In this issue:

Technical Topics reaches 50 – Pages 6-7
Aberdeen Branch News – Pages 9-10
Company News – Pages 16-18
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CONTENTS

Institute News

The President Writes 4
London Branch News 5-6
Technical Topics No.50 6-7
Cumbria’s first ICATS Training Course 8
North East Branch News 9
Aberdeen Branch News 10-11

Technical Article

Pull-off Adhesion Testing Of Coatings – Improve Your Technique 12-16

Company News

Winn & Coales (Denso) Ltd 17
Alfred Bagnall & Sons Limited 18

Sustaining Members 19-27
ICATS Registered Companies 28-31

Diary and Branch Contacts 32
The Institute of Corrosion is in full flow now that spring has sprung. Nothing like a bit of sunshine (and a lot of rain) to make things grow. There is good news from several branches and two of our northern branches will have held Extraordinary General Meetings to elect new Chairmen and Branch Committees to reactivate events in their region. The North East Branch has already met and elected its new Chairman, Neil Wilds and its new Secretary, Gemma Malthouse. Special thanks are due to our Vice President, Sarah Vasey, for his enthusiasm in assembling what appears to be a significant number of interested parties for this meeting.

As I write, the Yorkshire Branch are about to meet, in Lancashire if their visas are all in order, with the objective of electing Chairman, Richard Green and Secretary Nigel Peterson-White. In this case the thanks are due to Nigel for his enthusiasm in assembling what appears to be a significant number of interested parties for this meeting.

I will be attending the North West Branch Golf Day and AGM on 28th May but I expect to have more luck at the AGM than I will have on the Golf Course, as ICorr keeps me too busy to practice adequately. At least that is the excuse I am going to use.

London Branch has their 2015/2016 programme in place and a new, larger venue at Imperial College planned. The new meeting room, which will host the evening meetings from October 2015, has many presentation facilities and I think it will be found to be just as welcoming as the Navel Club has been. I think we should collectively offer our thanks to the Naval Club for their service in accommodating London Branch events over many years. However, Imperial College offers the Branch more space and as London Branch events have been growing over recent years this new venue will provide room for the Branch to continue growing the attendance at their event.

It is unfortunate that London Branch has had to cancel this year’s Golf Day due to withdrawal of several of the regular attendees. There does seem to be a direct correlation between this situation and the turmoil in the oil and gas industry cause by the drop in crude oil prices. It is believe that this is temporary and thought is already being given to the 2016 Golf Day.

Midland Branch held their AGM back in March and have a site visit planned for June and will also host the Institute’s AGM with a half-day meeting on 3rd December. More details on both of these events to follow.

CED will also have held their annual meeting in Aberdeen by the time you read this article and CSD will be holding their annual meeting conjunction with the Electro-Chemical Society in Durham in September, again look out for more details in the near future.

At the recent ICorr Council Meeting it was reported that individual membership has increased so far in 2015 and this is a very pleasing situation. I would like to reinforce the thought that we cannot have too many members and I encourage you all to encourage your colleagues with similar interested and who are not members to consider joining.

I note that this issue contains the fiftieth article from our Technical Secretary, Douglas Mills. I would like to offer my congratulations to Douglas for reaching this mile stone. I recognise how difficult it is to continue to be original in these regular articles and I am sure that if anyone has any topics for consideration for the 51st article, Douglas will be pleased to hear from you.

As I mentioned in my piece for the March/April issue, Trevor Osborne and I meet with the Australian Corrosion Association at the NACE Conference in Dallas. The relationship between the two corrosion organisations continues to develop and ACA have graciously invited me to attend their conference “Corrosion and Prevention 2015”, which is to be held in Adelaide in November.

I have submitted an abstract for a paper on the adhesion testing of coatings to justify the long distance travel involved and I am pleased to report that this abstract has been accepted. I look forward to meeting the ACA on their home turf and to progress the relationship further.

I trust that you are all very busy dealing with the multitude of corrosion issues that arise every day and that good progress is being made in all your endeavours. But if good progress is eluding you, please remember that there is very considerable experience and expertise within the Institute of Corrosion and networking with other members will, generally, give great support to your work.

John Fletcher
President of the Institute of Corrosion

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[www.icorr.org](http://www.icorr.org)
LONDON BRANCH NEWS
NEW VENUE FROM OCTOBER 2015

After 26 years of holding its regular Winter/Spring programme of Technical Evening meetings at The Naval Club, Mayfair, increasing attendance figures mean that we have outgrown the facilities currently available. The London Branch Committee has decided that a change of venue is necessary.

Our first meeting of the new season will be held on the evening of Thursday 8th October 2015 at Imperial College, London, in South Kensington, SW7. It can be reached directly by an underground walkway from the nearby Tube Station.

Presentations will be made in the Skelton Building of the Civil Engineering Department, which offers excellent meeting facilities and state-of-the-art presentation equipment. Up to 100 members and guests can be accommodated in pleasant and comfortable surroundings.

Our tried and tested format of complimentary pre-presentation refreshments as well as post presentation drinks and sandwiches will be available in the Assembly Foyer adjacent to the Lecture Room. As usual, there will be no charge for these meetings. All ICorr Members, guests and visitors are most welcome. The dress code will be Smart Casual and Members will be encouraged to wear their Institute ties.

The London branch of the Institute of Corrosion host a technical programme of monthly presentations from September through to May each year as well as special events such as a golf day, Christmas luncheon and London walking tour. You will find details of all our events for the technical presentation programme in our online calendar and in the conferences and events section. If you would like any further information please don’t hesitate to get in touch at icorrlondon@gmail.com

Institute of Corrosion London branch meetings begin at 17:45 with complimentary drinks and the opportunity to network with other corrosion professionals, followed by the technical presentation at 18:15. There is then a complimentary buffet and bar open to discuss the presentation and continue the networking. The events finish around 8:30 pm.

In May an outside event is normally held which is in recent years has been a blue badge guided walk around parts of London followed by a supper at the Naval Club.

For the 2015-2016 season our meetings will be held at Imperial College, London SW7 2AZ, with our first meeting being held on the 8th October 2015 details of the meeting can be found on the online calendar. It can be reached directly by an underground walkway from the nearby Tube Station. Presentations will be made in the Skelton Building of the Civil Engineering Department.

