

information

The Southern Branch – “All in the Air”

The Southern Branch of the IMF held a mini symposium entitled “All in the Air” on Tuesday 23rd May at Farnborough Air Services Trust (FAST Museum) in Farnborough Hampshire.

The FAST museum was opened to the public in 2003 is now recognised internationally as the showcase for the key technological developments undertaken since the early days of military flying and our seminar visitors were given the opportunity to look around the museum prior to the seminar.

THE FOUR PRESENTATIONS (WHICH WERE DESIGNED TO FIT INTO THE AEROSPACE INDUSTRY) WERE AS FOLLOWS:

- A brief introduction on NADCAP
- Material Finishing in Aerospace Engineering
- ISO Standards (Where are we now?)
- Development of selectively metallised 3D Polymer Surfaces

Poeton are accredited in NADCAP and Martin gave a brief summary of what is required to attain NADCAP.

Martin emphasised that there are MANY steps to the NADCAP process, but it was essential to only do what is required for your company in order to obtain what he termed “**The Golden Ticket**” which allows you to work in the aerospace industry.

Checklists are provided on the NADCAP website and he gave examples which can be obtained.

For example: -

- A ‘Baseline’ check list involving 47 pages
- A ‘Plating’ check list involving 37 pages
- An ‘Auditors’ check list involving 46 pages, etc. etc.

In each of these checklists there are multiple choice answers that must be answered honestly otherwise the auditors of NADCAP will find you out.



The first speaker was Martin Trigg Hogarth from Poeton.

imf dairy

IMF Events

8th September 2017

Education Enrolment Date

1st & 2nd November 2017

Advanced Engineering

28th November 2017

AGM

Cobden Hotel Birmingham

25th & 26th September 2018



Southern Branch Events

4th October, 2017

at Lloyds Register Surface
Engineering and Welding
Seminar Combined meeting
with The Welding Institute

Keep in Touch

Please make sure we have your contact details up to date. Any changes please contact David on 0121 622 7387 or email: david@materialfinishing.org

NADCAP is paperwork, paperwork and more paperwork, which inevitably produces a cost to the prospective user.

Besides paperwork regarding the processes, paperwork filters down to the shop floor instructing people what to do and what to record. Everything must be traceable.

The final emphasis of the paper was: If you wish your company to work in the aerospace industry then you will require "The Golden Ticket" but it does come at a price.



Our second speaker was Graham Armstrong from Indestructible Paints

Graham spoke at our last symposium "Paint Your Wagon" about the application of paint to the body of the aircraft but in this meeting he spoke about the more rigorous requirements for paint where it is used in the engines and those "out of the way places" that are not seen but absolutely vital in the survival of the aircraft in flight.

The paints used fall into primarily 3 categories; Structural Primers, Anti Corrosive primers and Finish coats.

Graham described how the jet engine is subjected to many degrees of temperature. In flight, the nose cone of the engine will be around -50 -/-60°C and also subjected to high dosage of Ultra Violet. The fan blades in the compressor will be around 600 / 700°C.

In each instance a different paint will be required to withstand the temperatures. The fan blades in the front housing are carbon fibre/titanium – these require a flexible polyurethane paint, the high pressure compressor use an aluminium ceramic slurry and dry film lubricants are used where the blades are mounted in the roots. Aluminium fan cases use primers but these are slowly being changed for titanium in order to save weight.

One area where corrosion can be serious is within the undercarriage. The undercarriage now uses slurry coating and chrome or chrome free anti corrosive epoxy primers, which give a high erosion resistant finish. The hydraulic brake fluid material (which has a much great corrosive property than that used in the automotive industry) requires the use an anti corrosive primer and a fluid resistant polyurethane.



Our third speaker was Nick Sawyer from Lloyds Register

Nick talked about ISO standards 9001 and 140001 : 2015, giving his own personal view on some of the issues he has encountered on recent assessments and transition work.

