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October 2016

DESIGN | INNOVATE | ENGINEER

Eureka!

RAPID RESPONSE

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New Look
SAME!
Great Content

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SMALLEY

THE ENGINEER'S CHOICE®

Problem solving by design

Smalley wave springs in various different forms solve problems for design engineers in many applications, and across numerous industry sectors. TFC Product Manager Simon Ward answers typical questions customers pose when considering these products.

Why should I consider using a Smalley Crest-to-Crest® Wave Spring in place of a standard coil spring?

The simple answer is that crest to crest springs save space, and thus help reduce the size and weight of the customers overall assembly. Wave Springs also provide a true axial force; whereas the force from a Coil Spring can be skewed by the pitch of the coils. Axial space savings of 50% are not uncommon since the crest-to-crest spring can operate at a much lower working height, and consequently within a smaller spring cavity.

What type of applications are your springs used for?

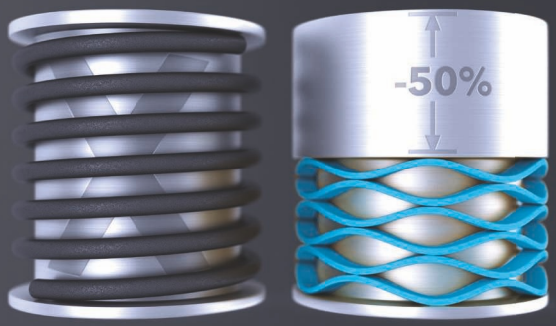
These springs are used to exert a force where light to medium loads are required. However, by virtue of the many alternative types of Smalley Wave Springs now available, and utilising different design options, they can also be used where dynamic performance or much higher forces are required. Wave Springs are specified extensively within the automotive, petrochemical, aerospace, medical, motorsport and off-highway industries.

What diameter springs you can supply?

Advances in manufacturing technology at Smalley now allow us to design and supply springs as small as 4mm in diameter. These springs can be applied in medical devices as well as in the electronics industry. At the other end of the scale we have produced springs in excess of 1m in diameter for construction and quarrying equipment and at nearly 2m in diameter for wind turbines.

Can prototypes be easily manufactured?

All Smalley springs are produced using their unique edge-coiling process, there are typically no tooling charges and small prototype quantities can be produced economicaly. Prototypes are manufactured in exactly the same way as volume production so you are assured that what you test in the early stages of a new program will be wholly representative of production parts. Furthermore, alterations to the design can be made easily and quickly without compromising the design.



What Spring Materials are available from Smalley?

Standard ranges are available in carbon spring steel and 17-7 stainless steel, but we have numerous other material options. For high temperature applications we can use A286 stainless steel, whilst for corrosive environments we have 316 stainless, Elgiloy and several different Inconels to consider.

I cannot see a standard size wave spring to suit my application so I think I will need a special. Does this present any problems?

75% of the Smalley springs we sell are special designs, developed to suit our customer's exact requirements. TFC engineers are available to provide design assistance, including customer visits if necessary. In all these cases we are keen to get involved in the development process as early as possible. This ensures that TFC can offer the optimal design solution and thereby maximise the benefit to the finished product.

TFC brings it together

ENGINEERING DESIGN SHOW
Jaguar Exhibition Hall at the Ricoh Arena, Coventry
STAND F44
19–20th OCT 2016

call now to speak to our expert team
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www.tfc.eu.com

TFC have a team of engineers available to discuss in more detail these and any other questions regarding the Smalley Wave Springs. Tel 01435 866011 or e-mail sales@tfc.eu.com with any further questions you may have.

Editor **TIM FRYER**
tim.fryer@markallengroup.com

Technology Editor **JUSTIN CUNNINGHAM**
justin.cunningham@markallengroup.com

Editorial Assistant **TOM AUSTIN-MORGAN**
tom.austin-morgan@markallengroup.com

Group Editor **GRAHAM PITCHER**
graham.pitcher@markallengroup.com

Art Editor **CHRIS CHARLES**
chris.charles@markallengroup.com

ADVERTISING SALES 01322 221144

Sales Manager **JEZ WALTERS**
jez.walters@markallengroup.com

Area Sales Manager (North) **SIMON BONELL**
simon.bonell@markallengroup.com

Sales Executive **CHRISTIAN KOSTADINOV**
christian.kostadinov@markallengroup.com

Production **HEATHER UPTON**
heather.upton@markallengroup.com

Circulation Manager **CHRIS JONES**
chris.jones@markallengroup.com

Publisher **LUKE WEBSTER**
luke.webster@markallengroup.com

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ENGINEERING'S UPWARD SPIRAL

THESE ARE TANTALISING times at *Eureka!* As this issue lands on desks the announcement of this year's British Engineering Excellence Awards (BEEAs) winners will only be days away. Another two weeks and the doors will be opening on the Engineering Design Show (EDS). These are the two highlights in the *Eureka!* calendar as they give us an opportunity to showcase the Best of British.

This is not down to any jingoistic, blind patriotism, but instead a conviction that engineering is fundamental to the future health of British society. A society that creates and makes – and encourages its children to do the same – has to be healthier than one that just consumes. The BEEAs highlight the cream of the crop – engineers, projects and products that ooze innovation and expertise. EDS provides a meeting place for the whole engineering industry – a place to share, learn, inspire and be inspired.

Like *Eureka!* itself, we hope these events add strength to the British engineering sector. Communicating achievement results in an upward spiral of success, not only in terms of the feel good factor, but more significantly in expertise and opportunity. At the time of reading it will be too late to get tickets to the BEEAs Gala Luncheon, but there is still time to register for EDS, including reserving places at conference and workshop sessions.

Everyone is part of that upward spiral and, it could be argued, the bigger part that everyone plays, the more successful that spiral will be.

On a related note, most of you have now realised your copy of *Eureka!* has landed with a fresh new look. The engineering industry does not stand still and in fact has changed significantly since we last had a redesign in 2009. As we approach the BEEAs and EDS there could not be a better time to launch our new design – a new look but the same editorial team trying to bring you the best in engineering design every month. We hope you like it – please do let us know your thoughts.

Tim Fryer, Editor
tim.fryer@markallengroup.com

Light up the way with LEDs

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SCOTLAND URGED TO SEIZE HS2 OPPORTUNITIES

THE GOVERNMENT IS encouraging Scottish engineering firms to bid for the billions of pounds of contracts that are up for tender under the HS2 high speed rail project, due to begin next year.

The initiative formed part of the HS2 Scottish supply chain conference in Aberdeen last month, with representatives from 85 small, medium and large companies in attendance. The event principally focussed on how to prepare to bid for work on the high speed line.

Speaking at the event was HS2 commercial director, Beth West, who said: "Scotland's strong engineering and construction base is well placed to benefit from the opportunities with HS2.

"Building HS2 is a massive long-term project and one that offers a huge opportunity for businesses from across Scotland to bid for billions of pounds worth of contracts, starting with enabling works packages through to supply chain opportunities in engineering and construction."

It makes up part of a series of supply chain 'roadshows' that have taken place across the UK in recent months. Construction on Phase One of HS2 between London and Birmingham is due to start next year. Transport Minister, Andrew Jones, said: "HS2 is an opportunity for businesses across the UK – including those here in Scotland – with significant numbers of jobs being created throughout the supply chain."

More information can be found at: **www.hs2roadshow2016.co.uk**

Spray-on hydrophobic material

SCIENTISTS AT THE Australian National University (ANU) have developed a spray-on material with the ability to repel water. The researchers say their protective coating could eventually be used to waterproof mobile phones, prevent ice from forming on aeroplanes, keep skyscraper windows clean or protect boat hulls from corroding.

The team created a much more robust coating than previous materials by combining two plastics, one tough and one flexible.

"It's like two interwoven fishing nets, made of different materials," explained PhD student William Wong, from the Nanotechnology Research Laboratory at the ANU Research School of Engineering.

The water-repellent or superhydrophobic coating is also transparent and extremely resistant to ultraviolet radiation. The team developed two ways of creating the material, both are cheaper and easier than current processes.

PRODUCTS

Here is a selection of the latest products featured on the Eureka! website. Just enter the reference number in the search box for the full story

145404 NSK extends high load actuator portfolio
145400 Safety for compact stepper motors
145226 Improved roller guideway MR 45 from Schneeberger
145044 Miniature motor performance and durability
145015 Easy, rugged, stand-alone RFID scanner
144957 Flowmeters for critical applications
144955 Fully integrated proximity probe
144775 Customise your cables
144550 Services slip through ring

NEXT-GEN AUTOMOTIVE COCKPIT

LUXOFT HAS UNVEILED a next generation automotive cockpit. Its AllView II is designed to showcase the look-and-feel of Luxoft's vision of the future for in-vehicle user interaction concepts and driving experiences to compliment autonomous driving, the connected car, and the automotive Internet of Things (IoT). The software development firm has used multi-modal inputs with touch, gesture, eye-tracking and natural language voice systems as well as classic controllers.

The AllView II cockpit-level HMI software system focuses specifically on the digital cluster, infotainment, driver monitoring, consumer-style driver inputs, and connected services, all contained within an integrated HMI software architecture and framework.

In-vehicle infotainment focuses on social media access through an agile messaging co-pilot that provides the ability to safely react and respond while driving. It also delivers wireless device and cloud services integration, as well as improved navigation, telecommunication, and climate control capabilities.

Georg Doll, Luxoft's managing director of automotive, said: "Our AllView II concept demonstrator highlights how automotive trends and technologies can be combined into a state-of-the-art, holistic vehicle cockpit concept that integrates multiple screens. This includes car head units and mobile devices, and also enables situation-aware human machine interaction where passengers help to reduce a driver's workload."

TECH **BRIEF**

Intelligent plasma treatment

Plasma Treatment technology supplier, Dyne Technology, has introduced the PlasmaTEC-X Atmospheric Plasma System. The solution is said to provide an economical, efficient and environmentally friendly method of improving adhesion and wetting qualities of a wide range of substrates from traditionally 'non-stick' polymers to composite blends, ceramics, glass and metals.

This method of material preparation is often undertaken prior to bonding and coating applications on small, targeted treatment areas due to the high level of accuracy and repeatability offered. Example components treated include brake pads, centre consoles, instrument panels, engine control units, EPDM profiles, lighting units and a wide range of interior and exterior trim components.

The PlasmaTEC-X is claimed to offer a footprint of less than half the size of traditional Atmospheric Plasma systems and features Dyne Technology's highest performance Atmospheric Plasma output yet. Boost Mode is said to further increase Plasma output by up to 50%, and is suitable for the high performance automotive industry.

30

EVENTS

06 OCTOBER 2016
Additive manufacturing today: Recent advancements in software, process and materials
Webinar

06 OCTOBER 2016
British Engineering Excellence Awards
HAC, London

19 - 20 OCTOBER 2016
Engineering Design Show
Ricoh Arena, Coventry

02 - 03 NOVEMBER 2016
Innovate 2016
Manchester Central Convention Complex

07 - 11 NOVEMBER 2016
Tomorrow's Engineers Week
Nationwide

16 - 18 NOVEMBER 2016
CWIEME Istanbul
Istanbul Expo Centre, Hall 11

29 NOVEMBER 2016
NIDays – Graphical System Design Conference
QEII Conference Centre, London

12 DECEMBER 2016
What next for British science?
Central London

13 DECEMBER 2016
National Instruments Hands-on Taster
NI HQ, Newbury

20 - 22 JUNE 2017
CWIEME Berlin
Messe Berlin

ADVANCED MANUFACTURING AND AUTOMATION CENTRE OPENED

THE £1.2MILLION ADVANCED Manufacturing & Automation Centre (AMAC) has been opened in Blackburn. It includes advanced equipment alongside a dynamic team of trainers recruited directly from industry, the AMAC is a unique facility which enhances the skills of engineers and manufacturers through powerful, bespoke training.

The training centre will enable more people to study for Higher Engineering Apprenticeships and take part in upskilling programmes. Successful apprentices will have the opportunity to continue their studies up to degree level.

