Most of our members have career aspirations. They may be a mature, senior employee or a young person just starting out on their career. They will want to advance their knowledge, skill and experience in order to improve themselves to gain promotion, to increase their salary, and to attain personal goals.

The Institute of Corrosion recognises Continuing Professional Development and wishes to help its members develop their own career in their own manner.

It is good practice to plan, record and review your CPD activities on a regular basis. CSci are required to submit a CPD report annually and CEng/IEng/TechEng are required to submit CPD reports every five years. Other requirements such as recertification of cathodic protection engineers, NACE specialists etc. also require CPD reports every five years.

To assist in this, as a benefit to members, the Institute has licenced mycareerpath® through the Engineering Council to assist members plan and record their CPD activities and to provide reports where required.

mycareerpath® is an online professional development system, designed and held by the Engineering Council and adopted by many professional engineering institutions for use by their members. The system is mobile and tablet compatible, so records can be accessed or added to on-the-go.

The system is aligned with the UK Standard for Professional Engineering Competence (UK-SPEC) for EngTech, IEng, and CEng. The system is also aligned with other titles such as CPhys, CEnv, and CSci, to provide one platform to suit all. Progress can be measured and tracked against the competence statements for the chosen registration category.

mycareerpath® is designed to help you to plan and record any activity that contributes to your professional competence (IPD and CPD).

This could include mentoring colleagues, learning new techniques, attending training courses, involvement with a professional body, and other activities that contribute to the maintenance or development of knowledge and competence.

Using mycareerpath® puts your complete records in one place so that they can be simply and easily sent to your institution as part of your professional review, or to update them on your CPD record if you’re already registered. You could even send your complete records to your employer as part of your appraisal.

mycareerpath® is now fully accessible in the members area of the ICorr website under CPD. You will need to register onto the system and we would encourage all members to use this major benefit provided by the Institute of Corrosion.

David Harvey, CEng, FICorr.
## Institute News

- Continuing Professional Development  
  - The President Writes
  - John Fletcher Stands Down as Chairman of ASTM D01 Paint Committee
  - London Branch News
  - ICorr Membership Subscription
  - Engineers’ Guide to Nickel Aluminium Bronze Launched
  - The Paul McIntyre Award
  - Aberdeen Branch News

## Technical Article

**Effect of % silicon addition and dip-coating immersion time on the corrosion resistance of aluminized mild steel**

## Company News

- Winn & Coales (Denso) Ltd  
  - Alfred Bagnalls & Sons Ltd

## Sustaining Members

- ICATS Registered Companies

## Diary and Branch Contacts
The President Writes

The sun is poking through the typical local cloud cover and the green leaf buds on the local trees appear more advanced than they really are. This has a very cheering effect after the extreme weather we have experienced in the UK this winter.

ICorr is busy as usual and we are moving very rapidly toward the new 2016/2017 member application reminder letters which are due to be sent out in June for July renewals. A recent Council meeting has agreed to keep subscriptions for all grades of membership at the same level in 2016/2017 as for the year 2015/2016. This decision recognises the difficulty some of our members are experiencing in the Oil and Gas sector with the low oil and gas prices affecting projects both home and abroad. It is also the case that the retail price inflation in the UK is still very low. It is difficult in this economic environment to justify an increase in our members’ subscription rates.

As usual, the subscription rates will be reviewed again at the February Council meeting next year and it is likely that an increase will be considered then for the following year but, in the meantime, I recommend that all members pay their subscriptions as promptly as possible and keep your Institute membership current. All members will be receiving a prompt with the subscription reminder letter to apply to the ICorr office for their membership lapel badge marking their period of continuous membership. I urge you to get your lapel badge and wear it whenever you can to help spread the word about the Institute of Corrosion.

As I write the ICorr group that have attended the NACE Conference in Vancouver are returning to the UK after their long distance travels. This group of ICorr envoys included the Young Engineers 2015 Program Winners and they were due to receive their awards at the NACE award event. The prize which included registration at the NACE Conference is a result of the BP sponsorship of the Young Engineers Program and it is hoped that the YEP can run again in 2017. I am expecting there to be more information on this visit in the next issue of Corrosion Management.

Over the next few months, there are several ICorr events planned and you can find more information on these activities on the ICorr website; www.icorr.org please see the conference and events page.

By December 2016 ICorr will have to move out of the office we have been occupying in the excellent facility at the Newton Building in Northampton. This is because the University of Northampton wants to use the office space in the Newton Building for their administration functions. We are therefore now seeking alternative accommodation in the Northampton area and have been assessing various options since the end of 2015. It is possible that this change will happen quite quickly over the next few weeks so I will undertake to try to keep members informed via this column as matters proceed.

The recent Council meeting has also confirmed that the AGM for 2016 will be held in the Birmingham Council Chamber on Wednesday 30th November 2016. Although this seems to be many months away I would recommend that you put the date in your diary now as the time will fly by. Is should be noted that Midland Branch are planning a Half-Day meeting before the AGM so there will be more details in due course.

Finally, I would again encourage all ICorr members to stay active and involved in your Institute. We can only get the message about corrosion and its prevention or mitigation across to those who need to know if our members carry the message to their contacts.

John Fletcher
President of the Institute of Corrosion

John Fletcher Stands Down as Chairman of ASTM D01 Paint Committee

John F Fletcher, Elcometer Limited’s Technical Support Manager, has now stood down as Chairman of the ASTM D01 Committee on Paint and Related Coatings Materials and Applications after three successive two-year terms in office.

John received an Award of Appreciation in recognition of his outstanding service as an ASTM Committee Chairman from the beginning of 2010 to the end of 2015, at the ASTM D01 meeting in San Antonio, Texas at the end of January 2016.

John has stepped down as the ASTM constitution limits an individual to three successive two-year terms as Chairman of D01. He has now become the First Vice Chairman in support of the new Chair, Cynthia Cosselin.

John will continue in his role as Chairman of D01 Sub-committee D01.23: Physical Properties of Applied Paint Films, which holds its Task Group and Sub-committee meetings on the Mondays when the D01 Committees meet. The D01.23 Sub-committee has 31 standards under its jurisdiction.

The D01 Committee currently has more than 630 members and holds two sets of meetings each year in January and June. The Committee is supported by approximately 30 technical sub-committees and a further 7 administrative committees. D01 is responsible for a total of more than 675 individual standard test methods, practices and guides, which are published in the Annual Book of ASTM Standards, Volumes 6.01, 6.02, 6.03, and 6.04.

These standards have and continue to play a pre-eminent role in all aspects important to the coatings industry including: classification, sampling, preparation, components, application, analysis, quality assurance and end-use performance requirements.

www.elcometerndt.com
London Branch began the New Year with a presentation entitled ‘Trends in Tank Lining Test Methodology for Oil and Gas Service’, at Imperial College, Skempton Building, on 14th January 2016. Under the Chairmanship of Jim Glynn the presentation was given by Michael Harrison, Business Support Manager-Speciality Linings of Hempel A/S.

Michael began his presentation by reviewing the changes that had occurred through the history of linings from the 1990’s, particularly from challenges from oil and gas production, product transportation and storage, including higher temperatures, greater levels of sour media, the increased use of bio fuels and the use of amine scrubbers with their aggressive chemicals. Accordingly many traditional lining materials were no longer appropriate and linings now involved high-solids and solvent-free epoxies, glass flake vinyl esters and thin film epoxy-phenolics.

Michael went on to state that basically there were two ways to demonstrate the suitability of a lining, one, by using an appropriate, extensive testing regime or two, by showing a proven track record. Inevitably testing has become more extensive, covering more characteristics of the coating and with exposure to more complex and realistic conditions. Besides testing for adhesion, flexibility, and cathodic disbondment after more traditional exposures, testing now includes pressurised ‘Atlas’ cells with high thermal gradients and high temperature autoclave tests with rapid depressurization. Michael went on to mention electrochemical impedance spectroscopy (EIS) which can be used to evaluate linings after exposure to selected test conditions and also may be used to evaluate linings in service, to predict continued performance; a facet which will become even more important.

The 30+ attendees participated in a searching question and answer session, which somewhat inevitably lead to the long term question of how to achieve satisfactory factory/site application of these ‘highly tested’ linings and whether Paint Manufacturers should be more involved with such application. After which, on behalf of the committee, a vote of thanks was given by George Winning of Element Materials Technology, who raised the question of the growing expense of tests and how they should be paid for. All present then enjoyed the traditional hospitality of the London Branch.

