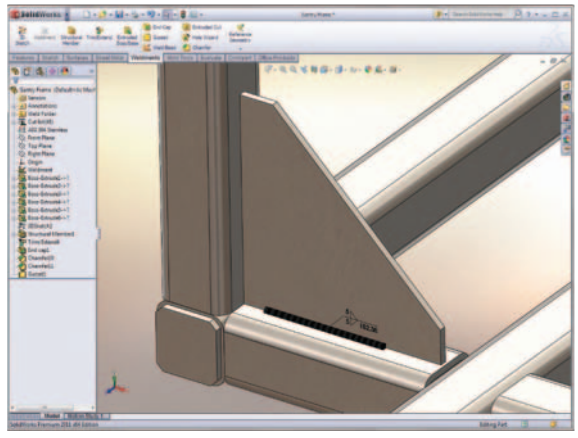
He said that, in contrast to what Rambøll was using before: "The modelling interface is quite easy to learn. It's very easy to make drawings, has good exportation possibilities and has a rendering capability."

The company design offices are in Copenhagen, Esbjerg and London and coordination and revision management is undertaken using PDM Vault, which, "always allows us to go back to previous revisions, improving traceability and collaboration", Ângelo explains. At first, changing the model updated all drawings, destroying previous versions, which was overcome by creating a configuration for each drawing. There is also a direct plug in to ANSYS in three clicks, which is vital for analysing structural integrity. The designers make full use of the parameterisation capability in designing access platforms since changing the diameter of the main pipe changes all the structural beams.

Ângelo says Rambøll was "working to do this a bit better". It also made use of the welds feature, which was described as "very useful", as was the ability to locate the centre of gravity and total mass, since it is necessary to know these in order to work out installation procedures. The external platform also has to include a crane, and the software is used to ensure that the crane can be rotated and doors opened without problem. The bottom line is that tendering now, "has taken a step forward in terms of detail, accuracy and flexibility, allowing the client to ask for changes at a much earlier stage than before, making final cost much lower. Furthermore, in the detailed phases, robust models can now be taken to risk assessment meetings making it easier to identify risks and increase the safety of the foundation".

He said that challenges included the modelling of welds, something that has been specifically addressed in SolidWorks 2011, now officially launched. This version includes automated weld placement and documentation and includes enhanced fillet and groove features. Other enhancements include new sheet metal bend calculation tables, new drawing detailing functions, allowing the automatic alignment, staggering and centring of dimensions and 2D simplification to accelerate static, nonlinear, pressure vessel and thermal studies. There is a new electronics cooling module and a new HVAC module with new fan models and curves.

www.ramboll.com
www.solidworks.co.uk



AutoCAD goes back to Mac

Autodesk's decision to launch for Apple platforms opens up a number of possibilities, as Paul Fanning discovers.

The news that Autodesk has released AutoCAD for a number of Apple platforms is not perhaps as earth-shattering as the company would have liked. Rumours of such a release have been around for several months now. However, the final release is still seen as a significant statement by the company that these platforms represent a growing market for engineering design.

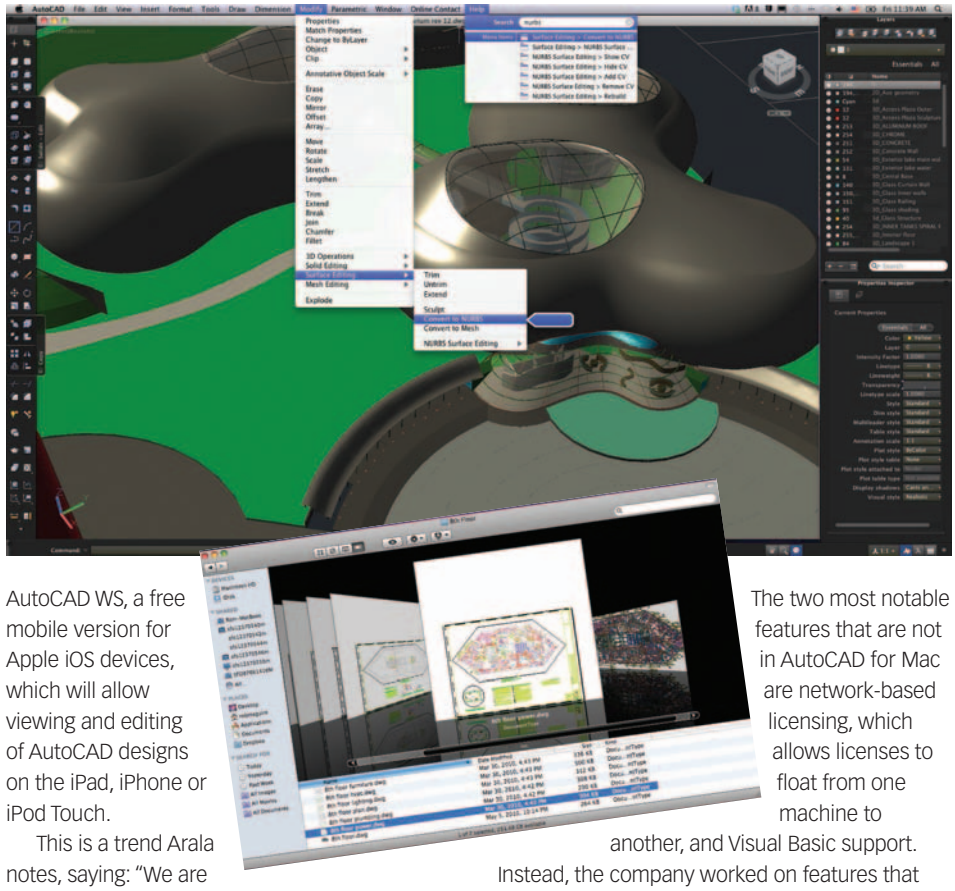
"We were really just responding to customer demand," says Miikka Arala, Autodesk's Head of platform solutions, EMEA. "We had extensive feedback that the Mac platform was increasingly popular amongst designers and so we felt we had to follow that route ourselves.

Of course, this is not the first time that AutoCAD has been available on the Mac platform; the last version was launched in 1992. However, since then, claims Arala, the platform has moved on considerably. "The Mac has moved from a consumer and student focus to a business platform and we had to follow that trend." Equally, the Mac's popularity with students has had a bearing on this decision, as a generation of Mac-literate students has moved into the workplace, the demand to be able to work using Macs has increased considerably.

"Increasingly," says Arala, "we're seeing that hardware is more and more a personal choice in offices rather than an IT standard choice. That's a shift we had to follow."

From a technical point of view, Apple's move to Intel's CPUs has made it feasible for Autodesk to consider returning to the Mac ecosystem, not least because many of the optimisations that Autodesk had undertaken over the years on the Windows platform involved not just optimising for Windows, but also for Intel hardware."

Perhaps the single most significant factor in determining this move is revealed, however, by the fact that, at the same time as it released AutoCAD for Macs, Autodesk also unveiled



AutoCAD WS, a free mobile version for Apple iOS devices, which will allow viewing and editing of AutoCAD designs on the iPad, iPhone or iPod Touch.

This is a trend Arala notes, saying: "We are seeing more and more of our customers using their iPhones and iPads as a business tool – either as a means to display existing designs to customers or partners or to produce initial sketches. We see this as a really exciting development for the future."

The user interface of AutoCAD for Mac takes advantage of the Mac OS X features. Pan and zoom intuitively with Multi-Touch operation, and find designs quickly using Cover Flow navigation to flip through graphical previews of your files.

Some features from the existing Windows version did not come over to the Mac version, however. make the transition to the Mac version.

The two most notable features that are not in AutoCAD for Mac are network-based licensing, which allows licenses to float from one machine to another, and Visual Basic support. Instead, the company worked on features that Mac users consider part of the core experience, such as Cover Flow views and Spotlight search, as well as compatibility with Apple's multitouch devices such as the Magic Mouse and Magic Trackpad.

