

AEMT Journal

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ASSOCIATION OF ELECTRICAL AND MECHANICAL TRADES



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Journal

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Front cover photos:

1. Winners and finalists of the AEMT Awards 2017.
2. Central Group headquarters in Merseyside.
3. Sulzer Marine Generator Repair.

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AEMT COMMENT

This winter edition of the Journal celebrates the very best of the association. We explore how we are leading the circular economy through the service and repair of electrical and mechanical equipment, and that ‘yes!’ energy efficiency is maintained when we do this. We also acknowledge the winners of the AEMT awards 2017.

After visiting EEMODS 2017 in Rome earlier this year with the AEMT, Dr. Hugh Falkner picks up on a paper presented by Nidec (Leroy Somer) discussing the Circular Economy, an EU mandate actualised in ISO 8001:2017, which ensures the rapid consumption of raw materials is slowed and managed through product design, to enhance repair, reclamation, re-use, or recycling. The service and repair centres of the AEMT are at the forefront of this, and Dr. Falkner looks at how this can be strengthened.

We feature two case studies on failed generator exciters, which demonstrate how the circular economy works among AEMT members. In one article, Sulzer refurbishes the equipment, keeping most components operational, while in the other Quartzelec builds a brand new retrofit, but salvages components such as the fan, shaft interfaces and housing.

Tim Marks of the secretariat looks at how in the repair/rewind of electric motors, efficiency is maintained by referring to the joint AEMT/EASA project, and how it still applies to today’s practices.

Steve Ashman takes a visit to Central Group in Merseyside, to find out more on how the company is preparing for the 4th industrial revolution and talks to Shaun Sutton, member of the AEMT council, for his vision for the AEMT.

As with many emerging technologies, the internet of things is fraught with security issues. Siemens looks at one way we can address the problem by using ‘Honeypot’ security flaws into fooling hackers.

Bearings are an integral part of all rotating machines, so SKF takes us back to the basics to understand how bearings are designed for different applications.

Finally, we take a look at the AEMT Awards, with a selection of the best images from the night, including those of the well deserving award winners.

Thomas Marks,
Editor.

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Looking Forward!

I guess it is customary that when a new person takes over at the helm, it is a time to take stock of where we are and where we are going, and as newly elected President of the AEMT, that is certainly my thinking. So, it is with the AEMT in mind, that I attended the CBI conference in London on November 6th.



So, you may think, what does the CBI have to do with the AEMT or the electro-mechanical repair trade? Well, it has certainly become obvious that whilst the services offered by our members have been around for 100 years or more, our market and the players within it, are increasingly becoming global and technology led.

Our international membership grows ever year, as does the wide range of exotic locations that the AEMT now trains and educates across the world. So, whilst we may all live in our “little bubbles” and most of our members’ customer bases are localised geographically, we are all becoming increasingly affected by global thinking and we shouldn’t hide our heads in the sand as to what is happening outside of our local area or indeed our “comfort zone”.

The CBI conference is very much about private sector businesses, especially larger ones, but as the AEMT’s membership of the CBI proves, the CBI represents nearly 90% of all private sector employment. When you are representing businesses at such a large scale, it is all about creating the right environment for businesses to thrive, so it inevitably has to involve government lobbying and an eye to technological advance and what that means for business survival, growth and development in the UK.

The list of the speakers at the CBI conference was extremely impressive, with both the prime minister, Theresa May, and the leader of the opposition, Jeremy Corbyn, given prime speaking slots, with both knowing that business votes are important in any election, and the success of business and the

economy has a massive effect on how much revenue the government can raise in taxes to fund the NHS, schools and everything else!

Both Theresa May and Jeremy Corbyn were impressive speakers, as you would expect, and they actually agreed on many points around business policy. A common theme of the day was the concern over the nation’s productivity, with the current flat/decreasing productivity a real concern for all. It is not until productivity increases that businesses can afford to increase wages, with the “living wage” becoming the new minimum wage target for policy makers.

So, looking at your own organisation, how productive are your staff? What can you do to increase productivity - which means you will be earning more per employee and make more profit in your business, which can then ideally allow you to increase staff wages and share the wealth?

The first thing is to look at your processes and try and remove inefficiencies – paperwork is a big part of the electro-mechanical service process and how many times do people have to write down the same thing only for someone else to type it in again later? Try to remove that in your business as much as possible! The 2nd thing is to look at the skills base of your staff and invest in training. A less skilled/competent person will take longer to do the same job than a skilled worker. Also, how much is re-work costing you, because you haven’t done the job correctly in the first place? The skilling and re-skilling of your workforce should not be seen simply as cost, but actually as an investment in your future profitability.

There was also great debate on the economy in the light of Brexit, with many business leaders calling on the government to make faster progress on its plans, so businesses know where they stand and can plan for the future and continue to invest in their strategic plans without uncertainty holding them back with unnecessary effort and time spent on ‘no deal’ planning.

There were also fantastic speakers from Microsoft, Twitter, BT, Veolia, Accenture and many more on the “digital industrial revolution”. One direct impact of this is that the availability of cheap sensors will increasingly facilitate that all pumps & motors will be connected to the “cloud” and this will allow for online monitoring of the machines that you currently service. The cloud, through “machine learning” will tell you when an item needs to be serviced or has a problem, and this will increasingly replace the need for onsite “conditioning monitoring” visits. This is a big change that will affect AEMT members and it is something you need to be aware of as it is happening now! I plan to write a separate article on the Digital Revolution for future editions of the journal and for presentation at AEMT meetings, so please keep an eye out for more info and look to attend an AEMT meeting soon.

The world is changing and full of opportunities, especially for those with their eyes open, so let’s make sure that the AEMT and its members are amongst those staring wide-eyed at an exciting future!

All the best,

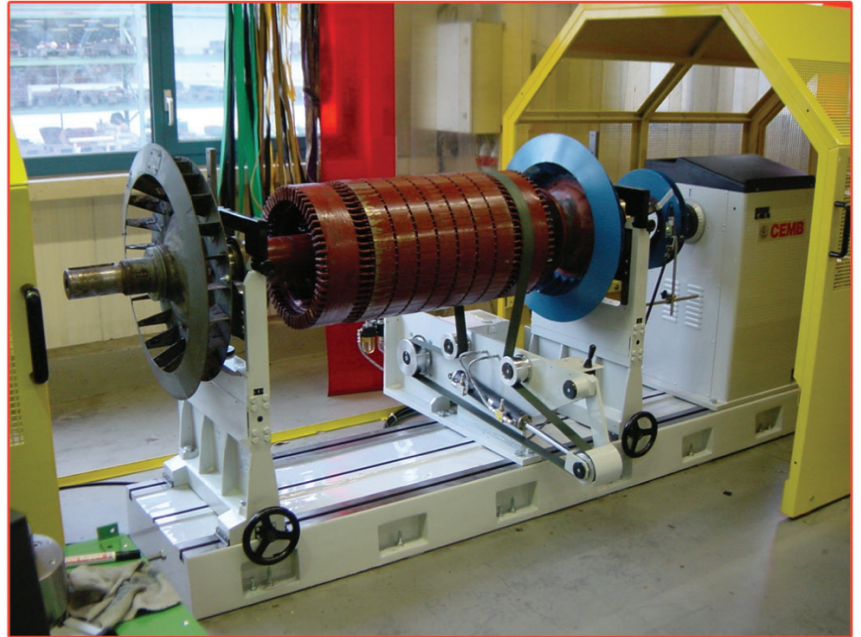
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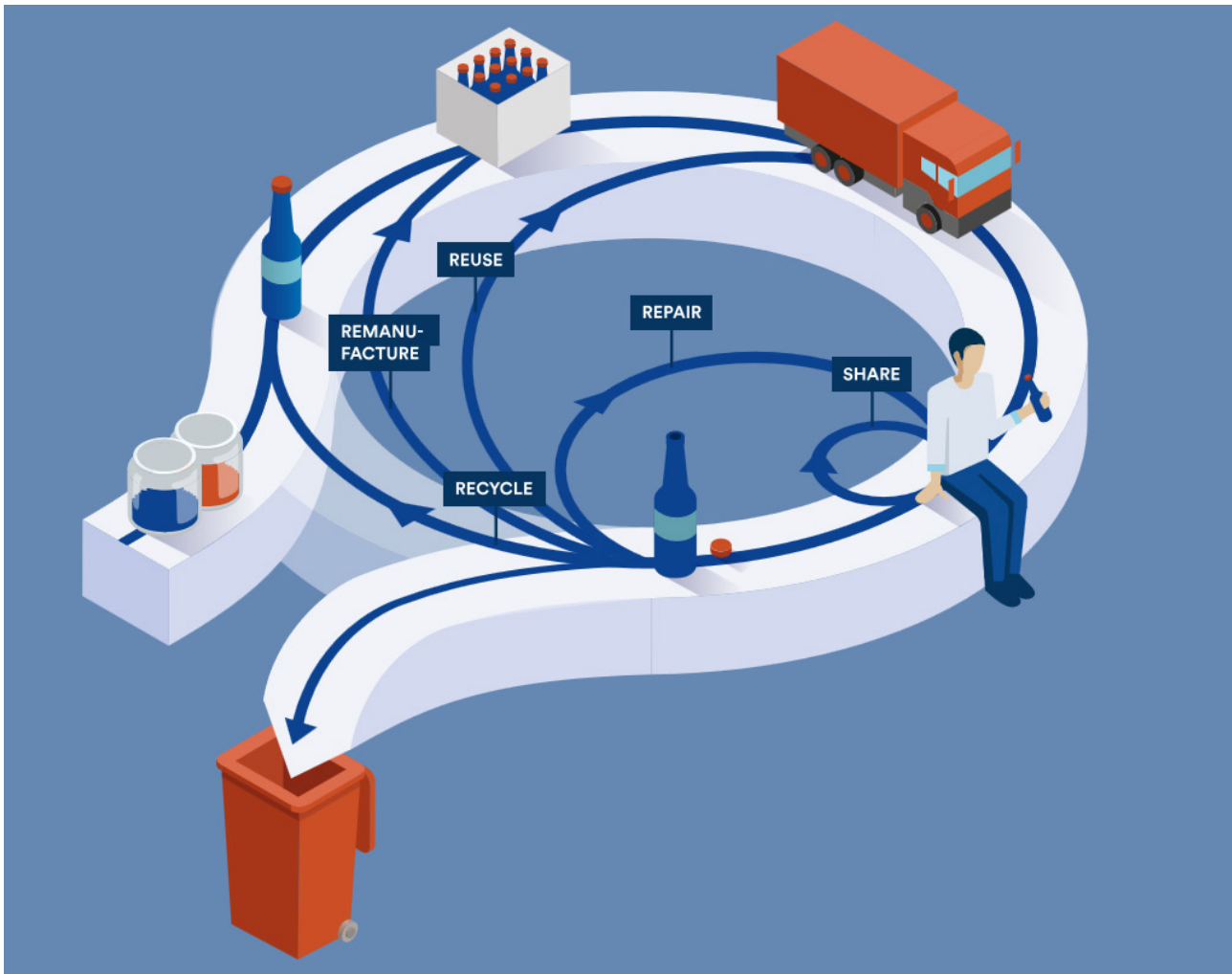


Figure 1. The Circular Economy (Picture: The European Commission)

Dr. Hugh Falkner looks at The Circular Economy and the Motor Repair Industry

According to a 2016 report by McKinsey, the average European uses 16 tonnes of resources a year, of which only 40% is recycled¹. This is clearly not sustainable, so the idea of the Circular Economy was born to develop new business models that will help us to move away from this situation. Some motor manufacturers are already looking ahead to consider what this might mean for their businesses², and CEN/ CENELEC is already engaged in early standardisation activity.

To understand more about what the Circular Economy actually is, and why it is relevant to the motor market, we need to look back at the history of motor efficiency regulation. What emerges is an unexpected story of how

¹ The circular economy: Moving from theory to practice McKinsey Center for Business and Environment Special edition, October 2016 Available at <https://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/europes-circular-economy-opportunity>

² Technology to support Circular Economy: will standardisation limit the outstanding benefits of new motor technology with or without drive and the use of raw material content of electric motors. Regis Giraud and Cedric Plasse, Leroy Somer, France. Proc. EEMODS 2017, "Motors 3". Available on request from the AEMT



the motor repair industry turns out to be a leading example of how the Circular Economy can work in practice, and further the business opportunities that this presents.