Contact Details
If you would like any further information on the London Branch’s events and activities please contact our secretary at icorrlondon@gmail.com

London Branch Committee
The committee is made up from individuals from the industry and without their support the events would not take place. The committee for 2015-2016 is:

Chair: Jim Glynn
Vice Chair: M Biagioli
Immediate Past President: Trevor Osborne
Immediate Past Chairman and Past President: John T O’Shea
Honorary Secretary: Paul Brooks
Honorary Minutes Secretary: Brian Goldie
Honorary Treasurer & Journal Correspondent: Mike Allen
Venue Booking and Raffle Master: Derek Hoskins
PRO, Website and Diary Dates Co-ordinator: George Winning
Current Institute Vice President and Newsletter Editor: Sarah Vasey
General Committee Members
David Deacon
David Dore
David Mobbs
Geoff White
Polina Zabelina

For all the latest news, events and debates join us on LinkedIn
BLACK MAGIC FROM GEOFF WHITE

On 9th April 2015 The London Branch met for their traditional April joint meeting with NACE UK at The Naval Club, Mayfair. Under the Chairmanship of Jim Glynn, the presentation was made by Geoff White, long time member of London Branch committee.

Geoff took us back in time to his days in the 1980’s spent as a cathodic protection technician in the area utility company, SEGAS. Geoff remarked about the reputation of the cathodic protection industry, being seen as a ‘black magic’ operation. To support this perception, he highlighted the confusing use of jargon, such as describing ‘higher’ pipe to soil potentials when in fact they were actually becoming more negative and in this particular case study, the measurement of line currents when in fact measurement was actually of voltages.

The case study involved an investigation into the loss of protection on a 6 km, 12” gas Main provided with sacrificial magnesium anodes. Geoff reminded the audience that at the time, this work was not hampered by over demanding health and safety issues and this allowed measurements to be made along the length of the Main which was installed within a roadway, with over 60 cast iron surface test boxes requiring ‘forced entry’, due to the ravages of Bexhill’s salt laden atmosphere.

With the temporary use of some impressed current provided from an adjacent pipeline section, diligent measurements of voltage-drop along the Main were made, using each pair of adjacent test points. These measurements, which were graphically displayed by Geoff, clearly identified the existence of two pipeline services, which, being unwrapped and in contact with the Main in question, were demanding or ‘draining’ a high proportion of the protection current supplied. A satisfying result, which proved that although cathodic protection was a simple and proven method of protection; its application was often compromised by all too casual installation works, brought about by a lack of understanding.

I am now editor of the EFC (web site www.efc.org) newsletter and in the last Issue there was article on Corrosion Awareness Day which was instituted fairly recently by the World Corrosion Association. This took

INTERNATIONAL LINKS AND CORROSION AWARENESS DAY

By Douglas J Mills, Technical Secretary

I thought I’d have a rest from discussing technical issues in this TT. This “column” started just about 10 years ago (July/August’05 CM) at the suggestion of the then President, Stuart Lyon. Write whatever you like about corrosion as long as it is not libellous or licentious he said. And here we are at the 50th. No doubt I have covered a range of topics. Some people have been enthusiastic about (or critical of) my TTs and have written to me. And I have enjoyed the dialogue. To try to avoid controversy, when I write about areas that I don’t know too much about, I run an article past an expert in that particular field.

How do I decide what to write about each month? Well as regular readers will guess there is no master plan! If it appears to be somewhat random, this is because it is! What inspires the topic is often something that has come up in my (professional normally) life a short time before the TT is due to be written. As long as I have good topic I enjoy writing them because although I try not to get facts wrong most of what I write is off the top of my head and, unlike my normal scientific writing one does not have to justify every statement with references. Also I can adopt a more informal chatty style than is the “norm” in “scientific” writing. So how much longer will I go on? I hope to do a few more yet. But when I retire from the TS role which seems at the same time. Maybe CM will invite me to contribute an article annually – eg “interesting corrosion related issues come across by the ex Tech Sec in the last year” or something like that?

Anyway I thought I would talk a bit more generally in this TT. And particularly our liaison with other bodies outside UK. Of course there is the European Federation of Corrosion (EFC) which now has forty members from over thirty countries. The Institute of Corrosion is one of the larger EFC societies in terms of numbers of members. But of course we are dwarfed by NACE and NACE international which probably has twenty times the number. Then there is the Australasian Corrosion Association with which we have good relations. There must be opportunities elsewhere as well e.g. Brazil, Argentina Mexico, Japan and China and India have societies and are all big players. The more we can share and interact with other bodies the better (luckily English is the language of science so we have a big advantage there).

I am now editor of the EFC (web site www.efc.org) newsletter and in the last issue there was article on Corrosion Awareness Day which was instituted fairly recently by the World Corrosion Association. This took
place on 24th April. At the time I was near La Rochelle in France at an organic coatings meeting (AETOC) and we acknowledged it in the meeting. As there has often been some interest in my holiday snaps in these TTs I will include a couple of shots of La Rochelle. And one shot of corrosion of a cognac producing building on the Isle D’ete. This is a severe chloride environment close to the sea. But maybe the preservation of the structure was not helped by the fumes from the cognac!

Anyway I will conclude this article with some selected extracts from George Hays (the President of the WCO)’s open letter about Corrosion Awareness Day “This is intended as a means to educate the public, industries and government agencies regarding the deleterious effects of corrosion on our infrastructures worldwide. The worldwide cost of corrosion is currently in the same order of magnitude as the cost of producing and distributing food worldwide. The difference is that the public is somewhat aware of issues related to hunger and the cost of food, but totally unaware of the cost of corrosion and its effect on our infrastructure. The corrosion industry is rapidly losing its expertise as our top technologists retire and are not replaced. For example, in the 80’s and early 90’s, virtually every oil refinery and most petrochemical plants had their own resident corrosion staff. Then industry restructuring led to replacement of in-house corrosion experts with consultants hired on an as needed basis. Furthermore, a number of universities which previously offered metallurgical engineering programs have replaced these with materials engineering, focusing on advanced materials and nano technologies that are more attractive to both students and industry, but which neglect the basic corrosion issues. Consequently, we now have a pressing need for more personnel in the fields of corrosion research and applications, but the industry has yet to find ways to capture the interest of youth and young adults. At the same time the number of students in other engineering specialties appears to be at least steady if not growing. It is high time that the various societies began to work together to promote the field of corrosion to the youth of the world. I would envision the focus beginning with students as young as 8 or 9 and continuing through high school and university or technical school. That is the goal of Corrosion Awareness Day!