Details of forthcoming Branch technical meetings can be found on the ICorr website and in the Diary Date page of Corrosion Management and are held at Imperial College Skempton Building, at 18.00 for an 18.30 start. Enquiries can also be sent to icorrlondon@gmail.com

On 11th February 2016 at Imperial College, Skempton Building, London Branch meet to enjoy a technical presentation entitled ‘Organic Coatings, First Line of Defence Against Corrosion – What Do We Need to Know?’ Under the guidance of Branch Chair Jim Glynn, the presentation was given by Michael Young, Senior Corrosion Engineer, dealing with asset integrity issues and risk based inspections for MACAW Engineering, a leading engineering consultancy based in Newcastle-upon-Tyne.

Michael began his presentation with a quick review of the history of coatings, mentioning examples of the use of pitches and balsams from 1500 BC and some chrome plating from 200 BC, the fondly remembered red lead coatings and onto the development of epoxies and urethanes. In the search for the perfect coating film there are many, if not too many, properties and aspects to be considered. These include the type of substrate, the basic function required, environmental factors to be considered and ideally to undertake a review of life cycle costs to justify the right coating selection.

Michael mentioned the reliance on coating testing and service history and the attention to detail on features of the structure to allow a successful coating to be applied. Further when discussing the critical task of substrate surface preparation, he put forward the hypothesis that 75% of premature coating failures were due to improper surface preparation and that this percentage could well be higher. Michael emphasised the importance of meeting the requirements of the coating product data sheets, not least to ensure good product storage, mixing and thinning, together with application and curing.

Michael then negotiated his way through a question and answer session with the attendees; after which Committee Member Brian Goldie thanked Michael for his comprehensive review on ‘what needs to be known’ and he then invited all present to enjoy the traditional hospitality of the London Branch.

Details of forthcoming Branch technical meetings can be found on the ICorr website and in the Diary Date page of Corrosion Management and are held at Imperial College Skempton Building, at 18.00 for an 18.30 start. Enquiries can also be sent to icorrlondon@gmail.com
A new publication, launched at today’s Marine Corrosion Forum in London, offers practical guidance for engineers wishing to specify, design or produce nickel aluminium bronze components for marine, aerospace and other sectors.

Copper Development Association’s ‘Guide to Nickel Aluminium Bronze for Engineers’ assembles, for the first time, technical information previously scattered across industry publications and defence standards, making it readily accessible and presenting it in an easily-browsed and -digested form.

The publication aims to give an engineering overview of the properties of the alloys, their specifications and their applications for operators, designers, manufacturers and fabricators. Their corrosion behaviour is explained and guidance is given to obtain optimum service performance. Methods of manufacture, welding and fabrication are described and a list of references and useful publications is provided. The Appendix covers full details of designations, specifications and related composition and mechanical property requirements.

The publication has been written by Ivan Richardson, and reviewed by a group of technical metals and corrosion specialists. Ivan Richardson is an industry specialist in copper alloys. His experience spans all aspects of manufacture, product development, testing and metallurgical investigation. He has worked throughout his career with aluminium bronze alloys, both in their production and application, in various technical, marketing and management roles, primarily at Delta Manganese Bronze and latterly as an international consultant, including work with Copper Alloys Ltd.

Alloys of copper and aluminium are known as aluminium bronze and, together with other alloying additions, produce a range of properties that are beneficial to a diverse range of industries. Of these, the nickel aluminium bronze group of alloys is the most widely used. They have been adapted with time to optimise performance and can provide a combination of properties that offer an economic alternative to other types of alloy systems.

Nickel aluminium bronzes are available in both cast and wrought product forms and have a unique combination of properties including:

- Excellent wear and galling resistance
- High strength
- High corrosion resistance

The author delivered a joint Copper Alloys Ltd/ Copper Development Association presentation on nickel aluminium bronze to the audience of marine specialists at the Marine Corrosion Forum, an association meeting for discussion of materials and corrosion matters relevant to the marine, offshore, and associated industries.

The Guide will also form the basis of a presentation at Technical Committee TEG 523X at NACE International’s Corrosion 2016 conference this March.

Available to download from www.copperalliance.org.uk/nab, the Guide can also be requested in hard copy, free-of-charge, from the website.

Copper Development Association is a non-profit organisation that promotes and supports the use of copper based on its superior technical performance and its contribution to a higher quality of life. Its services, which include the provision of technical advice and information, are available to those interested in the utilisation of copper and copper alloys in all their aspects. The Association also provides a link between research and the user industries, and is part of an international network of trade associations: Copper Alliance.

**Our Rates Remain the Same as Last Year!**

**Membership Subscription Rates 1st July 2016**

<table>
<thead>
<tr>
<th>Membership Categories</th>
<th>Annual Rate from 1 July 2016</th>
<th>Registration Fees</th>
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</thead>
<tbody>
<tr>
<td>Student Member</td>
<td>*Free £73.50</td>
<td>*Free £15.00</td>
</tr>
<tr>
<td>Technician Professional Member</td>
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<td>£15.00</td>
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<td></td>
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<td>£130.00</td>
<td>£15.00</td>
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<tr>
<td>Sustaining Membership</td>
<td>The annual rate from 1st July 2016 is £375.00 (plus VAT)</td>
<td></td>
</tr>
<tr>
<td>&quot;Gold&quot; Sustaining Membership</td>
<td>The annual rate from 1st July 2016 is £725.00 (plus VAT)</td>
<td></td>
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</tbody>
</table>

*Requires proof of enrolment as a full time student at an approved science or engineering based study programme.*
New Institute of Corrosion Award From Corrosion Engineering Division: The Paul McIntyre Award

The Institute of Corrosion’s Corrosion Engineering Division is pleased to announce the establishment of a new award called the Paul McIntyre Award.

Background on Paul (provided by Douglas Mills, Technical Secretary)

Dr Paul McIntyre graduated from the University of Newcastle upon Tyne with a 1st class honours degree. He spent his early career in the steel industry. In 1978 he moved south and joined the Central Electricity Research Laboratories in Leatherhead as group leader of EAC studying stress corrosion, localised corrosion and corrosion fatigue in conventional and nuclear power plants. Later he was involved in asset management and remaining life assessment of components including development of remedial methodologies such as RAM (reliability, availability and maintainability) and RCM (reliability centred maintenance). From 1996 until 2006 he was Editor or the British Corrosion Journal (which became CEST). For six years from about 2004 until 2010 he worked as consultant in the electrochemistry and corrosion group at NPL. His scientific insight and depth of engineering experience was critical to successful analysis of a wide range of failure investigations including fracture of wind turbine bolts, corrosion pitting in a desalination plant as well as providing informed corrosion control guidance to industry. Paul wrote almost 60 published papers and over 200 internal reports. In addition to his career in industry Paul had almost thirty years of participation in corrosion standardisation within BSI and ISO committees. These included being past chair of ISO/NFE 8 Corrosion of metals and alloys, and UK representative on the equivalent ISO committee TC 156 and within that being secretary of WG2 Stress Corrosion Cracking and member of WG 7 Accelerated Corrosion Tests. He made an immense contribution as Scientific Secretary of the EFC. He was also on the Council of the Institute of Corrosion from the early 2000s specializing in standards work and pan European activities. In 2003 Paul was awarded the T B Marsden prize of IOM for his considerable achievements in promoting standards, education and publishing in corrosion and materials. The chair of ISO TC 156 stated at the award citation “Paul has provided more input into the development of ISO standards in the corrosion field than any other individual”. Paul was invariably polite and accommodating to everybody. But he had core of steel and dry sense of humour. In 2010 he was diagnosed with secondary liver cancer and very sadly passed away in 2012

Eligibility for Award

This Paul McIntyre award will be presented to a senior corrosion engineer, who, as well as being a leading practitioner in his field, has advanced European collaboration and international standards development (in keeping with Paul’s areas of interest). The criteria for the recipient of this award are as follows:

- They have established an international reputation in the field of corrosion engineering.
- They have demonstrably advanced European collaboration and international standards development in the field of corrosion engineering.
- They must be living and working in the European corrosion community.
- They must be a member of a corrosion-related body in the European area (e.g. NACE UK, The Institute of Materials, or the Institute of Corrosion, or another European corrosion society).
- They must be aged over 30.

Procedure for nomination

The procedure for selecting the recipient of the Paul McIntyre award will be the same as for the U R Evans award, namely there will be a standing invitation for anyone to submit nominations to the CED chair. The award will alternate between a UK-based recipient and a Europe-based recipient. The CED chair will be responsible for maintaining a rolling shortlist of candidates (typically between 5 and 10) and the selection committee, consisting of the CED Working Group chairs and the Institute’s Technical Secretary, will vote on the nominations each year and propose them to Council for approval.