August 2018 is the drop-dead date for earlier versions. Annex SL is the structure for all new and revised ISO Standards and this defines the framework for a generic management system. All new ISO management system standards (MSS) will adhere to the framework and all current

MSS will migrate into this system.

Nick described the Layout of Standards – ISO directive: Annex SL, Appendix 3 The Ten Clauses, The High Level Structure for Quality Management and The High Level Structure for Environmental Management that led into integration possibilities and risk based thinking.

Understanding the organisation and its context, external and internal issues and using common tools such as PEST analysis, PESTLE analysis, SWOT analysis and Stakeholder analysis were examined.

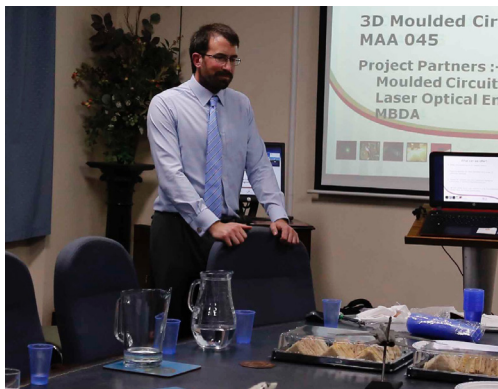
Interested parties – needs and expectations is now driven by a new requirement and these were examined and evaluated.

Leadership, Planning (Quality and Environmental), Risk1 and 2, Clause 7 and 9, Process approach for waste were all discussed.

The final thoughts of the transition to the 2015 standards were:

- If it is in the standard it should be within your Management system
- If the clause says “document” or “documented” it needs to be written down
- EVIDENCE, EVIDENCE, EVIDENCE
- Records, signed and dated, Photographs, emails, reports, minutes, attendance list signed and dated etc. etc.

Although this is only a resume of Nick’s talk it is suggested that should anyone be very interested in the implications then please have a look at his paper (see page 4 for details).



Our final speaker, Daniel Lloyd was from Laser Optical Engineering

David gave a talk on the use of lasers in 3D metal connections.

Laser Optical Engineering Ltd (LOE) specialises in the development of innovative and bespoke laser based products and services and was established as an independent spin-out company from Loughborough University in 1996.

Daniel has been working with a company in Leicester on how, by using lasers upon a catalysed polymer, selective copper plating could be carried out and thereby allowing intricate and complex 3D patterns to be produced. The end user wants a highly functional and very precise circuitry using new materials that can save weight and this can be achieved by using these processes.

He then went on to describe what is a laser, laser selection followed by several videos showing applications of laser technology. Videos showed laser cutting, laser sculpturing, laser cleaning, laser marking and also the addition of a second metal to a different base metal.

For the first time a questionnaire was left for attendees to fill in order to give the Southern branch committee a feedback and questionnaires received have all given very

positive results, which is very encouraging.

The committee would like to thank Martin Trigg Hogarth, Graham Armstrong, Nick Sawyer and Daniel Lloyd for giving up their time both to the preparation of the papers and also presenting the papers to us.

We would also like to thank Metalor and Fischer Instruments for exhibiting at the seminar.

Copies of the papers are now available on the IMF website (www.materialsfinishing.org) for anyone who might be interested. resistance and low erosion. Engineering coating paints are used for wheels and brakes. **J Burgess**

The Organics Group

The Organics Group, going forward, will focus more on paint and powders, to include advances in technology, application to diverse substrates and surface pre-treatment.

We would like to start a forum on common aspects of paint failure so will be discussing types of failure and the reasons why they happen in future issues of Information. This will involve difficult substrates, correct pre-treatments, cleanliness of the substrate and external factors such as temperature, humidity and the environment. Feedback and readers views would be welcome.



Brenda Peters
Chair Organics Committee

Secretary General's Column, May/June 2017

It hardly seems possible that we are now nearly half way through 2017; where does time go, or is it really just a sign of "getting old"?

The last 4-6 weeks have been really hectic; my supposedly part time job has taken me on four business trips into Europe, and this can limit the time I can effectively spend on IMF matters, apart from week-ends of course!