Good stuff eh. Like the Cognac!

Any comments please contact as usual Douglas@harrbridge.freeserve.co.uk
DREAM JOB AT SELLAFIELD RESULTS FROM CUMBRIA’S FIRST ICATS TRAINING COURSE

The first ICATS training course to be held in Cumbria has resulted in a ‘dream job’ at Sellafield for a ‘Painting and Decorating’ student from Lakes College. Having passed the ICATS course Nicky Pattinson, 20 from Maryport, was offered a full time job with Jacob Stobarts working at the Sellafield site. This opportunity was instigated by ICATS course tutor Eddie Blackmore from Livingstone Surface Treatments Ltd who was impressed by Nicky’s determination to do well.

The ICATS course was the first to be held in Cumbria and booked up quickly. Conscious of the skills gap in West Cumbria, ICATS trainer Eddie Blackmore was keen for youngsters to embrace more of the upskilling opportunities available. Offering a student a free place on his ICATS course was the first step. Consulting with Christine Steele, Lakes College Tutor on the Painting and Decorating course, Nicky Pattinson was offered the free training place.

From the offset Nicky impressed Eddie Blackmore who said “There was no question over Nicky’s determination to succeed – on his first day his lift let him down so he had to set off at Sam, taking three busses and walking the final couple of miles from Thornhill to Blackbeck. He was mature in his approach and fitted in well with the nine delegates from Altrad NSG Ltd working off shore on the Morecambe Bay rigs.

The 40 hour course included modules covering all aspects of industrial coating, combined with practical sessions and discussions on the correct way to preparing and coating the steelwork. The final part of the course was a multiple choice exam which all those attending were relieved to pass. Commenting on the training the attendees said “it was enjoyable, informative and Eddie’s personality helped make the course come alive.”

Nicky Pattinson said “I’d like to thank Eddie Blackmore for the opportunity to progress with my learning and develop new and existing skills; I have enjoyed my time on the course and found a new passion - the industrial coatings industry having my eyes opened to opportunities available”.

Throughout the week Nicky’s attitude and aptitude stood out to Eddie Blackmore “Nicky did extremely well, he was not intimidated at all by the fact he was in a room full of much more experienced people, he performed well on the practical assessments as well as the theoretical side and I was delighted to be able to announce he passed the course and received his ICATS certification and wallet card.

“In fact he impressed me so much, I decided to speak to a work contact - Mike Sharrock, Head of EHS and Q at Jacobs Stobbarts on the Sellafield site. I really believed Nicky could be a key employee of the future and wanted Mike to meet him – hopefully with a view to a job offer at some point.”

Unbeknown to Nicky, Eddie Blackmore had arranged a meeting at the Blackbeck Hotel when the course finished, giving Mike chance to see for himself the potential Nicky showed. It was a relaxed and informal conversation, but it was very evident just how much Nicky has learned and his tenacity to do well and achieve something. Mike Sharrock was so impressed that he offered Nicky a full time permanent job on the Sellafield site (subject to security clearance), once he has completed his Lakes College course.

A stunned Nicky Pattinson went pale and was speechless before a beaming smile of delight took hold. Nicky said “I can’t believe it, I have been offered a life changing opportunity to go and work on the nuclear site at Sellafield. I’m glad I managed to show my determination and a passion for the industry, but I never thought I would make it to the position I am now in! I would like to thank Christine Steele and Mark Docherty from the Lakes College and Eddie Blackmore of Livingstone Surface Treatments for their help and guidance which drove me to try harder and better myself.”

Mike Sharrock from Jacobs Stobarts said “When Eddie called it was clear he was impressed by Nicky’s determination and ability to learn – so we were eager to find out more. Straight away I cold see that Nicky has an excellent attitude towards work and learning and already has some valuable skills, so it was a real joy to be able to offer him a job once he graduates from college.”

Reflecting on the news Eddie Blackmore said “Nicky was very enthusiastic when talking to Mike, he was relaxed and passionate about where he wanted to achieve in his career, but he didn’t realise he was being interviewed! I was thrilled that it all went so well, it was an immensely proud moment to watch the look on his face when Mike offered him a job. I could not have written a script with such a great outcome.

“This has been our first foray at linking education and employment. Moving forward I can see potential for creating practical links between college and employers; the more of this we can do, the better for future generations of employees in West Cumbria. With the potential new nuclear academy and colleges on our doorstep, we need to keep up the momentum going. Hopefully Nicky’s story will inspire more students to be determined and focused on improving their skills.”

For further information on the ICATS training available in the North West, contact Eddie Blackmore on 01946 841191 or visit www.livingstonesurfaces.co.uk
After almost a decade of inactivity the North East Branch of the Institute of Corrosion was reinvigorated in March 2015. A new committee chaired by Neil Wilds has been formed breathing a new lease of life into the branch.

The first order of business was to re-establish branch meetings with the first being hosted on the 31st March at the Marriott Gosforth Park Hotel. 31 people attended the meeting to hear guest speaker Dr Hailiang Du for Overview of High Temperature Corrosion in Power Industry and the committee chair who lead a discussion on Modes of Coating Failure Offshore. Both topics created lively debate amongst the branch members and feedback on the evening was overwhelmingly positive.

'It was great to see so many faces from across the industry at our first branch meeting in the North East' said Diane Smith, Vice-Chair who co-hosted the event. 'This really reinforces the need to develop momentum locally and make our meetings regular to ensure that we are creating the opportunity to network and discuss the topics that are really important in the corrosion industry today'.

'We learned a lot from our first meeting' added Gemma Malthouse, branch secretary. 'It was so helpful to have assistance from some of the London Branch members to guide us through both our first committee and branch members meetings. Further to this we have been able to tie up with Newcastle University already to start to develop our academic links locally. The committee agree that getting young people involved in the branch is key to its longevity and we’re really forming an enthusiastic team to drive this forward'.

The team are working hard to develop a schedule of meetings for the rest of 2015 which will be published online shortly.

The branch’s next meeting will be hosted at Newcastle University on the 26th May at 18:00 for more details or to get involved with the branch contact icorrne@outlook.com

North East Branch Committee: Neil Wilds (Chair), Diane Smith (Vice-Chair), Gemma Malthouse (Secretary), Evenna Ottey (Treasurer), Hailiang Du, Jozef Soltis, Sarah Vasey (Committee members).