Nature of the award

The award will consist of a certificate and something along the lines of an engraved shield or medal, which will be presented either at the Institute’s AGM, or the annual CED working day meeting. In addition, the recipient will be requested and encouraged to prepare an article for publication in Corrosion Management.

Competition for Design of the award

The exact nature of the award itself has not yet been fixed. Hence we would like to run a competition for the design among the membership if the Institute of Corrosion. Please send any entries to the chair of the corrosion engineering division, Nick Smart (nick.smart@amecfw.com) by 31 August 2016. The winner will be chosen by the Council of the institute and will be awarded free entry to two CED working day meetings.

Note: this informatory article is in lieu of Technical Topics The latter will return in the next issue.
The guest speaker for the January 2016 branch meeting was Donald Chapman of IMG Composites. After the safety briefing, the speaker set out an overview of the night’s two part presentation stating that he would give an introduction to composite materials, explain the historical context and developments in the composite materials. A case study of the application of composite repairs from an operator’s perspective will be presented in the second part of the session.

Donald outlined a list of advantageous properties of composites such as, lightweight, strength, robustness, corrosion resistance, ease of application and cost effectiveness in comparison with alternative repair options and replacement. In demonstrating the strength and stiffness of composite materials in relation to steel, the speaker explained the anisotropic nature of composites showing graphically the inverse relationship between strength and reinforce fibre angles. He went on to explain the historical evolution of composite structural repairs showing examples of how it has been used for difficult repairs in onshore and offshore facilities. He mentioned that although there were no governing standards on the application of composite repairs, Finite Element analysis (FEA) was used to supplement the design process with client engagement essential to the process.

In the second part of the presentation, Rorie Thomson presented a case study from an operator’s perspective. Rorie explained the challenges faced and the path taken to deploying a structural repair including consideration of other options such as localised and full scale structural replacement. He concluded that the design choice made was composite repair, due to low cost, less operational impact, ease of construction and duration of application. He stressed that this option was preferred even though it was a relatively unknown. He described the testing performed to validate the option, concluding that it was an ultimately successful solution to remedying deferred fabric maintenance.

Following the presentation, there was a showcase of the composite repair product with the speaker demonstrating various aspects and properties of the material to eager delegates.

For information about the Aberdeen branch activities please contact our branch secretary, Frances Chalmers, ICorrABZ@gmail.com. Alternatively a calendar of local events of interest to corrosion professionals in the Aberdeen area and the opportunity to sign up to the branch mailing list is available at https://sites.google.com/site/icorrabz/home.
The February 2016 branch meeting was held at the palm court hotel and the guest speaker was JD Demore of Aegion, (parent of Corrpro Companies Europe Limited). The speaker explained that Aegion provide a comprehensive corrosion protection and pipeline rehabilitation services for the energy and mining market.

Mr Demore presented some very good graphical illustrations of internal and external coating processes used for a variety of applications. He explained that coatings were designed to provide a range of chemical/mechanical resistance properties, often applied as multi-layer process. He explained that field joints were very critical and field welds must be properly prepared and pre-coating was essential to the process.

He emphasised the essence of good quality assurance techniques, particularly automated daily reporting for Pipelay – Joint Field Coatings. He stated that correct surface preparation, heating (normally by induction coil) and curing times are critical for reel-up and subsequent pipe lay to prevent cracking explaining further that induction coils must be very carefully controlled to prevent detrimental ‘overheating and magnetic’ effects. He stated that there existed a very wide range of coating DFT’s according to coating type 400 microns (for FBE) to 3000 microns (for Flame Spray PE).

He explained the importance of good field joint coating stating that field joints could take between 15-100 minutes to complete the preparation and coating process depending on coating system design. With insulated joints he said this will be longer.

Following the presentation, there were questions on water based coatings – not currently used within pipeline industry, despite being more environmentally friendly, the current and historical use of coal tar coatings with recommendations for automated systems.

For information about the Aberdeen branch activities please contact our branch secretary via ICorrABZ@gmail.com. Alternatively a calendar of local events of interest to corrosion professionals in the Aberdeen area and the opportunity to sign up to the branch mailing list is available at https://sites.google.com/site/icorrabz/home.

JACK TIGHE 1930-2016

The Directors and staff of the Tighe Group of Companies are saddened to announce the death of the founder, Mr Jack Tighe, who died peacefully aged 85 years on 22nd March after a long illness.

In a tribute to Jack Tighe issue 131 of Corrosion Management will feature a special article dedicated to his memory.
EFFECT OF % SILICON ADDITION AND DIP-COATING IMMERSION TIME ON THE CORROSION RESISTANCE OF ALUMINIZED MILD STEEL

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¹ Corrosion Control Research Cell, Department of Metallurgy and Materials Engineering, CEET, University of the Punjab, Lahore-54590, Pakistan
² Institute of Quality and Technology Management, University of the Punjab, Lahore-54590, Pakistan

ABSTRACT

The aim of the research work was to investigate the effect of silicon and holding time on the corrosion resistance of aluminized mild steel in 3.5% NaCl. The mild steel was coated by a hot-dipping method by the variation of silicon from 0, 2.5, 7 and 11% in pure aluminum at a temperature of 765°C for different holding times of 10, 40 and 90 sec. The thickness of the coating was determined by optical microscopy. The hardness of the coated samples was also determined by using micro Vickers hardness testing technique. The electrochemical behavior of the coated samples was determined using potentiodynamic polarization and cyclic polarization technique. The thickness of coatings generally increased with increase of the holding time and decreased with increase in silicon content. The hardness of coatings generally decreased with increase in hold time and increased with the increase in silicon content in aluminum-silicon alloys. A maximum coating thickness of 67µm was obtained on 7% Si for 40s dipping time and maximum hardness of 184 Hv was obtained on 11% Si for 10s dipping time. The electrochemical results showed that the coated samples exhibit a more negative reduction potential compared to the bare sample, indicating that aluminizing acts as an anodic coating for mild steel. The corrosion rate decreases and protection potential increases with increase in holding time.

Key words: Potentiodynamic polarization; Cyclic polarization; Aluminizing

1. INTRODUCTION

Steel is the widely used material, owing to its versatility, economical use and its flexibility in heat treatment and shaping processes. The steel forms an oxide layer on its surface, however it is not stable and can be removed easily, hence conventional steel has poor corrosion properties [1]. Whilst the process of alloying of steel (e.g. Cr, Ni) can address the problem, it can be costly and it is not economically viable in many cases. An alternative solution to the problem is surface modification [2], which allows an increase in wear, chemical, mechanical and oxidation resistance [3, 4]. Metallic coatings can protect the steel substrate from corrosion in many aggressive environments, an example being zinc coatings which provide sacrificial protection [5]. However, zinc has several drawbacks, such as its high price and is easily dissolved in fresh water.

Due to the drawbacks of zinc, aluminum-based coatings are gaining momentum worldwide. The reason is it can withstand high temperature, which makes it suitable for use in car engines and ovens [6]. One application method is via Hot-dip aluminizing (HAD). The diffusion of aluminum into the iron lattice can be achieved by dipping steel in molten aluminum. The first layer formed is a γ-phase (Fe₃Al₁₄). The outer layer of aluminum also contains the precipitates of this phase [7] unfortunately, due to the brittle nature of this layer; it is susceptible to cracking and peeling off [8]. In order to overcome this problem silicon is added to the aluminum in the range of 1 to 10% by weight. The effect of this addition is that it reduces the thickness of the intermetallic layers and has special reduction in Fe₃Al layer. The intermediate compounds are also brittle in nature hence it is always preferable to minimized the layer thickness [9-11]. Silicon-doped aluminized coatings haves a silvery luster and are mainly used in the building industry, e.g., domestic heating and ventilation equipment, in the automotive sector, e.g., exhaust system and in telecommunication and power transmission [12, 13]. Continuous process is used for the aluminizing of sheets while hot dipping is used for aluminizing of individual components for a particular exposure of time [14, 15]. The composition of the molten aluminum and steel substrate has a direct influence on the thickness and morphology of the coatings [16], and temperature; fluxing and handling parameters have an effect on the coatings produced by continuous process. The mechanical properties of the coatings are also influenced by parameters such as coating morphology and thickness [17]. Masayoshi et al. [18] concluded that aluminized press-hardened steel when compared to bare steel showed good corrosion resistance during cyclic corrosion tests. Milenkovic et al. [19] conclude from the research that in aluminum and aluminum—silicon coating the aluminum matrix will dissolve in an aluminum silicon eutectic. Vu et al. [20] concluded that in chloride media the mild steel was cathodic protected due to presence of the aluminized coating. The present work is focused on the surface modification of a mild steel by the application of a hot dip aluminizing method, with the aim to improve its hardness, wear and corrosion resistance properties.