Over the last few weeks I have been involved in two industry wide initiatives; firstly we have been continuing to put together the "promotion to schools" with IOM3, and secondly with Innovate UK on a workshop to look to plan the future of "Surface Engineering and Advanced Coatings".

The work on the promotion of materials finishing and surface engineering to schools is almost completed, and the "teachers" day is arranged for the 28th June. This event will invite up to 20 teachers from across the UK, who teach science and/or engineering to secondary school level. The day will include 4 presentations on varying aspects of materials finishing, including systems used on smart phones, and organic finishes on bicycle frames. There will also be some practical demonstrations, including ultra violet curing of lacquers which will hopefully wet the interest of the teachers so they can "promote" materials finishing and surface engineering as an exciting career in science and technology. I will be attending on behalf of the IMF, and hope to be able to report a successful day in my next column.

You may remember I represented the IMF on the Surface Engineering and Advanced Coatings Special Interest Group back in 2014-2015. This group had been put together to include senior players from all sides of the finishing industries to put together strategies to move the industry forward into the 21st century. A full report was written and presented to all interested and concerned bodies, including parliament.

As a follow on to this, Innovate UK, have been tasked to review this report 2 years on, and to put together working group to "brainstorm" new

ideas and technologies to continue to develop surface engineering and materials finishing as a core industry within UK Plc. A two-day workshop was held in Derby at the end of April, and four initial areas for more in-depth study were agreed upon. Innovate UK are to issue notes from the workshop; as these become available I will forward any relevant information to members.

There is a further Cross Sector Group meeting scheduled for mid-June, to continue the assessment of implications of the REACH regulations, and any implications on the UK position on these regulations as Brexit kicks in and we have a new government. The group continues to enjoy an excellent working relationship with DEFRA, who will manage the UK position on this legislation. Any news from this meeting will of course be reported to our members.

It was fun to meet up with our colleagues from the Southern Branch on the 23rd May at their seminar on aerospace, held at the Farnborough Air Sciences Trust; the museum at FAST is really interesting with many vintage exhibits from the early days of aviation, including a full-size replica of the first English plane to fly! I know John Burgess will be writing a synopsis of the papers given at this well attended evening.



Graham Armstrong
Secretary General - May 31st 2017

Dr. Arthur Brace – “The Father of Anodizing”

Dr. Arthur William Brace, 24 May 1923 – 5 April 24, 2017



A native of Bristol, Dr. Arthur Brace entered the aircraft industry at the age of 16 as a metallurgical assistant. Some years later he joined the Aluminium Development Association where he was responsible for a range of projects. He subsequently moved to the Research Laboratories of Alcan Aluminium in Banbury, initially as Head of Metal Finishing Research and Development and later Head of Chemistry Division. During this period he built up a team which gained a high reputation and later became a recognized centre of excellence for anodizing research.

After a period as an anodizing plant manager, he established himself as a professional consultant. His consulting activities were world-wide and saw him undertaking numerous assignments involving aluminium finishing in the Arabian Gulf, Australia, Europe, the Far East and the USA. On several occasions, he served as an aluminium expert for the United Nations Industrial Development Organization. He provided expertise for

the Argentine Government in planning a series of downstream enterprises to utilize the aluminium produced from the Puerto Madryn reduction plant. These projects were later successfully implemented. He advised the Government of China on the expertise needed to establish a training establishment for the manufacture of aluminium windows in the 1970s. This led to the setting up of manufacturing plants which are operating successfully today. He was also adviser to the Government of Iran on the possible future development of its aluminium industry.

Dr. Brace was also in demand internationally as a lecturer. He published numerous papers in his areas of expertise and was author of three books: “Anodic Coating Defects”, “The Technology of Anodizing Aluminium” and “Hard Anodizing of Aluminium”.