Overview of High Temperature Corrosion in Power Industry

Dr Hailiang Du, Macaw Engineering

Dr. Hailiang Du gave a very interesting incite on the corrosion issues that occur in modern power plants and the challenges that face today’s engineers in combating corrosion such as fireside corrosion, steam oxidation and solid particle erosion.

Part of his presentation centered around the mechanisms behind 'fireside corrosion' and 'steam oxidation' in the boiler and steam turbine, an area of particular interest to the group who were not all aware of the challenges faced in this area. Attendees heard about the various corrosion processes that are present including gas-phase oxidation and deposit-induced liquid phase corrosion which is an accelerated form of corrosion induced from the melting of impurities in coal. Overall this presentation gave a very good overview of corrosion in coal fire power plants.

Modes of Coating Failure Offshore

Neil Wilds, AkzoNobel

Neil delivered an informative session covering the evolution of testing for coatings and how failures offshore have influenced the way in which product performance is evaluated in the laboratory.

The overview of the history of corrosion testing presented highlighted the change in the industry from static testing, simple salt spray, to more dynamic cyclic testing such as Norsok M501 ageing resistance test. Neil’s presentation looked at how modern day coatings are put through more rigorous testing protocols than before and it was interesting to see how previous coating failures offshore were linked to test methodology development in an attempt to mimic the mode of failure.

Overall the presentation received a positive response from the audience with an active discussion resulting from many questions posed.
ICORR ABERDEEN BRANCH MARCH MEETING

INDUSTRIAL VISIT- NATIONAL HYPERBARIC CENTRE

On 24th of March 2015, delegates from the Institute of Corrosion Aberdeen visited the National Hyperbaric Centre (NHC). Mike McDonald was the host of the event and after a brief on safety; he explained that the session will be split into two parts.

For the first part of the visit, Mike gave a presentation of the activities of the Centre summarising its history highlighting that the company was recently acquired by James Fisher Defence. He explained that the Centre provided training, testing, subsea consultancy and emergency services to a variety of clients both in the UK and abroad. Mike explained that subsea weld trials (wet and dry), pressure testing using chambers, diver training, life boat reception were some oil and gas related activities performed at the Centre. Other services provided involved using pressure chambers to support high altitude conditioning and National Health Service (NHS) tissue regeneration treatment.

The second part of the visit was a tour around the facilities. Gordon Boyle showed delegates various facilities using a model to explain the layout of the centre. He took members round the site and explained how facilities, including the control centre, equipment area, habitat, dive tank etc were utilised. He focused on the how the pressure chamber was utilised, demonstrated use of emergency rescue with a pressurised safety boat and explained how the habitat was used in practice to deliver subsea welds that were of a high specification.

Questions were asked by members on various aspects of the presentation and tour throughout the visit. 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.
Does a Cathodic Protection Engineer Need to Be an Electrochemist?

Chris Googan of Anticorrosion Limited was the guest speaker during the joint meeting with the Marine Corrosion Forum held on the 21st of April 2015. Chris started by explaining the significance of Sir Humphry Davy’s work in development of Cathodic Protection (CP) explaining how CP was practically applied at the time. Chris explained the mechanism of corrosion and introduced the various CP techniques i.e. Sacrificial and Impressed Current CP. He posed a series of technical questions and explained the importance of electrochemistry in CP design and application. “How can CP be measured and what potential do we require to achieve full protection?” Chris pondered and used illustrative diagrams (including the Pourbaix diagram and Evans plots) to explain the use of reference electrodes for CP monitoring. Chris introduced the work of Walther Nernst, Michael Faraday and Julius Tafel highlighting their contribution to the field of CP. He explained how an increase in the electrolyte pH reduces corrosion rates and put forward the “case” for both immunity and passivation highlighting the thermodynamics aspects of CP with inherent assumptions made by scientists when estimating protection potential criteria.

Chris discussed challenges faced today by engineers in life extension of aged subsea structures and pipelines. He posed questions like “Is there a need for a retrofit CP system?”, “How much of the original anode is left?” and suggested a technique of “reverse CP calculation” to estimate anode mass and output remaining for an asset in service. Chris concluded that while electrochemical knowledge was not essential and a basic CP Design could be produced without it, working to International Standards, a far more cost effective and more appropriate design would result from having a good understanding of electrochemical science.

With illustrative photographs, Chris presented a series of case studies showing practical problems encountered. He presented a case of a tank experiencing bimetallic corrosion due to poor CP connection. He presented a case of a ship propeller with corrosion issues simply because the CP system was not switched on after commissioning. Another case related to a ship rudder not protected because the connection lead was painted over. Another had an insulation kit installed but then incorrectly bridged over causing CP interference issues. There was a solar powered CP system with its capacitors switched off so the pipeline was not being protected at night. There was a pipeline that was not protected although the “ON” potential readings showed levels that exceeded the protection criteria highlighting the importance of measuring accurate “OFF” potentials during CP surveys.

Questions were from various aspects of CP were taken and a lively discussion ensued as the meeting came to a close. 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.
PULL-OFF ADHESION TESTING OF COATINGS – IMPROVE YOUR TECHNIQUE

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ABSTRACT
Pull-off adhesion testing is widely used to assess the protective coating process and to determine if a coating is fit for service in new construction and for repairs to existing structures. The result is often critical to the acceptance or rejection of a coating process, as the adhesion value quoted by the paint manufacturer can be adversely affected by aspects of the coating process. Low adhesion values are indicative of premature failure of the coating and are often due to inadequate surface preparation of the substrate. ASTM D4541 and BS EN ISO 4624 describe several different test apparatus; however, the basic approach of gluing a test dolly to the coated surface and then exerting a perpendicular force to the surface in an effort to remove both the dolly and the coating from the substrate is common to all these standards. A measure of the adhesion of the coating system is the force at which the coating fails and the type of failure obtained.

Trials have demonstrated that many aspects of the testing method, such as the mixing of the glue, the preparation of the coating surface and the face of the dolly and the temperature of the test, all affect the results. This paper will investigate the effects of any deviation from the prescribed method in every aspect of the test. Each aspect is examined in turn, the results tabulated and the potential effect on a valid test result is discussed.