The project has been helped thanks to £800,000 received from the Lancashire Enterprise Partnership (LEP) towards the cost of the facility, as part of its £30m Growth Deal Skills Capital Programme to improve the skills of thousands of people in a number of key areas of Lancashire's economy.

SOLUTION TO LAST MONTH'S

Coffee Time Challenge

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Last month's Coffee Time Challenge was to think about the next generation of personal assistants. The solution we had in mind was Moorebot, an animated robot for homes, businesses and office use.

It combines robotic technology and cloud intelligence with a unique 'one eyed' camera design that can abstractly mimic human eye expressions. Like a living thing, it responds to its environment and even learns to respond to various spoken commands and instructions.

Underlying the overall simplicity of the look is a sophisticated mechanical design with four high precision motors that control the movement of Moorebot's head, eye lid and eyeball, enabling a wide range of fun and dynamic movement options.

It dances, it sings, it can be happy, it can be sad. According to inventor Pilot Labs, it is not just a personal assistant, it is an entertainer as well.

For more information, go to: www.moorebot.com

DFT MULLS FUTURE RAIL STRATEGY FOR DRIVERLESS VEHICLES

SENIOR OFFICIALS AT the Department for Transport are mulling future rail expansion plans in light of the fast moving developments around autonomous vehicle technology. Rather than further large scale developments beyond HS2, the idea of a motorway for driverless cars is being contemplated, though any formal study is still some way off.

Autonomous vehicles could instead be used as an on demand pay per travel service, would be able to form 'trains' on motorways to get aerodynamic benefit, offer increased flexibility for travellers and the potential for higher passenger density. A motorway option would also be potentially lower cost, with vehicles supplied by private companies, rather than costly rolling stock that would require Government buy-in.

TECH **BRIEF**

World's most efficient electric propulsion system for marine vessels

ABB's latest podded electric propulsion system, Azipod XL, increases vessel fuel efficiency up to 20% compared to modern shaft line propulsion systems. The efficiency gain is achieved by a unique nozzle system that accelerates the water flow into the propeller to increase thrust, and by redesigning the thruster for reduced water resistance.

Azipod propulsion is a gearless steerable propulsion system with the electric drive motor located in a submerged pod outside the ship hull. Having 360° manoeuvrability, it is used to steer and drive a broad variety of vessels at the same time.

The Azipod XL concept can be designed to give high bollard pull thrust at lower speed and still have good characteristics at higher speeds. Thus it fits vessels such as tugs and offshore construction vessels, as well as ferries and LNG tankers.

The propulsion's features include the capability for advanced condition monitoring utilising ABB's concept of the Internet of Things, Services and People (IoTSP) and its Integrated Operations Centres for Marine, continuously monitoring equipment and performance parameters of more than 600 vessels.

"Azipod XL represents the biggest jump in the systems' fuel efficiency in recent years," said Peter Terwiesch, president of ABB's Process Automation division. "To put it in perspective, replacing all existing Azipod units with the new model would save the shipping industry an additional 2.2million tons of fuel and 7million tons of carbon dioxide over the next 25 years."

GRAPHENE INFUSED EPOXY EYES PREPREG

HUNTSMAN ADVANCED MATERIALS wants to incorporate graphene into its ARALDITE epoxy resin systems, currently used in many advanced composite materials. It hopes the use of graphene could lead to a new generation of composites that are ultra-light, flexible and electrically conductive.

Huntsman's research involves using a low temperature plasma (under 100˚C) patented by one of its partners, Haydale Composite Solutions, which activates and allows modification of the nanomaterial's surface energy and enables dispersion into a host medium, such as resin. Without using chemical acid treatments which can cause damage and degrade functional performance, this process maintains the structural integrity and mechanical strength of the final product.

Taking test plates cast from the activated graphene mixed into master batches of various concentrations of ARALDITE epoxy resins, Huntsman has been conducting a series of physical, electrical and thermal tests in the continued evaluation of the composite performance.

So far, an ARALDITE Euremelt hot melt resin and a general purpose epoxy resin have been specified to look at developing new prepreg applications using the former and advance other types of composite processes, such as filament winding and Resin Transfer Moulding (RTM), with the latter.

David Hatrick, European technology director of Huntsman Advanced Materials said: "This work is set to deliver the platform for a new range of graphene-enhanced ARALDITE resins which will benefit the industrial composites, automotive, aerospace and other markets.

"We are now focused on the further demonstration of these resins in composites manufactured with a range of typical processes used by our end customers."

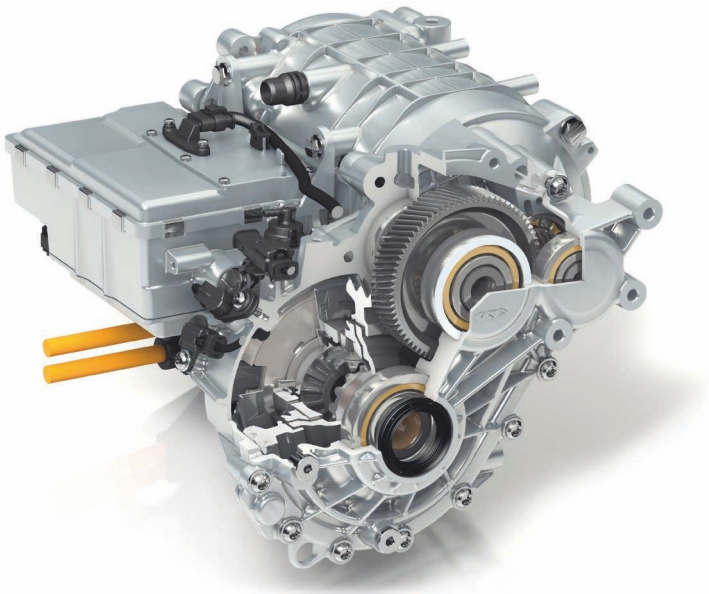
GE in £1bn 3D print acquisitions

GE has announced plans to acquire two suppliers of additive manufacturing equipment, Arcam and SLM Solutions, for a total of £1.05bn, in a bid to grow as a digital industry company.

"We are poised to not only benefit from this movement as a customer, but spearhead it as a leading supplier," said Jeff Immelt, chairman and CEO of GE. "Additive manufacturing will drive new levels of productivity for GE, our customers, and for the industrial world."

GE expects to grow its additive business to £750million by 2020.

Arcam invented the electron beam melting machine for metal-based additive manufacturing, and also produces advanced metal powders. SLM Solutions produces laser machines for metal-based additive manufacturing.



BIG WIN FOR GKN

GKN DRIVELINE HAS developed an electric drive system for plug-in hybrid vehicles that will go into production in 2019 on a global European vehicle platform.

It is a big win for the company that has been advancing the development of its eAxle technology since 2002. The new module integrates a water-cooled electric motor and inverter with a single speed eAxle reduction gearbox.

Peter Moelgg, chief executive of GKN Driveline's eDrive and AWD business, said: "Automakers increasingly want complete eDrive systems from suppliers, rather than sourcing different elements from different companies. This is the first all-in-one eDrive system to replace external wiring with a bus bar to eliminate unnecessary mechanical interfaces. The result is an eDrive system with higher power density that is simpler to install."

The system generates a maximum 65kW of power and can deliver up to 2,000Nm of torque to the rear wheels. The complete eDrive module measures 300mm high and 325mm wide and weighs 54kg, making it around 20mm narrower and 2.5kg lighter than comparable systems.

Materials engineer scoops enterprise award

A PhD student at the University of Manchester, Sebastian Leaper, has won the Eli and Britt Harari Graphene Enterprise Award 2016 for his business proposal to develop world changing water filtration technology using graphene.

The £50,000 prize money will help to fund the project to revolutionise current desalination methods, which are costly in terms of energy usage and require need pre-treatment.

Using a graphene membrane in the desalination process can help improve the process and fine-tuning. Its properties can overcome some of the challenges associated with desalination as it can allow water to permeate through them with hardly any resistance.

This uses less energy and is not susceptible to clogging. Untreated water can also be used in the membrane, making it low maintenance.

LAID BACK APPROACH TO AERODYNAMIC DRIVE

Designing a sports car starts with making it look good. Or does it? Elemental started with aerodynamics and it resulted in a fundamental shift in the driving position.

Elemental kicked off in 2012 when former McLaren engineer John Begley set out on a quest to design and build the ultimate lightweight track day car that would also be road legal.

It was a notion that came to Begley when he was trying to buy himself a track day car and found during his test drives that every car was a compromise – there was always something in the design, the performance or the functionality that could be done better. And so he set out to try and do better.

His goal was to design a car that would be capable of driving to Le Mans, a car designed with F1/LMP inspired aerodynamics, cutting edge materials, modern powertrains, and built to the highest production standards. LMP (Le Mans Prototypes) require all the mechanics to be covered and are regarded as the fastest closed wheel cars.

Peter Kent, another ex-McLaren engineer who built up experience of composites working on the P1, has had a critical input into the design of the car. However, the use of advanced materials was always going to be a given. The fundamental design was not. ''It's all derived from the aerodynamics,'' he said. ''The aerodynamics has defined the seating position of this car and it turns out that it's incredibly comfortable. So it actually made it quite hard for Guy [Colbourne], who's done all the styling on the vehicle, because a lot of the time styling dictates and it can have a detrimental effect on the aerodynamics or the performance. But not with this one, performance comes first and then styling has to fit around that, whatever the cost.''

Mark Fowler, co-founder of Elemental, brought his F1 experience of aerodynamics to the company. Introducing the novel seating position, otherwise only used in motorsport, needed some hard evidence if it was to become the starting point for the design. ''I think the most elegant way to generate downforce is with the floor,'' commented Fowler. ''You don't have any wings and aerofoils sticking out. It's also very efficient because you've got a very large surface. The air's going to go into the car anyway, so all we wanted to do was use it. So by putting the feet up, you can fit in a front diffuser and, by packaging the engine longitudinally, we can fit in a large rear diffuser.''

More importantly it means the path the air takes can be started early and use the full length of the car, so the maximum amount of 'work' can be extracted from the air. This aerodynamic work is essential because the vehicle is so light (either 540kg or 580kg depending on the engine) and therefore not supplying enough intrinsic load on the tyres to provide grip while cornering at high speed would result in poor handling.

Essentially, said Fowler, it operates like an upside down wing with a splitter at the front of the car sending as much air as possible under the car. ''The more air you put under there, the lower the pressure you get. Then, once you have that air, you want the big diffusers to extract work from it. By giving those diffusers as much air as possible, you maximise the amount of downforce they can generate. So that's why it was conceived right from the start.''

More complex analysis was to follow as iterations of the concept developed. Such analysis required more sophisticated software and for this Elemental turned to LCS, a consultancy specialising in Computational Fluid Dynamics for high-end customers. Its CFD package, Fast, was used to refine the design of the RP1 – the name of the launch vehicle.

This is authentic, high-end technology,'' said LCS' CEO Mark Taylor. ''Freeware was a useful tool initially, but no use if you want to get the type of performance these guys want. They have twice the downforce of any of their competitors. They definitely do have that, although some of their competitors are not so sure how. So as soon as you want to push the boundaries like that, you need the higher end tools to be sure of the accuracy, which is where we came in.

''The first thing we did was take the concept car to a wind tunnel to verify our CFD was right. Because CFD is a mathematical model, it has assumptions about turbulence. So the first thing we have to do is make sure that your mathematical model is correct. Having established that with data from the wind tunnel, we can do the next design with confidence.''

Using this tool it was possible to tune the aero balance on the front and rear axles, ensuring that the car behaved properly – no understeer or oversteer when it was operating at its limit. Taylor continued: ''We can refine that based on what Mark [Fowler] understands from the mechanical side. So from the vehicle dynamics side you get the aero integrated with mechanical and the driver gets the optimum car behaviour. So before Elemental spent any money making carvings or designing the tooling, they know it's going to work.''