Product Eco-design Regulations

In Europe, the Minimum Energy Performance Standards (MEPS) are

called the Eco-design regulations, but when you look carefully at the methods for assessing just how far it is justifiable to push legislation, the Eco bit is not quite complete. This is because while the financial lifetime costs of ownership to the User, and the environmental emissions to water and air, are taken into consideration, it is now recognised that the Eco-design analysis doesn't

adequately address the important question of product durability and the need to reduce material consumption.

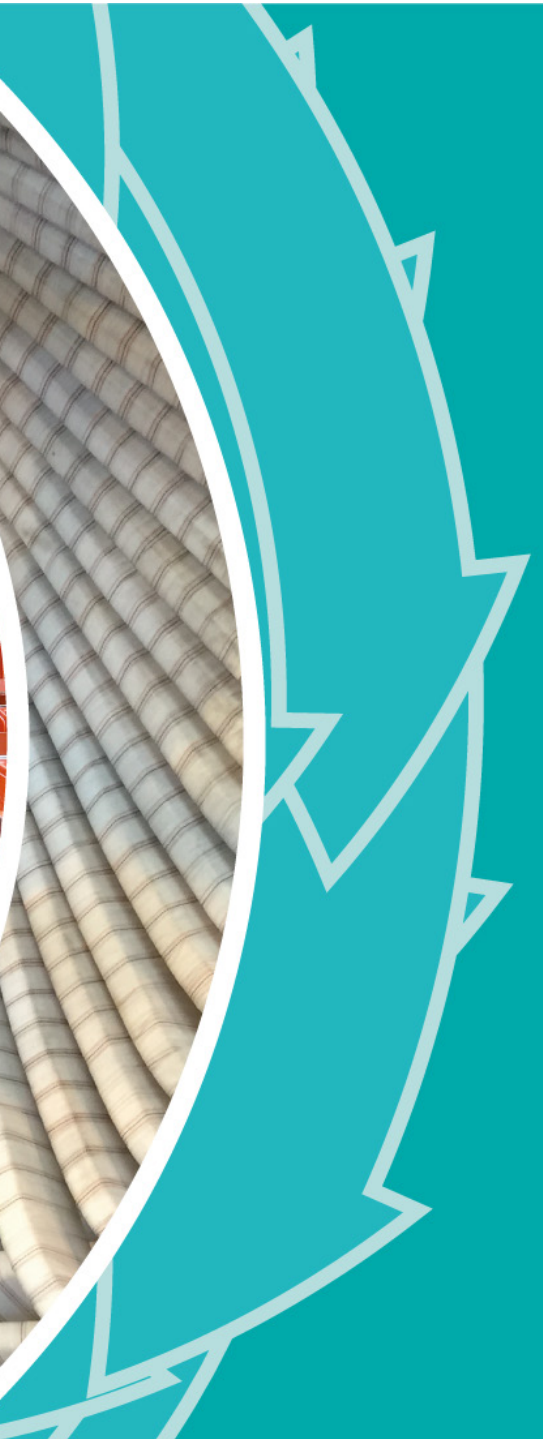
The Circular Economy

This Circular Economy aims to “minimise waste through reusing, repairing, refurbishing and recycling existing materials and products³”, ideas which look to be helpful in achieving the right

³ From the European Commission Circular Economy Infographic. <http://www.europarl.europa.eu/thinktank/infographics/circulareconomy/public/index.html>

⁴ Efficient Motor Policy for Europe view from CEMEP – Motor Summit 2016, Jurgen Sander www.motorsummit.ch/sites/default/files/2017-06/610_ms16_sander_0.pdf

⁵ In collaboration with Zero Waste Scotland and Scottish Enterprise <http://www.zerowastescotland.org.uk/sites/default/files/Scotland%20and%20the%20Circular%20Economy%20%28a%20report%20for%20the%20Scottish%20Government%29.pdf>



use less premium materials, or simply be easier to repair or recycle.

As an example, Figure 1 shows how a bottle might travel around several loops between first use and eventual landfill. In one sense, “all” that we have achieved is to extend the time between a product raw materials being dug out of one hole, used, and then put back into another hole. But it does reduce the amount of raw material that needs extracting and processing, and so conserves resources for future generations. This resource life extension is the best that can be hoped for from most manmade systems. This is what industrial equipment repairers have always done – in fact its hard to think of any other sector placed so centrally to take their part in the Circular Economy. In terms of the above diagram, the repair sector sits in the second smallest loop, with tighter loops being the most efficient in terms of minimising waste.

How the Circular Economy benefits the Conventional Economy

Governments recognise the benefits of the Circular Economy through the following:

- ✓ More local, and higher skilled jobs
- ✓ Less imports, and so improved balance of payments
- ✓ Exports of remanufactured parts
- ✓ Less exposure to fluctuating material prices or material scarcity

As we will see, the motor repair sector is a very good example of what is possible, and can demonstrate the value of these benefits to the economy.

It will be important to moderate the Circular Economy ambition to what is best overall for both the motor user and the environment.

In an October 2016⁴ presentation, the European Committee of Manufacturers of Electrical Machines and Power Electronics (CEMEP) is similarly positive about the Circular Economy, but equally cautious that any new regulation must take account of the advances in motor technology, and maintain a balance between energy efficiency and material use considerations.

energy:material balance in any future eco-design regulations impacting motors.

What this brings is more of a focus on material use, which compliments the traditional focus on product energy consumption that the motor repair sector has supported. It is fundamentally different to the Linear “Take-make-dispose” economy that underpins most material use.

In practice, reducing global material consumption might be about making things that use less material, last longer,

The Motor Repair Industry emerges as Industry leader

In the report by the Ellen MacArthur foundation on how Scotland might benefit from the Circular Economy, six diagnostics (numbered in bold below) were given to show the different aspects of the Circular Economy as they might appear in practice⁵. Here the motor repair industry is tested against the same diagnostics, and surely qualifies to call itself part of the Circular Economy:

1. Circular product design and innovation – product re-design promotes standardisation and modularisation so that they can be easily disassembled, and the value of resources is retained within ‘tight’ reverse circles

- ✓ A commonality of designs that means that it is possible to keep replacing motors from many different suppliers, without carrying large and expensive inventories of spares.
- ✓ The capability to manufacture spare components in order to keep obsolete or unusual models working.
- ✓ The careful sorting of scrap materials to maximise sale value.
- ✓ Valuable materials like copper and permanent magnets extracted from DC brushless motors for re-use.

2. Product re-use, repair and remanufacturing – ensuring longevity of use requires manufacturers to enable re-use and remanufacture products in the system for as long as possible. This tips the balance away from ‘production’ to ‘maintenance’. It also demands new competences to ensure the effective collection and sorting of products along reverse cycles.

- ✓ Repair of products is what the industry does.
- ✓ An underlying philosophy of stretching life and reliability, avoiding obsolescence.
- ✓ Many repairers offer condition monitoring services to help optimise maintenance interventions and reduce unplanned downtime.

3. Innovative business models – creating value-adding business propositions

Item	Title of deliverable	Planned Publication Date	Lead (CEN or CENELEC)
1	Guide on how to use generic material efficiency standards when writing energy related product specific standardisation deliverables.	2019-03	CENELEC
2	Definitions related to material efficiency.	2019-06	CENELEC
3	General method for the assessment of the durability of energy related products.	2019-03	CEN
4	General method for the assessment of the ability to repair reuse and upgrade energy related products.	2019-03	CEN
5	General method for the assessment of the ability to re-manufacture energy related products.	2019-03	CENELEC
6	General methods for assessing the recyclability and recoverability of energy related products.	2019-03	CEN
7	General method for assessing the proportion of re-used components in an energy related product.	2019-03	CEN
8	General method for assessing the proportion of recycled material content in energy related products.	2019-03	CEN
9	General method to declare the use of critical raw materials in energy related products.	2019-03	CENELEC
10	Methods for providing information relating to material efficiency aspects of energy related products.	2019-03	CENELEC
20	Overall coverage for a specific product group (ICT network infrastructure goods).	2016-11	ETSI
21	Overall coverage for a specific product group (ICT network infrastructure goods). Including aspects such as product durability, upgradability, reparability, reusability, recyclability, and re-manufacture, as well as re-use, recycling, recovery of materials and relevant metrics, indexes or criteria.	2018-12	ETSI

Figure 2. List Of Standardisation Work Items Related To The Circular Economy Being Led By Cen/Cenelec ¹⁰

around better-designed, long-lasting products. Disruptive business opportunities based on performance (e.g. shared ownership, hire and leasing and pay-for-use models) can compete successfully against low cost, ownership-based linear models. They also enable much closer interaction with customers ('users') and increased personalisation and customisation.

✓ "Keep you running services" are already offered that incentivise the service provider to ensure reliable operation, through pre-emptive monitoring, repair and replacement programmes. This is a classic indicator of the circular economy in practice.

- ✓ Advise on reasons for failure to enable operational changes to be made to extend lifetimes.
- ✓ Making small changes to motor design, such as winding and insulation design, to better match real life operating conditions.
- ✓ The wider use of low cost condition monitoring sensors that will indicate when service is required, allowing intervention before failure.

4. Renewable energy and materials substitution – while circular systems help optimise efficient resource use, they also avoid unnecessary exploitation of resources in the first place. Switching from fossil-fuels to

renewable energy, and substituting non-renewable and scarce resources for renewable alternatives are important aspects.

✗ The sector is not involved in design. It is also careful to keep products as closely as possible to their original design by avoiding unnecessary substitution of inferior parts.

5. Effective supply chain and cross-sectoral collaboration – a circular economy demands changes at all levels of the economy to drive collaborative solutions. Policy alignment, incentives, industry standards, access to finance, infrastructure and education are all vital elements.

- ✓ A highly developed infrastructure that provides local 24hour service.
- ✓ Rapid turnaround times to reduce financial and environmental costs of motor failures.
- ✓ Suppliers of new motors work hand in hand with motor repairers – it's a symbiotic relationship where both have a shared long term incentive of doing what is best for the customer.
- ✓ Testing of iron and no load losses as a useful proxy to formal efficiency measurement, giving the security that the repaired motor is fit for service.
- ✓ The AEMT, with EASA, has led the way on defining best practice in repair⁶, giving user confidence in the conforming repairers.
- ✓ The AEMT is leading the development of IEC 60034-23 standard on repair procedures, giving everybody a clearly defined understanding of best practice.

6. Re-use of waste, heat and energy – treating otherwise wasted outputs of business processes as the inputs for new processes reduces costs, boosts productivity and opens up new commercial opportunities.

✗ The repair sector is not involved in the "Use phase" of motors.

⁶ The Effect of Repair/Rewinding on Motor Efficiency: https://www.theaemt.com/content/1544/Live/Effect%20of%20Repair%20Rewinding%20on%20Motor%20Efficiency_Optimised.pdf

⁷ [http://www.europarl.europa.eu/RegData/etudes/BRIE/2016/573899/EPRS_BRI\(2016\)573899_EN.pdf](http://www.europarl.europa.eu/RegData/etudes/BRIE/2016/573899/EPRS_BRI(2016)573899_EN.pdf)

⁸ https://www.cenelec.eu/news/brief_news/pages/tn-2016-042.aspx

⁹ http://ec.europa.eu/environment/circular-economy/index_en.htm

¹⁰ Table taken from reference 2.



Copper Windings

CEN/CENELEC Standardisation activity relating to the Circular Economy

The new EU Circular Economy package⁷ demonstrates the European Commission's view of the importance of the circular economy. One outcome of this is Mandate 543,⁸ accepted by CEN and CENELEC, which has the aim of balancing energy efficiency considerations in Eco-design regulations with considerations of material used, in particular at the end of life stage. The European Circular Economy Stakeholder Platform gives an excellent overview of their many activities⁹.

This standardisation work (Figure 2), will be instrumental in setting the "ground rules" for further work and possibly regulations on the Circular Economy, and so early involvement in their evolution will be important to make sure that the views of the repair industry are made known alongside those of other stakeholders.

UK activity in the Circular Economy

Given the importance of the Circular Economy, there are many organisations active in the area, including:

- The Ellen MacArthur foundation¹¹ supports a wide range of initiatives that "works with business, government and academia to build a framework for an economy that is restorative and regenerative by design", and has a wide range of resources for inspiration.
- The Waste and Recycling Action Programme (WRAP) is a charity working waste in all sectors of the economy, and is particularly active in waste minimisation and recycling. Just one activity of interest is the Electrical and Electronic Equipment Sustainability Action Plan 2025 (esap 2025)¹², a key part of which concerns product durability, and how to communicate this to buyers. Although aimed at the domestic sector, it would be fascinating to explore how these concepts might be applied to the industrial sector, especially in the light of competition

from lower cost and potentially less durable motors appearing on the market.