INTRODUCTION
The tensile pull-off method for adhesion testing, as outlined in ASTM D 4541 and similarly in BS EN ISO 4624, involves gluing a test dolly to the coated surface and then pulling the dolly by exerting a force perpendicular to the surface in an effort to remove the dolly with the coating from the substrate. The force at which this occurs and the type of failure obtained is recorded as a measure of the adhesion properties of the coating.

Several aspects of the test method were assessed, including the mix of the epoxy glue, different types of glue, surface preparation, the design of the dolly, temperature of the cure and the test, and cutting the coating or not. The difference between manual and automatic pull-off tester operation was also investigated.

This paper evaluates the effects of any deviation from the required method in several aspects of the test. Each aspect is examined in turn, the results tabulated and the potential effect on a valid test discussed.

ADHESIVE MIXING
The test dolly should be glued to the surface using a suitable adhesive. Typically a two-pack epoxy adhesive is supplied with adhesion test units. The instructions for this type of adhesive state that the two components, resin and hardener, should be mixed in equal parts usually equal lengths of both parts. In order to achieve a more accurate mix, the amount of each component was measured by weight using an accurate electronic balance.

A test was carried out to understand the effects of mixing the adhesives incorrectly. Three samples of glue were mixed, a control sample consisting of 1:1 resin (a) to hardener (b) ratio, a 1:2 hardener to resin ratio and a 2:1 hardener to resin ratio. Unprepared dollies were stuck down on unprepared surfaces such that the only variable was the glue mix. The adhesive strength was not optimised. The dollies were then pulled using a manual Type V gauge. The average value is calculated excluding the maximum and minimum value in each set to avoid any skewing of the results due to any outliers. This approach was taken with all tests.

Table 1: Test Results for different ratios of two-pack epoxy glue.

<table>
<thead>
<tr>
<th>Set</th>
<th>Glue Mix ratio (a:b)</th>
<th>Pull 1 (MPa)</th>
<th>Pull 2 (MPa)</th>
<th>Pull 3 (MPa)</th>
<th>Pull 4 (MPa)</th>
<th>Pull 5 (MPa)</th>
<th>Average Pull Value (MPa)</th>
<th>% variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1:1</td>
<td>6.0</td>
<td>6.4</td>
<td>7.6</td>
<td>7.6</td>
<td>4.5</td>
<td>6.67</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>1:2</td>
<td>5.8</td>
<td>4.0</td>
<td>3.9</td>
<td>3.6</td>
<td>3.9</td>
<td>3.93</td>
<td>-41</td>
</tr>
<tr>
<td>3</td>
<td>2:1</td>
<td>5.8</td>
<td>5.5</td>
<td>6.2</td>
<td>7.9</td>
<td>7.0</td>
<td>6.33</td>
<td>-5</td>
</tr>
</tbody>
</table>

ISO 4624 has guidance on the selection of suitable adhesives. The relevant section is reproduced as Figure 1 above. ASTM D 4541 states that the adhesive is for securing the fixture to the coating and that it does not affect any coating properties. Two component epoxies and acrylic adhesives have been found to be the most versatile.

Both specifications clearly state that there is no single glue that can be specified for...
all coating pull tests; rather, glue suitable for the conditions of the test should be used. The correct glue is one that has bond strength greater than the adhesive strength of the coating being tested.

Different suppliers provide different adhesives with their adhesion test kits. Adhesives from the same supplier are often made in different parts of the world and the locally available version may differ from location to location. Indeed, in some cases, certain adhesives may be unavailable in given parts of the world. The relative strength of Araldite® Standard and Loctite® Hysol were compared. These adhesives are both commonly supplied in adhesion test kits but to highlight the point about availability, the Loctite was sourced in the USA as it is unavailable under that name in the UK. 10 dollies were stuck down to an uncoated, unprepared steel substrate, 5 using Araldite, and 5 using the Loctite adhesive. The glue was allowed to cure for 24 hours and the dollies pulled from the surface.

As seen in Table 2, the values for the failure strength and the type of failure indicate that the Loctite has stronger adhesive properties than the Araldite by approximately 4 MPa. Table 3 shows the results of a repeated test, this time on a coated surface. The average value for both adhesives is the same, 10.33 MPa. However with either adhesive, the crucial factor is that both have sufficient strength to carry out a successful adhesion test.

**SURFACE PREPARATION**

“To reduce the risk of glue failures, the surface of the coating can be lightly abraded to promote adhesion of the adhesive to the surface. If the surface is abraded, care must be taken to prevent damage to the coating or significant loss of coating thickness.”

The preceding paragraph is taken from ASTM D 4541 and is not an instruction, rather a suggestion. A series of tests were carried out to examine the effect of preparing both the dolly and the surface.

4 sets of 5 dollies were glued to an uncoated surface with various combinations of preparation. The results for this test are shown in Table 4. Set 1 had both dolly and substrate prepared, Set 2 has only the surface prepared, Set 3 has only the dolly prepared and for Set 4 no preparation was carried out. After curing, the dollies were pulled from the surface and the failure value recorded.

Using Set 1 as the “control” where both the dolly and the surface were prepared there are some marked differences to be seen when other combinations are utilised. If no preparation is carried out (Set 4), then there

![](image-url)
is a 7% reduction in the average failure value achieved. Preparing the dolly alone (Set 3) results in a negative variance of just less than 5%, whereas preparing the coating surface only, (Set 2), results in a 15% reduction in failure value.

The average failure value for each set indicates that preparing both surfaces increases the strength of the bond between adhesive and coating, and adhesive and dolly. This greatly increases the chances of a successful test as the strength becomes greater than the specified coating strength. This leads to a further question: “what level of surface preparation of the dolly should be undertaken for best results?”.

Tests were carried out using sanded and blasted dollies on a blasted metal surface and the results are listed in Table 5 right. These results clearly show that blasted dollies give a higher test value than a sanded dolly, in this case 22% higher.

In subsequent discussions with adhesive suppliers, it was recommended that both dolly and coated surface be abraded for their product to be most effective.

**VARIATION IN LOADING FIXTURE (DOLLY) DESIGN:**

Any reference to the dimensions of the dolly, in any of the relevant standards, is only a recommendation that the length (height) of the dolly be at least half the diameter of the dolly. If this recommendation is taken literally, then most, if not all, commercially available dollies do not comply with this recommendation because dollies are generally shaped rather than cylindrical. However, taking the “spirit” of this recommendation, the thickness of the base should be a consideration.