He was a strong believer in lifelong learning. He had left school at sixteen as his parents could not afford for him to continue his education full time but he continued to study part-time, receiving the City and Guilds Insignia Award and later an Honours Degree in Economics at the London School of Economics. At the age of 72 he was awarded a Ph.D. in Engineering at Aston University and a Doctor of Science degree at the age of 89, also at Aston, in recognition of his lifetime’s work. He was a Chartered Professional Engineer and Fellow of the City and Guilds of London Institute, the Institute of Materials, Minerals and Mining and the Institute of Materials Finishing.

For some years he was Chairman of the Management Committee of the City and Guilds Insignia Awards Association. He was part of a small team that drafted the structure of the new City and Guilds Senior Awards. For this contribution he was

awarded the Association's Gold Medal and became an Honorary Member of the City and Guilds of London Institute.

Dr. Brace received numerous accolades in recognition of his achievements. In the U.S.A. he was given the highest award of the American Electroplaters and Metal Finishers Society, being designated a Fellow. He also received from the same Society the Sam Wyman Memorial Award and a special award in recognition of his contributions to the work of the Light Metals Committee. He was also a recipient of the Robert L Kersman Award of the Aluminum Anodizers Council. In the U.K. he received the Hothersall Memorial Medal and the Jim Kape Memorial Medal of the Institute of Materials Finishing.

Dr. Brace was one of the founders of the International Hard Anodizing Association and a member of a small group which planned the setting up of the Aluminum Anodizers Council in the USA. A member of the Light Metals Committee of the American Electroplaters and Surface Finishers Society, he also served as President of its International Branch. He served two periods on the Council of the Institute of Materials Finishing and as Chairman of its Anodizing Group.

Although nominally retired at the age of 70, Dr. Brace continued to study and work part-time, chairing professional conferences and appearing as a guest speaker. His last significant professional contribution was a paper questioning the established theories of anodizing. Further work on this he left to his successors.

He was described by colleagues as a pioneer, a great mentor and a friend. To his family he was an example of what determination and hard work can achieve. He was an inspiration to all and he will always be remembered for his enthusiasm and lifelong curiosity.

He is survived by his wife Marion, his sons Geoffrey and Michael, eight of his nine grandchildren and eighteen great grandchildren.

Geoff Brace - May 2017

Alan Koch receives the IMF's Gold Medal

At the 2016 AGM of the Institute of Materials Finishing it was announced that the highest accolade that can be awarded, the Gold Medal, should be given to Alan Koch.

The Gold Medal is presented from time to time for outstanding personal, scientific or technical achievement relevant to the objectives of the Institute.



Alan has given continuous service as Treasurer for 14 years but unfortunately has had to resign through ill health and his role has been taken up by Nick Johnson.

Barry Gay, the IMF's President, was able to present Alan with the Medal at his home and stated that, "I have worked for a number of years with Alan and he has been a major contribution to the Institute's success. We wish him well in his retirement from the post."

Alan was surprised and delighted by this award.

Recent developments in high speed metal surface processing.

A Fellow of the IMF has developed an exciting electrochemical processing cell that is capable of successful high speed electro-processing of metal surfaces. Not only can it directly electrodeposit metals onto difficult to plate substrates with no significant pretreatments, but it can also be used to electropolish metals. Both technologies have been successfully demonstrated under laboratory conditions and trial samples have been produced, so the Technology Readiness Level is ~4.

The cell is readily suitable for reel-to-reel processing, although it can also be used for batch processing. It has been successfully deposited adherent nickel at rates of between 600-2,000um/hour on substrates such as aluminium, titanium and stainless steel. Furthermore, it has been used to electrodeposit alloys such as Ni-Co alloys and neither deposit has shown evidence of uncontrollable nodules or other asperities; there is no apparent reason why other alloys, such as Ni-Sn cannot be similarly deposited. The same cell design concept has been demonstrated to be capable of electropolishing metals such as aluminium and stainless steel.

The processing cell uses the principles of high speed metal deposition, with the electrolyte being circulated through the cell at a rate of 3-5m/sec.; the electrolyte has a Reynolds Number in the region of 4,700, so its flow can be considered as turbulent (non-laminar).