With support for native creation and editing files in the DWG file format, AutoCAD for Mac also offers easy collaboration with suppliers, customers, clients and partners regardless of platform. Files created in previous versions of AutoCAD will open seamlessly in AutoCAD for Mac, boosting productivity by reducing time-consuming file translation and data cleanup.

www.autodesk.co.uk

Better bearings last longer in hot spots

Tom Shelley reports on bearings aimed at meeting the requirements of challenging environments, particularly in the food and beverage industries.

Bearings have been developed to meet the requirements of environments that involve abrasive materials, corrosive conditions and high temperatures, doubling – and, in some cases, quadrupling – useful working lives.

The food and beverage industries often offer particularly difficult challenges. To meet them, SKF has developed special solutions as well as extending the ranges of standard products that it offers for such applications.

However, during the course of the recent launch of SKF's UK 'Solution Factory' at Luton, food and beverage sector expert David Oliver did concede: "These tend to be more expensive products, but you have to look at lifetime costs as well."

A particularly difficult application cited by Oliver was a producer of wafers for confectionary, with 13 ovens, each of which had 72 plates with a wheel on each corner and a top roller for baking tongs. Oven temperature was 230°C and every 16 weeks, all the bearings had to be taken out and relubricated with food grade grease. This took one to three days.

The solution was to turn to graphite sacrificial bearing cages that slowly abraded to provide lubricant, extending the period between maintenance operations to a year and allowing temperature to be raised by 10°C to 15°C. This led to the idea of SKF making complete wheels with integral bearings, allowing the graphite cages to be made much larger, extending lifetimes to four years, and allowing temperatures to be raised as far as 350°C.

The company produces a whole range of food industry suited bearings for use at more conventional temperatures, with bearings made of stainless steel or zinc coated with glass-reinforced polyester or polyamide housings and elaborate seals. Sizes are currently up to 40mm, to be expanded up to 50mm in February 2011. Housings are to be offered in stainless and zinc plated steel in addition to plastics. All bearings conform to ISO 22000.

Lubrication is always a problem in food industry applications because of the need for chemical washdowns. One solution in the past has often been to apply excessive greasing to purge water. As an alternative, the company currently offers is what it calls 'solid oil', with a synthetic oil lubricant retained in a polymer matrix, which completely fills the internal space in a bearing and encapsulates the cage and rolling elements. No seals are required and the material is resistant to chemicals, although not to organic solvents.

As well as the food industry, its adoption has found favour in applications in papermaking, pneumatically operated couplings, overhead cranes and hoists, and chemical mixers. In low temperature applications, such as on ski lifts, starting torque is lower than for conventional greases. The minimum startup temperature is -40°C and maximum operating temperature is 85°C although it can go to 95°C intermittently and bearings can be heated to 100°C for mounting.

The 'Solution Factories' embrace all possible applications for bearings, including the food and beverage industries, and include the offering of design and maintenance consultancy, condition monitoring and training.
www.skf.com

Design Pointers

- Sacrificial graphite cages allow bearings to be used at temperatures up to 350°C.
- 'Solid oil' bearings are available for food industry and a wide range of other applications.

Bearing innovations increase efficiency

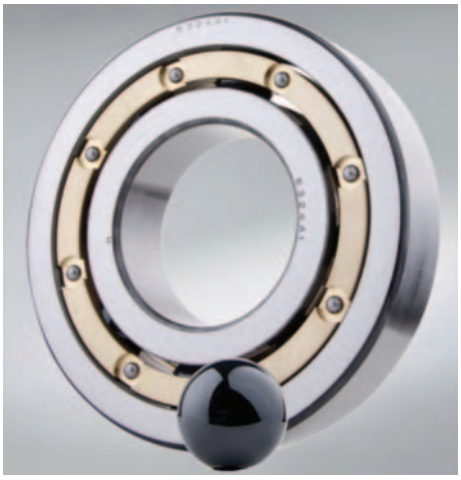
With bearing problems the single biggest reason for wind turbine failures, Paul Fanning looks at some of the latest methods being employed.

The wear on bearings is the single biggest technological problem facing the windpower industry, regularly leading to failure and stoppages. For this reason, a number of suppliers have developed or are developing solutions to reduce these failure rates significantly.

One such solution comes from Schaeffler, whose rolling bearing for wind turbine gearboxes is not only resistant to the effects of slippage, but actually prevents slippage from occurring in the first place.

Slippage is a huge problem for rolling bearings. The life and performance of a rolling bearing will suffer if it is overloaded or under-loaded. Because rolling bearings are designed with a minimum load requirement in order to function optimally, if f this minimum load is not met, slippage will occur. This means that the rolling elements not only rotate, but also slide on the bearing raceways. Eventually, this can lead to surface damage such as increased wear or smearing, particularly in critical lubrication conditions.

The FAG tube roller bearing is a conventional cylindrical roller bearing that incorporates three cylindrical rollers with a slightly increased diameter. These three rollers have a hollow design and are supported by a support roller in the inner bore. With a slightly increased diameter, the rollers generate preload in the bearing and drive the bearing cage (and therefore the entire roller set) at low loads.



NSK's hybrid bearing with ceramic balls offers long life and acts as an electrical insulator

Schaeffler's rolling bearings prevent slippage, one of the key problems for wind turbine bearings

At higher loads, the bore of the cylindrical rollers ensures sufficient deflection of the larger rollers so that that they are not overloaded. This means that the load is evenly distributed to all the rolling elements, similar to a conventional rolling bearing.

The support roller in the inner bore of the tube roller has a slight clearance to ensure that the roller is less rigid (more flexible) at higher loads. At the same time, this also prevents excessive deflection of the tube roller.

NSK presented a new innovation at HUSUM WindEnergy event – a hybrid bearing with ceramic balls that boasts a long life and also acts as an electrical insulator. This function is needed to prevent electricity from passing through the power train and to minimise the associated damage, when current peaks or circulating currents (electrical corrosion) occur.

NSK's ROBUST bearings with ceramic balls have gained a reputation as extremely stressable, long-life, high-precision bearings in the machine-tool industry. Now, NSK is utilising this experience for larger bearings – such as those used in wind turbines – and has ramped up its production capacities for high-precision ceramic components accordingly.

Another tack has been taken by Cooper Roller Bearings. The King's Lynn-based company has elected to address the issue of ease of repair by the use of its split roller bearings. The company recently received a grant of £256,250 from the Department of Energy and Climate change to, "develop and demonstrate the use of split bearing technology in large scale wind applications." Cooper is the world's largest manufacturer of split mounted roller bearings.

The advantage of the split roller bearing over the solid bearing is reliability and how easy it is to replace. If a wind turbine is 70 km offshore – which is being planned for the North Sea at the moment – it is very difficult to service.
Using these bearings is that you don't need to take anything off the shaft to replace the bearing, whereas if a fixed bearing goes, it is necessary to send a crane out to take the whole rotor off, which is both expensive and time consuming. Using split roller bearings, however, only a small work boat is needed.