Two designs of dolly were used, one having a base thickness of 4.0 mm (A) and the other a thickness of 2.6mm (B). The two styles of dolly are shown in Figure 2. Test results are given in Table 6.

Neither the dollies nor the un-coated surface received any surface preparation before the testing took place; hence any variation in readings can be attributed to the geometry of the dollies, as this is the only variable.

Results show a 16% higher pull strength is required to remove the thicker based dolly from the surface than the thinner based dolly. Video examination of tests carried out on glass showed that, in both cases, the dollies started to lift from the edges, but there was no discernible visible difference in the mechanical action of the pull test on each dolly.

**TEMPERATURE OF ADHESIVE CURING AND PULL TESTING**

Temperature and time of cure coupled with the temperature at the time of the adhesion test may have an effect on the results obtained. To investigate this, a series of tests were set up. Dollies were glued to a coated surface, both having been prepared as per the recommendations contained in ASTM D.
4541. Various cure times and temperatures were used, and the tests were carried out at different temperatures. Table 7 summarises the conditions and results.

It must be noted that no combination of cure and test temperature gives a higher test value than the “control” conditions of set 1. In an attempt to speed up the process, set 2 was cured at 30°C for 8 hours, a typical shift length, and pulled at room temperature with reduced results. These results suggest that under whichever conditions the cure occurs, the pull should be carried out at an ambient temperature of 22 ± 2°C.

TO CUT OR NOT TO CUT

ISO 4624 states “… carefully use the cutting device (5.4), see figure 3 for example, to cut around the circumference of the dolly through to the substrate, unless otherwise specified or agreed” whereas ASTM D 4541 states “Scoring around the fixture violates the fundamental in situ test criterion that an unaltered coating be tested. If scoring around the test surface is employed, extreme care is required to prevent micro-cracking in the coating, since such cracks may cause reduced adhesion values.

Scored samples constitute a different test, and this procedure should be clearly reported with the results.”

The approaches by the two leading standards institutions as to the cutting of a dolly underline the uncertainty of whether it is the best thing to do when carrying out an adhesion test.

10 dollies were stuck down on a coated surface, 5 were left uncut, and the other 5 were cut once the glue had cured. Results are presented in Table 8.

<table>
<thead>
<tr>
<th>Dolly</th>
<th>Cut or un-cut</th>
<th>Test result (MPa)</th>
<th>Type of failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Un-cut</td>
<td>10.3</td>
<td>Adhesive</td>
</tr>
<tr>
<td>2</td>
<td>Un-cut</td>
<td>8.5</td>
<td>Partial</td>
</tr>
<tr>
<td>3</td>
<td>Un-cut</td>
<td>10.5</td>
<td>Partial</td>
</tr>
<tr>
<td>4</td>
<td>Un-cut</td>
<td>10.5</td>
<td>Adhesive</td>
</tr>
<tr>
<td>5</td>
<td>Un-cut</td>
<td>10.6</td>
<td>Adhesive</td>
</tr>
<tr>
<td>6</td>
<td>Cut</td>
<td>9.7</td>
<td>Partial</td>
</tr>
<tr>
<td>7</td>
<td>Cut</td>
<td>9.6</td>
<td>Partial</td>
</tr>
<tr>
<td>8</td>
<td>Cut</td>
<td>9.0</td>
<td>Partial</td>
</tr>
<tr>
<td>9</td>
<td>Cut</td>
<td>10.6</td>
<td>Adhesive</td>
</tr>
<tr>
<td>10</td>
<td>Cut</td>
<td>9.2</td>
<td>Partial</td>
</tr>
</tbody>
</table>

Table 8: Test results for cut and un-cut coating.

“Partial” failure indicates a failure which is a combination of a partial cohesive failure of the coating and a partial adhesive failure between the glue and the coating.

Given the distribution of the partial type of failure, there was some thought that the cutting of the dolly once the glue had cured was affecting the bond strength of the adhesive. Were micro-cracks being initiated by the act of cutting? In order to eliminate this possibility, 5 more dollies were stuck to the coated surface, but this time the cutting took place before the dollies were stuck down.

If we discount the highest and lowest value from all three groups of tested dollies, Tables 8 and 9, then take the average, the un-cut test shows an average of 10.43 MPa and the cut dollies 9.5MPa. This gives an 8.9% variation between cut and un-cut. If we now look in the same way at the pre-cut set, the average value is 9.93MPa, a variation of 4.3% from the un-cut test.

These results would indicate that cutting the dolly does have an impact on the test results, but this effect is minimised if the cutting takes place before the dolly is stuck down.

The cutting of the dollies prior to gluing, by hand, is difficult, if not impossible. The tool skates across the surface, similar to a needle across an LP record, and it is difficult to stop this “freehand”. A guide was made using a steel disc 10mm thick with a hole slightly larger than the cutting tool drilled through it. Holding this guide down was difficult if not impossible, as the act of turning the cutting tool dragged/pushed the disc across the surface. This situation was rectified by using two G-clamps to hold the ring in place whilst the pre-cuts were made.

Table 10 lists the result obtained for 5 dollies where the coating has been cut after the dollies have been stuck down (Post) and 5 dollies where the coating was cut by hand as described above.

Using the same approach of discarding the highest and lowest values before calculating the average, the average value of post-cutting the dollies was 9.73 MPa and pre-cutting the dollies 11.1 MPa. This would indicate that pre-cutting the dollies has less effect on the adhesion than cutting after the glue has cured.

One factor that must be considered when drawing this conclusion, is that if the guide ring needs 2 G clamps to hold it still, but this would be difficult if not impossible, as the act of turning the cutting tool drilled through it. Holding this guide down was difficult if not impossible, as the act of turning the cutting tool dragged/pushed the disc across the surface. This situation was rectified by using two G-clamps to hold the ring in place whilst the pre-cuts were made.

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The cutting of the dollies prior to them being stuck down was carried out in a machine shop, with the test plate fixed and the cutting tool inserted into a drilling machine. These are most definitely not field conditions. Cutting the dollies prior to gluing, by hand, is difficult, if not impossible. The tool skates across the surface, similar to a needle across an LP record, and it is difficult to stop this “freehand”. A guide was made using a steel disc 10mm thick with a hole slightly larger than the cutting tool drilled through it. Holding this guide down was difficult if not impossible, as the act of turning the cutting tool dragged/pushed the disc across the surface. This situation was rectified by using two G-clamps to hold the ring in place whilst the pre-cuts were made.