The cell is the subject of an active Patent Application and background to the technology was published in TransIMF (TIMF 2012 90(1) p 15-19), but the concept needs further industrial development to achieve full commercialisation.

Further information on this exciting development can be obtained from the Science Committee, via Exeter House.

**Mohammad Sakhawat Hussain
(aka Sakhawat)**



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The IMF receives further accreditation of its training courses



The Institute of Materials Finishing's training courses have long been recognised as the industry standards for education in our sector of materials finishing and we are pleased to announce another organisation's acknowledgement of their value.

We already have the acceptance of the IMF's Technician Course by the Engineering Council and now the Royal Society of Chemistry has added the course to their approved list.

Considerable work goes into the generation and updating of the Institute's courses ranging from Foundation to Licentiate and the Technician course is a popular and well recognised qualification; there is current work being put into improving the Organic subjects.


Dr. Kurt Wood ARKEMA Receives Award for Best Technical Paper at CoatingsTech 2017

Held March 20-22, 2017, the **2017 CoatingsTech Conference**, provided coatings professionals the most innovative technologies and applications shaping the industry, as well as regulatory trends and networking opportunities. The theme of this year's conference was "Meeting the Sustainability Challenges of Today and Tomorrow."

On Tuesday, March 21, the second day of the conference, our own Dr. Kurt Wood, received the inaugural **CoatingsTech Best Paper Award** for his research paper titled "Evaluation of the ASTM D7869-13 Test Method to Predict the Gloss and Color Retention of Premium Architectural Finishes." The paper containing the results of the research was also presented by Dr. Wood at the conference.



Congratulations Kurt!



A Bright Future: Electroplating and Electropolishing from New Solvents

Prof. Karl S. Ryder - (Materials Centre, Department of Chemistry, University of Leicester)

Throughout almost all of its history since Michael Faraday, the metal plating and polishing industry has been dominated by the use of water based electrolytes. This is for very good reasons! Water is familiar, abundant, relatively inexpensive and it easily dissolves many metal salts to make aqueous solutions. However, the increasing concern about the environment, health and safety and the use and recycling of noxious and toxic chemicals has forced a re-think at a fundamental level. As a result, alternatives are now sought to replace aqueous plating processes for metals such as Cr (VI), Cd and many others.

These political and social drivers have ushered in a new technology for metal electroplating and electropolishing based not on water but on molten salts. Such molten salts are liquids at room temperature and are known as ionic liquids (IL). Ionic liquids have many variants depending on the type of salt used and offer many technical, environmental and process advantages.

Ionic liquids offer very good solubility for many different metals salts and oxides, as well as a wider range of temperatures and conditions over which they can be used. Crucially, IL's offer the possibility to process (electroplate or polish) reactive metals such as aluminium, magnesium or complex alloys that cannot be processed in water. A drawback of the IL electrolyte technology is that it is comparatively very expensive and that relatively little is known about long-term process operation and life cycle. This is a young technology but these issues are being addressed by research groups around the world. Many of the UK's groups

include industrial partners as end-users and are funded by collaborative Government initiatives.