2. MATERIAL AND EXPERIMENTAL TECHNIQUES

The rectangular mild steel specimens (50.54 ×38.40 × 2.19 mm) were used as the substrate material, having a chemical composition is listed in Table 1.

<table>
<thead>
<tr>
<th>C</th>
<th>Mn</th>
<th>P</th>
<th>S</th>
<th>Si</th>
<th>Fe</th>
</tr>
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<tr>
<td>0.162</td>
<td>0.401</td>
<td>0.025</td>
<td>0.023</td>
<td>0.215</td>
<td>Bal.</td>
</tr>
</tbody>
</table>

Table 1: Composition analysis of the mild steel substrate (wt. %)

The specimens were subjected to hand grinding on silicon carbide paper up to 1000 grit size and the surface was alkaline cleaned before aluminizing. Different molten bath compositions were prepared for aluminizing, notably aluminum with 2.5%, 7% and 11% silicon respectively. The mild steel specimens were preheated and then lowered into the molten bath having a temperature of 765°C. The specimens remained immersed in the bath and were gently shaken inside the bath to ensure good wetting. The specimens for hot dipping were immersed in each composition at 765°C for holding times of 10, 40 and 90 s as given in Table 2. The bath temperature was maintained with ± 2°C variation. After the hot-dipping, specimens were taken out from the melt and air cooled.

Small pieces from the coated specimens were cut using precise wire cutting machine. Then these small pieces were cold mounted in resin and grounded on wet emery papers of grit size 120, 240, 320, 400, 600 and 1000. Polishing
Table 2: Aluminum with different percentage of silicon for different holding time at 765°C.

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Bath Composition</th>
<th>Dip Time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al-0-Si-90</td>
<td>Pure Aluminum</td>
<td>90</td>
</tr>
<tr>
<td>Al-0-Si-40</td>
<td>Pure Aluminum</td>
<td>40</td>
</tr>
<tr>
<td>Al-0-Si-10</td>
<td>Pure Aluminum</td>
<td>10</td>
</tr>
<tr>
<td>Al-2.5-Si-90</td>
<td>Al – 2.5 % Si</td>
<td>90</td>
</tr>
<tr>
<td>Al-2.5-Si-40</td>
<td>Al – 2.5 % Si</td>
<td>40</td>
</tr>
<tr>
<td>Al-2.5-Si-10</td>
<td>Al – 2.5 % Si</td>
<td>10</td>
</tr>
<tr>
<td>Al-7-Si-90</td>
<td>Al – 7 % Si</td>
<td>90</td>
</tr>
<tr>
<td>Al-7-Si-40</td>
<td>Al – 7 % Si</td>
<td>40</td>
</tr>
<tr>
<td>Al-11-Si-10</td>
<td>Al – 11 % Si</td>
<td>10</td>
</tr>
<tr>
<td>Al-11-Si-90</td>
<td>Al – 11 % Si</td>
<td>90</td>
</tr>
<tr>
<td>Al-11-Si-40</td>
<td>Al – 11 % Si</td>
<td>40</td>
</tr>
<tr>
<td>Al-11-Si-10</td>
<td>Al – 11 % Si</td>
<td>10</td>
</tr>
</tbody>
</table>

was carried out using nylon cloth impregnated with 1 micron diamond paste lubricated with lapping oil. After polishing the specimens were etched in 3% Nital (3ml HNO₃, 97ml Ethanol) for 10 s, followed by rinsing in water and dried. The coating thicknesses were measured from the micrographs taken at magnification of 100X (Leica Microscope, Germany). The micro hardness of the surface layers of the aluminized specimens were measured using a micro vickers hardness tester (HMV-2, Shimadzu, Japan). Hardness test was performed under an indentation load of 980.7mN for 10 s.

Potentiodynamic and cyclic polarization were used for investigating the electrochemical behavior of aluminized specimens by using Potentiostat PC14/750 (Gamry Instruments, Inc., USA) and Echem analyst software version 5.68 was used to analyzed the resulting spectra. For electrochemical testing a three electrode cell was used, with a saturated calomel electrode (SCE) as reference, graphite rod as counter and the aluminized coated samples as the working electrode. The electrolyte used was 3.5% NaCl. Potentiodynamic polarization scans were obtained by polarizing the surface from – 0.25 V to +0.25 V with respect to open circuit potential (OCP) with a scan rate of 1 mV.s⁻¹ while cyclic polarization scans were obtained by polarizing the surface from – 0.5 V to 1.2 V with respect to OCP with a forward scan rate of 5mV.s⁻¹ and reverse scan rate of 2.5 mV.s⁻¹ respectively and 10mA.cm⁻² apex current density was adjusted.

3. RESULTS AND DISCUSSIONS

3.1 COATING THICKNESS

The result of the thickness of coatings which was measured by using microscopic cross-section method and the relationship between the dipping time, coating thickness and variation of percentage of silicon are graphically represented in Figure 1.

![Figure 1: Effect of silicon and holding time on the coating thickness of aluminized coating.](image1)

An almost uniform and adherent coating was observed on mild steel substrate. The coating thickness shows an unpredictable trend, with the maximum thickness being noted at 7% silicon.

The coating thickness of Al-0-Si for 10, 40 and 90s dipping time respectively. However, there is increase in coating thickness in Al-7-Si for 10, 40 and 90s dipping time having the value of was 30.5, 55.6 and 38.4µm respectively; with the maximum coating thickness being obtained in the case of Al-7-Si-40. Further increase in percentage of silicon decreases the coating thickness as 29.0, 36.0 and 40.4 µm for 10, 40 and 90s holding time respectively in Al-11-Si. Therefore, the results suggest that the maximum coating thickness is obtained for 7% percent silicon with 7%Si with a hold time not exceeding 40 s.

3.2 COATING HARDNESS

The results of coating hardness are graphically shown in Figure 2. The hardness of the coated substrate generally increased with increase in silicon content and decreases with increase in the dipping immersion time. In the coatings with zero Si content the hardness was 68.5, 48.2 and 38.8 HV for 10, 40 and 90s respectively. With the small addition of silicon in Al-2.5-Si the hardness increase from the same sequence as 55.6, 53.4 and 41.7 HV for 10, 40 and 90s dipping time respectively. For further increase in the percentage of silicon the hardness increase as 68.7, 51.8 and 49.6 HV for 10, 40 and 90s holding time respectively in Al-7-Si. Addition of the highest amount of silicon (11%) further increased the hardness as 184.4, 103.3 and 96.1 HV for 10, 40 and 90s holding time respectively. The results of coating hardness showed that with increase in the silicon percentage the coating hardness increases which adversely affects the coating ductility.

![Figure 2: Effect of silicon and holding time on the microhardness of aluminized coating.](image2)

3.3 POTENTIODYNAMIC SCANS

Results of Potentiodynamic polarization are shown in Figure 3 and the kinetic parameters from the Tafel extrapolation are summarized in Table 3. It may be seen from these results that the corrosion rate in 3.5% NaCl decreases significantly with increasing dipping time. The polarization curve shifted to the more negative
value after aluminizing as compared to the bare specimen which clearly shows that it is an anodic coating. The corrosion rate of the all coated samples was much smaller than the bare specimens. The corrosion rate results also show a relationship with the hardness of the coating, notably it increases with an increase in hardness as illustrated in Figure 4. The longer holding times allow the formation of more uniform and adherent coating through diffusion, which results in a decrease in corrosion rate.

### 3.4 CYCLIC POLARIZATION TECHNIQUE

Results of cyclic polarization tests are shown in Figures 5. It may be seen from these results that the resistance to pitting increases significantly
which was coated with Al–7–Si–90. Therefore, the cyclic polarization testing results suggest that aluminizing with different percentage of silicon alloys on mild steel samples significantly increased the pitting potential of mild steel in 3.5% NaCl solution.

4. CONCLUSIONS

The following conclusions are drawn from the above research study:

The thickness of coating shows unpredictable changes with increase in silicon content, although the maximum thickness was obtained at 7% silicon and 40% hold time. Although unknown at this time, this thickness did not coincide with the maximum protection potential.

Hardness generally increases with increase in silicon content but ductility of the coating decreases with increase in hardness.

The protection potential will be enhanced due to a silicon-doped aluminized coating, however high silicon content can lead to a reduction in its value.