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This lateral or shear force must be quite substantial, and must have an adverse effect on the adhesive strength of the test dolly set up, thus impacting negatively on the results.

**MANUAL VS. AUTOMATIC ADHESION TESTERS**

The Type V self-aligning adhesion tester is available as a manual, hand-operated, or automatic device. There are two known manufacturers of this apparatus. The automatic versions are similar in operation using a hydraulic pump to generate the pull force; however, the manual versions differ. One is operated by winding a handle, in a similar fashion to a fishing reel, the other by pumping a handle, similar to a car jack. The tests reported in this paper were carried out using the winding method.

A total of twenty dollies were glued to a coated surface using two-pack epoxy glue in the optimum manner as outlined in Table 11. 10 were left uncut and 10 were cut. Half of each group were tested using a manual Type V adhesion tester (Figure 3) and half using an automatic model (Figure 4).

![Figure 3 (left): Hand-operated adhesion. Figure 4 (right): Automatic Adhesion Tester.](image)

It can be seen in Table 11 there is very little difference between the values obtained with a winding manual gauge, where the load is applied smoothly and evenly (1 turn per second, approximately 1 MPa/s) and an automatic gauge. The tests produce an average value of 10.56 MPa for the uncut coating and 9.50 MPa for a coating that has been cut using the manual gauge. 10.64 MPa for the uncut coating against 9.85 MPa for a coating that had been cut using the automatic gauge.

This test result supports the results given in Tables 8, 9 and 10 where the tests were carried out using a manual gauge only.

**CONCLUSION**

It is clear from this series of tests that the results can be significantly affected by minor variations in one or more of the test steps. From the choice of adhesive, through the preparation of the coating surface and the test dolly, to the decision to cut through the coating or not, the test needs to be precise and consistent. This allows results for the same coating under different conditions or different coatings under the same conditions to be compared with confidence.

Different adhesives have different operating constraints. It must be noted that the bond strength of the cured adhesive must be greater than the bond strength of the coating, either to the substrate (adhesive failure), to the coating beneath (also adhesive failure) or within a single layer (cohesive failure). As with coating processes, the preparation and cleaning of the surface of the coating and the face of the dolly is crucial to optimising the adhesion of the dolly to the surface and therefore increasing the probability of a coating adhesion failure rather than a glue failure. It should be noted that glue failures are invalid adhesion tests unless the specified adhesion strength is exceeded. Such tests must be repeated until the coating fails or the minimum specification value for the coating adhesion is exceeded. ASTM D4541 states that when 50% or more of the dolly face is covered by adhesive then that result shall be disregarded.

The design of the dolly is significant in the adhesion values obtained but further work is required to determine why this is the case. Care and best practice should be employed at all times when carrying out adhesion tests and if there are any concerns then any or all of the coating, adhesive and test gauge manufacturers should be consulted for advice.
SEASHIELD SYSTEM PROTECTS SUBMERGED PILE

Winn & Coales (Denso) Ltd report increased interest in their SeaShield systems, used in marine environments in the immersed and splash zone area. One of the most frequently used worldwide is the SeaShield Series 2000FD system.

A typical UK application is one at Grangemouth jetty in the Firth of Forth where it was applied within the splash zone from the underside of the jetty to 500mm below the low water level on 77 piles.

The Denso SeaShield 2000FD system used globally begins with the application of Denso Paste S105. This is followed by Denso Marine Piling Tape and then HDPE jackets which are put into place with stainless steel fixings. Denso Marine Piling Tape, a cold-applied petrolatum-based tape for application under water, is the primary anti-corrosion protection in the SeaShield system with a 40-year proven record. The jackets will also give abrasion protection for the tape system.

DENSOBAND AIDS PREVENTION OF CONCRETE SURFACE CRACKING

Winn & Coales Densoband was specifically developed to meet Highways Agency requirements for concrete-to-asphalt joints and asphalt-to-asphalt road joints. Now, a new use has been found by CLS Civil Engineering of Brigg, Lincs., which does not rely on Densoband’s long-term water sealing properties.

Following discussion with Winn & Coales (Denso) Ltd a 55x8mm version of Densoband was used to provide an expansion joint between the concrete and the steel anchoring in a gap in the channel of a steel anchor plinth base for a wind turbine foundation. The purpose was to prevent cracking on the surface of the concrete base to which the turbine is anchored, which can be caused by temperature differences and the vibration that can arise from movement of the wind tower. The Densoband strip also prevents any stone or gravel debris getting into the channel.

Densoband is a polymer-modified bitumen strip whose fundamental use is for sealing joints. Providing a uniform flexible seal, it is ideal for base and wearing course joints that can withstand thermal changes and the movement from traffic load.
NATIONAL PAINTING CONTRACTOR CELEBRATES 140 YEAR ANNIVERSARY

Bagnalls, one of the country’s leading national painting contractors, celebrates an incredible 140 years in the painting and decorating industry on Friday 13 March, 2015. The company was established in 1875, by Alfred Bagnall, an apprentice trained painter and decorator and five generations later, Stephen Bagnall, Alfred’s great, great grandson continues to run the family owned business.

Stephen Bagnall, Group Managing Director, spent the day visiting the Doncaster branch of Bagnalls, delivering a talk on site safety and company values to the painters and visiting the company’s painting academy to see what the apprentices had achieved.

Stephen said “We are proud to be celebrating such a landmark anniversary. We have a number of fundamental values, the key one being to continue to invest in people, our greatest asset. This, I believe, has been the bedrock of our success over many, many years.”

“The company also has a well deserved reputation for quality workmanship, customer care and professionalism in site safety. Qualities that can only be achieved by directly employing the painters who work on our customers’ premises and investing in their training and development.”

Bagnalls has an enviable record for the training and development of people with many employees having worked for the company for more than 25 years. Many of today’s craftsmen painters, skilled foremen and management at all levels started with the company as apprentice painters, just like Alfred Bagnall. The company’s continued investment in apprentices, competency training and safety procedures has been recognised by not only the industry’s trade body, the Painting and Decorating Association (PDA) but also the Royal Society for the Prevention of Accidents (RoSPA) and national accreditation bodies such as Achilles and CHAS.