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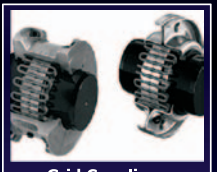
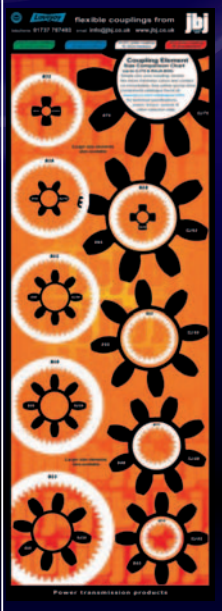

Grid Couplings


Miniature Couplings


S-Flex Couplings



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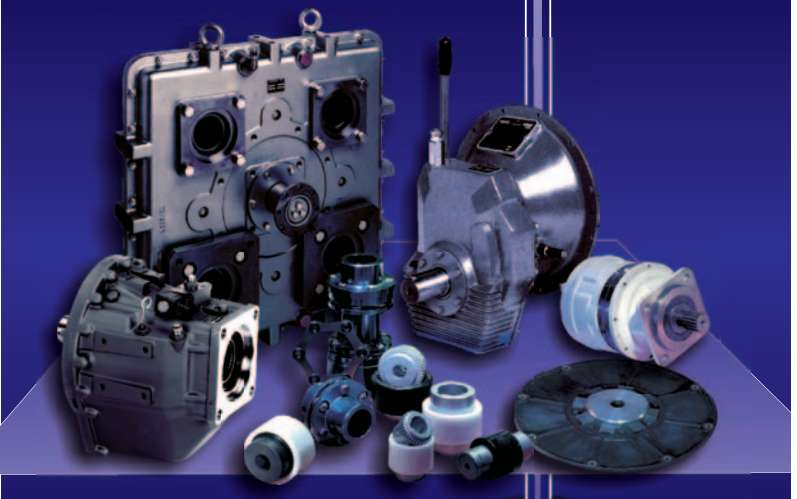

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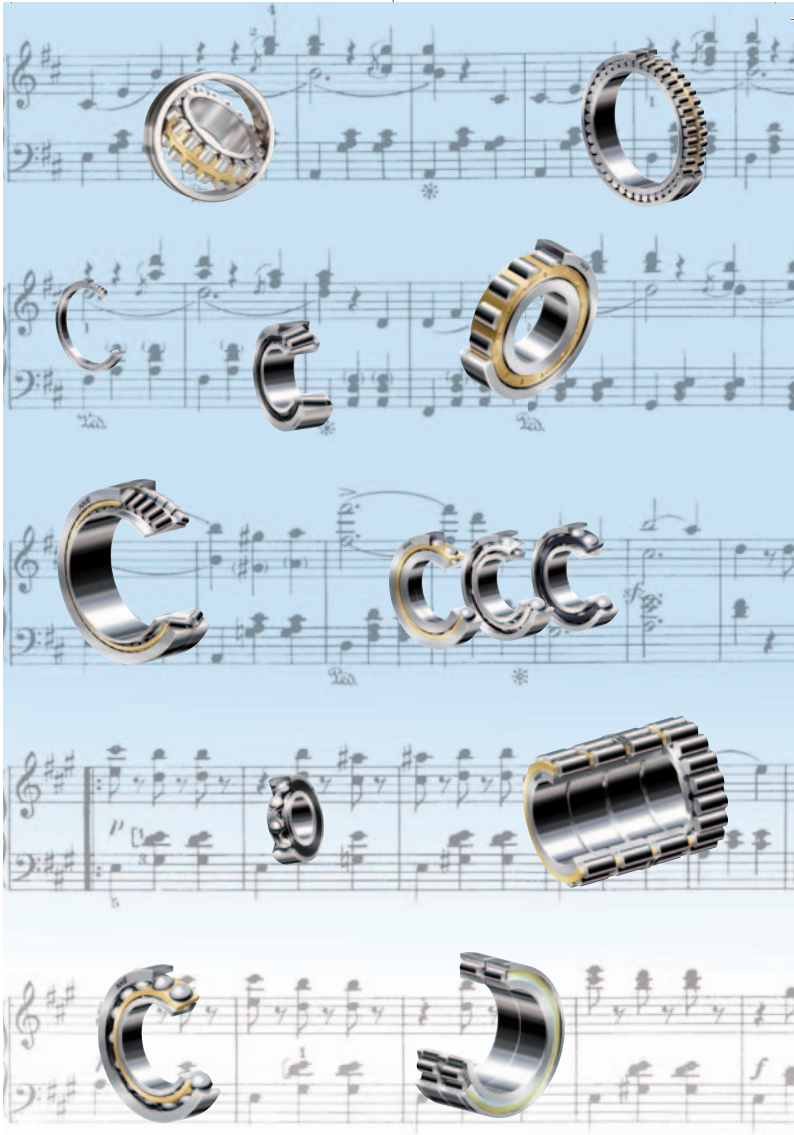

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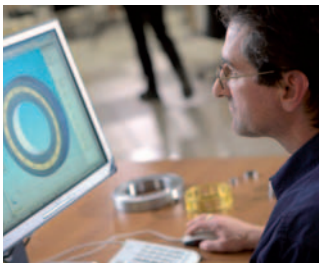

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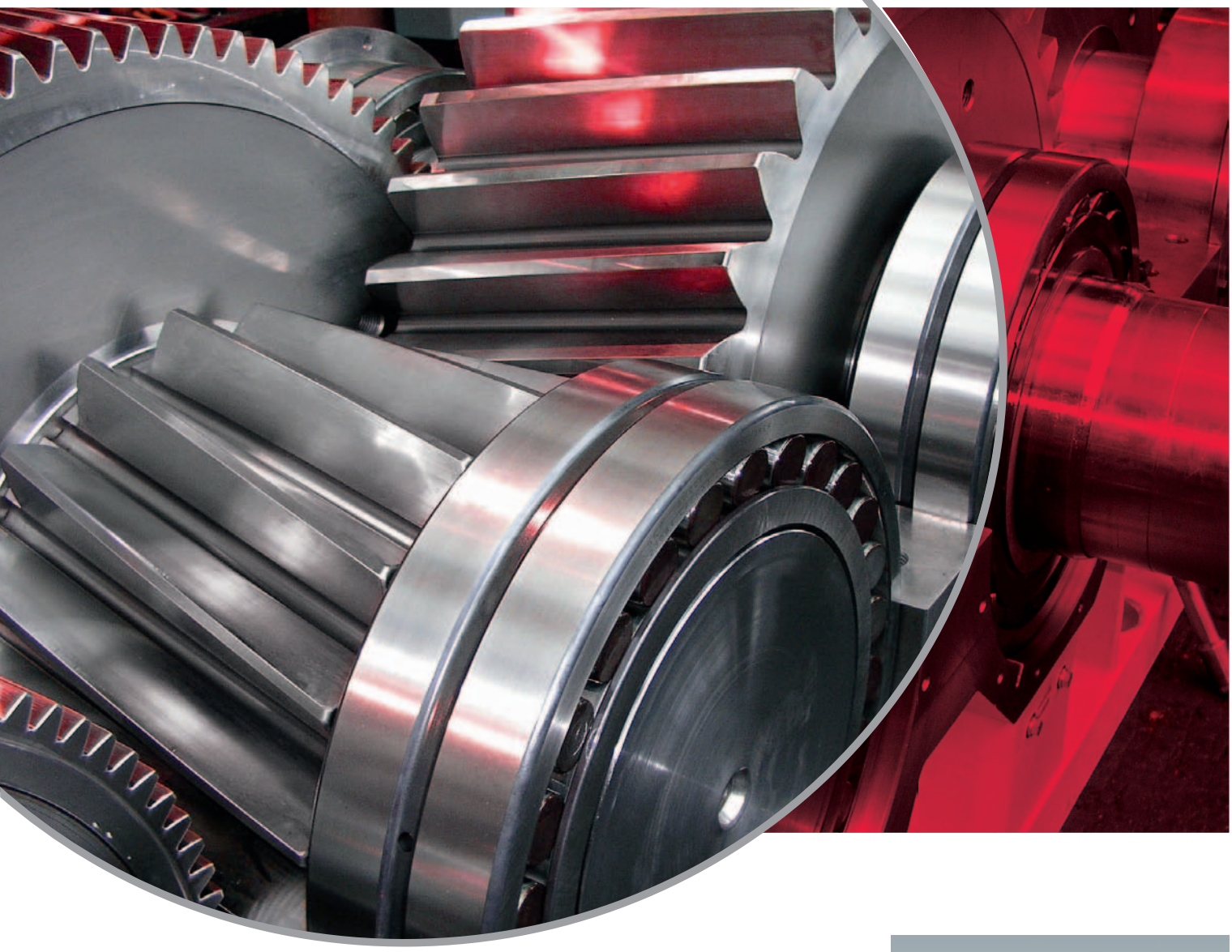

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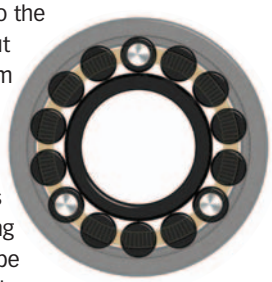
Tube roller bearing for wind turbines

A novel design of rolling bearing for wind turbine gearboxes has been developed, which is not only resistant to the effects of slippage, but prevents slippage from occurring at all.