5. REFERENCES


DENSO STEELCOAT PROTECTION FOR SEVERN TRENT PIPEBRIDGE

Design–and–construct specialist Mott MacDonald Bentley has recently refurbished the 21 metre pipebridge carrying treated water over the river Weaver near Nantwich, Cheshire, for Severn Trent Water plc.

Winn & Coales standard Denso Steelcoat 100/400 protection system was again chosen by Severn Trent Water for this pipe bridge.

After removal of the residue of the previous coating, hand surface preparation was carried out to St2 standard.

The Denso Steelcoat system consisted of application of Hi-Tack Primer followed by Denso Profiling Mastic on required surface areas. This was followed by Hi-Tack Tape, Ultraseal Tape and a Denso Acrylic top coat.

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PREMIER COATINGS INVESTING IN NEW TECHNOLOGY

The demand for high quality anti-corrosion products continues to grow. Premier Coatings Ltd has just finished installing a brand new production plant for its anti-corrosion and sealing products.

With confidence in the future of the market, and order levels at an all-time high, the company decided that the time had come to invest in an additional production line utilising the latest technology at its facility based in Smarden, Kent. The new plant, now fully functional, has already proved itself to have significantly increased the company’s manufacturing capabilities.

Premier’s Managing Director, Terry Capps, said: “The new plant has contributed to improved efficiency and has reduced waste, with both financial and environmental benefits. This investment has raised our overall capacity, which in turn has helped us to improve turnaround times. This enables us to continue to delight our existing customers, whilst also securing new business in emerging markets and elsewhere.”

Premier’s anti-corrosion tapes are used to wrap steel pipeline before it is buried in the ground. The Premier anti-corrosion tapes can be applied by hand or by wrapping machines. For over 25 years the company has been providing easy to apply, convenient and reliable anti-corrosion solutions to the oil, gas and utilities sectors.

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CROWN PAINTING ON THE QUEENSWAY TUNNEL

Bagnalls have delivered the specialist coatings works on the Queensway Tunnel, a road tunnel, which runs under the River Mersey connecting Liverpool to Birkenhead. The tunnel, which is over two miles long, is one of three Mersey Tunnels, the other two being the Mersey Railway Tunnel and the Kingsway Tunnel.

Works on the Queensway Tunnel required the ceiling, or crown, of the four lane single carriageway to be prepared and painted as well as the re-painting of the black and white curb chevrons on either side of the carriageway.

The tunnel is active 24 hours a day so the planning of this project had to be meticulous. The works were completed during planned night closures every 3-4 weeks over a period of nine months. Bagnalls had to coordinate painters and equipment to maximise the possession times, which were typically from 9 o’clock in the evening to 6 o’clock the next morning. Clearing the site of all paint and equipment, to ensure that the tunnel was reopened for the early morning commuters, was imperative.

And, of course, nothing stood in the way of football, and possession times were significantly reduced when evening football matches were being played at the home grounds of Liverpool, Everton and Tranmere Rovers.

To deliver the project, the four lane single carriageway was split in half completing the ceiling over two lanes, while keeping the other two lanes open for emergency access. Teams of directly employed Bagnalls’ painters worked in sequence to clean, prepare and spray apply the coatings to meet the required PPG Johnstone’s specification. All works to the ceiling had to be undertaken using mobile elevated work platforms, and at any one time there were between twelve and fifteen scissor lifts in operation.

An International Paints specification was applied to almost five miles of curb, once it had been prepared using a 5000psi jet wash, to reinstate the safety critical, black and white curb chevrons.

Nothing was too much trouble for the Bagnalls’ operatives, who ensured that the site was kept safe and tidy at all times. To prevent environmental contaminants falling on the road surface, the roads were sheeted during the works and at the end of each shift Bagnalls hired a road cleaner to fully clean down the carriageway.

Steve Bethell, Director said “This project was in the public spotlight the whole time we were working on it so we had to make sure all aspects of our service were delivered to the highest standards. Thankfully, we had a great client to work for in Balvac and a very understanding general public. We hope they are as pleased with the final result as we are.”

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Successful completion of the ICATS course by operatives leads to certification by Correx. Trainers and operatives will require re-certification after 3 years and renewal after 9 years.