RP1 VITAL STATISTICS

WIDTH	1775 mm
LENGTH	3740 mm
HEIGHT	1070 mm
GROUND CLEARANCE	110 mm (adjustable)
TURNING CIRCLE	10.2 m

1.0L ECOBOOST

MAX SPEED	145 mph
0–60MPH	3.2 sec
0–100MPH	7.8 sec
POWER	180 bhp
WEIGHT	540 kg

2.0L ECOBOOST

MAX SPEED	165 mph
0–60MPH	2.8 sec
0–100MPH	6.4 sec
POWER	320 bhp
WEIGHT	580 kg

MATERIAL MATTERS

The original plan had been to build an aluminium frame and clad it with carbon or glass fibre bodywork. It took a long time to build so the company pulled on its experience of composites in Formula One and aerospace, and decided to make the central tub of carbon and bolt the

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front and rear chassis on to that. Kent said: ''We were really pleased with the results on that and the torsional stiffness is phenomenal.''

The material is a prepreg carbon fibre material that is well proven in F1 and aerospace, but it comes at a cost. However, when Kent looked further into the reason why it cost so much it revealed the material itself is not expensive at all, the costs come from the labour intensive methods in which parts are made.

Kent described how Elemental tackled the problem: ''We developed processes that completely minimise that labour time. That's how we've got the cost out of it, but still use the very high-tech material.''

That process was developed with a Portuguese company called Optimal Structural Solutions (OSS), who manufacture the tubs and all the composite bodywork.

OSS is run by another McLaren associate, Antonio Reis, who became involved when Elemental started to gear up towards production.

Kent said: ''He's known about this project from day one and he's always done the stress analysis on the vehicle. He's set up a tooling and composite manufacturing business in Portugal – he wanted to be part of this and we were really happy for him to be manufacturing the parts for us, it just seemed perfect.''

Taking the cost out of the moulding process essentially came down to making it very quick and easy to produce, by designing it in manageable pieces.

Rather than try and use a single sheet to make an entire moulding, a kit of plies in easy shapes is created.

''If you're clever about the way you split it up, it becomes incredibly easy to laminate a part,'' said Kent.

There are actually four composite parts now in the tub – two side pods, the dash panel and the centre console – along with the aluminium floor and bulkheads.

Just about everything else on the vehicle is made within a 20-mile radius of the Elemental base in rural Hampshire. Even the engine comes from the Ford dealership in Portsmouth.

One departure in the material regime is the rear wheel arch, where Elemental is trialling a new carbon fibre composite from Coats Industrial. Processing it is a two part drill, different from the other moulding techniques.

''It's not complicated once you've got the tooling,'' said Kent. ''There are initial tooling costs for this, but part cost is minimal. Because it's a brand new process, we would look to start using it in other areas of the car. And also, unlike a lot of other new materials out there, you can keep 99% of the properties of the material. You can align the fibres in exactly the direction, and orientation, that you want them. It's called tailored fibre placements.

''When we designed the tub, this material didn't exist. We were approached by Coats and Shape Machining, who do work with us on this car. They approached us and said, 'we'd like to trial a part on the car'. So we had a look around the vehicle and thought, right, what can we start with? This [the rear wheel arch] actually seemed perfect because it's going to get a whole load of stuff thrown at it by the tyre and it's got to be fairly stiff, because it's linking one of the 200L luggage pods to the rear structure.''

The balance is delicate. Higher tooling costs against lower piece costs on account of the reduced manufacturing time. Potentially the material could be rolled out to all the other body parts of the car.

ROLL OUT

The pre-production car made a successful debut in June doing the hill climb at the Goodwood 2016 Festival of Speed and the first production models have rolled off the assembly line since. But has it satisfied Begley's original vision – a road/track high performance car with no compromises?

His response is confident: ''It looks like it's going to be unnerving to get in, but the controls and the feel of the car, just feels right. The performance is extreme, but you can work within that. It's not hit the pedal and you go at a million miles an hour; it's controllable.''

ENGINEERING DESIGN SHOW

WANT TO FIND OUT MORE?

Design manager Guy Colborne will be presenting at the Eureka! Conference during the Engineering Design Show, at 09.15 on 20th October.

The actual Elemental Rp1 will be there to admire in the Innovation Zone.

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RESPECT ENGINEERING

Engineers aren't known for their need to form close relationships but, at the pinnacle of sport, it can mean the difference between finishing first and last. Justin Cunningham talks to Ben Ainslie and Martin Whitmarsh about its importance.

As far as names go, Ben Ainslie and Martin Whitmarsh are pretty impressive ones. Both have carved out distinguished careers in competitive sport and have been reliant on forming close relationships to be successful: Whitmarsh with his drivers, Ainslie with his boat builders and coaching staff.

Both are entering a new phase in their careers. Whitmarsh, after acting as team principle for the McLaren Formula One team and Ainslie after repeated Olympic gold medal glory. Despite their amassed success, both are seeking more by entering a race never won by a UK team. So why is the America's Cup so important?

"It's the history and the aura of the America's Cup," said Ainslie. "It started in the UK in 1851 and an American boat won. They took the trophy back to New York and renamed it the America's Cup. We've never seen it since. So it's really important to right that wrong in our maritime sporting history."

Like a modern Formula One team, the America's Cup has evolved into a highly technical sport that requires many top experts and engineers to give the sailing crew a reasonable chance to fight for a win. The price tag for development and entry runs in the region of £100m, meaning Ainslie needed organisational and engineering nous to form a serious bid. He needed a team principle.

"My goal was to find somebody that could take on the day to day running and allow me to focus on the sailing and performance on the water," he said. "It took quite a while to find the right person, but it was probably the most important decision for me in this campaign.

"Within five minutes of meeting Martin, it was clear he was the right guy. His personality, mindset and experience – and ability to tap into other industries here in the UK in terms of technology and engineering – were really strong."

That ability to bring in external expertise is something that has fundamentally changed Land Rover BAR's operation and put it in serious contention. For Whitmarsh, it was the challenge he was looking for post-F1. So how does it compare?

"There are a lot of similarities with F1," said Whitmarsh. "You need the best technology, the best sailors, the best team and the best organisation to win."

It's meant that for the most part, Ainslie has to work alongside a host of expert engineers and discuss with them the issues he's facing and what can be done to go faster.

"I'm not an engineer by background or by training," said Ainslie. "But, the crew and I, sailing the boat, need to give technical feedback to designers and engineers. It's absolutely critical we get involved with that."

Ainslie sits in on the weekly tech review meetings that includes all of the key designers and engineers to discuss progress and problems,

Photo credit: Lloyd Images.

MARTIN WHITMARSH AND BEN AINSLIE

MARTIN WHITMARSH is Chief Executive Officer for Land Rover BAR, a position that he formerly held with the McLaren Group. Whitmarsh studied engineering at Portsmouth University, before starting his career at BAE Systems. He was quickly promoted to work on advanced composites in Weybridge, rising to manufacturing director before moving to join McLaren as Head of Operations in 1989.

By 1997 Whitmarsh was managing director of the McLaren Formula One team, eventually rising to CEO of McLaren Racing alongside his role as deputy chairman of the McLaren Automotive Group.

SIR BEN AINSLIE is the most successful Olympic sailor of all time. At his first ever Olympic Games, aged 19, he won an Olympic silver medal and went on to establish himself as the world's best by winning consecutive gold medals at the next four Olympic Games.

In the summer of 2013, he went on to join ORACLE TEAM USA for their defence of the 34th Cup, helping the American team win the event, 9-8, against Emirates Team New Zealand.

Now stepping into a new role, as BAR Skipper, Ainslie will develop and lead the British entry into the 35th America's Cup, with the aim of bringing the trophy back to Britain where it all began in 1851.

philosophies and strategies. However, like Formula One, what the crew thinks is a good idea or problem, is not always the same as the engineers. Fortunately, Whitmarsh is used to managing that difference in opinion.

"I've found, in a past life, that to reconcile the thoughts, ideas and views that differ between engineer and driver, data is a good place to start," he explained.

Like Formula One, the Land Rover BAR boat is full of instrumentation – around 400 to 500 channels measuring all sorts of parameters.

"Data is a great leveller," he continued. "An engineer's role is to pull out something from that data to help train or educate a driver or sailor. But, ultimately it is the skipper or driver that decides how late to turn and how daring to be."

Data also helps here, as the refined engineering of the boat means that a great deal of tailored adjustment needs to happen to give Ainslie and his crew confidence in the boat's capability in the heat of the moment, and allow them to push the performance envelope to the absolute limit. However, for all that data, it's important that engineers pay close attention to the most refined sensors on board: Ainslie and his crew.

"Engineers can be a bit dismissive about a driver or a sailor's 'feeling'," said Whitmarsh. "They might think, 'calibrated sensors are giving us high frequency real world data, I'll trust that over a human response'. But with the best racing drivers and sailors in the world, the 'feeling' and feedback they have is nothing short of amazing."

Whitmarsh has worked with Formula One legends and recalls also being dismissive earlier in his career, putting driver comments down to ego and emotion. That soon changed.

"I've always been astounded," he said, "that if something is wrong – a vibration, a noise, a tone, a feeling – these guys are so super sensitive that they notice it before we see it in the data. Over the years, I've found myself having to tell engineers to listen, and trust, the driver.

"Building that trust and relationship is vital. The driver has to believe in the engineer, and the engineer has to believe in the driver, if you are to be successful and ultimately win races."

Q&A

0808 274 2837 hello@ntcadcam.co.uk

SOLIDWORKS 2017 means new CAMWorks for Manufacturers

Momentous things are happening in Computer Aided Manufacturing (CAM) software right now and with the launch of SOLIDWORKS 2017 imminent, CAMWorks updates aren't far behind. New Technology CADCAM's Business Development Director Ian Weston tells us more.

What's the hottest thing in manufacturing right now?

Model Based Definition (MBD). SOLIDWORKS MBD, which provides Product Manufacturing Information (PMI) and geometric dimensioning and tolerancing instructions in 3D CAD design, was launched last year and is amazing. Now CAMWorks, our CAM software that's fully associative to SOLIDWORKS 3D CAD, is launching CAMWorks MBD that will automate the transition from design to manufacture.

What 'pain points' are customers asking you about?

Model integrity is crucial for any manufacturer. Often, we see a product design being moved from supplier to supplier and potentially going through several different CAD systems before it gets to the manufacturer. The problem is that every time that file is opened and saved in another format, it is losing some of its data integrity. If there is any data lost in translation, then the manufacturing process can easily be compromised. We help our customers that require good quality, stitched surfaces fix this problem with a clever piece of software called TransMagic.

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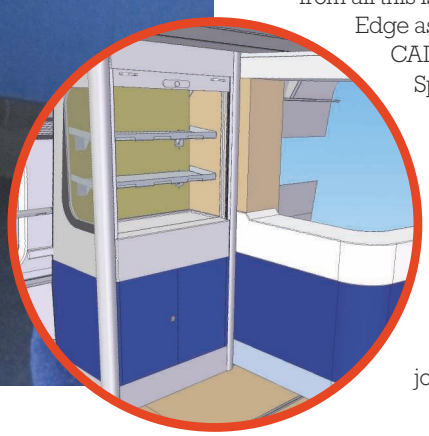
nt CADCAM

RIGHT PLATFORM FOR EVERY TRAIN

Recent Governments have seen the virtues of a competent rail system and have invested accordingly. Such investments might not appear evident to Southern Railway commuters, but for engineering these are good times. Tim Fryer reports.

New projects, like Crossrail and HS2, obviously help, but there has been long overdue investment in the existing network and rolling stock, which is gradually creeping back to 'fit for purpose' condition, through supply of new trains or refurbishment of old ones.

One of the problems with the railways in the UK is that there are so many stakeholders, and this in part contributed to underinvestment in previous decades. Since the days of a single nationalised entity, the rail sector is populated by numerous organisations who design, make, own, operate and regulate both rolling stock and infrastructure. SNC-Lavalin Rail & Transit fits into the mix as, originally, a designer of trains under the guise of Interfleet which was one of the companies that sprung out of the dissolution of British Rail. SNC-Lavalin, with its wider interests in infrastructure, bought Interfleet four years ago and now has involvement in rail network infrastructure projects as well.