Rather than using conventional rolling elements, Schaeffler's FAG tube roller bearing incorporates three tube rollers. These tube rollers enable the bearing to rotate without slippage under all load conditions. At the same time, the load rating and rating life are unaffected.

www.schaeffler.co.uk

Tougher performance from NSK

NSK has increased its ability to provide bearing users in tough, demanding environments with continuous operation and minimum maintenance, following the expansion of its HPS (Trademark) range of spherical roller bearings up to 260mm bore. Fully optimised and uprated, the HPS (Trademark) bearings offer twice the lifespan and a 20% higher limiting speed, compared to conventional spherical roller bearings (SRB). Designated as the CAM series, the larger size HPS (Trademark) bearings differ in design from the existing HPS- EA range of SRB (up to 130mm bore), due to the increased demands placed upon them.

www.nsk.com

Coating enhances ball guides

A new addition to HepcoMotion's LBG linear ball guide range is now available with a cost-effective, corrosion resistant coating.

This hard chrome alternative is available for all rails and bearing blocks in this linear ball guide product programme. It provides a good degree of corrosion resistance for applications where moisture or contaminants could cause surface pitting. Introduction of this variation also opens up the market for this product in cleanrooms.

High quality, good accuracy and exceptional rigidity characterise the LBG range. Its basis is a four row angular contact ball track that has numerous benefits. These include low friction and reduced differential slip, high load carrying capacity in four directions and installation compliance.

www.hepcomotion.com

Linear servo driven stages available

Dover's recently introduced Mini-MAG high precision linear servomotor stages are available from Heason Technology. The compact 80 mm wide all-stainless steel stages use Dover's MAG moving magnet concept that eliminates moving motor cables.

With overall accuracy to 3.0 µm, positioning resolution to 5.0 nm and bi-directional repeatability to +/- 200 nm, the powerful 3-phase brushless linear servomotor facilitates an impressive speed rating of 500 mm/sec with 9 g acceleration.

www.heason.com

Parker offers power and flexibility

The Parker-Origa Division of Parker Hannifin has launched a new range of magnetically-coupled pneumatic rodless cylinders. The latest P1Z linear drives are available with a single rod and rotating carriage or with integrated parallel anti-rotating guides, can be used at low speeds from 0.05m/s and feature thrust forces of 942N.

The series incorporates a stainless steel pneumatic cylinder body fixed between two end plates. A hard anodised aluminium carriage is fitted to the the cylinder body, with the carriage and cylinder piston magnetically coupled.

www.parkeroriga.com

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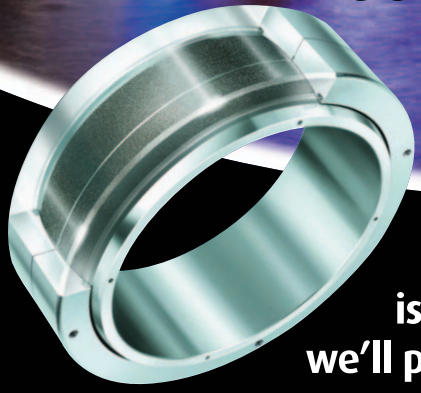

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Pneumatics move ahead in efficiency

Tom Shelley reports on energy saving and using new pneumatic devices to pump mud and burrow through the ground.

Because of the convenience of pneumatic power and the appearance of new devices that use it to do things that are difficult to accomplish by other means, the compressor industry remains competitive, with a strong emphasis of improving energy efficiency.

Last year, Eureka reported on Atlas Copco's 'Carbon Zero' compressors that recovered their waste energy in the form of hot water. This year, the same company has brought out retrofit heat recovery units for its GA11-90 rotary screw compressor range that recover between 72% to 94% of wasted heat energy from air compression in the form of what energy audit manager Anthony Cornes describes as: "A fair amount of warm water or a lesser amount of hot water up to 90°C."

All compressor manufacturing companies are making efforts to improve the energy efficiency of their products. Atlas Copco has issued a paper that attempts to prove that rotary screw compressors are inherently more efficient than lobe and other 'external compression' devices. Andy Jones, general manager of Mattei Compressors, however. expresses the view that his company's latest vane compressors, "Were every bit as efficient as screw compressors", because they did not have a "blowhole" in their compression process, and required only 5.4kW of electricity to produce 1m^3 /minute of compressed air. He also added that he considered that they were inherently more reliable than screw compressors, because they did not have, thrust bearings to wear out and so were now being offered with an up to 10 years, unlimited hours, air end warranty.

Mattei also includes heat recovery systems in its range of products, and both companies argue the case for very large savings that can be obtained by making use of variable speed drives to match variable demand. The other solution to reducing compressed air consumption in an industrial system is to turn compressors off. This is best achieved using a central controller. Atlas Copco has announced that as an aid to such practice, its ES130V master controller is now qualified for the Enhanced Capital Allowance Scheme and has been included in the Energy Technology List.

Pneumatics enables applications that are hard to accomplish by any other means. An example is a range of Australian sludge and mud pumps that use a venturi to suck material into a holding tank, whose contents are then blown out under pressure before they have time to settle and compact.

Made by Supavac in Queensland, they use a venturi to suck material into a holding tank, whose contents are then blown out under pressure before they have time to settle and compact. Timers regulate the suck and blow cycles which last 10 to 15s. Pump sizes range from the 10,000 litre/hour SV60 to the 25 to 40m3 per hour for SV400. The pumps were used in the recent Gulf of Mexico oil spill cleanup.

In the UK, Mike Brice, proprietor of Geo-Mole in Faversham, Kent, has developed the Geo-Mole – a penetrator that drives itself into and through the ground under the action of a reciprocating piston, driven by compressed air. At the end of each stroke, the hammer force is

about 28tonf. Its latest application is to install pipes for ground source heat pumps. As the penetrator proceeds, it tows behind it a compressed air line and an exhaust line. When a suitable length, typically 100m has been laid, the two lines are joined, and become the heat extracting circuit for the pump. The penetrator is cheap enough to be left where it is. The rate of progress is about 1m/minute, which means that 100m of pipes can be inserted in 1h 40min.

www.atlascopco.co.uk
www.mattei.co.uk
http://supavac.com
www.geomole.co.uk

Design Pointers

- Waste heat from air compression can be used to produce hot water by retrofitting heat exchangers to screw compressors
- The efficiencies of all compressors continue to improve, whether they are based on screws or vanes
- Mud and sludge can be very conveniently pumped using compressed air to create suction, depositing material in a vessel which is then blown out

Hydraulic power unfolds for the big view

Tom Shelley reports on a UK based design and manufacturer of hydraulic systems.

New challenges in hydraulics are mounted by very large outdoor television screens that are installed in large trucks, then unfolded and extended to provide visibility for spectators who may be distant from an event.

Ever larger - 100 square metre designs are being planned – they nonetheless need to be easily portable and deployable, if transport and setup times and costs are not to be excessive.

Penny Hydraulics based in Derbyshire, has recently designed and built the working mechanism of three very large, truck-mounted outdoor screens for Vipex, which is based in neighbouring Nottinghamshire. Penny Hydraulics specialises in bespoke hydraulics, while Vipex specialises in equally bespoke specialist vehicles and trailers. Robin Penny, managing director of Penny Hydraulics says that, as well as having to unfold, the screens must be able to be raised, rotated through 360°C and not tip the trailer over if the wind blows strongly. The latter is accomplished by a system of extending supports, but the design is complicated by a trailer that incorporates a stage that unfolds when the screen extends.

The rotation is accomplished by a hydraulic motor and gears, but the screen raising and support extending system combines hydraulic rams, some of which are 3m long and 150mm in diameter, with box section inside box section telescopic slides, so there is no side loading on the rams. A particular challenge is posed by the need to run hoses and rams inside the box sections in the limited space available.