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<td>Nigg Energy Park, Nigg, Ross-shire, Scotland, IV19 1QU</td>
<td>01862 852960</td>
</tr>
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<td>Actavo</td>
<td>Unit C, Cedar Court Office Park, Denby Dale Road, Wakefield, WF4 3QZ</td>
<td>019244 16071</td>
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<tr>
<td>Alc Access s.r.l.</td>
<td>I.L. Caragiale, 21 Ploiesti, 100015, P.H. Romania</td>
<td>+44 (0) 722140858</td>
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<tr>
<td>AIC Steel Ltd</td>
<td>1 Neptune Works, Newport, NP20 2SS</td>
<td>01636 528400</td>
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<tr>
<td>Alfred Bagnall &amp; Sons</td>
<td>6 Manor Lane, Shipley, West Yorkshire, BD18 3RD</td>
<td>01302 853259</td>
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<td>AlpAccess s.r.l.</td>
<td>15/17 Colvilles Place, Kelvin Industrial Estate, East Kilbride, Scotland, G75 0PZ</td>
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<td>Austin Hayes Ltd</td>
<td>Carlton Works, Cemetery Road, Yeaden, Leeds, LS19 7BD, UK</td>
<td>0113 250 2255</td>
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<tr>
<td>B&amp;A Contracts Ltd</td>
<td>Dale Road, Hubberston, Milford Haven, Pembrokeshire SA73 3PR</td>
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<tr>
<td>BAE Systems Surface Ships Support Ltd</td>
<td>Room 213, Naval Base Headquarters, Building 1/100, PP127, Portsmouth, PO1 3JS</td>
<td>023 92857297</td>
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<tr>
<td>BAM Nuttall Ltd</td>
<td>St James House, Knoll Road, Camberley GU15 3XW</td>
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<td>Beever Limited</td>
<td>Little Coldharbour farm, Tong Lane, Lamberhurst, Kent, TN3 8AD, UK</td>
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<td>B. A. W. Coatings Ltd</td>
<td>Unit D, Davy Industrial Park, Prince of Wales Road, Darnall, Sheffield, S9 4EX</td>
<td>0114 2432162</td>
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<td>Billfingers Salamis UK Ltd</td>
<td>4 Greenhole Place, Bridge on Don, Aberdeen, AB23 8EU</td>
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<td>BSM Consulting</td>
<td>11 Kingsmead, Naisle, BS48 2XH</td>
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<td>Smeckley Wood Close, Chesterfield Trading Estate, Chesterfield, S41 1PZ</td>
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<td>C E Pittaway &amp; Son Ltd</td>
<td>106 – 114 Flinton Street Hull HU3 4NA</td>
<td>01482 329007</td>
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<td>Celtic Specialist Treatments Ltd</td>
<td>Enterprise House, Herbert Road, Newport, South Wales, NP19 7BH</td>
<td>01633 267007 (office) 01633 215900 (workshop)</td>
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<tr>
<td>Centregreat Engineering Ltd</td>
<td>11/12 Wyndham Close, Brackla, Brackla Industrial Estate, Bridgend, CF31 2AD</td>
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<tr>
<td>Chemcem Scotland Ltd</td>
<td>Wester Crosshill, Avonbridge Road, Falkirk FK1 3DF</td>
<td>01324 851987</td>
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<td>Cleveland Bridge UK Ltd</td>
<td>Cleveland House, Yarm Road, Darlington, DL1 4DE</td>
<td>01325 502345</td>
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<tr>
<td>Coastground Ltd</td>
<td>Morton Peto Road, Capton Hall Industrial, Great Yarmouth, Norfolk, NR31 0LT</td>
<td>01493 650455</td>
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<tr>
<td>Coatings &amp; Blasting Services</td>
<td>Unit 2, Ash Court, Viking Way, Winch Wen Industrial, Estate, Swansea, SA1 7DA</td>
<td>01792 792800</td>
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<tr>
<td>Coating Services Ltd</td>
<td>Parlington Street, Mumps Bridge, Oldham, OL3 3RU, UK</td>
<td>0161 665 1998</td>
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<tr>
<td>Collis Engineering Railway Contracts</td>
<td>Salcombe Road, Meadow Lane Industrial Estate, Alfreton, Derbyshire, DE5 7RG</td>
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ICATS REGISTERED COMPANIES
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<tr>
<th>Company Name</th>
<th>Address</th>
<th>Telephone</th>
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<tr>
<td>Community Clean</td>
<td>11 Old Forge Road, Ferndown Industrial Estate, Ferndown, Wimborne, Dorset, BH21 7RR, UK</td>
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<tr>
<td>Corrocoat</td>
<td>Forster Street, Leeds, LS10 1PW</td>
<td>01132760760</td>
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<tr>
<td>Corroless Eastern Ltd</td>
<td>Greens Road, Greens Industrial Estate, Dereham, Norwich NR20 3TG</td>
<td>01362 691484</td>
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<tr>
<td>County Building Services Ltd</td>
<td>Unit D3, Spectrum Business Estate, Anthony’s Way, Medway City Estate, Rochester, Kent, ME2 4NP</td>
<td>01604 711507</td>
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<tr>
<td>Darcy Spilicare Manufacture</td>
<td>Brook House, Larkfield Trading Estate, New Hythe Lane, Larkfield, Kent ME20 6CN</td>
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<tr>
<td>D&amp;D Rail Ltd</td>
<td>Time House, Time Square, Basildon Essex SS14 1DJ</td>
<td>01268 520000</td>
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<tr>
<td>Denholm Industrial Services</td>
<td>200 200 Carmichael Street, Glasgow, G51 2QU</td>
<td>0141 445 3939</td>
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<tr>
<td>D F Coatings Ltd</td>
<td>Unit 17, Willsments Ind. Estate, Hazel Road, Woolston, Southport, SO19 7HS</td>
<td>02383 044 5634</td>
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<tr>
<td>Donyal Engineering Ltd</td>
<td>Hobson Industrial Estate, Burnopfield, Newcastle UPON Tyne, NE16 6EA</td>
<td>01207 270909</td>
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<tr>
<td>D RH Coatings Ltd</td>
<td>Suite 5, 3 Shawcross Industrial Estate, Ackworth Road, Poulton PO3 5JP</td>
<td>023 9266 6165</td>
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<tr>
<td>Dyer &amp; Butler Ltd (Rail)</td>
<td>Mead House, Station Road, Nursling, Southampton, S016 OA1, UK</td>
<td>02380 667549</td>
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<tr>
<td>E G Lewis &amp; Company Ltd</td>
<td>Unit 5, 3 Shawcross Industrial Estate, Ackworth Road, Portsmouth, PO3 5JP</td>
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<td>ENC Industrial Ltd</td>
<td>Houghton Road, North Anston Trading Estate, Dinnington, Sheffield, S25 4J</td>
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<tr>
<td>Enzo South West Ltd</td>
<td>Unit 3, City Business Park, Somerset Place, Plymouth, PL3 4BB</td>
<td>07850 888808</td>
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<tr>
<td>ESB Surface Engineering</td>
<td>203 Westgate Street, Gloucester, GL12 RN</td>
<td>01452 306272</td>
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<tr>
<td>F A Clover &amp; Son</td>
<td>Bardolph Road, Richmond, Surrey, TW9 2L</td>
<td>0208 948 6321</td>
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<tr>
<td>Farbuild Ltd</td>
<td>Trelawny Lodge, Vicarage Road, Wingfield, Diss, Norfolk IP1 5PB</td>
<td>01379 640670</td>
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<tr>
<td>Ferrous Protection Ltd</td>
<td>Units 27-29 Saddlesworth Business Centre, Huddersfield, Delph, OL3 5DF</td>
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<tr>
<td>Forth Estuary Transport Authority</td>
<td>Forth Road Bridge, Administration Office South Queensferry, EH30 9SF</td>
<td>0131 319 1699</td>
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<td>Forward Protective</td>
<td>Vernon Street, Shirebrook, Mansfield Notts, NG20 8SS</td>
<td>01623 748323</td>
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<tr>
<td>Fountains part of OCS Group of Companies Ltd</td>
<td>Blenheim Court, George Street Banbury, Oxfordshire, OX16 5SB</td>
<td>01295 750000</td>
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<tr>
<td>GABRE (UK) Ltd</td>
<td>12 Church Street, Omagh, Co Tyrone, BT78 3BX</td>
<td>028 8240391</td>
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<tr>
<td>GPL Civil Engineering Ltd</td>
<td>Kennedy House, Cheltenham Street, Salford, M6 6WY</td>
<td>0161 745 7888</td>
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<tr>
<td>Harssco Infrastructure UK Ltd</td>
<td>Unit 3 Manby Road, South Killingholme, Immingham, North Lincolnshire, DN40 3DX</td>
<td>01469 553800</td>
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<tr>
<td>Harrisons Engineering Lancashire Ltd</td>
<td>Judge Wilimley Mill, Longworth Road Billington, Clitheroe, FY7 9TP</td>
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<tr>
<td>HBS Protective Coatings Ltd</td>
<td>40 Manse Road, Belfast BT8 6SA</td>
<td>028 90708280</td>
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<td>Hempel UK Ltd</td>
<td>Benvyn House, The Pavilions, Cwmbran, Torfaen, South Wales, NP44 3DF</td>
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<tr>
<td>Herrington Industrial Services Ltd</td>
<td>Crown Works, Crown Road, Southwick, Sunderland SR5 2BS</td>
<td>0191 5160634</td>
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<tr>
<td>Hi-Tech Surface Treatment Ltd</td>
<td>Unit 8, Deacon Trading Estate, Chickenhall Lane, Eastleigh, Hants SO50 6RP</td>
<td>023 80611789</td>
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<tr>
<td>Hyspec Services Ltd</td>
<td>Unit 3 Meadowfield Industrial Estate, Cowdenbeath Road, Burntisland, Fife, KY3 0LH</td>
<td>01592 874661</td>
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<tr>
<td>Industrial Coating Services</td>
<td>A1 House, Rolling Mill Street, Norton Canes, Cannock WS11 9UH</td>
<td>0845 474 0007</td>
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<tr>
<td>International Energy Services Ltd</td>
<td>94 Awolowo, Ikyo, Lagos State, Nigeria</td>
<td>014615636</td>
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<tr>
<td>Interserve Industrial</td>
<td>Unit 2, Olympic Park, Poole Hall Road Ellesmere Port, Cheshire, CH66 1ST</td>
<td>0151 3737660</td>
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<tr>
<td>Jack Tighe Coatings</td>
<td>Sandall Lane, Kirk Sandall, Doncaster, DN3 1QY</td>
<td>01302 880360</td>
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<td>Jack Tighe Ltd</td>
<td>Redbourne Mere, Kirton Lindsey, Gainsborough, Lincs, DN21 4NW, UK</td>
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<tr>
<td>JW Industrial Services Ltd</td>
<td>47 Barton Road, Stretford, Manchester, M32 9FA</td>
<td>0161 2823329</td>
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<td>JTL Fire Ltd</td>
<td>24 Cove Road, Farnborough, Hants, GU14 OEN</td>
<td>01252 545741</td>
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<td>JW Coatings Ltd</td>
<td>9 Prospect Road, Ossett West Yorkshire, WF5 9AE</td>
<td>01924 267022</td>
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<tr>
<td>Kaefer Limited</td>
<td>Riverside House, Rolling Mill Road, Viking Industrial Estate, Jarrow, Tyne &amp; Wear NE32 3DP</td>
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<tr>
<td>K &amp; N Finishers (Southern) Ltd</td>
<td>Castle Trading Estate, Porchester, Fareham, PO16 9ST</td>
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<tr>
<td>Klinbridge Construction Services Ltd</td>
<td>McDermott House, South Crescent, Cody Road Business Park, London E16 4TL</td>
<td>0207 511 1888</td>
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<tr>
<td>Company Name</td>
<td>Address</td>
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<tr>
<td>K P Coatings Ltd</td>
<td>Unit 4, James Park, Mahon Road, Portadown, Co Armagh, BT62 3EH</td>
<td>T: 02838 338151</td>
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<tr>
<td>New Image Contracts Ltd</td>
<td>Askrum House, High Street, Askrum, Doncaster, DN6 0AA</td>
<td>T: 01302 708070</td>
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<tr>
<td>Pipeline Induction Heating</td>