Positioning the sector as a leader in the Circular Economy

From this initial look at the Circular Economy, the motor repair sector in the broadest sense, which includes pumps, fans, and compressors, emerges as being in many ways "ahead of the pack" in demonstrating how the Circular Economy works in practice. Going forward there are three challenges that should be embraced to make the most of this pole position:

1. How to share the sector knowledge and experiences with other sectors.
2. How to engage with other existing bodies so that the repair sector can learn to do even better.
3. How to promote a position of leadership in the industrial circular economy.

This could just be a fascinating time for the repair industry to raise its profile, and show leadership in helping the economy to meet one of the biggest challenges facing our futures. ■

¹¹ <https://www.ellenmacarthurfoundation.org/>

¹² <http://www.wrap.org.uk/sustainable-electricals/esap>

¹³ <https://www.ellenmacarthurfoundation.org/circular-economy/interactive-diagram/the-circular-economy-applied-to-the-automotive-industry>

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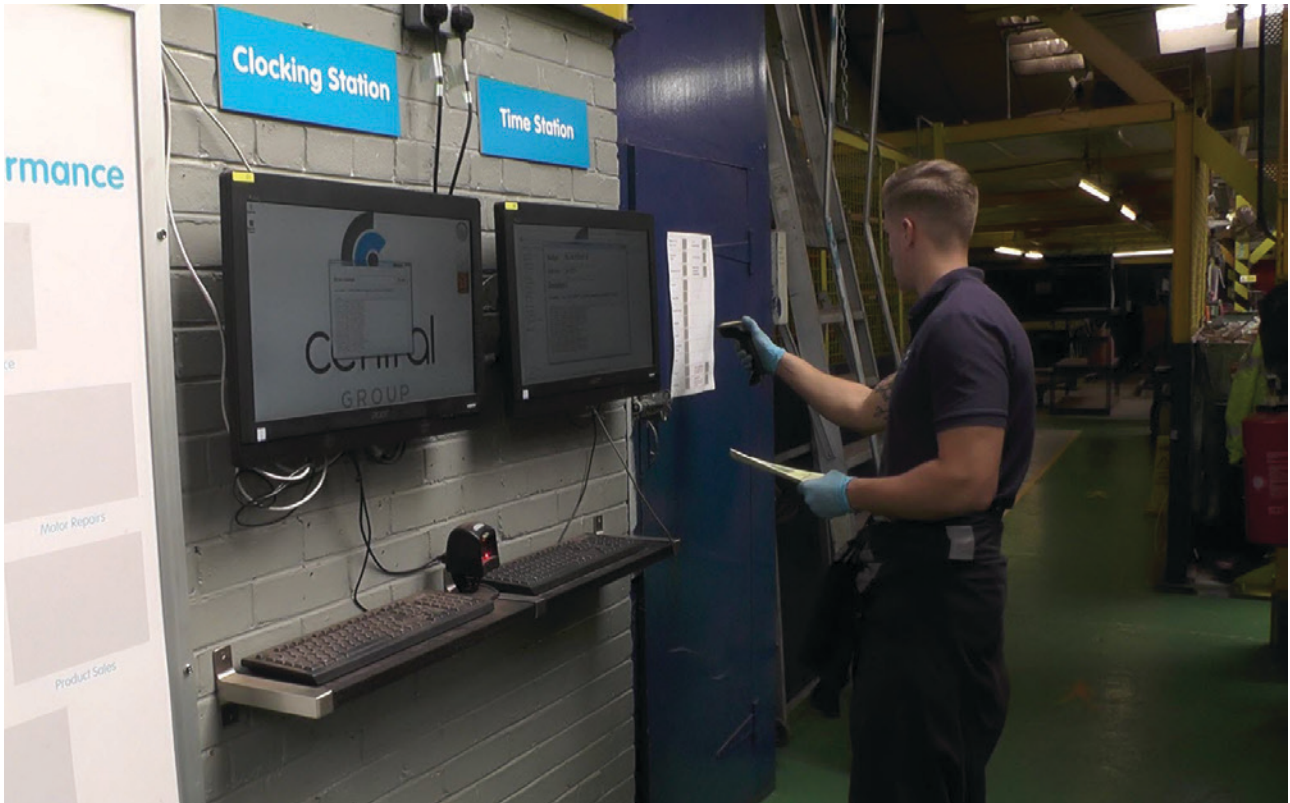


Background and Capability

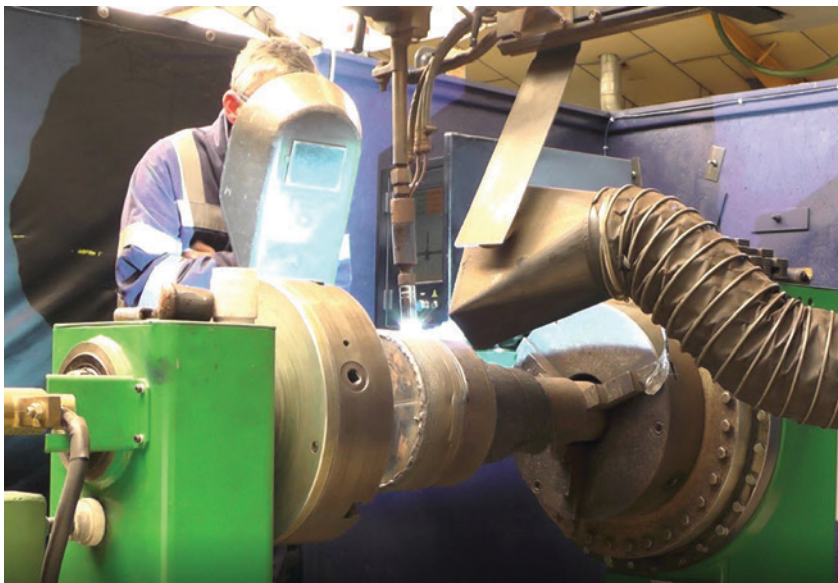
Central was born out of the need to service the manufacturing sector that existed in Liverpool in the 1970's when, as Shaun explains, there was far more industry than there is today. Back then, steel, marine, paper and chemical manufacturing dominated the industrial skyline and as with all areas of the UK, things have changed and the company has diversified and transformed to fill a new niche of trade requirement.

The origins of Central begin with Shaun's father, Mike Sutton who was a time-served armature winder in a local business in the Dingle (Liverpool) before departing for his national service in the Merchant Navy as an electrical engineer. After 7 years at sea, Mike returned to Liverpool and formed partnerships before setting up his own company, Central in 1972 in the city centre, right opposite the Albert Dock, where the Police Headquarters are today.

Shaun didn't join the business until 1991, but as he explains growing up, "We were always around it. It was like living above a bakery, you'd meet the customers, you'd know the process, you'd know all of the people and suppliers and although I've never wound a motor, I've done pretty much all of the jobs around the place at one time or another." As Shaun explains he'd left school with little interest in the electro-mechanical industry and chose a route through university, majoring



Using Barcodes to manage Time & Attendance



Spiral Welding

on Spanish and Portuguese, because working overseas had its appeal.

Business and dealing with customers had always played a part in his youth, working in C&A as a 16-year-old, some telemarketing work, and in bars and restaurants. As most of us come to realise, "You don't really know who you are until you get a bit older." In 1991

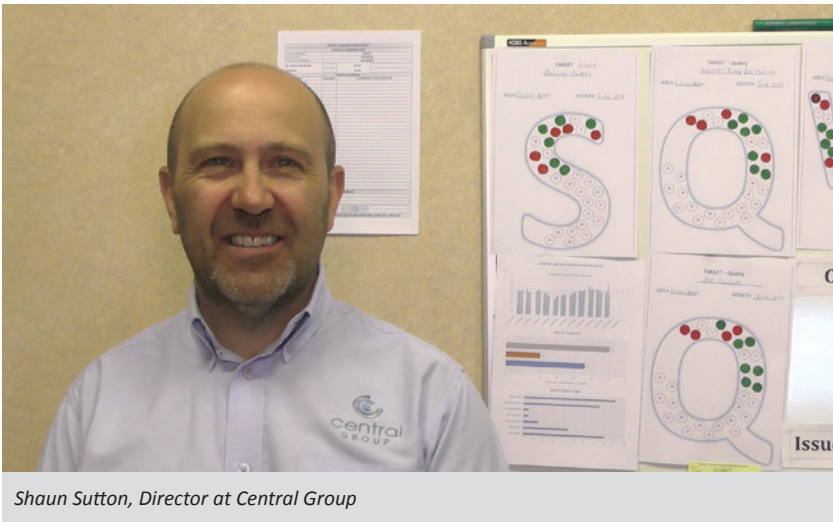
Shaun took the offer to work in the sales team at Central. At that time it was a different place to what it is now, "We'd repair oily stuff, motors, generators, gearboxes, pumps, a lot of work was steel industry heavy manufacturing process."

The travelling and responsibility began in earnest looking after accounts in the M6 corridor from Cumbria down

to Staffordshire and into Wales; a large patch of varied industry. Shaun recalls developing strong relationships throughout the region, many of which remain major customers to this day. Many of their customers were using old technology and control systems which were difficult to support, presenting Central with an opportunity to offer new solutions based on energy and efficiency saving, at the time believing that was the normal thing to do. "We didn't put the product first, we offered a solution which we discovered later was not the accepted norm."

Their successes can be attributed to two factors: technical expertise with customer service & support. This was demonstrated back in 1992 when Central upgraded 18 motor and drive systems on a production line using products manufactured by ABB. Recognising Central's expertise, ABB appointed the company as a technical distributor in the North West and so began a 25 year mutually beneficial working relationship.

Service for Central Group is a 24-hour 365 affair; as Shaun and I spoke, the service continues. Gary Hickey, the Central Group Service Manager, was on



Shaun Sutton, Director at Central Group

“I just want to create proper career opportunities for people. I think it’s great to see people come to work with a sense of purpose.”

a vessel floating off the coast of the UK providing onsite technical expertise and support. By making an adjustment to a thruster, Gary was helping the client to keep the vessel under control.

Providing a free energy and efficiency survey, is an approach by Central that appeals to the modern manufacturing business who have smart targets to increase efficiency, reduce costs, and keep all their plant up and running without downtime. Aiming towards a 2 year return on investment period, the survey is generally done during a half day site visit, where a surveyor will pick out a selection of varying applications to put through Central’s desktop proposal system. The facts are substantiated by replacing the existing unit for a trial period and presenting the measured results. With no cost incurred or contract committed the client has an open opportunity to look at the impact that uncontrolled equipment and breakdowns is having on the business. Invariably they are won over.

Making recommendations is all about the application, which vary greatly from client to client. If you’ve ever ridden the Master Blaster at Alton Towers, an epic water ride which entertains over a 1,000

visitors each day, it’s an engineering masterpiece that relies on 60 drives supplied, installed and maintained by the Central Group.

A milestone in the history of the company came in 2002. Mike Sutton, the founder who had nurtured Central since its inception in ’72 introduced the idea of his retirement, leaving Shaun, with brother Tim, to form a partnership and take the business forward.

Shaun questioned his new role, “What is my purpose as a business leader? For me I just want to create proper career opportunities for people. I think it’s great to see people come to work with a sense of purpose. I will have felt my legacy is leaving it in a better place.”

The Digital Motor and Industry 4.0

There is a lot of talk about change in the industry and few can deny the constant influx of new technology that since the early induction of computerisation in the ’70’s has permeated and enriched almost every aspect of our lives. The emergence of VSDs – Variable Speed Drives - amongst other devices continues to have a massive impact on the amount of energy used with a return on

investment that few would consider long term. Reducing your carbon footprint is now a measurable and achievable goal all forward-thinking purchasing departments will have researched and adopted.

So, what’s new? Where does technology take us next?

The Central Group are gearing up for the next wave of digitalisation. Shaun explains how the reactive world of the repair and service industry will begin to offer a little more than a fast turnaround on damaged items. The conventional normality of a relationship with a motor repair centre is the minimisation of downtime and quality repairs that bring equipment back to their manufactured standard to ensure a long running life. There is no doubt that technology, testing equipment and modern rewinding techniques have all attributed to a service that is credibly achieving consistent high results, but the future may turn this all around.

What if clients were billed for uptime, not downtime!