An interesting thing to emerge from all this is the adoption of Solid Edge as the predominant CAD platform. Graham Spencer, design engineer for rolling stock enhancements at SNC-Lavalin, started designing for the rail industry just at the time mainstream CAD was making its mark in the 80s. His first job was working for

British Rail Engineering (BREL), formed out of the breakup of British Rail. He commented: ''I went on to a CAD terminal then; it was MicroStation because that was the main tool in the rail industry at the time. It was mapping software at one time for things like the surface of the Earth. It was brilliant. Then they tried to put an engineering base into it, and that's probably one of its drawbacks. But I used to like using it, at the time it was a good tool.''

BREL decided that it needed to change its CAD platform and spent a year deciding which one to use, finally plumping for Solid Edge. During subsequent company changes to ABB Transportation, Adtranz, Bombardier and finally SNC-Lavalin, Solid Edge has remained the CAD package of choice. In fact, given that much of the rail industry's family tree has a common starting point, it is no surprise that most design houses in the sector use Solid Edge.

So why has the industry stuck with it rather than move onto higher end products? Apparently there was a move from Adtranz to impose CATIA on its supply chain, but users found it too expensive and difficult to learn at the time. Nor does Spencer think that using a mid-range package like Solid Edge place any limitations on the work he does.

Also in the Siemens family, for example, is NX. ''It's surfacing tools are far superior to Solid Edge's surfacing tools,'' admitted Spencer, ''but they're not things that bother me. I can create all of the surfaces I need with what tools I've got. I'll be honest with you, I have not designed an engine on Solid Edge, those are things that the rail industry buy from a specific supplier. But I've designed everything else on a train – the bogies, the structure, the interiors, the seats, everything I've designed using Solid Edge. If we got an order tomorrow to design a train, we would be able to do it using Solid Edge. We wouldn't need any other tools.''

Other tools do have their uses. Much of the investment in the rail industry has been ploughed into refurbishing the existing rolling stock. ''There's rolling stock in this country that was planned to be scrapped many, many years ago but has been refurbished and is still running,'' said Spencer. ''But some of it's not going to last much longer.''

Britain's railways are the most improved in Europe, according to a 2013 European Commission study across the European Union's 27 countries

A Retail Unit (main picture p23) added to the MK4 Catering Cars (operated by East Coast Franchise at the time), with an image from the CAD model (inset). The main picture above is a rendered image of the model, with 'see-through' (inset).

To add equipment or adapt the vehicle in any way, it needs to have a current CAD file and this is not always the case, so measurements need to be taken and models created. It can be a slow process and, as Spencer points out, it's all just background: ''It's just scenery and you can spend a lot of time creating scenery. So people are looking at using scanners to get point cloud information for the scenery. At the moment Solid Edge can't accept point cloud information, but NX can. So we're looking at that to speed up the way we work. We would use NX to create solid models, but we would then carry on the work in Solid Edge.''

One of the problems with old rail carriages, and sometimes the factor that makes refurbishment a necessity, is the need to comply with legislation regarding People with Restricted Mobility (PRM), which needs to be adhered to by 1 January 2020.

All new trains are compliant with these latest accessibility requirements, but cost will prevent the UK having an entirely new fleet by the time the legislation requires. ''A lot of the refurbs are due to making vehicles suitable for disabled people. Some have got standard toilets, the ones where you stand there and you're touching both walls. That's no good for a disabled person in a wheelchair. So you put in a larger toilet [a UAT – Universal Access Toilet], and that moves the carriage seats about. If you modify one area of the train, you've got to do the rest of it - they change the seat layouts and carpets and so it becomes a full refurb in effect.''

It all paints a positive picture. Spencer concludes: ''It's a good market because successive Governments have invested in the rail industry to improve our infrastructure and improve the rail – so it's a good industry to work in at the moment.''

UK RAIL - FAST FACTS

TRACK KILOMETRES	32,000
STATIONS	2,500
TRAINS	4,000
DAILY SERVICES	20,000
PASSENGER JOURNEYS	1.5 BILLION
FREIGHT TONNES	110 BILLION
UK JOBS	200,000

SOURCE: UKTI

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FIRST OF THE MOHICANS

A novel design could revolutionise the torque coupling world dominated by universal joints and gear couplings. Tim Fryer finds out more.

Sometimes a good idea spawns another, then another and soon that idea turns into a whole range of products or technologies. This is the case at Punk Couplings, where the quest for lightweighting a downhill trike resulted in the development of a technology that may have applications wherever a system has parts that move relative to each other. From a mechanism in a photocopier to the drivetrain of a cargo ship.

Bored skiers, thought Simon Parker, needed some high-speed downhill thrills when the snow was scarce, so he started working on a high performance downhill human powered Tadpole Trike. Prototypes showed the need for lightweighting. Not to increase speed, it already reached 75mph, but to provide control at such speeds. Parker explained: ''They had a very unresponsive suspension. I found if I was going pretty fast down a mountain and one of the front wheels hit a rock you would take off and rotate axially thus landing on your face. I'd almost parked the design because it wasn't going to be a safe vehicle. So I had a think about that, and this is where the Punk story starts.''

Much of the weight was in the steering hub so Parker, for the purposes of making a better trike, developed Punk Hub centred steering. ''What we've got here is a male and female nesting ring with spherical surfaces and loading slots,'' described Parker. ''Then the cylindrical key ways which we call mohicans because they look like the punk haircut. These control the plane of movement.''

It allowed ±15° movement of the front wheels, more than enough for a high speed vehicle, and an assembly that weighed a quarter of the one that it replaced. Parker said: ''It gave us a much more responsive suspension due to the reduced unsprung weight and so the wheel can change direction very quickly.''

(Above) A selection of Punk Prime torque couplings.

FIRST TEST

PUNK COUPLINGS

Inventor Simon Parker tested several early Punk Coupling prototypes in his garage using a lathe to power the rotation of a pair of Punks connected via a misaligned driveshaft. A motorcycle hydraulic disk brake with a weight attached to a master cylinder provided the load, which had to be cooled with water to stop it glowing red hot. It successfully ran for 10 days to reach a million cycles. The test was critical in designing the self-lubricating function of the Punk.

It then occurred to Parker that adding a third ring with a plane of movement at 90° to the other effectively created a universal joint that could be used for torque coupling. Given the vast number of applications for torque couplings, the focus over the past couple of years has been to refine the design to build in sealing and lubrication.

The technology has evolved into two core streams: The Punk Prime, which is the original concept of the three nested rings guided by the mohicans; and the Punk Gim-Ball. Again its core components are three nested spherical rings with the mohicans replaced by axles to produce an equivalent pair of rotating axes, again at 90° to each other in the same way as the mohicans are in the Punk Prime. Patents for both the Punk Prime and the Punk Gim-Ball have now been granted and Punk are seeking to licence its technology to manufacturers.

> "It looks like a bearing, but actually it's the complete opposite. Bearings by definition don't transmit any torque."
>
> SIMON PARKER

In the Punk Prime the pressure is distributed across a relatively large surface area and so it can be used in high torque but lower speed applications, but the consequence of this large surface area is that bearing pressure is low but the surface velocities are high due to the distance from the centre of rotation. Conversely the contact point at the axle of the Punk Gim-Ball is much smaller, so it is not capable of as much loading, but can move faster than the Punk Prime.

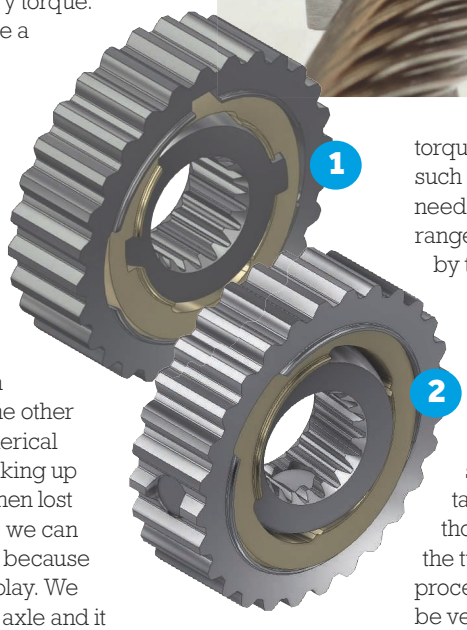
Figs 1 and 2 show the Punk Prime and Punk Gim-Ball respectively, while Fig 3 shows the Failsafe version, which is where the two streams of evolution merge to form a hybrid solution.

Parker claimed: "We have a combined axle and mohican solution, which we believe is the world's first waiting fail safe geometric coupling." Non-geometric options are available that rely on the deformation of materials, like bending springs or elastomerics, but this is the only one with perfectly fitting geometry.

Failsafe is important in such sectors as aviation, where a monitored gradual part failure is appreciated more than a single, unexpected catastrophic failure. Parker explains: "This particular failsafe has been weighted in the direction of high torque low speed, so we've made the mohicans the primary torque. In aerospace we have a term called damage tolerance, which means 'can it break and still carry on operating?' We've got an interesting case here, which we believe is unique, in that we could lose one mohican and it would still carry on operating with just the other one because the spherical surfaces then start taking up that kick load. If we then lost the second mohican, we can tolerate that damage because the axles come into play. We could lose one more axle and it would still carry on operating, with just one axle."

The largest application areas basically fall into either an alternative for a universal joint, or as a new form of gear coupling, but both are essentially transmitting torque. Early target markets are industrial, aerospace, automotive and marine but it extends into any application where there is a mechanical motor driving something with rotational movement.

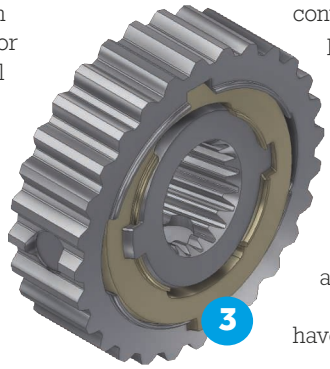
In static rotating equipment such as industrial machinery, factors such as manufacturing tolerances, vibration, thermal expansion, structural flexing and wear require the misalignment to be compensated for by a flexible torque coupling. In dynamic systems such as a vehicle these factors still need to be considered, as well as the range of movement/travel required by the driven elements.



Top: A PunkNut leadscrew assembly.

Above: Figs 1 and 2 show the Punk Prime and Punk Gim-Ball respectively.

Below: Fig 3 shows the Failsafe version.



Parker worked in large passenger aircraft design in the past and during his involvement published 19 patents, two of which have found applications in the newest models. It is no surprise that one of his first target markets is aerospace, even though he concedes that, due to the type of product and certification procedures, 'talking to aerospace can be very frustrating'.

This early stage study is involved in the deployment of flaps on the trailing edge of aeroplane wings. Wings bend up and down in flight depending on how much fuel they are carrying, how much lift, where they are in the flight cycle and so on, and the resultant angle of misalignment needs to be catered for in the flap control. Parker looked at solving this problem with Punk's couplings. He said: "Our analysis showed we could potentially save several kg's per aircraft on the first pass. We were encouraged by this large passenger aircraft manufacturer to go and talk to their Tier 1 suppliers, which we are currently doing."

The analysis mentioned would have been the output from the

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company's 'Punk Coupling Sizer and Analytics Software', which is capable of automatically sizing and performance analysing a Punk coupling for any given application. The software outputs component dimensions for specified variables such as shaft size and maximum misalignment angle. User defined options on interface type (key or spline), materials and sealing methods are automatically incorporated into the design.

Having created what it calls the Punk geometric philosophy, the problem becomes focussing on a manageable product range, as applications and variations are abundant. For example, the 'double Cardan' coupling to deliver constant velocity through a misaligned drivetrain can be resolved with a 'double Punk' – two Punk Primes connected with a common sleeve.

Other variations include the PunkNut, which applies the philosophy to leadscrew and ballscrew nuts in linear actuators as a means of accommodating angular misalignment between the leadscrew or ballscrew and carriage rails. In this application the inner surface of the inner ring has the lead nut thread or contains a ballscrew nut. The axial load is carried by the spherical surfaces and the axles purely react the torque of the leadscrew, or ballscrew, and nut. Simple linear slides allow movement, which is particularly useful when accommodating variations in a system.

For example, one large boat manufacturer was looking for a better way of controlling a moveable sun deck. The parallel guides were on either side of the boat at some distance apart, and set up was difficult because tolerances were minuscule. What's more the material of choice in such environments is GFRP, which will flex. PunkNut in this application allows more forgiving installation reducing assembly time. The resulting mechanism will deal with the structural flexing of the system it's bolted to.