<td>The Pipeline Centre, Farrington Road, Rosendale Rd Industrial Estate, Burnley BB11 5SW</td>
<td>T: 01282 415323</td>
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<tr>
<td>Lanarkshire Welding Co.</td>
<td>B2 John Street, Wishaw, Lanarkshire, ML2 7TQ</td>
<td>T: 01698 264271</td>
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<tr>
<td>N L Williams Group Ltd</td>
<td>Westside Industrial Estate, Jackson Street, St. Helens, Merseyside WA9 3AT</td>
<td>T: 01744 265260</td>
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<tr>
<td>Port Painters Limited</td>
<td>Unit 3, Ringside Business, Hoel-Y-Rhosog, Cardiff, CF3 2EWx</td>
<td>T: 02920 77070</td>
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<tr>
<td>Ledwood Protective Coatings Ltd</td>
<td>Pembroke Dock, Pembrokeshire, SA72 4RR</td>
<td>T: 01646 623600</td>
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<tr>
<td>Northern Protective</td>
<td>16 High Reach, Fairfield Industrial Estate, Bill Quay, Gateshead, Tyne &amp; Wear, NE10 0UR</td>
<td>T: 0191 438 5555</td>
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<tr>
<td>Possilpark Shotblasting Co Ltd</td>
<td>Dalmarnock Works, 73 Dunn Street, Glasgow, G40 3PE</td>
<td>T: 0141 556 6221</td>
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<tr>
<td>Livingstone Surface Treatments Ltd</td>
<td>Unit 4, The Energy Coast Business Park, Haile, Egremont, Cumbria, CA22 2NH</td>
<td>T: 01946 841191</td>
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<tr>
<td>NSG UK Ltd</td>
<td>Fourth Avenue, Deeside Industrial Park, Deeside, Flintshire CH5 2NR</td>
<td>T: 01244 833138</td>
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<tr>
<td>Prestec UK Ltd</td>
<td>168 Birmingham Road, Shenstone Wood End Staffs, WS14 2NX</td>
<td>T: 0121 308 8001</td>
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<tr>
<td>Maclean &amp; Speirs Blasting Ltd</td>
<td>Unit D, East Fulton Farm, Darluith Road, Linwood, Paisley PA3 3TP</td>
<td>T: 01505 324777</td>
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<tr>
<td>Nusteel Structures</td>
<td>Lymnpe Industrial Estate, Lymnpe, Hythe, Kent, CT21 4LR</td>
<td>T: 01303 268112</td>
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<tr>
<td>Radleigh Metal Coatings Ltd</td>
<td>Unit 30, Central Todington Estate, Cable Street, Wolverhampton, WV2 2HX</td>
<td>T: 01902 870606</td>
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<tr>
<td>MAG Industrial Painters</td>
<td>14 West Stevenson Street, South Shields, Tyne &amp; Wear, NE33 4AG</td>
<td>T: 07976305298</td>
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<tr>
<td>Offshore Marine Services Ltd</td>
<td>Brumby House, Jalan Bahasa, PO Box 80148, 87011 Lubuan F.T. Malaysia</td>
<td>T: +356214244410</td>
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<tr>
<td>Randell Industrial Services Ltd</td>
<td>Factory 2, Hardley Industrial Estate, Holbury, Southampton, SO45 3NQ</td>
<td>T: 02380 983999</td>
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<tr>
<td>Maldon Painting Company Ltd</td>
<td>2 Spital Road, Maldon, Essex CM9 6EB</td>
<td>T: 07976305298</td>
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<tr>
<td>Offshore Painting Services Ltd</td>
<td>B4 Coronation Road, Crosby, Liverpool, L23 3BJ</td>
<td>T: 0151 792 9627</td>
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<tr>
<td>Ripblast &amp; Co Ltd</td>
<td>Oakwood Industrial Estate, Harling Road, Snetterton, Norfolk, NR16 2JU</td>
<td>T: 01953 885200</td>
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<tr>
<td>Megarmo Qatar LLC</td>
<td>Al Rayyan Al Qadeem Street, Doha PO Box 20054, Qatar</td>
<td>T: +974 66264616</td>
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<tr>
<td>MCL Coatings Group Ltd</td>
<td>P Powerful Coatings, Halebank Industrial Estate, Widnes, Cheshire, WA8 1BN</td>
<td>T: 0151 423 6166</td>
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<tr>
<td>Orrmac Coatings Ltd</td>
<td>Newton Chambers Road, Thorncliffe Park Estate, Chappleton, Sheffield, S3 2PH</td>
<td>T: 0114 246 1237</td>
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<td>RJC (UK) Ltd</td>
<td>Mews Place, The Street, Hatfield Peverel, Essex, CM3 2EH</td>
<td>T: 01245 380870</td>
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<tr>
<td>Miller Fabrications Ltd</td>
<td>Banthorpe Works, Overtown Road Wishaw, Lanarkshire, ML2 8E</td>
<td>T: 01301 311200</td>
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<tr>
<td>Offshore Painting Services Ltd</td>
<td>Unit 10 Millhead Way, Purdys Industrial Estate, Rochford, Essex, SS4 1ND</td>
<td>T: 01268 7244410</td>
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<tr>
<td>R.L.P. Painting Contractors Ltd</td>
<td>Unit 1, Grange Lane, Balby, Doncaster DN4 9HR</td>
<td>T: 01302 853077</td>
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<tr>
<td>MIS North East Ltd</td>
<td>Units 2, S/Fa Hill Mill, North West Ind Estate, Peterlee, SR5 2HR</td>
<td>T: 0191 514 2804</td>
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<tr>
<td>Over Rail Services Ltd</td>
<td>Unit 10 Millhead Way, Purdys Industrial Estate, Rochford, Essex, SS4 1ND</td>
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<tr>
<td>RMF Construction Services Ltd</td>
<td>Unit 2, Oughton Road Birmingham, B12 0DF</td>
<td>T: 0121 440 7970</td>
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<tr>
<td>Moores Steel Developments Ltd</td>
<td>Station Road, Thorney, Peterborough PE6 OQ</td>
<td>T: 01733 270729</td>
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<td>Over Rail Services Ltd</td>
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<td>Moore Steel Developments Ltd</td>
<td>Station Road, Thorney, Peterborough PE6 OQ</td>
<td>T: 01733 270729</td>
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<tr>
<td>P.H. Shotblasting &amp; Spraying Services</td>
<td>43a Drumrane Road, Castlescaufeld, Dungannon, Co Tyrone, BT70 3NY</td>
<td>T: 028 8776 7722</td>
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<tr>
<td>Sherwin-Williams Protective &amp; Marine Coatings</td>
<td>Tower Works, Kestor Street, Bolton, Lancs. BL2 2AL</td>
<td>T: +44 (0)1204 517711</td>
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**TO ADVERTISE CONTACT** SQUARE ONE Tel: +44 (0)114 273 0132 Email: jonathan@squareone.co.uk
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<tr>
<th>Company Name</th>
<th>Address</th>
<th>Telephone</th>
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<tr>
<td>Shirley Industrial Painters &amp; Decorators Ltd</td>
<td>Grand Union House, Bridge Walk, Acock’s Green, Birmingham, B27 6SN</td>
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<tr>
<td>Shutdown Maintenance Services Ltd</td>
<td>Kingsnorth Industrial, Hoo, Rochester, Kent, ME3 9ND</td>
<td>01634 256969</td>
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<tr>
<td>Sitecote Ltd</td>
<td>33 Kielder Close, Ashton in Makerfield, Wigna, WN4 0JE</td>
<td>07714678719</td>
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<tr>
<td>Solent Protective Coatings Ltd</td>
<td>Tredgar Wharf, Marine Parade Southampton, Hants, SO14 5JF</td>
<td>02380 221480</td>
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<tr>
<td>South Staffs Protective Coatings Ltd</td>
<td>Bloomfield Road, Tipton, West Midlands, DY4 9EE</td>
<td>0121 522 2373</td>
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<tr>
<td>Southern Coating Contractors Ltd</td>
<td>Malmesbury House, 227 Shirley Road, Shirley, Southampton, SO15 3HT</td>
<td>02388 0702276</td>
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<tr>
<td>Specialist Blasting Services Ltd</td>
<td>Smiths Quay, Hazel Road, Woolston, SO19 7GB</td>
<td>023 8043901</td>
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<tr>
<td>Specialist Painting Group Ltd</td>
<td>Unit 3 Propser House, Actone Park, Padholme Road East, Fergate, Peterborough, PE1 5XN</td>
<td>01773 309500</td>
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<tr>
<td>Stainless Restoration Ltd</td>
<td>Unit M1, Adamson Industrial Estate, Croft Street Hyde, Cheshire, SK14 1EE</td>
<td>0161 3686191</td>
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<tr>
<td>Stamford Construction Limited</td>
<td>Unit 9 The Joiners Shop, The Historic Dockyard, Chatham, Kent, ME4 4TZ</td>
<td>01634 816126</td>
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<tr>
<td>Standish Metal Treatment Ltd</td>
<td>Potter Place, West Pimbo, Skelmersdale, Lancs, WN8 9PW, UK</td>
<td>01695 455977</td>
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<tr>
<td>Stobbarts Ltd</td>
<td>Tarn Howe, Lakes Road, Derwent Howe Industrial Estate, Workington, Cumbria CA14 3YP</td>
<td>01900 870780</td>
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<tr>
<td>Story Contracting Ltd</td>
<td>Burgh Road Industrial Estate, Carlisle, Cumbria CA2 7NA</td>
<td>07730 764414</td>
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<tr>
<td>Stream Marine Training Ltd</td>
<td>Kintyre House, St Andrews Crescent, West Campus, Glasgow International Airport, Paisley, PA3 2TQ</td>
<td>0141 212 8777</td>
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<tr>
<td>Tees Valley Coatings Ltd</td>
<td>Riverside Park Road, Middlesbrough, Cleveland TS2 1UT</td>
<td>01642 226314</td>
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<tr>
<td>Surface Engineers (Manchester) Ltd</td>
<td>Globe Industrial Park, Off Astley Street, Dukinfield, Cheshire, SK16 4QZ</td>
<td>0161 330 9224</td>
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<tr>
<td>Surface Technik (Oldhill) Ltd</td>
<td>Rovereign Works, Deepdale Lane, Lower Comal, Dudley, DY3 2AF</td>
<td>01384 457610</td>
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<tr>
<td>TEMA Engineering Ltd</td>
<td>5-6 Curran Road, Cardiff, CF10 5DF, UK</td>
<td>020920 344556</td>
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<tr>
<td>Thompson Project Management Ltd</td>
<td>Newacre, Athey Road, Carlow, Republic Of Ireland</td>
<td>0353 599131624</td>
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<tr>
<td>Tinsley Special Products</td>
<td>Enterprise House, Durham Lane, Eaglescliffe, Stockton-on-Tees TS16 0PS</td>
<td>01642 784279</td>
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<tr>
<td>Taziker Industrial</td>
<td>6 Lodge Bank, Crown Lane, Horwich, Bolton, Lancs, BL6 5HU</td>
<td>0844 8800 385</td>
</tr>
<tr>
<td>Torishima Service Solutions Europe Ltd</td>
<td>Sunnyside Works Gartsherrie Road Coatbridge ML5 2DJ</td>
<td>0123642390</td>
</tr>
<tr>
<td>Transvac Systems Ltd</td>
<td>Monsal House, 1 Bramble way Alfreton, Derbyshire, DE55 4RH</td>
<td>01773 831100</td>
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<tr>
<td>Underhill Engineering Ltd</td>
<td>Plymouth Road, Estover, Plymouth, PL6 7LX</td>
<td>01752 752480</td>
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<tr>
<td>Vale Protective Coatings Ltd</td>
<td>Building 152 - Langar North Industrial Estate, Harby Road, Langar, NG13 9HY</td>
<td>01949 869784</td>
</tr>
<tr>
<td>Walker Construction (UK) Ltd</td>
<td>Park Farm Road, Folkestone, Kent, CT19 5DY</td>
<td>01303 851111</td>
</tr>
<tr>
<td>Wardle Painters Ltd</td>
<td>Unit 5, Wimbore Building, Atlantic Way, Barry Docks, Glamorgan, CF63 3RA, UK</td>
<td>01446 748620</td>
</tr>
<tr>
<td>Wescott Coatings &amp; Training Services Ltd</td>
<td>9b/9c Tyne Point, Shaftsbury Avenue, Simonside Industrial Estate, Jarrow, Tyne &amp; Wear, NE32 3UP</td>
<td>0191 497 5550</td>
</tr>
<tr>
<td>W G Beaumont &amp; Son</td>
<td>Beaumont House, 8 Bernard Road, Royston, PE1 0HJ</td>
<td>01708 749202</td>
</tr>
<tr>
<td>William Hare Ltd</td>
<td>Brandleholme House, Brandleholme Road, Burys, Lancs, BL8 1JJ, UK</td>
<td>0161 609 0000</td>
</tr>
<tr>
<td>Wood Group Industrial Services Limited</td>
<td>Kirkstone House, St Omers Road, Western Riverside Route, Gateshead, Wear, NE11 9EZ</td>
<td>0191 4932600</td>
</tr>
<tr>
<td>Xervon Palmers Ltd</td>
<td>331 Charles Street, Royston, Glasgow G21 2QA</td>
<td>0141 5334040</td>
</tr>
</tbody>
</table>