Penny told us that the systems include 34 functions, which are all operated by a wireless remote control, so the operator is well clear of everything as it unfolds and erects, and can also observe that everything is happening correctly. The systems are designed to be completely independent of external power supplies, and can be run for up to a week on the diesel stored on the vehicle. This is necessary because the screens are often used in fairly remote locations – a most recent usage being a display at the

finish of the Round the World Clipper Race. With each screen having to be bigger and better than its predecessor but go on the same sized truck, Penny commented that, "The next one is going to be a real challenge".

However, innovating to solve challenges is what the business is all about. A recent contract has been to design folding platforms for the extra cameras that Sky Television intends to use for its new 3D service, which was scheduled to be launched on October 1st. All Premier League clubs are to have these, but the clubs want them to fold up so that, when not in use, they can be folded to reveal extra advertising space.

The company makes its own hydraulic rams, because they are mostly non standard sizes, including 1m long 300mm diameter rams for up to 140 tonne presses for fork lift truck tyres. It also makes a range of small cranes and platform lifts for commercial vehicles, pub cellar lifts and various other products for customers that include what's left of the UK mining industries, but bespoke products is its real speciality. A recent contract relates to servicing scissor lift based mobile control towers for airfields in Afghanistan, so they can be lowered in between operations to make them less of a target .

www.vipex.co.uk
www.pennyhydraulics.com

Design Pointers

- Company specialises in bespoke designs involving a challenges such as self-erecting, truck mounted, outdoor, ultra large sized television screens
- This involves its making its own hydraulic cylinders, since most of the bespoke designs require non standard sizes.

Rachel Peachey, Knowledge Transfer Programme Associate,seen here flanked by David Littlechild, Chairman, (left) and Charles Maltby, Technical & Commercial Director of Shearline

Light alloys set to fly

Tom Shelley reports on the latest developments in magnesium alloys.

New magnesium alloys and processing methods are offering the capability to make stronger, higher-integrity magnesium parts for aerospace that save weight at acceptable production costs.

Shearline is working towards transferring the established technology of Thixomoulding magnesium alloys to processing new compositions. Engineering quality magnesium alloys have been used since before World War II. The Volkswagen Beetle, for example, launched in 1936, used nearly 25kg of magnesium castings in its transmission housing and air cooled engine. During the war, forged magnesium alloys were used to make engine bearers for most German aircraft as well as other parts.

Thixomoulding – semi solid metal casting – is today used to produce millions of thin-walled magnesium alloy laptop computer and mobile phone enclosures, because the strength per unit weight and rigidity of magnesium alloys is greater than that of plastics. Charles Maltby, technical and commercial director of Shearline explained that the basis of the process is to load the metal alloy as a solid powder, and put it through a machine that is , "Very similar to a plastic injection moulding machine, except that it has a clever modification in the form of a screw system that is much stronger." The granules are put into the hopper of the machine at room temperature, after which it is subjected heat, with more energy being put in by the shearing action of the screw, raising its temperature to one that at which the alloy starts to melt, but below the melting point of magnesium, which is 650°C.

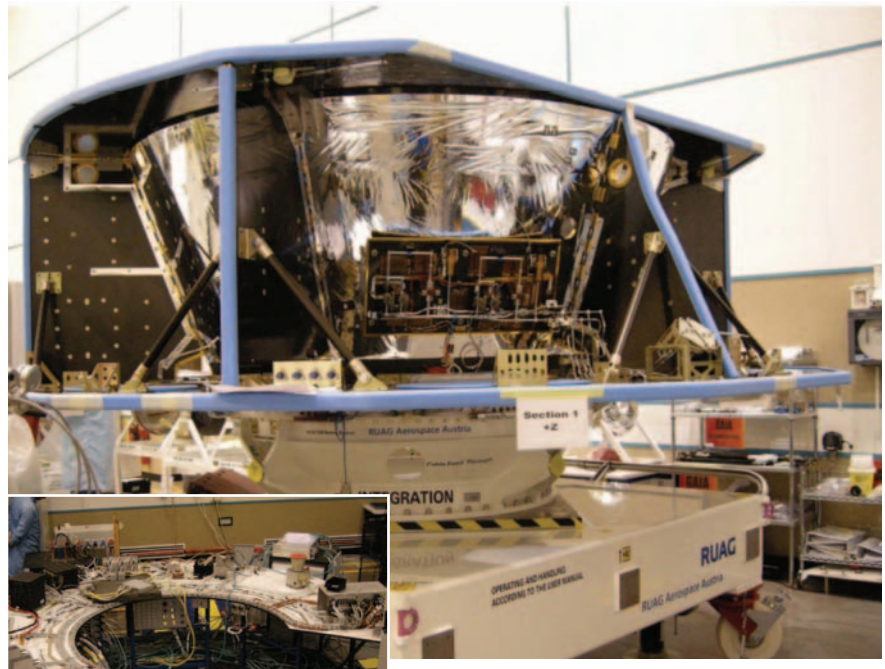
The resulting semi-solid slurry is forced into a mould, where it solidifies to form a structure made up of equiaxed grains, with very little porosity, unlike a conventional die cast structure which is likely to have greater porosity and columnar grains growing inwards from the cooled, mould face, resulting in potential lines of weakness. Parts made by thixomoulding should always be of superior quality "provided the mould tool has been well designed and taken advantage of the known benefits of injection moulding to improve net shape adherence and reduce mating part count wherever possible", according to Maltby.

While magnesium alloys were extensively used in military aircraft during WWII, there is traditional concern about using them today because of a possible fire risk, although to get it to burn easily, magnesium has to be in the form of either powder or thin ribbon. Despite the fact that there are no reports of mobile phone or laptop computer enclosures catching fire, there have been one or two accounts of magnesium alloy sports car wheels catching fire in competition when tyres are punctured and rims were dragged along the track. However, it is possible to come up with alloy compositions that resist ignition even more than normally, but these alloys, some of which can additionally offer enhanced fatigue and/or corrosion resistance, have hitherto not been thixomoulded. Machines for thixomoulding tend to be somewhat expensive, so Shearline has been working with the University of Sheffield, and the Advanced Manufacturing Research Centre (AMRC), and has secured a Knowledge Transfer Partnership and a KTP Associate – Rachel Peachey – in order to develop the process and ensure that the machines will not suffer damage or degradation working with the different alloys.

Shearline already has experience in handling thixomoulded AZ91D magnesium alloy parts for an electric folding bike. AZ91D is 9% aluminium, at least 0.15% manganese and 1% zinc. The new alloys are variants of the basic magnesium 9% aluminium composition, but with other additions and reduced aluminium.

The AMRC is closely linked to Boeing, as well as having partnerships with a number of other leading edge companies, including Rolls Royce and BAE Systems.

www.shearline.co.uk
www.amrc.co.uk



EADS Astrium has developed the EVS validation system fo automate test equipment

Testing the testers

Tom Shelley reports on a system that validates testing systems for satellites.

EADS Astrium has developed an automatic test equipment system for testing spacecraft test equipment.

Without some means of validating test equipment, testing becomes meaningless because malfunctioning test systems are unable to reveal malfunctioning equipment. Since testing of complex systems is normally automated, because of the large number of tests that have to be run, it makes sense to automate the test equipment testing the testers.

The solution, according to Clive Catley of EADS Astrium, has been to develop an Electric Ground Support Equipment (EGSE) validation system or EVS. The first target application is an ESA probe called Gaia, a billion pixel digital camera capable of measuring the equivalent of an object the size of a human hair at a distance of 1000km. Scheduled to be launched in 2012, it is to be placed 1.5m km beyond earth orbit and produce a star map of the more than 1 billion stars in our galaxy and by measuring their precise positions, identify hundreds of thousands of extra solar planets.

Typical for one-off science mission spacecraft, a "FlatSat" of the probe is first built with a set of engineering model electronic units, identical to those to be used in the actual satellite, in order to validate electrical interfaces, on board software and closed loop control systems. The platform consists of: a computer, an electrical interface, a power control unit, attitude and orbit control gyroscopes, star trackers sun sensors, a propulsion system and a radio frequency sub system. In addition, there are instruments, instrument support units, and devices to process all the data they produce. To support ground testing of the spacecraft, specialised test equipment typically includes: a solar array simulator, umbilical power and monitoring, a battery simulator, a radio frequency front end, an avionics front end, a spacecraft simulator, payload front ends and a checkout system. In practice, this means racks and racks of complicated equipment.