''This is a completely unique product which seems to have set the industry alight,'' claimed Parker. ''We showed a demonstrator to a group of manufacturers who've been doing this for 30 years and they couldn't believe what they were seeing. This is just an example of one of the spin-off products from this geometry. It's not just torque couplings which is the message I'm trying to get across.''

COMPARED TO UNIVERSAL JOINTS

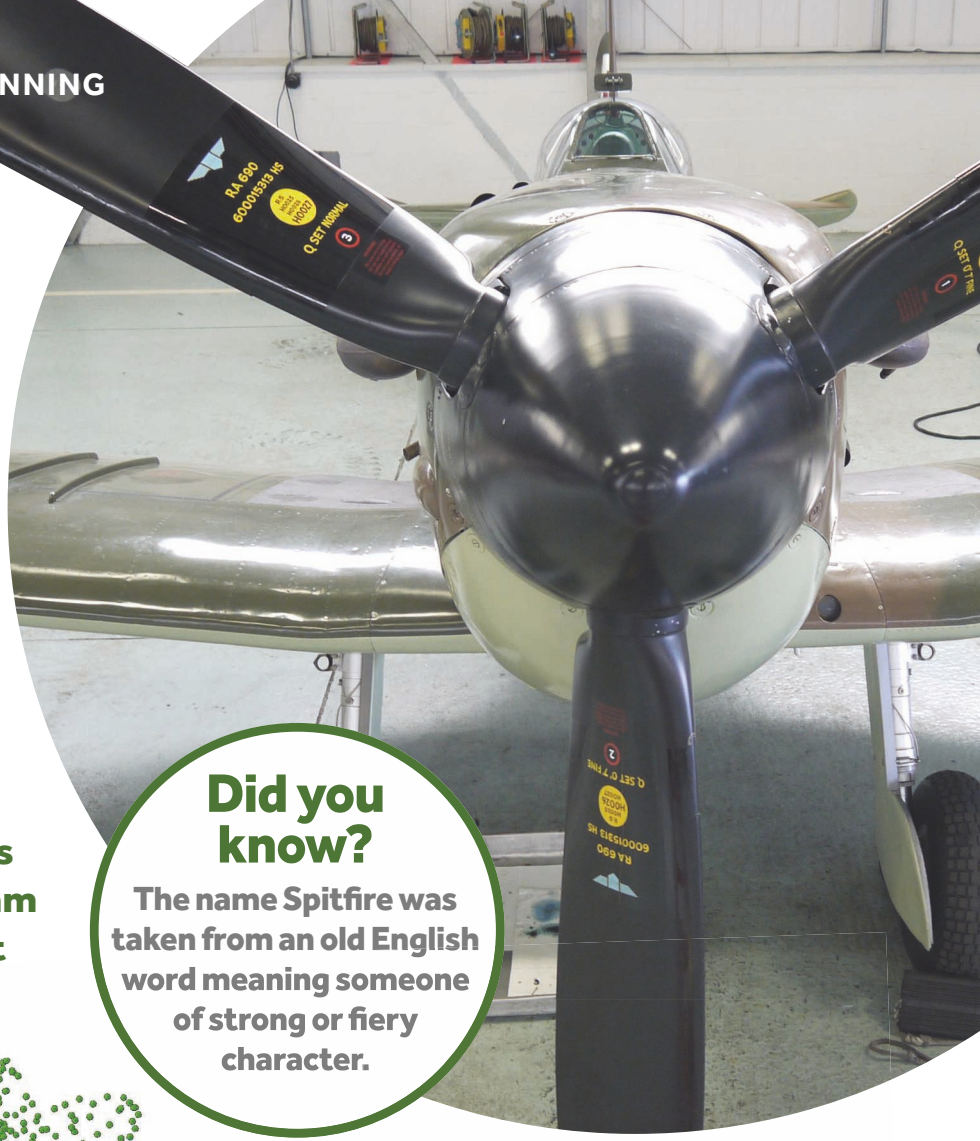
- Increased torque transmission capacity.
- Reduced moving parts and parts count.
- Reduced space envelope.
- Increased torque density (i.e. reduced weight).

COMPARED TO GEAR COUPLINGS

- Increased misalignment capability – up to 15°.
- Zero/low backlash.
- Axial load capacity.

STILL KING OF THE SKIES

It's an icon of British engineering prowess and ingenuity, and still turns heads 80 years on. Justin Cunningham finds out why they really don't make them like they used to.



Did you know?

The name Spitfire was taken from an old English word meaning someone of strong or fiery character.

It is perhaps the most revered British engineering icon of the last century. The Spitfire is hailed as a marvel, a saviour and king of the skies. It draws attention from all walks of life, turns heads and continues to be a household name 80 years on from getting off the drawing board.

You'd imagine then, it's a pretty big responsibility if you are asked to work with one of the few that remain flying, to capture its unique form for the digital archive.

Woking based Physical Digital specialise in taking physical things and making a digital representation of them and were given the daunting but exciting project. Managing director Tim Rapley is no stranger to working alongside iconic names in engineering, having previously worked at McLaren, but that didn't stop a certain amount of awe as he got up close to a still flying Spitfire that had seen battle in WWII.

"We got every rivet head, every repair, and every aero-surface so we could understand the geometry of the whole aircraft," he said. "I didn't realise how much of it was not aluminium, but actually cloth. That amazed me. There is no cockpit floor either, it's just spars and webs."

So how does the Spitfire compare under a modern engineer's eye?

"The detail of engineering and riveting is phenomenal," he said. "To think they were making one every 24 hours in war time – you think how long it takes to restore one of these planes now?! The engineer inside me was in awe of how they productionised it. The build quality and tolerances are still so impressive."

The Spitfire in question is part of the last remaining group of original WWII RAF aircraft and is part of The Battle of Britain Memorial Flight (BBMF) fleet based at RAF Coningsby in Lincolnshire, which is made up of other legendary aircraft including two Hawker Hurricanes and the UK's last flying Lancaster.

The MkIIa Spitfire has the unique number P7350 and took part in the Battle of Britain. It is the oldest remaining flying Spitfire and, over the course of the war, it was shot down three times before being promptly repaired and sent back in to battle.

THE PROCESS

Physical Digital was appointed by Amalgam Fine Model Cars to create the highly accurate digital model of the MkIIa Spitfire. Amalgam

FAST FACTS

ROLE	Fighter / Photo-reconnaissance aircraft
MANUFACTURER	Supermarine
DESIGNER	R. J. Mitchell, an engineer at Supermarine Aviation, designed the Spitfire originally to be a high performance, short range plane
FIRST FLIGHT	5 March 1936
INTRODUCTION	4 August 1938
RETIRED	1961
PRODUCED	1938–1948
NUMBER BUILT	20,351
WEIGHT	2,400 kg
TOP SPEED	582 kph
MAX ALTITUDE	7,000 m
WINGSPAN	11 m
LENGTH	9.12 m
POWERPLANT	1 × Rolls-Royce Merlin 45 supercharged V12 engine (1,470 hp)
TYPICAL ARMAMENT	8 × .303 in Browning MkII machine guns

has a long history of producing large models from luxury yachts to architectural developments to F1 cars, and now, a WWII fighter plane. Physical Digital applied a combination of processes over three days to gain all the necessary measurements needed to get the required digital information.

The first process was the TRITOP system, a photogrammetry technique that uses 5mm diameter coded and uncoded markers applied to the airframe and cockpit canopy. An SLR camera takes a series of 2D high-resolution photos at various angles, that a computer is able to compile into a 3D map. This is then followed by the use of the ATOS system, which uses high-resolution measuring cameras to precisely measure every surface on the aircraft.

The P7350 crashed three times during the war and had the highest level of damage, thought to be up to 60% of the airframe.

"We saw repairs where the tail fins had been shot and then subsequently repaired," said Rapley. "That was an original repair from late in the war.

"For our own interest, we did a full inspection report, so we did a symmetry plane down the middle and we flipped it, to look at one side against the other… and there were some anomalies. One of wings is slightly longer than the other. But that could be to do with the symmetry as the fuselage has got a slight banana in it, a slight bend (bow). And the tail fin is slightly twisted compared to the main wings."

Perhaps this should come as no surprise as, if you go through a World War on the front line, you are bound to come out with a few scars.

The BBMF flight team has its own hanger at RAF Coningsby that is open to the public. It is a working hanger where work is done on surviving aircraft from the era. Most of the guides are ex-ground crew, mechanics and even RAF pilots.

"The guys at the BBMF were really welcoming," said Rapley. "They gave us great access and we could also sit in it. I'm over 6ft and I could just about get in the cockpit. Sitting there was a very humbling experience.

"We met some Lancaster guys and thanked them for what they had done. They said, 'thank the ones that didn't come back.' It puts it all in to perspective."

The data from the scans was collected and turned in to an STL file that can then be turned into CAD data, though it wasn't part of this project. The data was supplied to the BBMF for their digital archive, as well as to Fine Model Cars, which went on to produce a very accurate model.

"To put your head inside and look at the Spitfire's structure was a great privilege," said Rapley. "It is a British design icon."

NO SHRED OF COMPROMISE

Designing a waste shredding machine is something of a black art. Tim Fryer found out from Untha how clever design can make dramatic improvements in performance.

"With a 40 tonne an hour throughput, this works out at savings of **£1.5m** every year"

The waste hierarchy mantra is reduce, reuse and recycle, but even within that there are potential inefficiencies that could render an environmental strategy counterproductive. A strategy to reduce landfill, for example, would be undermined if it involved extra energy to burn waste, increasing emissions and not using the energy resources wisely.

Indeed, any piece of equipment involved in the waste industry is going to make the most positive contribution if it operates as efficiently as possible. Of course there are many views of what represents good environmental performance and these vary depending on the machine.

For a waste shredder these may include lower energy input, reduced fines, longer equipment life and quieter operation, but these may be at odds with the business drivers such as faster throughput, broader functionality and mobility. Untha aimed to meet all of these challenges when designing its latest waste shredding beasts: the XR3000 and the XR3000 mobil-e. These machines can be adapted for producing biomass, SRF and RDF (Solid Recovered Fuel and Refuse Derived Fuel).

The distinctions between SRF and RDF are a bit woolly, but the general rule is that RDF is made from Municipal Solid Waste (MSW), quite literally any old rubbish, while SRF – the better quality of the two – is made from Commercial and Industrial Waste (C&I), which tends to be much cleaner and better sorted.

Chris Oldfield, chairman of Untha UK, summed up: ''Better quality in, means better quality out''.

Biomass, or at least the biomass that would be processed by an equivalent to an XR3000 shredder, typically contains such things as waste wood, pallets, kitchen units and demolition timber.

SRF is largely used in power generation plants but can also be used for heating cement kilns. Biomass, as a higher quality fuel, has further uses in smaller applications and in fact, on the continent, even individual residences use biomass burners for their heating.

Machines like this shredder are aimed at the fuel and biomass producers rather than sites that produce waste and are then looking to do something useful with it.

DESIGN SPECIFICATION

The first design criteria when developing the new machine was to produce one platform that could be adapted to all three main output requirements, for example by changing the screens or the operating speed. For all that, some internal reconfiguration is required. The XR300 achieves this, although generally speaking, plants of this nature will be bought to do a single thing. Where this versatility becomes more relevant is with the introduction of the mobile version, the XR3000 mobil-e. A 30 tonne shredder is not naturally the most agile machine, but putting it on tracks opens it up to dealing with different waste streams around a site. Designing in reconfigurability can allow different types of fuel to be processed – or even recycling applications although that is not its primary function – but realistically it will be used in the same format.

A normal high speed shredder will typically produce 20% fines (dust), the low speeds of the XR3000 results in just 5% being produced.

''What this new machine does,'' said Oldfield, ''which is different to anything else on the market, is that we can do SRF in a single pass, whereas traditionally we've always done pre-shred and secondary shred.

Untha's mobile XR3000 mobil-e can be moved to deal with different waste streams around a site.