Visit the ICATS website: [www.icats-training.org](http://www.icats-training.org)
DIARY DATES 2016

Thursday 14th April 2016
London Branch Meeting:
Joint Meeting with NACE (GB)
Venue: Imperial College, Skempton Building, London SW7 2BZ
18.00 Social half hour
18.30 Talk
Topics: ‘New risk based method for assessing the threat of MIC’
Elizabeth Hillier, Principal Engineer
Head of Section: Subsea and Pipelines, London Approval Centre
DNV GL UK Limited
19.30 Refreshments and networking
21.00 Finish

Tuesday 19th April 2016
Aberdeen Branch Meeting
Venue: Palm Court Hotel, 81 Seafield Road, Aberdeen AB15 7YX, United Kingdom, 18:00 – 19:30
Speaker: Raouf Kattan (Safinah)
Topic: The challenges of designing and complying with a ship’s coating specification.

Wednesday 20th April 2016
CED Working Day and Symposium on Microbial Corrosion Issues in Heating and Cooling Systems
Venue: National Motorcycle Museum Conference Centre Coventry Road, Bickenhill Solihull, West Midlands, B92 0E
T: 0121 444 1448
E: sales@nationalconferencecentre.co.uk
A One Day Symposium organised by the Corrosion Engineering Division and the International Biodeterioration and Biodegradation Society.
Directions and details of local accommodation are at: www.nationalmotorcyclemuseum.co.uk/museum/

Wednesday 26th April 2016
Midlands Branch Meeting
Venue: The Coates Building Room C35 (Building 36), The University of Nottingham, University Park, Nottingham, NG7 2RD. Postcode for satellite navigation is NG7 2QL.
Topic: Corrosion Failure Investigations and the Role of an Expert Witness

Tuesday 17th – Friday 20th May 2016
CEOCOR 2016 Congress
The CEOCOR 2016 Congress takes place in Ljubljana, Slovenia. Contact Brian Wyatt for more information:
brianw Wyatt@controlcorrosion.co.uk or visit http://ceocor.eu and the Marine Corrosion Forum at www.marinecorrosionforum.org

Tuesday 31st May 2016
Aberdeen Branch Meeting
Venue: Palm Court Hotel, 81 Seafield Road, Aberdeen AB15 7YX, United Kingdom, 18.00 – 19:30
Speaker: TBC
Topic: TBC

Monday 6th – Friday 10th June 2016
ICorr Level 1 Cathodic Protection Technician Marine Metallic Structures Course
ICorr are pleased to announce that the next Level 1 Cathodic Protection Technician Course for Marine Metallic Structures at the Royal Naval Submarine Museum in Gosport.
Contact: +44 (0)114 3995720 or trainingsolutions@imeche.org

Monday 5th – Tuesday 6th September 2016
57th Corrosion Science Symposium (organised by CSD)
Venue: University of Swansea Description: Further details including abstract submission will appear here in due course.

Wednesday 30th November 2016
Anticorrosive Coatings
Venue: Amsterdam, the Netherlands
Topics: ‘How does corrosion occur?’

TO ADVERTISE CONTACT JONATHAN AT SQUARE ONE Tel: +44 (0)114 255 7911 or Email: enquiries@squareone.co.uk

For all the latest news, events and debates join us on LinkedIn.

J OINT IBBS/ICC ORR MEETING
Just a quick note to inform you that delegates at the joint IBBS/ICorr meeting in April will be offered a free membership of the IBBS until the end of 2017.

London Branch publish a monthly Newsletter; to be included on the circulation list please contact Sarah Vasey sarah.vasey@sherwin.com

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Contact Brian Wyatt for more information:
brianwWyatt@controlcorrosion.co.uk or visit http://ceocor.eu and the Marine Corrosion Forum at www.marinecorrosionforum.org

Tel: +49 511 99 10 272
Email: vincentz.net
Website: www.european-coatings.com/Events/European-Coatings-
seminars-2016/Anticorrosive-coatings

•How does corrosion occur?
•What are the current trends in corrosion protection coatings?
•What distinguishes water-borne from solvent-borne systems?
•How do self-healing coatings work?

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