One of the first companies into the world of motor digitalisation is Siemens. They’ve developed equipment that talks to the Cloud while it’s still in operation, recording information on the health of not only the motor, but the complete drivetrain. “We began as a management team to explore the opportunities that this sort of technology can offer and frankly, we got excited about the future. Not long afterwards the partnership with Siemens was formed.” There is a pride that Shaun evokes when discussing the way decisions are made, as I would learn to appreciate throughout the day when employees at all levels are empowered to explore new methods and have their say, far more is achieved.

“We see the future as offering a company more productivity based on the analysis of information and being able to actively intervene before things start to fail.” Shaun is under no illusion, machinery will always surprise you and breakdowns will still need to be attended to, but Central will be holding the aces in terms of what is happening on site. Until now,



Upstairs SQWASHE Meeting

every customer site and every piece of machinery being watched 24 hours a day, would have been a pipedream, but the digital drivetrain is making it all possible.

At the moment, engineering apprentices have a predefined route of electrical and mechanical training often with added specialisms depending on the needs of the business and applicable abilities. Shaun can see analytical training proving to be a necessity in the future, after all having recorded every bit of data, the real challenge is making use of it. By admission, it's going to be a slow process finding their feet with the massive potential it brings, but the technology has been implemented at key sites and some success with those trials is already being identified.

SQWASHE, Continuous Improvement and Quality Output

Conventional management training would like you to think that building a hierarchy of experience and successful people, whose sole aim is to drive the vision of the business through the ranks, is the only tried and tested method of growth. At Central Group something else is happening. In my first exposure to their control system nicknamed SQWASHE (an acronym used to evaluate Service, Quality, Wellbeing, Accounts, Health & Safety) I saw an apprentice in charge. At the same time for 10 minutes each morning the team of workshop engineers, regardless of age or experience, take it in turns to chair a stand up discussion and review progress

of the initiatives in their part of the business.

The SQWASHE control system instigates change, and Shaun reveals why it's proving so important. "SQWASHE is the means by which we continually improve the business, it's an ethos, a state of mind. As a business you either accept the status quo and you think it's always been done this way and it works well for you, or you accept the fact that in a constantly evolving, changing world you need to continuously adapt."

What Central is trying to do is turn the leadership triangle upside down and try and get close engagement with everybody at every level in the business and get their input into how they change things. As we know the management team have set goals and financial targets for each diversification and a business plan which says what they want to achieve. SQWASHE doesn't restrict how the work is done, provided it follows a consistent methodology. This gives a continuity of process that everybody can relate to. Employees can see the changes working and because it works, it quickly becomes the norm.

Later that morning I joined the managers' SQWASHE meeting. Liam Brown,

"We've got some clients that are quite excited about embracing technology. One particularly is a company that manufactures vaping equipment. They are relatively new into the market, but they are really thought of as leaders who are driving ahead and this guy said yes let's go with this technology, so that's what we are up to."

Operational Support Manager, told me; “If we have an initiative, an idea, just a simple idea of how to make something better, it gets brought up and kicked around, and it won’t go anywhere until it’s put to bed, or resolved, or actioned. So everything is visible. For instance, if we have a problem with a failed unit, potential warranty claim, a safety issue, or observation it comes in here.”

SQWASHE sits alongside conventional quality and safety standards. Central are an ISO 9001 certified company, and working towards OSAS 18001, the safety and environmental standard.

Involvement in the AEMT

Shaun Sutton joined the AEMT Council in 2016 and sits on many of its committees. Thinking about what he can add to the association. Central have learned a lot of new techniques from the Manufacturers Alliance, a leadership development group in the North West giving floor space to similar companies to learn from each other. Shaun explains how this can be attributed to the AEMT, “it isn’t about empire building or protecting what you’ve done. We are all trying to

“My reason for joining the AEMT is to help spread the new ethos. There are great opportunities now, let’s all think of how we manage change and evolve and adapt. If I can be a bit of a catalyst towards that, that’s got to help macro economically because if every one of the 2,500 engineers, led by the 250 or so business leaders in the AEMT are able to make subtle changes that help manufacturing, the industry will be better for it.”

collaborate, share experience, help each other to problem solve, discuss issues around handling people and safety, all topics that underpin the quality of our work.”

Can much of this collaboration and learning be developed in the AEMT?

Shaun believes there is massive potential. Like many members Central joined the AEMT in the ‘70’s and remained passive for many years and have since realised the benefits of being directly involved in the future of the association.

Shaun concludes, “My reason for joining the AEMT is to help spread the new ethos. There are great opportunities now, let’s all think of how we manage change and evolve and adapt. If I can be a bit of a catalyst towards that, that’s got to help macro economically, because if every one of the 2,500 engineers, led by the 250 or so business leaders in the AEMT, are able to make subtle changes that help manufacturing, the industry will be better for it.” ■



Workshop SQWASHE Meeting



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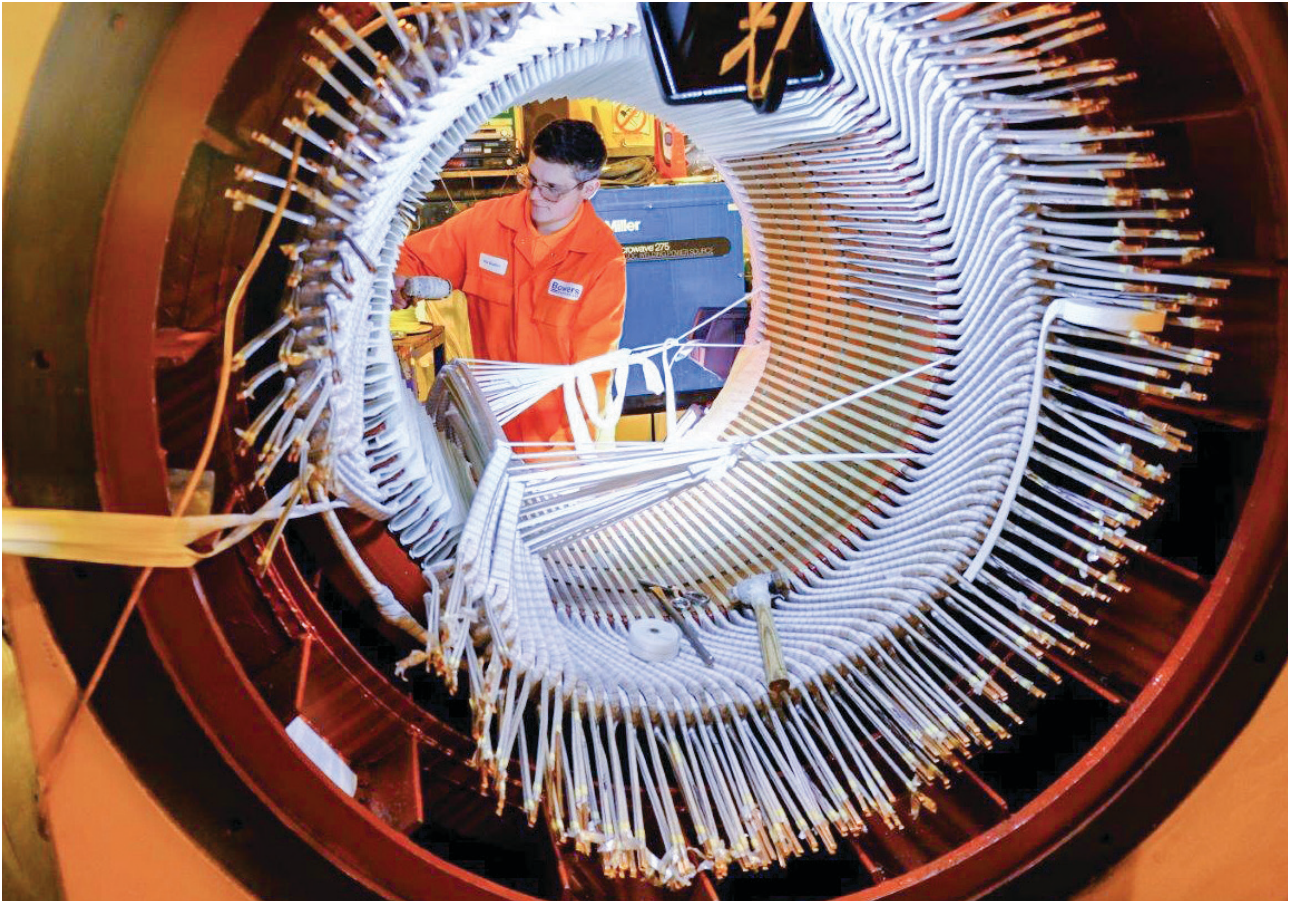
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Apprentice rewinding a motor

The AEMT ensures energy efficiency is maintained during service and repair

An extensive joint research project conducted at the University of Nottingham found that energy efficient motors remained within plus or minus 0.5% of their original efficiency after being repaired by a good service centre. This is within the specification tolerances of the label and efficiency banding. These tests were backed by a number of leading international industrial organisations and Government Departments in the UK and USA. Tim Marks of the Association of Electrical and Mechanical Trades (AEMT) reviews the projects and their findings.

Sometime ago, members of the AEMT and the American Association EASA worked together to establish "The Good Practice Guide to Maintain Motor Efficiency" after repair. The Good Practice Guide has since been used by members of the AEMT and

EASA internationally to ensure that any repairs carried out retain their rated efficiency.

The Good Practice Guide and research details are freely available from the AEMT Website.

The first Best Practice Guide to maintain Energy Efficiency was produced by the AEMT in conjunction with Department of the Environment, Best Practice Programme on Energy Efficiency. It was led by Professor David Walters, who

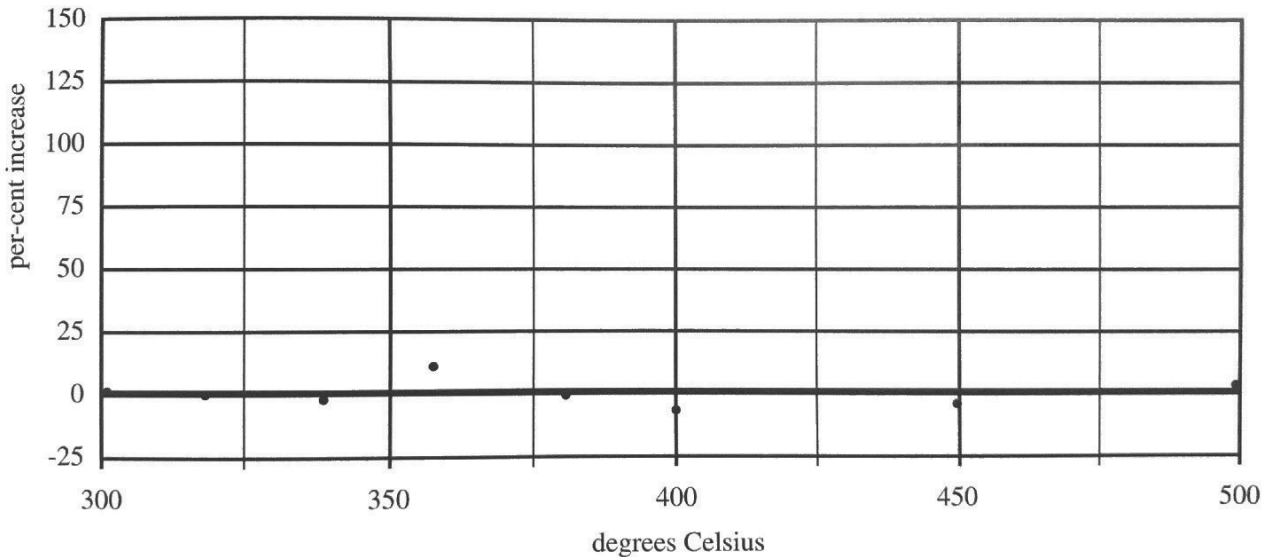


Figure 1: Shows that energy efficient motors incorporating the L3 varnish coated laminations showed no deterioration in core loss regardless of burn out temperature.

had previously led the Brook Crompton design team on their ground breaking W range of energy efficient motors.

The project remains the largest study of its kind with tests being carried out on 34 electric motors. These were

5.5 kW D132S machines supplied by manufacturers. They included 13 old design aluminium motors, 13 original design "Energy Efficient" motors, and 8 "higher efficiency" motors. A major difference between the machines was the quality of their stator laminations.