Secondary shredders are usually high speed and very problematical. They suffer with wear and very large motors make them very expensive to run. It also means you've got two machines, both depreciating and needing maintenance.''

Only one pass on the XR3000 is required even if the material has to be quite refined, e.g. down to a 30mm particle size for use in a cement kiln.

So what's the trick? ''It is a proper cutting system,'' claimed Oldfield. ''A lot of our competitors use a ripping process, so it's a lot more random. Most of them don't use the single shaft technology that we're using on the XR. They use blades which are two shafts coming together. The answer is in the design of the machine, the design of the rotor, and the setup within the machine which has put us out in front of everyone else technology-wise.''

This cutting technology, while not unique in all shredders, is not available in any other mobile shredder, according to Oldfield.

Wear is a massive challenge for any shredder, so Untha uses specialised hardened steels in the main contact areas. Oldfield continued: ''The way we design the machines, they are replaceable and can be swapped out easily. We've learnt from the machine tool industry where machine life is key, so we now use indexable cutters, for instance, so we get the additional life.'' These indexabl cutters can be turned four times to get quadruple the life.

''We've got machines that are 30+ years old and are still in daily use,'' said Oldfield. ''Waste machines tend to be very heavily used, so we say to our customers you'll get an eight- to ten-year life. They may get more or less. But what we're trying to indicate is the traditional life of a diesel hydraulic mobile machine is usually only four years, and we can double that.''

A principal reason this longevity can be achieved comes from the rotational speeds, which are typically five or six times less than a traditional hydraulic shredder. When specifying the rotation speeds the design team at Untha were looking to satisfy more than just the demands of the cutting operation.

Noise is a big issue at waste sites. HSE action points can be triggered at 80-85dB and many shredders can generate 100dB and more. By using slower speeds the XR3000 is significantly quieter, below that first action point, and so can allow extended operation hours without offending the neighbours. The design team also took advantage of special steels with noise absorbent qualities.

Another benefit of slower speeds is that less dust is created – and dust, or fines, is important in this environment for two reasons. One is that it creates an explosive atmosphere, and the second is that it costs money. Typically, a normal high-speed shredder will produce 20% fines, while the low speeds of the XR3000 results in only 5% being produced. These fines cannot be used in any way, their destination is landfill which comes at a cost of £60 a tonne. With a 40 tonne an hour throughput, this works out at savings of £1.5million a year. Or to put it another way, return on capital investment is in the order of four months in terms of fines disposal alone.

It is quite an unusual design environment, as Oldfield sums up: ''We're using Solidworks and we do use some CFD modelling. But you've got to understand as well, shredders are a little bit of a black art, and our expertise lies with the individuals within the company. Some of it is scientific and some of it is expertise and experience.

''And because we we're at the premier end of this industry we're also very conscious of quality design, and aesthetics – once you see an Untha machine, it's very easily recognisable.''

"The traditional life of a diesel hydraulic mobile machine is usually only four years – and we can double that."

CHRIS OLDFIELD

STEAM POWER FOR THE WET SET

As clouds of steam dissipate into the atmosphere, think of the amount of energy that represents? Tim Fryer reports on a technology that tackles the problem of waste steam in industry.

In an engaging historical coincidence, it is befitting that Heliex Power is developing its steam technology only a few miles south of Glasgow, where James Watt adapted the early promise of steam 335 years ago, to build the foundations for the industrial revolution.

Like Watt, whose gifts included being able to identify weaknesses in a system and improve them, Heliex has technology that remedies one of the great problems in modern industrial processes – that of waste. In particular waste steam.

The technology was initially developed at City University in London and taken on by spin-out company Heliex in 2010. City University had been looking at improving screw air compressor technology – an electric motor driving two screws taking ambient air and sending it out at a higher pressure.

Heliex's chief executive, Chris Armitage, explained the background: ''They said what if we looked at the whole thing the other way round, if we took some sort of fluid and expanded it through these screws the other way round, could we not use the machine to drive something else, such as the motor turning into a generator? And the obvious first fluid to consider for doing that is steam, as it's well known for driving turbines and the like.''

The steam used in power stations is 'dry' steam, in that it is superheated so it contains no condensate particles of water, which is the more familiar 'wet' steam we see coming out of kettles. Wet steam both contains less energy than dry, and is too erosive for standard turbine blades.

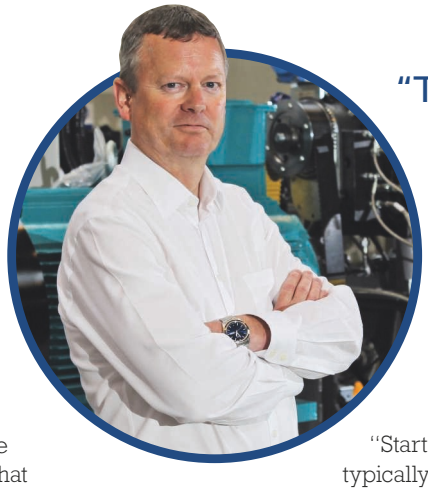
Armitage outlined the Heliex system: ''What we've got in a twin screw is a more robust, simpler, and will accept wet steam without being corroded. It can be used in the majority of steam systems in factories and process plants who only have saturated steam. They don't have superheated steam, because it's so much more costly to produce, and they just don't need it.''

This is not aimed at power stations, although there may be applications within power stations where it can be used, it is aimed at general industry, any process that uses steam directly as part of the process or has a steam system used as a heating medium. Or even a waste heat stream that could be used to generate steam. With such a wide range of potential uses Heliex believes there could be a huge market for the technology.

''We need to have some reasonable pressure differential to generate power,'' said Armitage. ''We've got to have a minimum of seven or eight bar gauge pressure. But the flow rates are not particularly huge. The higher the flow rate, the greater the power output, but a under reasonable pressure drop and three tonnes an hour of steam, we can produce a reasonable power output that's of interest to a customer.''

The erosive nature of 'wet' steam has made it impossible to recapture for CHP... until now!

In fact, some industrial users are perfect in that they already generate steam in a boiler, but it comes out at much higher pressures than they can use in their process, so they pass it through a PRV – a Pressure Reducing Valve. The Heliex machine can sit across the PRV and bring the system pressure down to required levels and generate electricity in the process.



> "The higher the flow rate, the greater the power output, but under reasonable pressure drop and three tonnes per hour of steam, we can produce a reasonable power output that is of interest to the customer."
>
> CHRIS ARMITAGE

Armitage described the machine itself: ''The core of it and the clever bit, is the screw expander, which is very similar to a screw air compressor in that there are two rotors entwined with each other. The profile of the rotor is the important part, those two rotors sit within a casing and are supported on bearings at each end. We expand the steam through that expander and in doing so, the two rotors turn and we have an output at one end. We connect that to a generator to produce electricity.''

Around those two fundamental pieces of equipment, there are some ancillaries; an oil system for lubricating the bearings, an inlet control valve to control the amount of steam, and a control panel that controls the system and the interconnection with the grid, because generally power will be exported to the grid.

There are two patents, one is around the profile of the rotors, as Armitage described: ''As the rotors turn, the edge of the rotors don't actually touch, but they do form a seal between themselves with a very small piece of water, which is where the wet steam is useful.'' There is also a patent, held by City University, for the use of this machine in a thermodynamic (Rankine) cycle.

So how does the Heliex system counter the erosive nature of wet steam? Armitage said: ''It's a combination of the way the steam is put into the machine, the profile of the rotors, and the robust rotors are a much more robust piece of equipment than a relatively thin turbine blade. The profile of the inlet port ensures we get maximum efficiency on the machine, but also that the steam expands in a manner that is more conducive to it not eroding the rotors.''

The rotors are nitrided to improve erosion resistance, but the casing does not need to be particularly resilient and is a standard casting.

Next stage in development is to effectively turn the system round the other way – using a motor to drive the expander to recompress steam in processes that don't naturally condense steam. Armitage explained: ''Starting with low-pressure steam, typically it would condense to water, then reheat it in a boiler back to steam at a higher pressure. So you've got the energy requirement to condense it in the first place, then the energy requirement to re-vaporise it, both of which are a waste of energy because you're putting it back to the state it was in. By using our machine, you just take the steam and increase its pressure with an electrical input which is much more efficient.'' It is also feasible that the expander could be used to drive other bits of equipment, like a pump or air-compressor, rather than a generator.

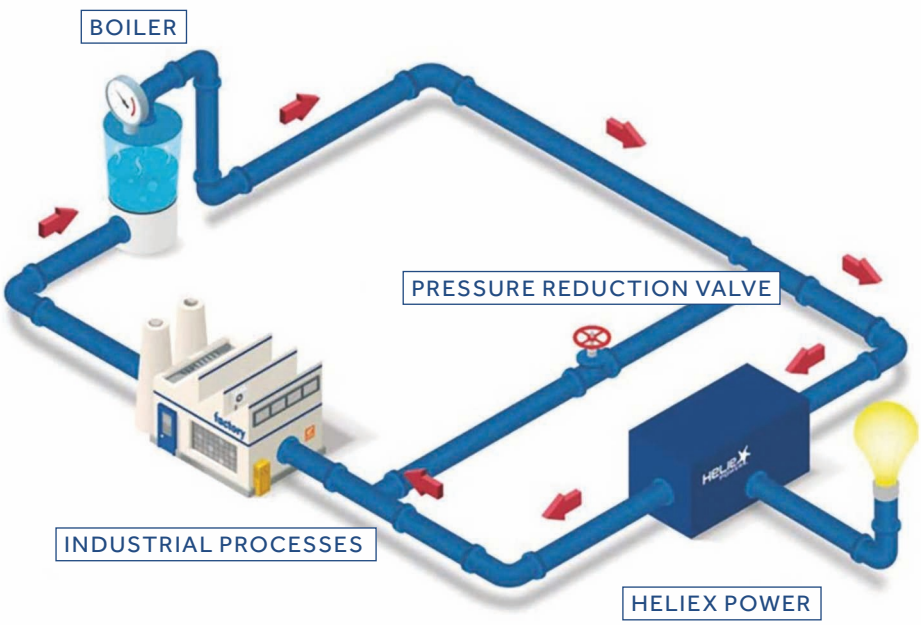
Currently there are two sizes of expander feeding into a range of sizes of generator that vary between 75 kilowatts (for an 8 bar, 2 tonne/hr of steam flow rate application) and 0.5 megawatt output (for a 25 bar, 12 tonnes/hr). They are both the same in terms of velocity and basic design. Systems could cost from £100,000 up to £500,000.

Already the company has over 40 installations. Armitage concluded: ''We do a lot within the biomass industry, but they are actually producing heat for many, many other industries. We've got units in steel manufacture, glass manufacture and on the back end of incinerators. So there's a whole range of industrial processes that use steam in one way or another.''

(Above) Chris Armitage, chief executive of Heliex Power.
(Below) A typical system where a Heliex Power unit can use the energy that would otherwise be lost through the PRV.

OPERATING CONDITIONS

- Temperature from 150 up to 300C°.
- Maximum inlet pressure 25 bar A.
- Minimum outlet pressure 1 bar A.
- Maximum delta P is 15 bar (HP145) and 20 bar (HP204).



CRACKING CARBON FIBRE

Far Composites and Axon Automotive have been collaborating on a low cost, low waste carbon fibre beam technology, called Axontex. Tom Austin-Morgan went to the recent Cenex Low Carbon Vehicle event where Axon's director, Lyndon Sanders, described the roadmap the companies have travelled along and what challenges lie ahead.

The niche sports car company, Westfield, is about to start tests with a carbon fibre frame made of Axontex in one of its Sport 250 cars. The frame can replace the standard steel frame the car is supplied with. One of the big selling points of Axontex is that it can be made for the same price as an aluminium frame.

"Westfield said 'prove it'," said Sanders, who is also director and general manager of Far Composites. "So we designed a passenger cell for them which they had priced up in aluminium and we met that price with Axontex.

"Our frame is around 35% lighter than the aluminium frame and 70% lighter than the standard steel frame," he added.

Sanders and his team were confident in their ability to produce this frame for Westfield because their technology has already proved itself. In 2011 the company built the Axon 8080, a 500kg, two-seater plug-in hybrid electric vehicle that used a small petrol powered engine for use in towns and cities. It emitted less than 50g/km of CO_2 in a government emissions test, half the level needed for free annual road tax in the UK.