The avionics front end, for example, supplies interfaces to the spacecraft attitude control units, and in tandem with the spacecraft simulator, is capable of simulating the units themselves. To accomplish this, it has more than 600 I/O interfaces including: analog, pulse generation, pulse acquisition, RS422, 1553, SpaceWire BUS interfaces and power simulators.

All test equipment has to be validated before use and all electrical interfaces to the spacecraft tested before connection. Previously, there were two means of doing this. One was to procure EGSE with built in test facilities. Because of complexity, this can typically cost more than €50,000 per piece of equipment, adding hundreds of thousands of euros to the cost of a project. The alternative is to validate each piece of test equipment manually using break out boxes and standalone test equipment, which typically takes two to three days.

The new EVS, on the other hand provides multiple generic test functions for validating spacecraft test equipment using National Instruments PXI platform instrumentation hardware and the same company's LabWindows/CVI to produce the software. Catley told us that using this tool, he was able to write, "The core software in two or three months", doing some of the work in his spare time. The hardware unit, he said, is small enough to be taken, "Up to the top of a launch tower and go inside vacuum equipment." It nonetheless, "Provides the majority of the test functionality required for multiple spacecraft projects, based on standard I/O specified in spacecraft GDIR and common functions such as power projection testing and solar array simulation." It is expected to save, "Many thousands of euros in EGSE costs."

www.ni.com
www.astrium.eads.net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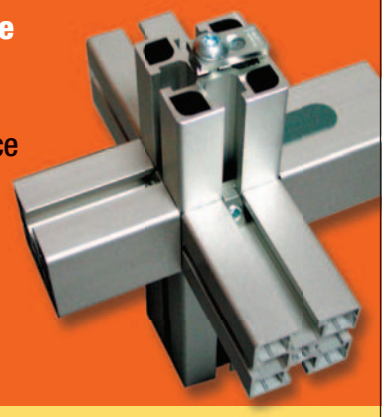

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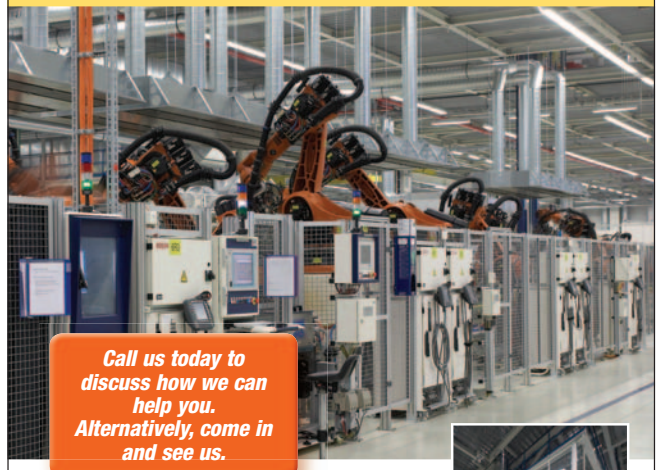

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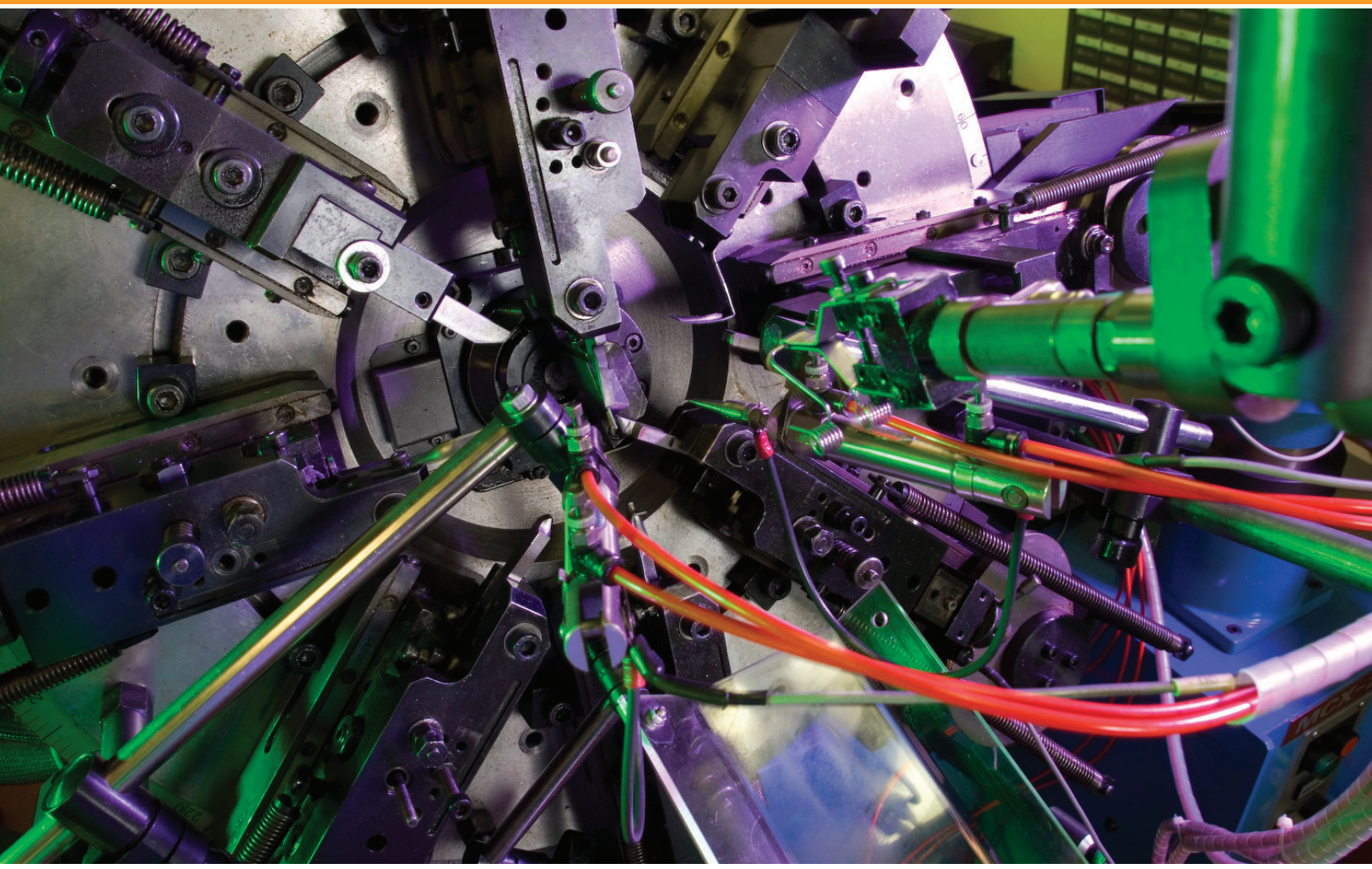

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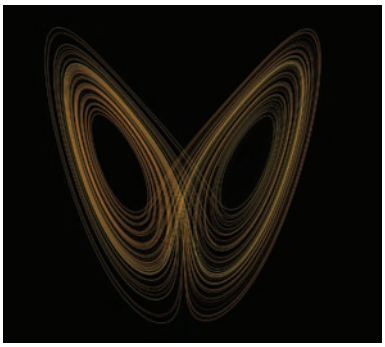
Tom Shelley reports on recent applications that either prevent or make use of chaotic behaviour.

Ensuring **order** from **chaos**

Chaotic and other potentially damaging oscillations in systems can be modelled, their onset can be detected before they get nasty, and they can be and are counteracted, or in other cases, made use of.

Understanding and making use of them allows machines to be driven harder, particularly certain military jet engines, and even allows the detection of the onset of potentially fatal heart attacks, up to two hours before crisis.