The "Higher Energy Efficient" machines were some of the first to use a high grade steel coated with an inorganic based L3 film. This heat resistant varnish film increased the ability of motors to withstand annealing temperatures, and withstand multiple burn out

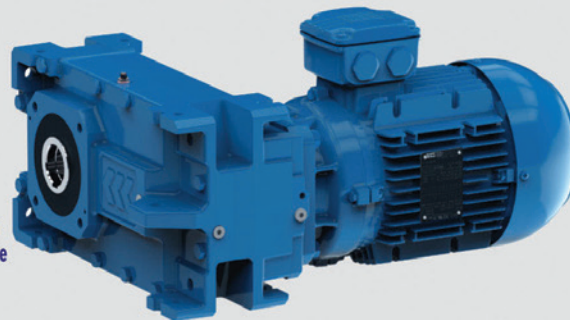


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temperatures without any detriment to the core laminations, as shown by tests during the project. Improvements in the electrical steels using L3 or better have formed the basis of new energy efficient machines over the past 20 years. This is shown in figure 1 above extracted from the original project

A few years later the original research programme was expanded to include larger machines up to 225 kW. Several Government Departments, electro-technical companies and industry groups - both domestic and international - were approached to join a wide-ranging project to broaden the base of the next research project.

Sufficient machines were included to give statistically reliable results, which increased the cost of the exercise. To mitigate this, the AEMT invited representatives of the US Department of Energy and through them the US repair trade association (EASA), both of whom agreed to join the project. The AEMT then approached their own national government for support and further



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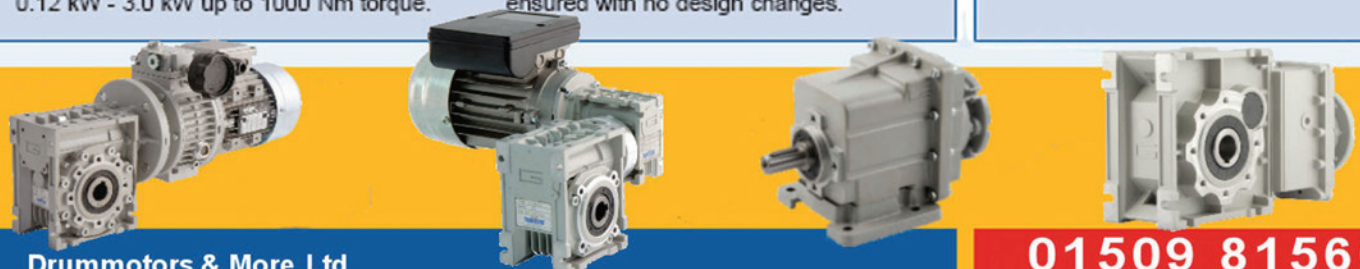
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Machine	150 kW 4 pole 50Hz New	150 kW 4 pole 50Hz Strip and Rewind
Winding Resistance Ohms	0.0196	0.0171
Temperature (°C)	45.75	36.85
Corrected Resistance Ohms	0.0182	0.0163
% load	99.0	100.1
Stator Loss Watts	2304.3	1981.1
Rotor Loss Watts	1053.0	1017.6
Core Loss Watts	2122.9	2075.1
Windage & Friction Loss Watts	740.1	772.9
Stray Loss Watts	904.8	1112.0
Efficiency %	95.4	95.6
Change %	-	+0.2%

Figure 2: The full test results above are extracted from the report on the project.

sponsors were encouraged to join. The final list of participating organisations was impressive, and included the UK Energy Efficient Best Practice Program, UK Ministry of Defence (Navy), UK Water Industry Research Centre, and British Nuclear Fuels.

Ten motor manufacturers also became partners to the project providing motors, technical data, and assistance for the study. These included ABB, Siemens, Brook Crompton, GEC (now GE) and VEM from Europe, and Baldor, Leeson, Reliance, US Motors and Toshiba from the USA.

Twenty-four 2-pole and 4-pole motors rated between 5.5 kW and 225 kW were used in the trial; these included 50 Hz IEC and 60 Hz NEMA machines with IP23 and IP54 enclosures.

The testing regime was devised by and conducted at the University of Nottingham. Importantly they were independent of the motor manufacturers and the repair industry. They were also recognised as having some of the best researchers and one of the best equipped labs for such work. A 30 kW motor was also tested on a “Round Robin” basis, the same machine being tested at Nottingham and three other reputed

test centres in America. Using the IEEE 112B test standard for efficiency testing, the variation between test stations was within plus or minus 0.5%, which was a good result. Tests used the calorimeter method for loss segregation at no load and full load. Finally a 75kW machine was kept at Nottingham as a calibration machine to ensure the repeatability of test results over the period of the project.

It should be appreciated that accurate testing of motor efficiency to this required accuracy is difficult, and takes time, 24 hours may be required just to stabilise the machine so that 3 constant readings can be taken and averaged. They can only be achieved in a suitable laboratory. The readings below show those taken for a new machine test, and the same machine after repair, this machine gained 0.2% efficiency after repair.

The results were averaged from three complete tests on each machine. After stripping and rewinding 5 machines up to three times each, the effect on efficiency ranged from +0.7% to -0.6%. No room for an error in testing, when the Round Robin Results between the test centres varied by plus or minus 0.5%!

The following table shows the results of these multiple repairs. After three rewinds, the third rewind was still very close to the original efficiency of the machine and well within the required efficiency band. This is probably more rewinds than most motors will go through over their 15 to 20 year life span in a clean modern factory. Similar test results ranging from +0.2% to -0.2% were noted for a single rewind on another 11 machines (Group B).

There are four basic contributors to the accuracy and repeatability of motor tests:

- the power supply,
- mechanical loading system,
- accuracy of instrumentation,
- and the test procedures.

The research team made certain all of these were consistently maintained for each motor. All tests were conducted in accordance with the internationally recognised IEEE 112 B guidelines, with test procedures, time between readings, and thermocouple location

Motor Type Project Group C	Tested	Efficiency %:	% Change	Efficiency Levels IEC 60034 30 1
100HP 2Pole 60Hz	New	95.0	0	Premium Efficiency (Equiv IE2) : 94.5
	Rewind 1	94.5	-0.5	
	Rewind 2	94.9	+0.4	
	Rewind 3	94.8	-0.1	
150HP 2 Pole 60Hz	New	95.9	0	Premium Efficiency (Equiv IE2) 95.0
	Rewind 1	95.9	0	
	Rewind 2	95.9	0	
	Rewind 3	95.8	-0.1	
200HP 4 Pole 60Hz	New	96.0	0	High Efficiency (Equiv IE2) 95.4
	Rewind 1	95.7	-0.3	
	Rewind 2	95.6	-0.1	
5.5kW 4 Pole 50Hz	New	86.7	0	IE1 (84.7)
	Burnt out three times Rewind 1	86.9	+0.2	
5.5kW 4 Pole 50Hz	New	83.2	0	Lower than IE1
	Burnt out three times Rewind 1	83.6	+0.4	

Figure 3: Test results of efficiency after multiple repairs



Inserting coils into a 2 pole stator

on the winding, all optimised to provide accurate results before the test sequence started. The tests collated data using both the American IEEE 112B method and the IEC 60034 2 readings. Due to the greater accuracy of the IEEE method at the time of the test, these were used for the project and the IEC 60034 2 readings taken to show the difference between the two standards. Recently IEC 60034 2 has been updated to be more in harmony with IEEE 112B. Recent tests have shown that the difference between the two standards is now minimal.

Each motor was tested as new and then sent for stripping, rewinding, and tested again. Some machines were rewound and retested multiple times as per figure 3. Comparisons could then be made between the motor 'as new' and after each repair and rewind.

Motors were sent to a repair workshop, who used the original AEMT Best Practice Guide; others were sent with specific instructions concerning winding configuration, copper section, mean

length of turn (MLT) and other design characteristics, the results of these were then used to update to the new Good Practice Guide to Maintain Energy Efficiency.

Tim Marks is convenor of the maintenance team reviewing an update of the International Standard IEC 60034 23 for Rotating Machines: Repair, overhaul, and reclamation. All the hard work from the initial two projects above has been incorporated into the new IEC International Repair Standard, which is on schedule for publication in 2018. The new standard includes all the recommendations that came out of the above extensive projects to ensure that repairs to the new standard will maintain the rated efficiency of machines after repair.

It is not surprising that the repair process maintains the efficiency of modern machines. Generally a repair will re-use the majority of the machine sent in for service and repair.

Items that ensure the efficiency is maintained are:

Bearings: Normally the only wearing parts of an electric motor are the bearings and seals. Most AEMT members use high quality bearings during a repair, which are as good as, and sometimes better than, the original specification. Energy efficient bearings may be fitted which are rarely used in the manufacture of standard machines.

Cooling: the fans are rarely damaged and are normally refitted. Good practice ensures a fan of the same size as the original is refitted. This maintains the same level of cooling and energy efficiency.

The Rotor: Although a shaft may become worn and require reclamation, the electrical properties of the rotor and the air gap between the rotor and stator are not normally items that alter during overhaul and repair. A damaged shaft may be replaced with new after a critical bearing failure, or the shaft reclaimed on



Testing a motor after rewind at Team Rewinds

larger machines. The energy efficiency of the rotor will be maintained during repair.

The stator: Stator laminations fitted to machines over the last twenty years and used in energy efficient machines are designed to be able to withstand a burnout and rewind, and as shown throughout the projects the laminations now meet higher standard specifications designed to withstand even higher temperatures. Insulation and varnish materials have improved by leaps and bounds over the past 20 years and now workshops use materials as good as, and sometimes better than those used during manufacture. With products as good as the original going into the stator repair as when originally manufactured, the efficiency of the machine is going to be maintained, as shown in the above

projects. This is equally true for the first, second, or third repair. The same quality of materials goes in as came out, so the same efficiency rating is maintained before and after repair.

The repair process is also very environmentally friendly, the cast iron or aluminium end shields and stator housing are cleaned and reused, steel laminations, and steel and aluminium rotor reused. The steel bearings are virtually always replaced and the steel bearings returned as pure steel to be recycled.

If the windings are burnt out, they are normally removed by hand as pure burnt copper wire, which does not require separating from any other materials when returned to a copper refinery.

"Good repairers and service centres use materials that are as good as or better than the original specification, the machine designs are also to a much higher standard to enable a much longer service life."

Considering it takes hundreds of tonnes of spoil, and a large amount of water and chemicals, to get one tonne of copper out of a good copper mine, this is a huge environmental saving. Interestingly about 41% of copper now used in Europe is from recycling. With current known reserves able to supply the world's copper requirements for around 60 years, it is not an infinite resource. Weight for weight the service industry returns to copper refiners the same weight of copper removed as it uses, and could exist without mined copper. This means that the repair process leads the way in meeting the requirements of the "Circular Economy", making the best use of the world's limited resources. So the repair of equipment should have a very valuable place in a company's ISO 50001 policy document.

Good repairers and service centres use materials that are as good as or better than the original specification, the machine designs are also to a much higher standard to enable a much longer service life.

Most AEMT Service Centres will sell, service and maintain electrical machines and can give an unbiased view as to why a machine failed and whether to repair a machine or buy a new replacement. ■



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Quartzelec completes bespoke brushless exciter retrofit at Mucomir Hydro

Quartzelec completes bespoke brushless exciter retrofit at Mucomir Hydro-station for SSE

When the Mucomir Hydro-power station in Scotland identified the urgent need for a new Brushless AC Exciter it turned to Quartzelec to develop, implement and commission the retrofit solution.

In addition to winning the contract to refurbish an existing generator stator and rotor, Quartzelec was also contracted to design, build and commission a new AC brushless exciter to replace the old DC exciter. As the owner and operator, SSE was looking to eliminate both the dust and maintenance burden plus significantly reduce the risk of extended outage resulting from brush and commutator

wear. The existing commutator was suffering badly with uneven wear issues, due in part to the intermittent loading and the humid environment at the site.

Owned and operated by SSE, the run-of-the-river hydro facility is fed from Loch Lochy. The station, which has been in continuous operation since 1962, is part of the Great Glen Hydro Group and the power plant comprises of a Kaplan

turbine driving a 3300V, 40pole, 150rpm AC synchronous generator.

“Each project comes with its own unique requirements,” comments David Swaffield, Quartzelec’s Lead Electrical Engineer on the Mucomir Hydro-power station project. “The slow 150rpm shaft speed of this turbine, presents its own challenge for the electrical machine design. Combined with the

limited access, available cooling, original footprint, and a limited envelope, meant this project necessitated some significant engineering and a high pole count.”