"We couldn't convince anyone to buy them," admitted Sanders. "Nonetheless, it was a demonstrator, we proved the technology worked."

In 2012 Axon went on to produce the Axon 60, which won the company a JEC Award for Innovation. Using Solid Edge, an FEA model was made to demonstrate the performance of the Axontex frame in a crash and to analyse its torsional rigidity. The team put the frame through a full

CARBON FLAX HYBRID OFFERS GREATER DAMPING

As part of the Innovate UK funded CARBIO project, Composites Evolution has developed a carbon/flax automotive roof panel using its Biotex Flax material.

Compared to carbon, flax fibres are renewable, lower in cost, CO_2 neutral and have excellent vibration damping properties. The 50/50 carbon/flax hybrid biocomposite panel features equal bending stiffness to carbon fibre, but is 15% cheaper, 7% lighter and exhibits 58% higher vibration dampening.

Composites Evolution has also developed hybrid fabrics that contain carbon and flax yarns that allow tunable performance, vibration dampening and unique aesthetics at lower cost than carbon. This material would suit complex structural and decorative parts in the sports as well as automotive industries.

> "It's 154% stiffer and it's quite a bit lighter, so we're expecting the racing driver to come back and says he likes it"
>
> LYNDON SANDERS

crash test for a 600kg vehicle and by adjusting various material grades and thicknesses and running iterative models, a compliant structure was specified. This allowed them to produce three road-going models, a petrol electric hybrid, a pure electric vehicle and one with an internal combustion engine that ran on hydrogen.

Hyundai approached Axon to provide an Axontex frame for its hydrogen fuel-cell powered Intrado concept car for the 2014 Geneva Motor Show. Hyundai reported that the Axontex frame achieved a weight reduction of 70% over a traditional steel frame. It also said that the strength and rigidity of the central structure would allow body panels to be made from any material, giving designers greater flexibility and aiding repairability.

This led Axon to offer Westfield a frame which featured the same benefits as it had on the Axon 60 and Hyundai Intrado: a 'crash proof' carbon fibre frame that costs the same as a lightweight aluminium one. It is also lighter and stiffer allowing for higher cornering speeds and stability.

The next step is for a professional racing driver to test the Westfield with the Axontex frame on a race track. "It's 154% stiffer and it's quite a bit lighter, so we're expecting the racing driver to come back and say he likes it," said Sanders. "Let's assume he does, then it will go through crash tests – which we know it will pass – then it can go into production."

What makes Axontex so innovative and inexpensive is the way it is made. Instead of being constructed like conventional carbon fibre beams, which are hollow and filled with foam, Axontex incorporates a carbon cross-web which effectively makes it more like an I-beam. Sanders explained that if it is loaded from the side it won't buckle. It is designed to crush progressively so it can absorb large amounts of energy without failing.

Sanders continued: "To get a column strong enough when it's hollow you have to make it very deep, which uses a lot of carbon. If you think about the size of the door sill of a BMW i8, for example, there's a lot of carbon to step over to get into the car because they're trying to make a hollow beam buckle-proof by making it bigger. We make ours buckle-proof by making it cleverer and by using less carbon."

The production process for Axontex doesn't involve any expensive aerospace or Formula One technologies. Axon uses a low cost manufacturing group that removes a lot of the capital from the process and strips down the tooling prices. The process is also said to produce a carbon yield of 97%, whereas larger car manufacturers only reach yields of between 50 to 65%.

If the test of the Axontex frame is a success, it is expected to be available for Westfield's customers sometime at the end of 2016 or the start of 2017.

As for the next steps for Axon and Far Composites, they are looking to take the material to OEM customers for mass adoption. However, OEMs are looking for short cycle times and high process repeatability as well as low costs.

Sanders is confident about it passing crash tests and being able to achieve mass production part costs because of Axontex's low cost and high strength. He also thinks the company is ready to meet investment costs because of its range of low cost tooling solutions. But there are other factors like supply chain and short cycle times that he is less confident about; even though the Axontex resin cures in around 60 to 90 seconds, they would need a cell to prove it.

"Process repeatability is an entirely tougher standard – we're talking about one or two PPMs of rejects, and very tight repeatability. We physically haven't made enough cars to prove that we can hit those targets, because you have to have samples of 100 and we haven't made 100 cars yet," he admitted.

The Westfield test, as well as others these companies are working on, should help get them closer to working with OEMs. However, Sanders could not elaborate on these, he concluded: "A lot of what we do is covered by NDAs so there's a lot of stuff I can't tell you about, come back next year and maybe I'll have some more news for you."

Eureka Knowledge

is a free online resource for the discerning design engineer

Eureka's Knowledge provides useful content and tools to help make your designs more efficient, cost-effective and commercially successful.

In the first of a series of topics, Eureka has teamed up with simulation experts ANSYS and COMSOL to explore simulation, which is of integral importance to a vast range of projects and industries.

Used at the right time and in the right way, simulation can reduce design time, help identify potential failures earlier in the product development cycle and enable simulated tests that might not otherwise be possible.

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INNOVATION IN ANOTHER DIMENSION

The Engineering Design Show caters for all aspects of engineering design under one roof in an easy to navigate, dynamic environment. The workshops and conferences will feature inspirational speakers giving insights into ground-breaking projects as well as helpful hints and tips on how to optimise your project. Over 200 exhibitors will also be on hand to offer advice and solutions to problems you may have encountered. But, it's not all about listening, there are also exhibits to amaze and astound in the Innovation Zone as well as the brand new, immersive and interactive Future Zone, where you can get hands on with the latest virtual reality technology.

The Innovation Zone, located on stand B2, will features eye-catching and stimulating projects, many of which will be the subject of conference sessions. Some of these will be made using components and materials being exhibited by the vendors in the show. While all these tools are available for all engineers in the UK, the Innovation Zone features some of those projects where the engineers quite simply 'got it right'. Here is what you can see.

Innovation Zone

Lightweight supercar

Elemental will be displaying its RP1 lightweight track day car at this year's Engineering Design Show. Weighing 540kg, it's front and rear diffusers create 200kg of downforce at 100mph.

The RP1 achieves superior stiffness thanks to its carbon fibre tub with a feet-up driving position usually seen in Formula One. Ride height, and underbody aerodynamics can be adjusted as well as pedal position which allows drivers of virtually any height to drive it.

Out of this world

Early stage space tech company, Oxford Space Systems' AstroTube Max boom represents a new generation of space hardware. It has been designed to be as versatile as possible to suit a range of space and satellite mission needs such as to deploy communication antennas, scientific instruments and electric propulsion systems.

The AstroTube Max boom uses proprietary flexible composite. This novel means of actuation sits inside a nested stack of space-grade carbon fibre tubes. When powered, a mechanism unrolls the unique material from a storage cassette and feeds it into the stored stack of tubes. These then extend and retract the tubes like a telescope.

Future Zone

New to EDS this year is an area to showcase the very latest and emerging design tools and give you the opportunity to try them and discover how they could benefit your design projects.

Virtual Reality has been around with varying degrees of success for many years but in 2016 the processing and software technology is finally available to make these systems really useful in an engineering environment. So, this year VR is taking centre stage in the Future Zone, courtesy of Virtalis and the AMRC.

Collaboration

Imagine if you could walk through the design of your latest project as it is being developed, to get a feel for how the various components interact with each other and improve it before the prototype is built. Or work on your design simultaneously and collaboratively with your colleagues in different time zones or at the other end of the country.

You may need to allow a range of people to have input into your new designs. They could be production engineers, test engineers, production operatives or manufacturing leaders. All of these are in addition to the expertise required from R&D or from mechanical, electrical or electronics engineers. VR tools enable all these stakeholders to work collaboratively and efficiently in the VR environment to perfect the design and gain essential buy-in.

VR could be a game changer for your business, shortening product development times and providing multi discipline communication and understanding.

Contemporary VR systems are flexible, scalable and can be configured and specified to meet your needs, depending on what you want to visualise, the available space, number of users and your budget.

The immersive, interactive 3D visualisation systems in the Future Zone draw on active stereoscopic technology and feature custom screens, specialist computers, custom software and powerful projectors, coupled with eyewear and head and hand tracking. Market applications for you to test include:

- **Aerospace**
- **Automotive**
- **Industrial**
- **Marine**
- **Power generation**
- **Immersive training**

The headsets provided by Virtalis track the motion of the user's head as well as allowing them to interact with computer models driven by CAD data.

Be sure to step into the Future Zone on stand D61 and immerse yourself in the future of engineering design.

Improved motorcycle fork end

The Manufacturing Technology Centre (MTC) is showcasing a motorcycle fork end that has been additively manufactured from 7075-T6 aluminium and a titanium alloy. The design project was a continuation of a CASIM funded project between the MTC and SME design consultancy GRM.

After several design iterations, an improved fork end design was manufactured and, despite the use of denser material, was 50g lighter than the original design while offering improved fracture toughness. The MTC says that the weight reduction and improved material properties justify the increased manufacturing cost.

Different digger design

JCB will lend the Coventry hall its innovative Hydradig, the first wheeled excavator designed for operating within inner city construction sites. It bridges the gap between full-size excavator and a mini-digger, allowing better visibility from the cab as the engine is housed underneath, rather than at the back to provide a counterbalance, providing it with twice the lifting capacity.

The Hydradig is 35% smaller than the previous 3CX Compact, yet has maintained its speed and power. According to JCB, the Hydradig is the construction industry's equivalent to keyhole surgery because it is smaller, can be in and out quicker while doing the same job as a bigger excavator.

BuddyWOTCH

This wearable, provided by Renfrew Group and Aseptika, has been designed to provide 'expert' pathways for use by patients, carers and healthcare teams to inform, manage and report the success of self-care plans so that patients can remain independent at home, taking the burden off hospitals.

The BuddyWOTCH is aiming for medical device certification and not only monitors fitness levels, it also features sensor-based tests for respiratory diseases.


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FLEXIBLE FRIENDS

For some, the benefits of flexible working means that they can spend more time with their family. For others, it's about being paid to work, productively, from the comfort of home. But is flexible working all it's cracked up to be, or is nine to five the healthier way to make a living? Tom Austin-Morgan finds out.

Since 30 June 2014 every worker, full- or part-time, with at least 26 weeks' service has been able to apply for flexible working hours to improve their work-life balance. Previously this arrangement was only offered to parents and carers. At the time the decision was lauded by both politicians and union leaders as a sensible and modern approach to work that could improve the lives of everyone.

However, over the last two years, surveys and articles have said that workers are more stressed than ever thanks to flexible working hours promoting an 'always on' culture with workers 'grazing' their emails at all hours which keeps stress hormones at high levels.

''I think an 'always on' culture is a factor in today's society,'' said Dunstan Power, director of Bytesnap Design. ''However, I don't think – and wouldn't expect – anyone working here to answer an email I sent them after 10pm, for example.''

Bytesnap allows all its staff to work flexi-time as long as they are in at the core hours of 10am to 4pm (2pm on Fridays) and work 40 hours per week. ''Flexible working promotes a more relaxed and productive working environment because everyone is working the hours they are comfortable with,'' Power added.

He conceded that the main downside of flexible working is that because most of Bytesnap's customers work earlier in the day, the employees who work later may miss phone calls from clients with questions that they could have the solution to. It can also work the other way around, Bytesnap's employees may need to ask a question of the client, but can't as some clients' offices close around 5 or 6pm.

This is a view shared by DC White's managing director, Jenny White, who said that having people start and finish at different times during the day presents a challenge as you can't always rely on who will be in and when.

White said: ''As engineers, we need to interact with each other as and when needed on our projects.''

DC White offers flexible hours but tends to find that its engineers use them mainly when they need extra time to work on a project or time out of the office. ''We find that flexi-time works very well for our staff who have family and child care commitments,'' she said. ''But, it doesn't work for everyone.''

However, Power added that the positives of flexible working outweigh the negatives: ''We have a longer working day where there are experts on hand to help customers for up to 12 hours per day, which wouldn't be the case if we had a 9 to 5:30 set-up.''