Chaos is ubiquitous. By chaos, we do not mean randomness, but movements that are highly complex, such as in turbulent flow.



Chaotic motions can be counteracted and, in some cases, made use of,

As Professor Mohammed Sohby of the University of Kent school of engineering explained and demonstrated in a lecture earlier this year, the mathematics of chaos is now quite well understood, thanks to the work of the late US meteorologist, Professor Edward Lorenz. A simple example of mechanical chaos is a pendulum whose bob is attracted to four magnets on a surface, or a pendulum with a joint in the middle. The motion is complicated – it never goes back to exactly the same configuration – but it is not random. He demonstrated chaos in an electronic system, and showed how it could be modelled on a computer, and how the transition from harmonic oscillation to chaotic motion occurs when more energy is put in, and how the input of still more energy can lead to the system moving into a completely new area of states.

As energy is input, the beginning of the transition to chaotic behaviour is marked by the appearance of oscillations with double the natural frequency time interval called 'Alternans'. If the oscillation is initially harmonic oscillation, the alternans act as a warning that full chaos is liable to follow. Professor Sohby commented that he was particularly interested in the fact that, when this effect appears in the human heartbeat, the patient is, "About two hours away from fibrillation", when the heart beats in a completely chaotic manner and fails to pump blood. If alternans have been detected however, it is possible to have a paramedic with a defibrillator standing by ready, who can then save the life of the patient.

Chaotic behaviour and its control is well known in power electronics, but Professor Sohby also says it is relevant to aerodynamics and jet engines. A researcher at Rolls Royce confirms this, saying the company. had been involved in research into a strategy to control chaotic mechanical vibrations in rotors which involved, "Semi active control, as it is not necessary to control it with full cancelling energy, but only to feed in enough to re-stabilise the motion." They then referred us to the Whittle Laboratory in Cambridge.

Senior research fellow Dr Ivor Day told us that they had indeed looked at a strategy where a "Small spike" in the pressure distribution in a compressor was found to tip it into chaos under extreme conditions and a strategy had been devised to open valves round the compressor to "Blow it away". The strategy worked, but was not found to be cost effective.

However, Dr Robert Miller, reader in energy technology told us that there was a strategy that can and is used in jet engine combustors and afterburners. If an oscillation is detected, fuel input can be modulated to either decrease or increase heat. If fuel injection is modulated so that peaks correspond with combustor pressure troughs and vice versa, turbulence and heat is reduced, but if peaks are made to correspond with combustor pressure peaks, turbulence is increased and combustion temperature rises by, "150ºC plus", "Supercharging" the afterburner and increasing thrust.

http://www-g.eng.cam.ac.uk/whittle

READER INTERVIEW

KEVIN LEE
MANAGING DIRECTOR, MENARD COMPETITION TECHNOLOGIES

60 SECOND

Q How did you get into motorsport?

A A fascination with cars in general. My father did a bit of road rallying for a time. I had a Mini doing auto tests before I was old enough to drive, so there was something ingrained in the blood there. Like I say, my father did road rallying; the mechanic that I was apprenticed with did Formula 2 Stock Car racing, so invariably every weekend I was involved in looking after a rally car or off to a Brisca Formula 2 Stock Car race. When the chance came to work with TWR and be involved with motor racing, it was as though all my dreams had come true at once and I jumped in with both feet and I've been in motorsport more or less ever since.

Q How did you get into what you are doing now?

A I trained classically as a motor vehicle mechanic. I managed to get a job in 1979 as a TWR mechanic. I worked my way up through the ranks from apprentice mechanic to mechanic to chief mechanic, through various roles in parts and procurement to become Team Manager in the end.

I was Team Manager at the time we won Le Mans in 1988 and 1990 and General Manager when we ran the Ross Brawn-designed XJR-14 that won the World Sports Car Championship. I went on to Benetton with Ross and stayed there for three years until Tom [Walkinshaw] decided he wanted to do it under his own name. So I came back here and worked on the Arrows Grand Prix team until its demise.

I stayed at TWR until 2001 when I'm afraid I saw the writing on the wall and bailed out to work for Toyota F1 for three years. Then MCT bought this site and I came back here.

Q What projects is MCT currently involved in?

A I guess our biggest project at the moment is Superleague Formula. We supply the entire grid with a purpose-built V12 engine. That's probably the biggest task at the moment. The other significant project is Norton. We're providing the engine for their motorcycle. We've got other jobs on, including the machining of their aircraft engine and other aero parts for Wilksch aerospace. Because of our history and heritage, we supply a lot of parts to the USA for NASCAR racing, some of which I can talk about and some of which I can't. We also supply the Caparo T1 engine, which is pretty low-key at the moment, but nevertheless attracted a lot of publicity at one point. And we've just finished some work on a high-performance road car engine for one customer that effectively takes the best bits of a racing engine and translated that into a road car engine. So quite varied: everything from a V12 racing engine to aero parts to working with road car partners to add value.

We're particularly proud of the V12 Superleague Engine. We think it's the first V12 petrol acing engine design since the Ferrari F1 engine way back when. It was a blank sheet of paper (although these days I should say a blank CAD tube) design. We went from scratch and won a Motorsports Industry Association award for the design. We went straight from CAD to the final design in just over six months.

Q How has the industry changed?

A We're a total solutions provider these days. Our heritage and history are obviously in motorsport, but we're getting more and more into mass market products like the Norton engine and the aerospace engine.

I think the days of being able to be totally reliant on racing to support the company have probably gone, unless you're an F1 team. All the other companies are having to look to diversify into aerospace, defence or mass market products. It's been a deliberate shift by necessity. Very few companies have the luxury of enough money to fund their existence based solely on racing.

Q What is your involvement in the Bloodhound Project?

A With Bloodhound, we were one of first companies to offer support by providing them with one of our V12 engines and one of our dyno cells for testing of their pump. We've supported for them for the last two years doing that and will be quite happy to do that in the future. We're extremely proud to have been part of getting them up and running and if we can help in the future, we will. We wish them all the best.

Catching the oil

Cleaning up spilt oil on roads is a serious and important business. How can it be made more efficient?

Oil spills, particularly resulting from road accidents are a major nuisance. While nowhere near the scale of the oil spill in the Gulf of Mexico, there are, according to the Environment Agency, some 3,000 pollution incidents in the UK involving oil and fuel every year. Not all of these result from road accidents – some come from leaking oil and fuel tanks, spills during delivery and deliberate disposal into drainage systems – but quite a few involve damaged diesel fuel tanks on trucks and there are also a significant number of accidents involving oil and fuel from tankers, plus a certain number of incidents involving even more unpleasant liquids. The UK Highways Agency deals with a "Large number of incidents involving oil spills each year" and adds that, "Many of these incidents require specialist contractors to assist in their clear-up operations."