The brief for the Quartzelec design team was to retrofit a new AC brushless exciter solution into the existing footprint. Work began in August 2016 to characterize the available space, existing cooling circuit and fan performance curve. Then, drawing on the significant heritage and expertise Quartzelec has at its disposal, a 3-phase AC Synchronous generator and rotating rectifier hub could be designed to fit into the modified exciter housing while retaining the existing mounting interfaces.

The resulting designs were then approved and fabricated over subsequent months at Quartzelec’s engineering facilities in Rugby. In June 2017 the solution was shipped to site and installed during a scheduled maintenance window. The new solution provided to the customer is a bespoke brushless exciter to meet the duty of this site, whilst retaining the original fan, shaft interfaces and housing. Critically, however, it eliminates the risk and maintenance overhead of the original brush gear.

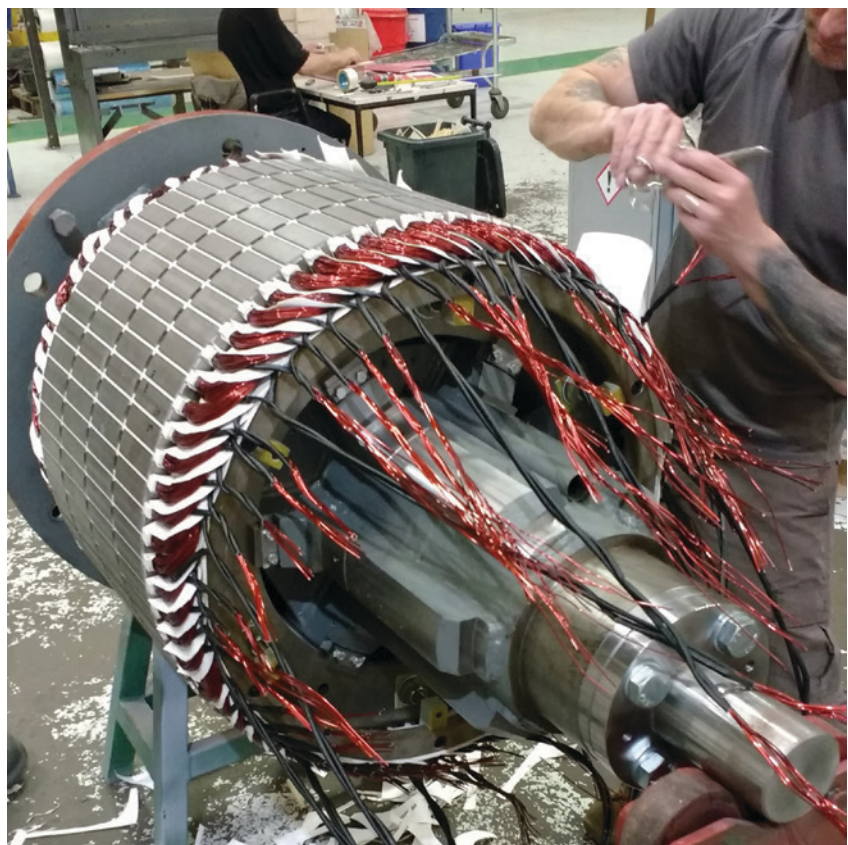
“This is a key part of our operation here at Mucomir, so we needed a cost effective but practical solution to ensure our continued operation. We were delighted with the service and attention to detail which everyone at Quartzelec demonstrated in respect to this project,” mentioned Angus Fraser, Lead Engineer for SSE. “Quartzelec clearly demonstrated their ability to draw on their heritage and expertise, developing a bespoke, retrofit design for this existing hydro plant ensuring the major overhaul could be successfully completed.”

Over recent months Quartzelec has seen a significant increase in demand for retrofit solutions along with preventative maintenance and inspections. This reverses the trend prevalent at the start of the last economic downturn, a decade ago, when many looked to defer upgrades and maintenance in a bid to cut costs.

This year Quartzelec is celebrating 10-years of OEM independence and 100



Completed Rotor pictured in the Rugby workshop prior to dispatching and installation on the Mucomir project



Exciter winding being worked on in Quartzelec's Rugby factory production area

years of heritage, building its reputation as a cost effective provider of electrical engineering services. Key to this has been strong leadership, a dedicated and knowledgeable 600 plus workforce and a positive ‘can do’ approach that has enabled the business to achieve a £68m turnover with continual global growth. Commenting on this Daniel Laval, Quartzelec’s MD concluded: “The past

10 years has given us the opportunity to flourish and truly establish ourselves as the competent partner of choice for reliable, responsive and cost effective independent support solutions and we are now consolidating plans to grow the business further over the coming decade and beyond.” ■



Sulzer delivered a fast solution to minimize the time in harbour [Source: Shutterstock / Paula Fisher]

Prevention is better than cure...

The failure of an exciter pack within an ice-breaker's shaft generator has led Sulzer on a mission to find the cause. The need for a swift and robust solution for the working vessel gave rise to a speedy repair. In conjunction with the manufacturer ABB, an additional in-depth investigation provided a solution that could be implemented on similar units across the fleet.

The vessel itself operates as an ice-breaker and an anchor handling tug, meaning its time at sea is valuable, and any time spent at the dock needs to be minimized.

The background to the project begins with Sulzer's field service engineers being invited onboard to investigate the failure of the exciter pack on a shaft generator. The requirement for the repair was immediately apparent and the damaged components were taken from the receiving port in Aberdeen to Sulzer's Falkirk Service Center, where they were overhauled and rewound.

As with any repair of this nature, the refurbished exciter pack was tested under load in the presence of the

All marine vessels need to minimize their time in the harbour and Sulzer worked closely with all of the stakeholders to deliver a reliable and long-term solution within the shortest timeframe.

customer and their insurer. Following a successful load test, the components were refitted by the same engineers that removed them in the first instance. However, finding the original cause of the exciter failure led to an investigation into the other component parts of the generator set-up to find a root cause.

Discovery

Immediately following the conclusion of the commissioning process, Sulzer launched an in-depth investigation that would focus on three main areas: the winding configuration, the serviceability of the automatic voltage regulator (AVR) and the electrical control system. Throughout both processes, the

investigation and the repair, regular communications were maintained between the various teams involved and the customer. Sulzer's technical design team looked at the evidence and concluded that the failure mode was consistent with a sudden spike in exciter load, which led to catastrophic failure, inter-turn or phase-to-phase.

This was supported with evidence from the commissioning engineer who stated that the only active alarms related to low voltage.

Uncovering the culprit

Every possible failure mode associated with the winding was thoroughly investigated and systematically eliminated. The stator and rotor coils were copy-wound to keep as close as possible to the original design, so that wasn't the problem. As part of the investigation the AVR was sent to the local UK agent for testing. Although it was not possible to carry out the tests under load, the unit passed and delivered the correct performance. Not being able to fully load test the generator/AVR combination outside of the vessel

itself, however, meant the AVR could not be ruled out, and remained the most probable cause of both failures.

Distributing the solution

At the same time, the electrical control system, including the switchgear, was inspected and tested and found to be within the manufacturing tolerances. This continued to indicate that the AVR was, in some way, responsible and further investigation was carried out using the drawings provided by the customer.

In a supreme example of the truth in the saying 'when all else fails – read the instructions', the original AVR manual was recovered and diligently read through. The manual gave a minimum field resistance of 9Ω , which conflicted with the original installation value of 6.753Ω . Operating at below the optimum resistance, the AVR had the potential to become unstable and lose optimum performance.

To resolve this situation, Sulzer provided 2.2Ω resistors that could be fitted in line with the DC exciter field. During

the commissioning of the newly repaired exciter pack, an agent engineer representing the AVR manufacturer noted that the shaft generator displayed excellent voltage control. In addition, the Chief on board the vessel commented that the shaft generator appeared to be more stable than previously.

The final conclusion to come from the investigation related to the overcurrent protection offered by the AVR. At the time of the failure, this was not being utilized and Sulzer advised that this option, and a number of other safeguards, should be implemented on all generators as a means of preventing similar failures in the future.

All marine vessels need to minimize their time in the harbour and Sulzer worked closely with all of the stakeholders to deliver a reliable and long-term solution within the shortest timeframe. The customer was pleased with the overall project conclusion and the vessel's chief engineer placed a separate order with the service center to cover further electrical maintenance once the ship was back at sea. ■



The damaged components were rewound while the investigation into the cause progressed



IT managers must discover vulnerabilities quickly and then take countermeasures.

Honeypots Versus Hackers

Production processes are becoming increasingly interconnected with digital communications technologies, opening new gateways for criminals operating on the Internet. The IT Security Technology Field at Siemens Corporate Technology is developing sophisticated solutions to protect against cybercrime and is subjecting them to rigorous testing, in part using its own team of hackers.

IT crime is on the rise. Once mainly limited to individual Internet users, it has become a major threat to industry and business, with damages caused by cyber attacks and industrial espionage already reaching many billions of dollars per year.

Many industrial companies are worried that as digital technologies spread and machines and installations become increasingly interconnected along the entire value chain, major additional security risks are being created. But to make their production faster and more flexible, and to keep it cost-effective, they have to convert their previously largely self-contained facilities into open production systems. It's a dilemma for which Dr. Rolf Reinema has a ready answer: "If industry uses an overarching and consistent security concept, the

risks are manageable." Reinema, who is responsible for the IT Security technology field at Siemens Corporate Technology (CT), heads a group of IT experts focused on developing comprehensive security solutions for Siemens' businesses.

Systematically Addressing Vulnerabilities

"In the past, gates and alarm systems protected factories. Today, on the other hand, the top priority for those responsible for security in industry is to be faster than hackers and uncover security gaps themselves," says IT security expert Klaus Lukas.

His ProductCert team, which is part of the Technology Field, addresses the

vulnerabilities of Siemens products that are reported from inside and outside the company. "The digitization of our business units requires us to respond quickly to such threats," says Lukas. As a result, his team immediately notifies a customer if weak points are identified and develops solutions as quickly as possible in order to rectify them.

At the same time, the team is continuously in touch with a network of security experts. "It's essential — not only for creating a mutual basis of trust but also to expand the scope of our own knowledge," says Lukas. That's why the members of his team also visit important conferences and IT events in order to communicate with other people from this field. Examples include the Blackhat USA and Defcon conferences, where researchers present their latest findings.

Scanning Data for Anomalies

Another IT security component is a monitoring system that identifies cyber attacks in close to real time. “In general, attacks aren’t detected fast enough. Once malware has penetrated a system, it can take its time looking through data and accomplishing its objective, whether that be pilfering data or manipulating it,” says Dr. Heiko Patzlaff. The monitoring system is intended to improve matters. “We’re developing algorithms that scan data streams for abnormalities,” he adds. For example, movements of large quantities of data at unusual times of the day or night might indicate an attack. The same goes for commands that are executed countless times in succession for no apparent reason. Or, if users who only work during the day suddenly log in at night, this could be a sign of a cyber attack. “Since every IT system has its own typical routines and patterns of behaviour, the search for clues has to be adapted to that,” says Patzlaff. If the monitoring system detects anomalies, it automatically notifies the appropriate security centre. “There, IT security specialists analyse the attempted breach and take countermeasures,” he says.

Forecasts illustrate just how extensive this challenge will become in the future. Not hundreds or thousands but billions of machines, systems, sensors, and individual products will eventually communicate with one another as the cyber-physical technologies collectively known as “Industry 4.0” become increasingly common.

Recognising Attack Patterns in Time

Another important IT security component is the ability to monitor operating environments such as manufacturing facilities or power plants to detect attacks. The CERT Research Group, which is headed by Dr. Martin Otto, is working on new solutions that will enable security experts to detect such attacks early on and successfully counter them. For example, CERT investigates new attack patterns every day. It analyzes them and works together with other departments to develop effective countermeasures and detection methods that greatly reduce the risk of an attack. “Such cyber threat intelligence enables us to understand the current threat situation and to protect our

systems and our customers in a more targeted manner,” explains Otto.

The experts at CERT and ProductCERT are also developing new technologies that can independently identify new attack patterns and generate recognition methods. In addition, the researchers are working to also make operating networks immune to such attacks and prevent breakdowns.