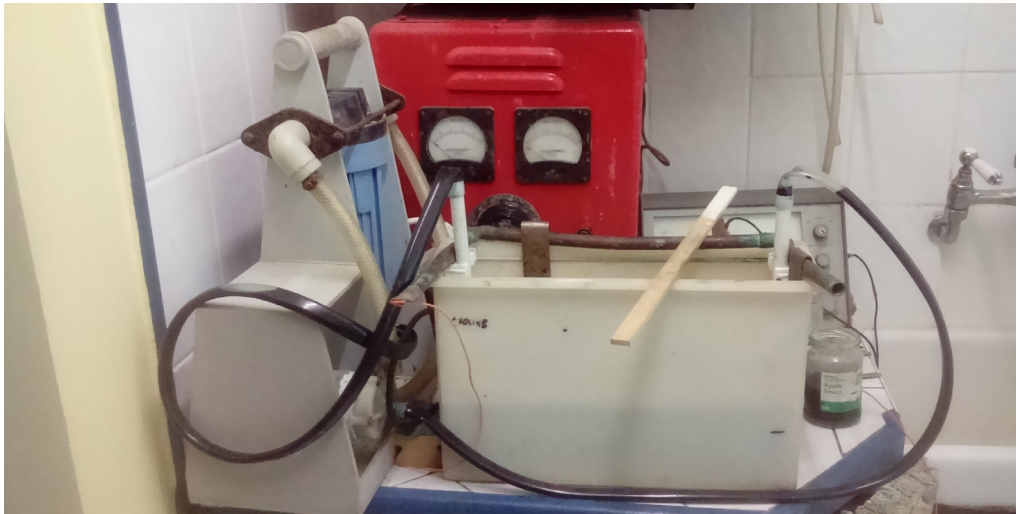
At the University of Leicester, we have developed a variety of IL technology that has many of the benefits of molten salts but at a fraction of the cost. These electrolytes are known as Deep Eutectic Solvents and are formulated from bulk commodity chemicals such as animal pro-vitamin and anti-freeze! From these liquids, we have developed new pilot processes for plating of Al, bright hard Ni, Cr, Co and many different composites and alloys. As well as this, the liquids work very well for polishing of steels, Ni and Ti alloys. We are working with industrial partners such as Airbus, Rolls-Royce and the supply chain, with funding from the EU (Framework Programmes), Innovate UK and the Royal Society, to develop technologies for the metals finishing industries of the future that are greener, cleaner and more energy efficient processes.

Reference (open access); "Deep Eutectic Solvents (DESs) and their Applications", Emma L. Smith, Karl S. Ryder and Andrew P. Abbott, Chem. Rev., 2014, 114, 11060.

One man's thoughts on the use of Trivalent Chrome in a high build application

When asked to do a very brief write-up of the work I thought I would like to make points that I haven't seen elsewhere and below is a brief summary of experiments done over thirty years or so.

In the late 1970s and '80s Product Finishing magazine used to have a column entitled "The World of Invention". This contained patent disclosures by the late Harold Silman and these I read with interest keeping photocopies that I still have.



These were largely plating process recipes and I used them in the '80s to investigate trivalent chrome, eventually producing my own simple recipe based on published material. The solution was designed for decorative use.

In 1986 I started my own, small plating business, doing mainly zinc and anodising but later decided to install two hundred litres of my own formulated chrome solution and by the time my business finally shut in 2005 the solution had grown to four hundred litres.


I was always looking for improved recipes and so was intrigued by a publication in Transactions in 1997 of a solution which,

when made up, had a pH of 0.6 and could be operated at this pH without any further adjustment.

The solutions I had used up to then tended to require pH values of between 2 and 4 and my own recipe stopped depositing at pH values below 2.0.

The pH of the published recipe alone singled it out as something a bit different, so I ordered the chemicals to try a litre or so. I was hoping that the lower pH would lead to a better deposit colour and better solution stability as it was operating further away from the precipitation zone.

I used 15mm copper pipe as cathodes and a



single insoluble anode.

Current densities of about 5 asd (50 asf), gave a lot of hydrogen gassing but no plating. Increasing the current density to 10 asd (100 asf) a deposit on about one third of the circumference of the tube was visible.

Using only a single anode I could get half the circumference plated but the central area and the end gave a 'burnt' deposit but what was noticeable was that the deposit was quite thick.

The solution was a standard urea/formate formulation, which had the novel feature of including methanol, claiming it extended the life of the solution although it did not appear necessary to be there in order to make the solution work.

Since I was trying to find a decorative solution it was no good for my purposes and I left it making a mental note that such a solution might be suitable for the heavy deposition of chrome on the simple cylindrical shapes used say in the hydraulics industry, obviously using more anodes than my single anode.

Moving into the 21st century experimental work was beginning to be published using so called ionic liquids primarily based upon the use of choline.