Andrea Pybus, HR director at Team Consulting, said that she has found that employees on flexible contracts tend to show higher commitment to their roles. She believes that because Team Consulting allows them to work hours that suit, when the company requires extra hours to be worked, staff are happy to be flexible as well.

Flexible working is something that Pybus is familiar with: ''My children are young, so it has been important and motivational for me to take on a part time role with the company. It has also encouraged me to progress within the company and encourages me to be flexible too.''

She claimed that some companies she has previously worked for have shown differing levels of encouragement when handling requests for flexible hours in the past.

Encouragement and an open and honest dialogue that strikes a balance between the needs of the employee, the business and, more importantly, the customer when considering a request is something all three companies think is important. They say they all have low levels of sickness and stress, despite reports in the media to the contrary. However, none have tested whether this is specifically due to flexible contracts.

Plextek has recently relaxed its dress code as well as introducing flexi-time.

Nicholas Hill, CEO of Plextek, said: ''It is really important to allow staff to enjoy a work-life balance that can make them happy in their work, and therefore more productive.''

At the end of every month work finishes early at Plextek and the employees can indulge in pizza and drinks. In November, a fireworks night and barbeque is held where the engineers' families are invited along.

Flexible working has its pitfalls, but having a clear agreement between employer and employee seems to reap the best results and appears to promote a healthy, happy workforce.

"Flexible working promotes a more relaxed and productive working environment because everyone is working hours they are comfortable with."

DUNSTAN POWER

FURTHER INFORMATION

EMPLOYEES

Looking to ask for flexible hours? Consider the following if you want your boss to accept your request.

1. Be confident when asking for flexible hours: Don't flounder, just include in your request the details of the change, the date the request is being made and when you want it to start. But...
2. Make it worth their while: Your company will likely reject your application if it feels your skills will be missed by not being at work as often. Agree on a realistic plan with your employer of how the company will benefit from your absence and what you aim to achieve with the change.
3. Reiterate your ambitions: Instead of letting your employer feel you are isolating yourself, reiterate that you still have ambitions to move up in the company.
4. Be flexible yourself: If you're asking for flexibility from your boss you need to demonstrate that there can be some give and take. For example, make yourself available for the odd meeting or briefing.
5. Never be negative: Even if the reason you're asking for fewer hours is that you can't cope with the hours you do, honesty isn't always the best policy. Try to sell your request in a positive light, such as wanting to maximise your potential.

EMPLOYERS

What do you need to keep in mind when considering a request from an employee?

1. You must consider the request in a reasonable manner: Arrange a discussion as soon as possible with the discussion attended by a third party if the employee wants. However, if the employee fails to attend two or more meetings, without a reasonable explanation, you may treat the application as withdrawn.
2. Weigh the benefits of the proposed changes against any adverse impacts on the business.
3. You can negotiate: If you're unsure of the benefits, agree to test the change on a trial basis with reviews after certain periods.
4. You can refuse an application if there is a clear business reason, such as: the burden of additional costs; a detrimental effect on the ability to meet customer demand; an inability to reorganise work among other employees; an inability to recruit additional employees; a detrimental effect on quality; a detrimental effect on performance; insufficient work at the times when an employee proposes to work; or planned structural changes.
5. You must reach your decision and inform the employee within three months
6. Allow the employee a right of appeal if you reject the request: Although you are not required to, it will be taken into account if the employee goes to an employment tribunal.
7. If the request is accepted, amend the employee's contract of employment straight away including the agreed changes in hours, which also could affect pay and holiday entitlement, and any agreed trial and review periods.

Coatings

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Anti Vibration Products

FULL CHARGE – BUT WHAT'S THE COST

There you are at home,peering at your electricity bill through a gloom barely lifted by a light that has been dimmed to its minimum in order to save electricity. But how much does it save? Is it more efficient than a lower wattage bulb running full tilt. And if that electricity bill is going to come down (and, of course, so that you do your bit towards keeping the ice caps in their frozen state), where are the savings going to be?

And what if you are thinking of new appliances? How long will it take for an A+++ fridge to pay back its capital cost in terms of reduced energy consumption? And if you could only afford to buy one appliance, would it be better to get a freezer, a washing machine or a dishwasher? So many questions, but they can only be answered if you have the right data at your fingertips. However, to get the exact electricity consumption of every light and every appliance would require an incredibly complex and continuous analysis of your meter. Alternatively, it would require extensive rewiring to get all the loads registered at a central reading point, or separate meters on each device.

There has to be a better way, and that is your challenge this month. We want a device or system that is going to give us all the information we need to turn us eco-friendly, to cut our bills and stop polar bears wondering why their habitat is melting. We have a solution in mind that we will print in the next issue.

- Any ideas please share with the editor at **tim.fryer@markallengroup.com** or go to the Coffee Time Challenge pages of the website and leave your ideas as a comment.

Our solution to last month's Coffee Time Challenge, to design a personal assistant for the modern age, is on page 9 of this issue.

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jbj Techniques 'AM' splitter gearboxes (or multiple PTO) are available in a number of mounting formats with various increasing and decreasing ratios.

Maximum input torques up to 5,600Nm can be accepted as standard whilst higher powers can be accommodated by the use of oil cooling.

All units can be supplied with either hydraulically or mechanically actuated clutch units.

jbj Techniques can also offer specialist design and manufacture for units outside of the standard range.

The pump drives range of equipment allows a single or a multiple of pumps to be driven from a single prime mover.

Single pump drives allow a pump to be close coupled to a diesel engine that has a flywheel and flywheel housing in accordance with SAE standards (non standard can also be accommodated).

Supplied in a kit format consisting of a bellhousing fully machined to suit the particular pump mounting and a flexible coupling to suit the engine flywheel and particular pump shaft.

Multiple pump drives allow two or more pumps to be driven from a single prime mover.

Available in a number of mounting formats, sizes and increasing and decreasing speed ratios.

All models may be close coupled directly to the prime mover (Model B) or may be fitted with an over-centre clutch (except AM 365 and AM 480) for close coupling (model BD) or for independent mounting (model BDS).

The multiple pump drive units are constructed from:-

- cast iron casings.
- straight tooth gears case hardened and ground, shaved on AM216, AM320, AM220, AM330 series.
- ball bearings.
- case hardened shafts.
- Viton seals on input shafts.

The input shaft is splined to the primary drive gear which transmits the drive to the secondary gear on whose axis drives the pump. The direction of rotation is therefore opposite from input to output.

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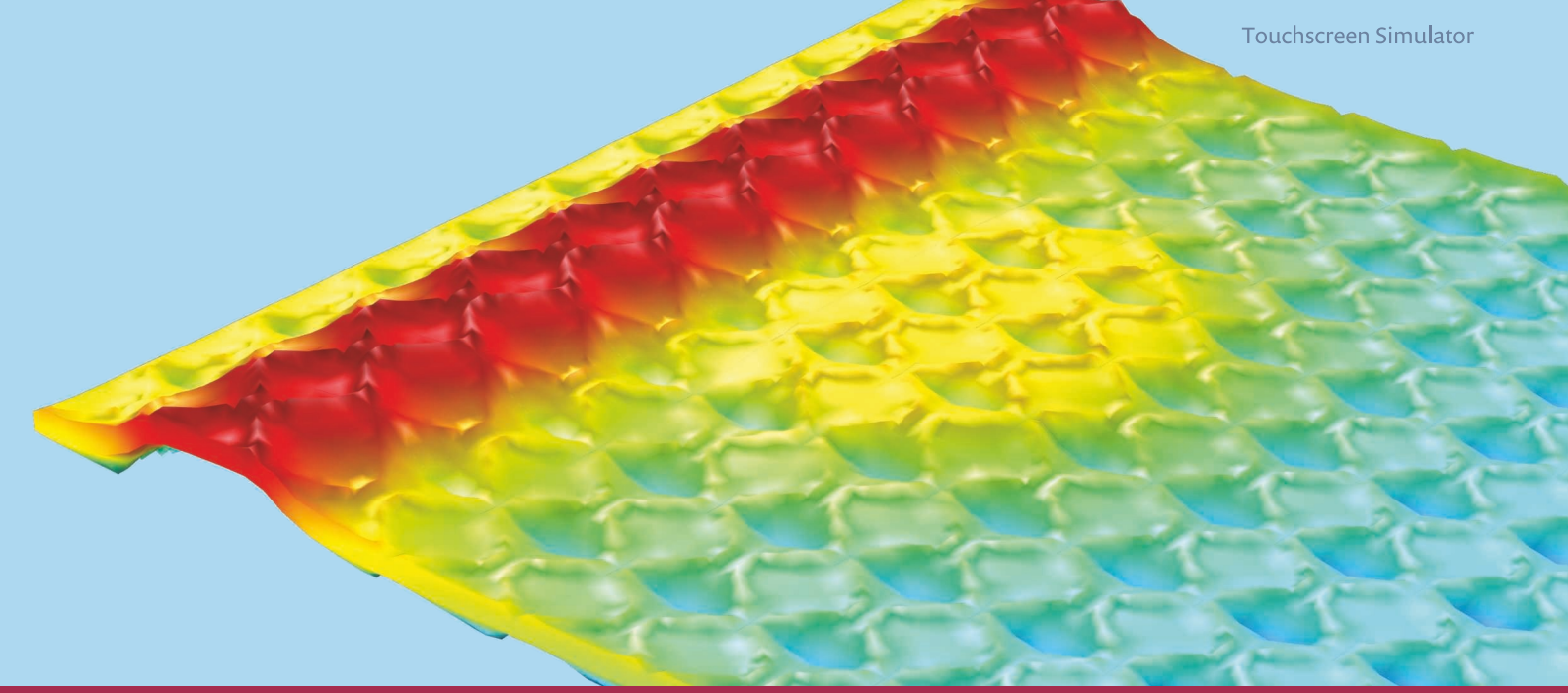

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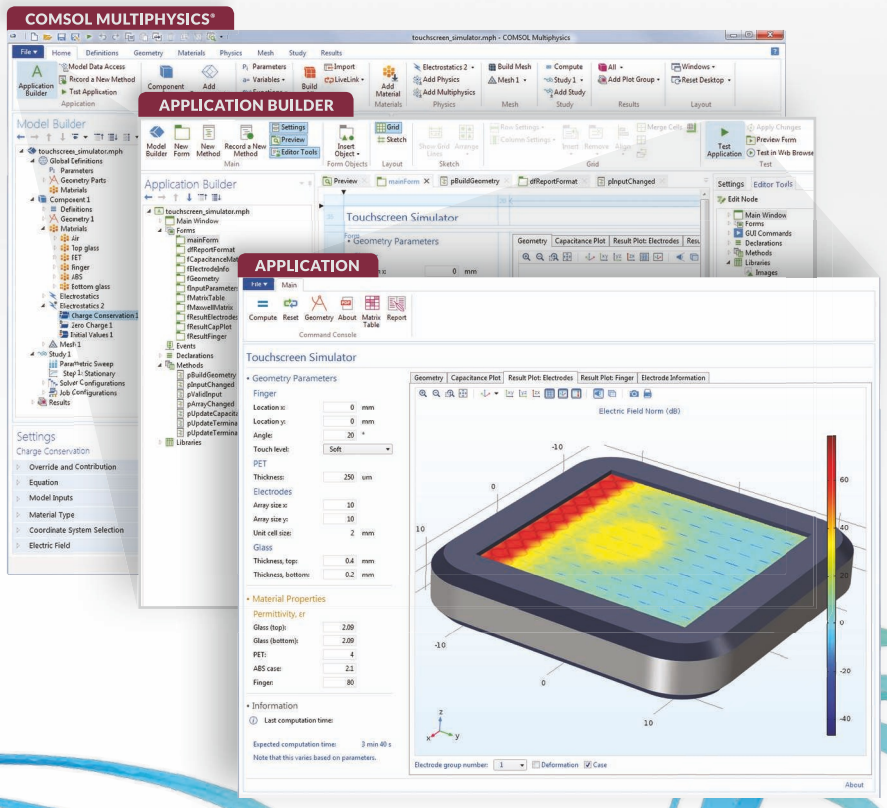

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