ID Check for Machines

This field is therefore in need of special security solutions. One idea, for example, is for machines to “identify” themselves before they can exchange data with one another or transmit it to databases. “This would make IT infrastructures more resistant to attacks,” says Hendrik Brockhaus. His team in Siemens’ IT Security Technology Field is currently demonstrating how an ID system of this kind for machines might work in a pilot system that was put together for the Siemens Mobility division. For the first time, Brockhaus is applying a public-key infrastructure (PKI) to industrial installations and using digital certificates to verify the authenticity of machines,



A gas turbine's operating data must be constantly analyzed. Before being transmitted, it must be encoded.

sensors, or components. For example, in the context of the pilot system, if a control system issues a switching command to the control unit of a field device, both the control system and control unit make certain, based on the PKI certificate, that the counterpart really is what it purports to be and that no hacking attempt is involved. The PKI certificates are issued by a "Trust Center" that operates according to very high standards of security and thereby establishes trust in the PKI certificates.

Hackers in the Service of Research

Another team in the IT Security Technology Field is also involved in defending against cyber attacks. "Our in-house hackers deliberately look for vulnerabilities in standard software for their attacks," says Reinema. In order to understand the methods hackers use, his department sets up what are called "honeypots."

These are vulnerabilities that are specifically sought out by hackers. Of course, the honeypot isn't located in the real IT system. Instead, it simulates a piece of software, a network, or a server and merely leads the hacker to believe that he is attacking the actual system. "By carefully analyzing hacker methods in this way, we can improve our threat intelligence and our ability to defend



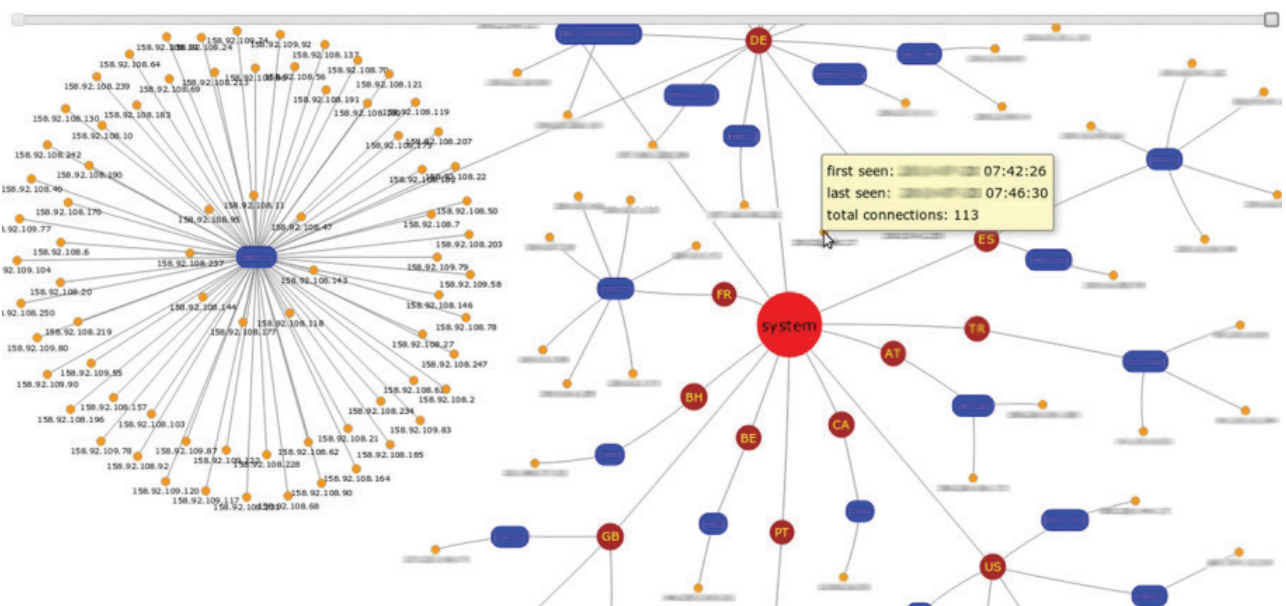
As more and more machines throughout complex infrastructures communicate with one another, eliminating the possibility of hacking is becoming a top priority.

against attacks on our solutions," says Reinema.

At the same time, in addition to IT infrastructure and Siemens products, Reinema's IT security specialists also thoroughly examine the department's

own solutions. Only then does it become apparent whether the walls erected by the IT Security experts are high enough, and whether the security checkpoints are rigorous enough. ■

Time range: 2009-05-18 - 2014-05-04



Corporate Technology has developed a monitoring service that helps to identify dangerous attacks.



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Back to Basics: The Ball Bearing

With rotating machinery at the heart of the AEMT, bearing technology comes into play on a continual basis.

Therefore, a deep understanding of how bearings work is important from a user's perspective. SKF take a look at the history of the ball bearing from their perspective, and offer some common bearing designs and features to understand.

First, a bit of history. The earliest recovered example of a rolling element bearing is a wooden ball bearing that supported a rotating table from the remains of a Roman ship in Lake Nemi, Italy. The wrecks were dated to 40BC.

Over a millennium and half later, Leonardo da Vinci incorporated drawings of ball bearings for cart axles around the year 1500. The first modern recorded patent on ball bearings was awarded to Philip Vaughan, a British inventor and ironmaster who created the first design for a ball bearing in Carmarthen in 1794.

His was the first modern ball-bearing design, with the ball running along a groove in an axle assembly.

Fast forward a century or more, and the first major ball bearing development of the modern industrial era was patented on 6 June 1907 by inventor, Sven Wingquist, the first managing director of Aktiebolaget Svenska Kullagerfabriken (a company we now know as SKF). This was the double-row self-aligning ball bearing, the basic design of which SKF has continued to develop to the present day. In the following years, from its base in Gothenburg, SKF promoted this innovative ball bearing design internationally, opening branch offices in Germany and France, and appointing agents initially in Finland, Switzerland, Belgium, Denmark, Austria and Australia. Agents in many more countries were to follow.

A subsidiary, SKF Ball Bearing Co, was established in New York in 1909. A year later the Skefko Ball Bearing Co. Ltd was registered in the UK and work started on a plant in Luton. Here some 180 bearing types were eventually being produced daily. By 1913, the company had 3,200 employees around the world, producing 1.3 million bearings a year.

What is a ball bearing?

Since then ball bearing technology has advanced apace, thanks to continuing research and development by companies such as SKF. But before we examine the many different modern variations and combinations of bearing geometries and materials of construction, let's take a moment to define exactly what a ball bearing is, its basic mechanical construction and the forces that act upon it when in service.

In their basic form, ball bearings are an assembly of four parts: a large outer ring, a smaller inner ring, the balls, sized so that they are free to rotate between and make contact with the raceways of the rings, and a cage, the purpose of which is to retain the balls, preventing them from touching one another. Variations of this basic design have given rise to a range of special types of ball bearings (of which more later) designed to meet specific application needs.

The main purpose of a ball bearing is to reduce friction in a rotating axis – for example, between a fixed shaft and a component (such as a wheel) rotating about that shaft. The more precise the internal geometry of the bearing is, the lower the friction will be. Friction will also be affected by speed of rotation, lubrication, load and other factors. Lubrication is a very important topic and a subject in its own right.

Basic ball bearings will handle both radial and axial loads, but as the point of contact with the balls and the raceways is very small there is considerable pressure created, so loads must be limited in order to avoid damage to the balls and raceways. Ball bearings are thus better suited to lower load applications. Roller type bearing designs overcome these limitations.

Calculation of the loads for a particular application and operating conditions is an important step, as a miscalculation is likely to result in premature bearing failure. Choosing the correct type and size of ball bearing can be a complex task. In addition to the loads they are subject to, there may be other parameters to consider such as high or low extremes of operating temperature, lubricant type, presence of corrosive agents, and even stray electrical currents which can cause damage to the raceways.

Modern types of ball bearing

Let's now take a look at modern ball bearing configurations and how their particular geometries and materials meet the demands of different applications and working environments. For the purposes of this article, we'll be considering five key types of modern ball bearing: single row deep groove, double



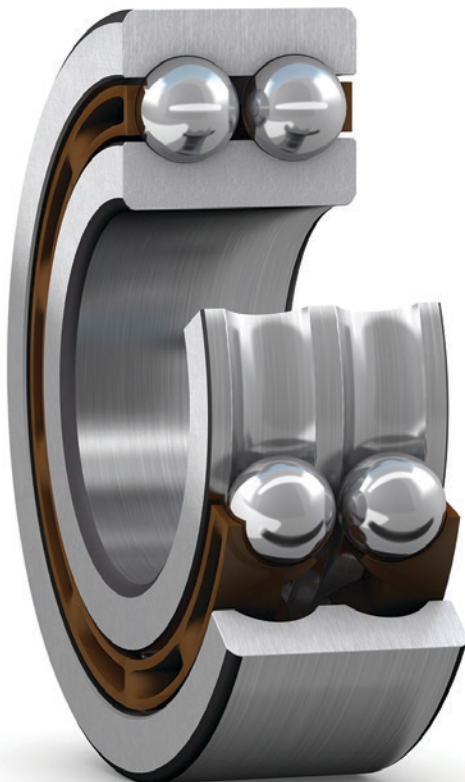
Deep groove ball bearing with steel cage cut view



Self-aligning ball bearing with E design in cut away view



SRACBB with optimized brass cage_cut view



Double row deep groove ball bearing with polyamide cage

row deep groove, self-aligning, angular contact and thrust.

Single row deep groove ball bearings

Single row deep groove ball bearings are the simplest and most versatile of all ball bearing designs, and so they tend to be the most widely used type. They are suitable for high and very high speed applications, and are robust in operation, requiring little maintenance. This bearing type has deep, uninterrupted raceway grooves that have a close osculation with the balls (maximum contact between the curved surfaces), enabling them to accommodate radial loads, axial loads and combinations of both. Variations include hybrid types comprising ceramic balls and steel raceways (offering insulation against stray electrical currents) and polymer bearings for applications subject to contact with corrosive agents.

Double row deep groove ball bearings

With very similar properties to single row versions, these are essentially a tandem arrangement of the single row deep groove type, where a single ring combines two raceways. They are suitable for bearing applications where the load carrying capacity of a single row bearing may not be sufficient. For the same bore and outside diameter, double row bearings are, by design, slightly wider than single row bearings, but have a considerably higher load capacity.

Self-aligning ball bearings

The bearing type that placed SKF at the forefront of modern bearing design and development over one hundred years ago, the modern self-aligning bearing has two rows of balls running in two inner raceway grooves and a common single spherically contoured raceway in the outer ring. This novel design allows the bearings to accommodate angular misalignment (shaft relative to the housing) of up to a maximum of three degrees.

Typically, self-aligning ball bearings are an ideal choice for light- to medium-load conveyor applications as they manage varying loads well with minimal friction, enabling higher conveyor speeds and longer bearing service life.

Angular contact ball bearings

Angular contact ball bearings have raceways in the inner and outer rings that are displaced relative to each other in the direction of the bearing axis. This means that they are designed to accommodate combined loads (simultaneously acting radial and axial loads). The axial load carrying capacity of angular contact ball bearings increases with increasing contact angle, the latter being defined as the angle between the line joining the points of contact of the ball and the raceways in the radial plane, along which the load is transmitted from one raceway to another, and a line perpendicular to the bearing axis.

Standard configurations provided by SKF include single row angular contact ball bearings (accommodating radial loads as well as axial loads in one direction only),

double row angular contact ball bearings (accommodating radial loads as well as axial loads in both directions) and four-point contact ball bearings supporting only axial loads in both directions).

Thrust ball bearings

Thrust ball bearings are manufactured as single direction or double direction units that are designed to accommodate axial loads only and must not be subjected to any radial load. Unlike other ball bearing types, thrust ball bearings are separable; that is, the shaft washer, housing washer(s), ball and cage assemblies can be mounted separately. Shaft washers have a ground bore to enable an interference fit, while the bore of the housing washer is turned and always larger than the shaft washer bore. Single direction thrust ball bearings consist of a shaft washer, a housing washer and a ball and cage assembly,

and are able to accommodate axial loads in one direction. Double direction thrust ball bearings consist of one shaft washer, two housing washers and two ball and cage assemblies, the housing washers and ball and cage assemblies being identical to those used in single direction bearings. Double direction thrust ball bearings can accommodate axial loads in both directions.

All of the ball bearing types mentioned in this article are available from SKF, together with expert application advice concerning special configurations, materials, sizing, and load and life expectancy calculations. ■



Take the crisis out of an Emergency

AEMT members are highly skilled Electrical and Mechanical Engineers often prepared to work round the clock to collect, repair and return faulty equipment, and keep downtime to a minimum. Most supply, service, and rewind electric motors, and look at the most economical and energy efficient solution.