I soon learnt that the conductivity of these ionic liquids is very poor by plating solution standards and this is not surprising as there is not that much ionic mobility.

I found that by adding 30 to 50% of original volume with water made an ionic mobile liquid with high conductivity, plating white chrome with good appearance and about 42% cathode efficiency which is a lot greater than any current hard chrome plating solution.

The solutions worked at room temperature, and unlike some decorative processes lost some efficiency on warming. The pH on make up, was highly acidic and since the

solution was no longer strictly an 'ionic liquid' it seemed that the resulting solution was not so very different from my original solution using the urea/formate formulation from 1997.

My current working solution is of a urea/formate type, without methanol. These solutions are good, on a polished surface to about 25 microns but for thicker deposits would need grain refiners and brighteners. I am currently testing out additives with some success.

The solution runs at about 35 degrees centigrade with agitation in a small tank.

It plates at about 25% cathode efficiency with additives but gives twice the chrome per amp hour as say "HEEF" at 25% because of the built in 2:1 advantage in trivalent processing. The fastest I have achieved measured with micrometer, not balance, is 75microns/hour at 100 ASF which is well over 50% efficiency. This was without additives.

Additives can be used to improve the deposits especially, if high thicknesses are required, but there can be a slight loss of cathode efficiency.

I did have some adhesion problems but were fairly easy to overcome using standard preparation methods and I no longer consider this to be a problem.

I also wish to point out the absolute necessity of the use of boric acid in decorative processes but I have found that high build processes do not need it. Of course REACH may have some impact of Boric acid in the future.

P. Alexander

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A vital quality is the ability to multi-task as you must manage several processes in a calm and professional manner. This needs to be balanced with full management of staff and ensuring that procedures are updated and deadlines met. Ultimately producing a quality product on time.

To be considered for the role you should have:

Experience in metal finishing techniques; electroplating and/or black oxide and/or spray coating, electrophoretic lacquering.

A manufacturing background, with good knowledge of manufacturing processes. Chemistry background would help but not essential

Experience in managing teams of people, and driven to allow individuals to succeed

Can demonstrate previous leadership skills

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News from the Southern Branch

Tuesday 23rd May 2017 saw our seminar "All in the Air" being held at the FAST museum in Farnborough. (See full article in this issue)

28 people attended the seminar and I must congratulate the volunteers at the museum for laying on an excellent buffet and opening up their museum to us.



It is a most interesting place and I would recommend anyone who is interested in aircraft and associated flight to go and visit.

Details can be found at www.airsciences.org.uk.

Wednesday 4th October 2017 will see our next seminar, which will be held at Lloyds Register in Southampton, and we will be hosting a joint venture with the Institute of Welding.

The title for the seminar will be "Let the Sparks Fly"

I will be producing a flyer for the seminar, which will give all the relevant information.

Tuesday 28th November will be our AGM and skittles night.

Again this is a very good evening and is well worth attending. The seating is limited to 35

people so early registration is recommended. Please contact Helen@materialsfinishing.org or clivearnold@lr.org

The committee are now looking into seminars for 2018 so if any member would be interested in any particular subject OR would even like to present a paper then please contact me at JohnB_IMF@btinternet.com

We are in the process of looking at the Southern area section of the website and any seminars that we hold we are hoping to be able to show the papers that were given at the appropriate seminar. This will give people an opportunity to revisit the papers if they attended. **J Burgess**

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KUKA Ireland Host the IMF

The Irish branch of the IMF were privileged to be invited to hold their recent branch meeting in the newly opened KUKA Robotics client support offices, in Dundalk. Committee members were shown around the impressive facility, home to several different types of KUKA Robots, some of which were in demonstration mode going through their routines.

The IMF would like to thank Brian Cooney, KUKA's General Manager - Ireland, for the invitation and the tour of their state of the art facility and the courtesy afforded to us.

KUKA Robotics has been providing automated robotic solutions in the UK since 1974. After experiencing a period of significant growth, operations have now been established in Dundalk, supporting a strategy to develop our presence within the Irish market.



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