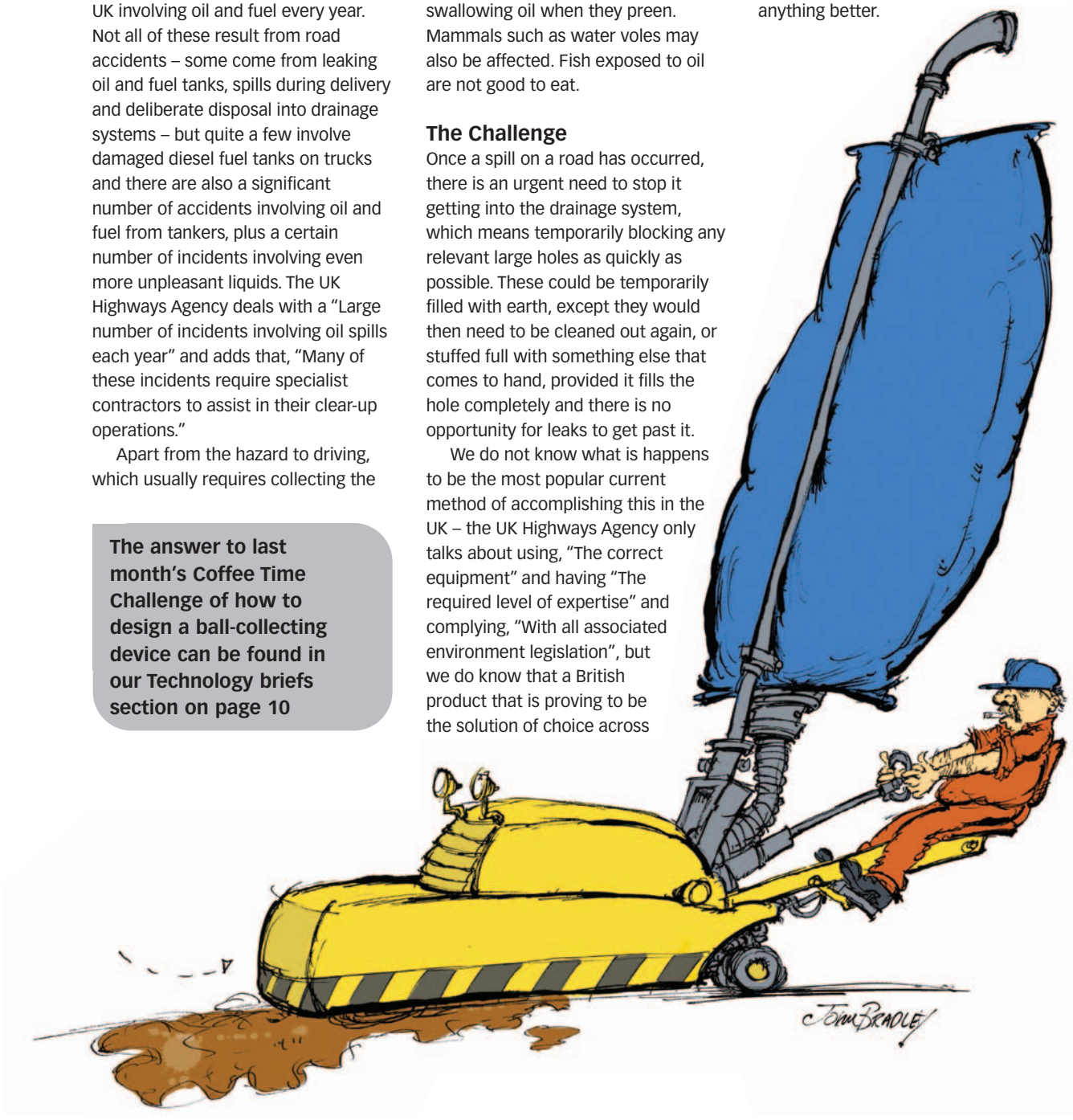
Apart from the hazard to driving, which usually requires collecting the spillage up in some way before the road can be reopened, oil getting into drainage systems causes all kinds of problems. Wildfowl are vulnerable both through damage to the waterproofing of their plumage and through swallowing oil when they preen. Mammals such as water voles may also be affected. Fish exposed to oil are not good to eat.

The Challenge

Once a spill on a road has occurred, there is an urgent need to stop it getting into the drainage system, which means temporarily blocking any relevant large holes as quickly as possible. These could be temporarily filled with earth, except they would then need to be cleaned out again, or stuffed full with something else that comes to hand, provided it fills the hole completely and there is no opportunity for leaks to get past it.

We do not know what is happens to be the most popular current method of accomplishing this in the UK – the UK Highways Agency only talks about using, "The correct equipment" and having "The required level of expertise" and complying, "With all associated environment legislation", but we do know that a British product that is proving to be the solution of choice across the water in France. This product is inexpensive, solves the problem elegantly at low cost, is very quick to deploy and will be described fully in our November edition both in print and online. See if you can come up with anything better.

The answer to last month's Coffee Time Challenge of how to design a ball-collecting device can be found in our Technology briefs section on page 10



www.prototypeprojects.com

Adhesives

Protection for Welding

Ceramishield is Henkel's innovative spray-on ceramic protective coating for welding processes. This unique dry film effectively protects welding equipment against metal spatter for durations of up to an amazing eight hours - and without the need for reapplication.

Tests reveal that productivity could be increased by up to 10 per cent, while running costs for consumables can be reduced by up to 70 per cent.

Ceramishield is easy to apply and can be used for both manual and robotic MIG/MAG welding, jigs, fixtures and fittings and laser and plasma cutting.

@: technicalservice.loctite@uk.henkel.com
✆: 01442 278100

www.loctitesolutions.com

Adhesive Tapes

www.tesa.co.uk

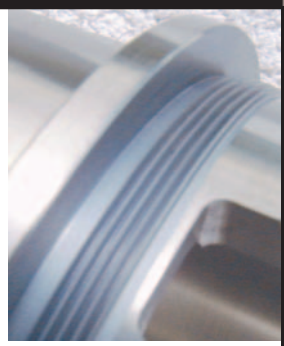
Coatings

WS2 Stops galling of SS and Titanium

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

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

Design Out maintenance problems with WS2!



@: sales@ws2.co.uk
✆: 01430 861222

www.ws2.co.uk

Electric Atomisers

Fine Droplets without High Pressure

The small electric rotary atomiser produced by Newland Design is an efficient way of creating small, consistently-sized droplets by means of high-speed rotation alone, without need of compressed air or any high pressure.

The Newland Atomiser rotates a small porous plastic cylinder at speeds up to 35,000 rpm and emits droplets of less than 40 micrometres in diameter.

Applications include:

- Humidification and Evaporative cooling
- Gas scrubbing and Odour control
- Dust suppression
- Oil misting.

Flow rates up to 25 litres per hour. Power input 24 Volts DC, consumption less than 40 Watts. Evaluation units always available.

@: newland.design@btconnect.com
✆: 01524 733 424

www.newlanddesign.com

Flowmeters

Titan's Breakthrough in Small Bore Flow Metering

Titan Enterprises breakthrough product is now available from £464 EXC VAT!

The new 'Atrato' is a direct and accurate through meter without a contorted flow path which can operate over very wide flow ranges. The ultrasonic technology used offers excellent turndown, linearity and repeatability.

The Atrato is capable of monitoring flow over a range of 200:1 and has accuracy better than ±1.5%. It's simple, yet effective design makes it applicable to a variety of markets, whilst its USB interface makes it extremely easy to install and use.

@: sales@flowmeters.co.uk
✆: 01935 812790

www.flowmeters.co.uk

Gears

www.davall.co.uk

Pin-Point LED

New SICK LED Gets Right To The Point

SICK (UK) has increased the intensity, brightness and accuracy of opto-sensor technology with the new Pin-Point LED. The Pin-Point, which delivers performance comparable to a short-range laser scanner, will significantly broaden the range and performance of SICK's LED-based photoelectric switches and photoelectric proximity switches.

A new design of LED, the Pin-Point vastly increases light spot intensity and concentrates the energy on a much smaller area. Pin-Point boasts greater functional reserves, improved detection reliability and the capacity to detect longer ranges. Using the Pin-Point, SICK photoelectric switches can detect much smaller objects, down to 1mm, and distances up to 500mm, providing an innovative alternative to Laser diode photoelectric switches.

@: Andrea.hornby@sick.co.uk
✆: 01727 831121

www.sick.co.uk

Temperature Transmitters

Temperature Transmitter Conforms to IEC61508

The T32.xS temperature transmitter from Wika, developed for a wide range of industrial applications, is now available with a variant certified for use in SIL2 and redundant SIL3 applications.

Certified for use in protection systems under IEC61508 conformity, the T32.xS is one of only two temperature transmitters worldwide which conforms to this stringent procedure.

Alongside comprehensive internal failure monitoring, the T32.xS offers dual sensor functionality with automatic redundancy changeover, integrated drift protection and compatibility with virtually all software and hardware platforms.

@: info@wika.co.uk
✆: 01737 644008

www.wika.co.uk

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Minimal effort, maximum effect

Many field components create voltage spikes in operation. Even low voltage loads can generate spikes of +/- 1000V with disastrous results. The most effective way to prevent this is to suppress these spikes at source.

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