The majority also repair pumps with some operating in confined spaces to remove and refit centrifugal and submersible pumps. Many also service gear boxes. AEMT members try to prevent problems and are probably the largest network nationally and internationally of companies able to carry out thermography, vibration analysis, and laser alignment. Their mechanical ability to rebuild and refurbish items is legendary. Many AEMT companies are trained to repair and work in Hazardous Areas, and most offer the quality expected with ISO9001.

So when you require help quickly at 1 am in the morning, or 5 pm on a Sunday afternoon, help is at hand! Whether you are in the UK or in Miri in Borneo, just look up the AEMT Website for a list of companies that are able to help you.

Remember: www.theaemt.com



Image credit: Quartzelec

PROMOTING ENGINEERING EXCELLENCE



Croner's knowledgeable and friendly staff are available for Free to AEMT Members

The chances of one of your employees making an employment tribunal claim against you just got significantly higher.

Steve Ashman of Solutions in I.T. explores the pitfalls and the ever-changing world of employment law with specialist AEMT partner, Croner.

Delivering a powerful message about the importance of employment law strategy within the business, Amanda Chadwick opened our eyes to the pitfalls of non-compliance at June's AGM. The message was compelling, but members are not alone. In the first of a series of Journal articles, Croner navigate you through this complex area of company

law and employment legislation.

On Wednesday 26th July 2017, the Supreme Court ruled that tribunal fees are unlawful and a barrier to justice, abolishing them with immediate effect. As a result of this ruling, if an employee feels that you, as an employer, have treated them unfairly, there is nothing to

stop them making a claim against you, which could have a devastating impact on your business.

You need to act now to protect yourself and your organisation, especially when considering that all tribunal judgements are now published publicly.

Background

After a court battle between UNISON and the Government, the Supreme Court has now ruled that Employment Tribunal fees are unlawful. The court said that the high level of the fee was stopping people from getting the justice they deserve after being treated unlawfully by their employer.

Government Took Immediate Action

Immediately after the ruling, the Government announced that Employment Tribunal fees were to be removed. This means that claimants are now able to take their employer to Tribunal for free. The Government also confirmed that everyone who has paid a fee will be refunded.

Impact on Employers

It is likely that the number of claims made to Employment Tribunal will increase because claimants no longer need to pay. The number of 'have a go'

claims from employees who wish to try their luck in Tribunal may well increase.

This means employers need to be sure that their workplace practices are watertight, and leave no room for dispute. Employers should also consider their risk in relation to actions taken within the last three months, as this is the time limit on making a claim to Tribunal.

Specialist Employment Tribunal Support

With unparalleled experience in the industry, Croner are able to provide comprehensive employment law and employment tribunal support, from start to finish.

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needed for a proactive approach.

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As an AEMT member Croner will take your call and offer guidance to set you on the road to complete peace-of-mind, they'll give you an appraisal of your specific situation and if needed, offer additional services to ensure your business is never put at risk.

If you don't know how to contact Croner as a member, please contact the secretariat on 01904 674 899 or email admin@aemt.co.uk



Amanda Chadwick talking to AEMT members on Employment Law at the AEMT AGM



Autumn 2018

CIRCULAR ECONOMY

Visit: www.aemtconference.com

The AEMT conference returns in Autumn 2018 focusing on how industry is looking for ways to keep resources as long as possible, extract the maximum value from them whilst in use, then recover and regenerate products and materials at the end of each service life.

The conference will incorporate a trade show alongside it, with a programme of speakers and

activities to attract both members and associates as well as end-users and plant maintenance engineers.

To keep up to date with news, visit the AEMT Conference website and sign up to news.

Autumn 2018

Visit: www.aemtawards.com



The AEMT Awards showcases the very best achievements from the entire electrical and mechanical trades sector in a global celebration of business and professional excellence.

After concluding the 2017 awards the website will remain live. Winners and finalists from the previous awards will be archived permanently along with videos and photos from the Event.

The AEMT Awards will return again in Autumn 2018 and will build upon the success of 2017. Details are being worked on and will be published on the awards website.

To keep up to date with news, visit the AEMT Awards website and sign up for news.



The AEMT Awards launches with triumphant success.

Through a blaze of dazzling lights and electrifying music, the inaugural AEMT awards launched itself with triumphant success on the 29th November. As the crowds drew towards the DoubleTree by Hilton Hotel in Coventry, it was wonderful to see so many new faces, and many old friends too. The glamorous Siren string quartet serenaded guests as the evening warmed up with canapes and sparkling wine, before a booming voice announced guests to head for their tables.

The host for the evening, Gary Downes, President of the AEMT, welcomed guests and gave great thanks to all those responsible for bringing the evening together, especially to the category sponsors EMIR Software, Fletcher Moorland, DFA Media (in the form of their publications Drives & Controls, Plants and Works Engineering, Hydraulics & Pneumatics), TEC Motors, and WEG UK. Their support made the whole evening possible. Thanks also went to Avonmore Electrical for sponsoring the Awards Brochure and Menzel Elektromotoren for the dazzling evening entertainment, Siren.

The President went on to talk about the Association and its future. Talking about the globalisation of business, and how the association is playing its part in this. The AEMT brand is very important in making sure the global success of

its members is centred on quality, trustworthiness and fairness. We must also be preparing for the next industrial revolution, which is happening now, and is important for the future success of the industry.

Thomas Marks, secretary to the Association, then ran guests through the evenings events including a fund raiser for a charity that shares many synergies with the association. The Red Cross reflects the same 'emergency response' service that many members offer for power stations, water treatment plants, factories, and refineries. Through a quick game of heads and tails at the end of the evening, guests raised a generous £1,317.50 for the charity. The lucky winner, who had already won the Rising Star of the Year Award, Ryan Davis from Rotamec, who received £100 from the pot.

After a delicious hearty meal served up by the hotel, the Awards ceremony commenced. Andrew Castle of Touchwave Media, who helped produced the Awards for the association, took to the stage with fantastic fanfare and applause to host the ceremony. The Winners and finalists of who can be seen in all their finery in the evening's photographs in the following pages. We offer our most sincere congratulations to the winners, who can now be recognised and respected as leaders on the work they do.

1. Winners and Finalists Celebration Photo.

All photos from the evening can be viewed online at www.aemtawards.com. Winners entries can also be viewed on the winners page



2



3

- 2. Gary Downes, President of the AEMT welcomes guests.
- 3. Industry Supplier of the Year to PEME Asset Care Partner.
- 4. Contributions to Skills and Training, Houghton International Apprentice Programme.



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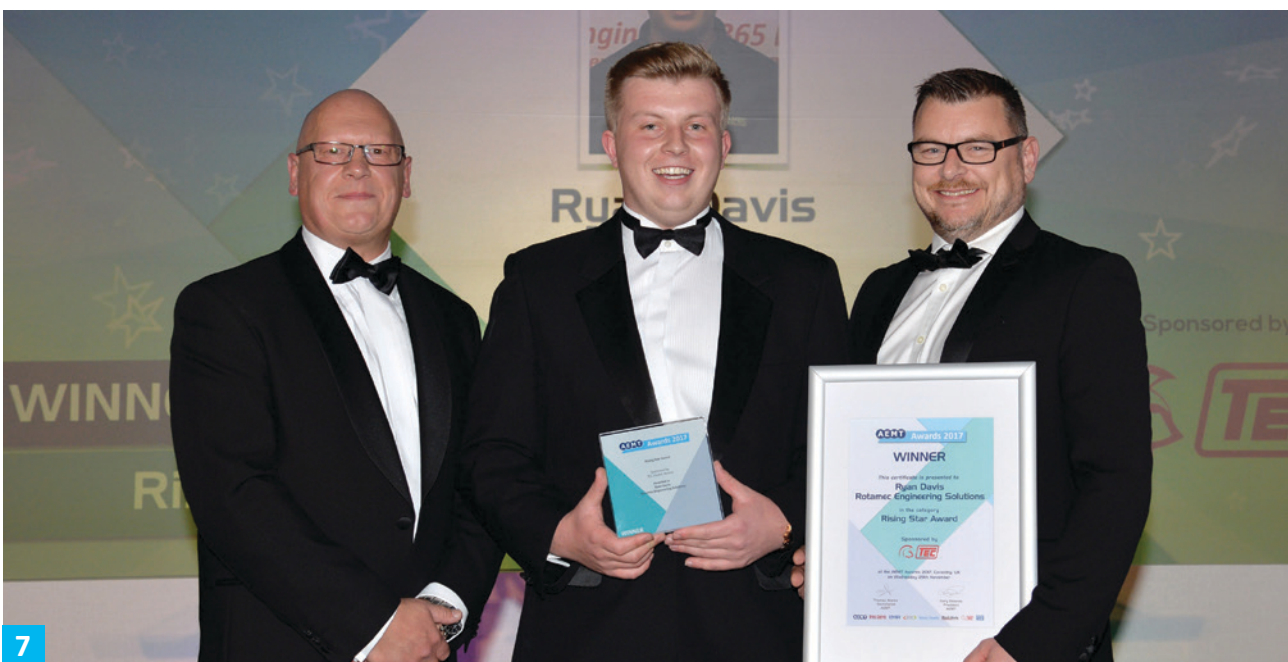


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- 5. Technical Innovation of the Year for Products, Fletcher Moorland's SERVICEview
- 6. The glamorous and sophisticated Siren String Quartet entertaining guests after the awards.
- 7. Rising Star Award Winner Ryan Davis of Rotamec Engineering Solutions



7



- 8. Technical Innovation of the Year for Projects, Central Group for the modification and installation of a new third party supplied process control panel containing a softstart unit.
- 9. Winner of the Heads and Tails charity fundraiser, Ryan Davis of Rotamec.
- 10. The AEMT Lifetime Achievement Award to David Bowers of Bowers Electricals



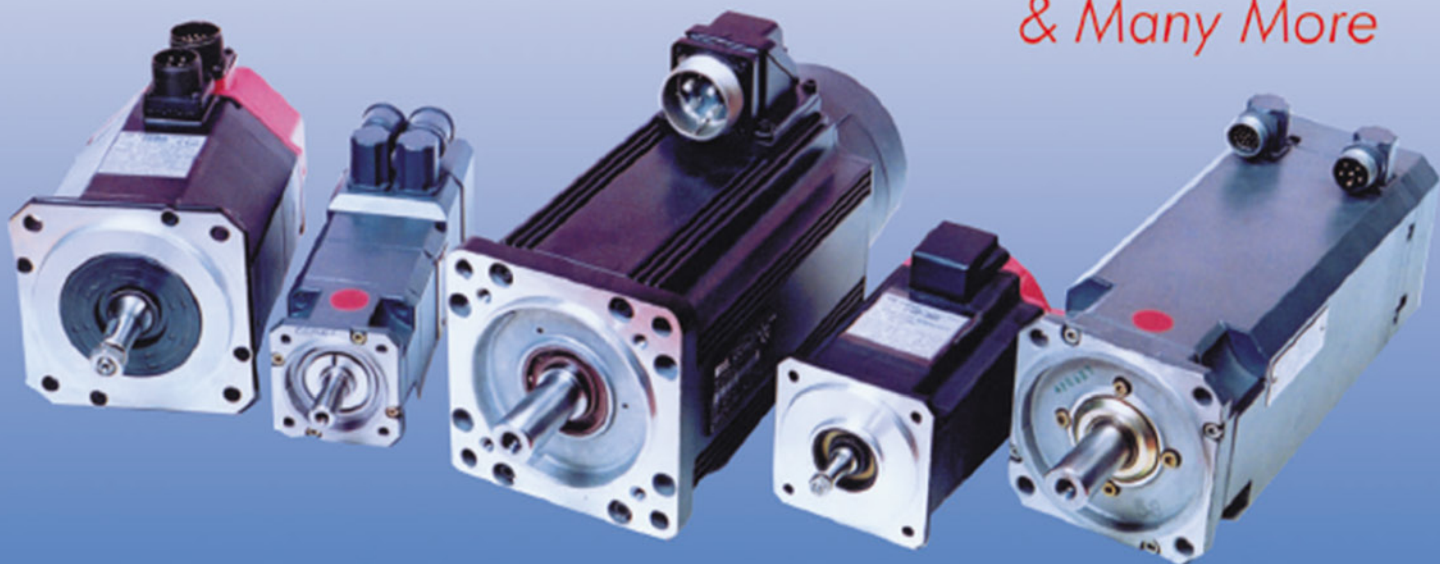
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