Bagnalls has also been involved in some notable projects over its many years in the painting trade. These include the Empire Stadium (Wembley) and the British Empire Exhibition in the 1920s, hospital painting during both world wars, the Longbridge factory in 1932 which later became British Leyland, the British Aircraft Company in Filton which famously made the supersonic plane, Concord and the Shell Oil Refinery, Stanlow.

With such a prestigious history, it is understandable that Bagnalls continues to grow from strength to strength despite the competitiveness of the marketplace. Here’s to the company’s success over the next 140 years!

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ICATS is a comprehensive structured training scheme for the registration, training and certification of industrial surface preparation and coating operatives. Companies wishing to have a workforce certificated under ICATS must first register with Correx.

Workplace training is carried out by ICATS certificated trainers who are qualified to train and assess operatives. Training is carried out in-house and may be undertaken by a certificated trainer employed by an ICATS registered training organisation. However it is more usual for registered companies to nominate experienced employees to ICATS for prior approval as company trainers. Subject to meeting the acceptance criteria, nominees attend a 2 day ICATS Company Trainer course held at various locations in the UK.

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.

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Address</th>
<th>Telephone</th>
</tr>
</thead>
<tbody>
<tr>
<td>A &amp; R Painting Services Ltd</td>
<td>Marwood House, Riverside Park, Bromborough, Wirral, CH62 3QX</td>
<td>0151 445 3589</td>
</tr>
<tr>
<td>Abbey Gritblasting Services</td>
<td>Unit 13, Clopton Commercial Park, Clopton, Woodbridge, Suffolk, IP12 3TP</td>
<td>0191 262 0510</td>
</tr>
<tr>
<td>Advanced Construction and Eng Resources Ltd (ACER)</td>
<td>5th Floor, Horton House, Exchange Flags, Liverpool L2 3PF</td>
<td>0161 408 0155</td>
</tr>
<tr>
<td>Alfred Bagnall &amp; Sons</td>
<td>6 Manor Lane, Shipley, West Yorkshire, BD18 3RD</td>
<td>01302 853259</td>
</tr>
<tr>
<td>AlpAccess 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>A McKie Building &amp; Engineering Ltd</td>
<td>19 Kyle Road, Irvine, Ayrshire, KA12 8JX</td>
<td>01294 279586</td>
</tr>
<tr>
<td>APB Construction (UK)</td>
<td>First Floor Offices, Grange Business Centre, River Works, Grange Lane, Sheffield, S5 0DP</td>
<td>01709 540000</td>
</tr>
<tr>
<td>APB Group Limited</td>
<td>Ryandra House, Ryandra Business Park, Brookhouse Way, Chedale, Statts, ST10 1SR</td>
<td>01538 755377</td>
</tr>
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<td>Armourcote Surface Technology Plc</td>
<td>15/17 Colvilles Place, Kelvin Industrial Estate, East Kilbride, Scotland, G75 0PZ</td>
<td>01355 248223</td>
</tr>
<tr>
<td>Austin Hayes Ltd</td>
<td>Carlton Works, Cemetry Road, Yeadon, Leeds, LS19 7BD, UK</td>
<td>0113 250 2255</td>
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<tr>
<td>Aven Offshore Ltd</td>
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<td><a href="mailto:dpetillion@avenooffshore.com">dpetillion@avenooffshore.com</a></td>
</tr>
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<td>01646 693489</td>
</tr>
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<tr>
<td>BAM Nuttall Ltd</td>
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<td>0782 5798440</td>
</tr>
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<tr>
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16B Birmingham Road, Shenstone Wood End
Staffs, WS14 0NX
T: 0121 308 8001
<table>
<thead>
<tr>
<th>Company Name</th>
<th>Address</th>
<th>Telephone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pro Steel Engineering Ltd</td>
<td>48a Severnbridge Industrial Estate, Symondscliffe Way, Caldicot, Monmouthshire, NP26 5PW</td>
<td>01291 424949</td>
</tr>
<tr>
<td>Radleigh Metal Coatings Ltd</td>
<td>Unit 30, Central Trading Estate, Cable Street, Wolverhampton, WV2 2HX</td>
<td>01902 870606</td>
</tr>
<tr>
<td>R H Painting Limited</td>
<td>Alexander House, Monks Ferry, Birkenhead Wirral, CH41 SLH</td>
<td>0870 7992020</td>
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<tr>
<td>R.L.P. Painting Contractors Ltd</td>
<td>Unit 1, Grange Lane, Balby, Doncaster DN4 9BB</td>
<td>01302 853077</td>
</tr>
<tr>
<td>RMF Construction Services Ltd</td>
<td>Unit 2, Oughton Road, Birmingham, B12 0DF</td>
<td>0121 440 7970</td>
</tr>
<tr>
<td>SCA Group Ltd</td>
<td>Woolsock Ind. Park, Three Legged Cross, Dorset, BH1 6FA</td>
<td>01202 820820</td>
</tr>
<tr>
<td>Severn River Crossing Plc</td>
<td>Bridge Access Road, Aust, South Gloucestershire, BS35 4BD</td>
<td>01454 633351</td>
</tr>
<tr>
<td>Sherwin-Williams Protective &amp; Marine Coatings</td>
<td>Tower Works, Kestor Street, Bolton, Lancs. BL2 2AL</td>
<td>+44 (0)1204 521771</td>
</tr>
<tr>
<td>Shirley Industrial Painters &amp; Decorators Ltd</td>
<td>Grand Union House, Bridge Walk, Acock’s Green, Birmingham, B27 6SN</td>
<td>0121 706 4000</td>
</tr>
<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>Malmsbury House, 227 Shirley Road, Shirley, Southamptton, SO15 3HT</td>
<td>0238 0702276</td>
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<tr>
<td>Specialist Blasting Services Ltd</td>
<td>Smiths Quay, Hazel Road, Woolston, SO19 7GB</td>
<td>023 80438901</td>
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<tr>
<td>Specialist Painting Group Ltd</td>
<td>Unit 3 Propser House, Astone Park, Padholme Road East, Fengate, Peterborough, PE1 5XL</td>
<td>01773 309500</td>
</tr>
<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>Barham Court Business Centre, Teston, Maidstone, Kent MW18 5BZ</td>
<td>0791 2037033</td>
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<tr>
<td>Standish Metal Treatment Ltd</td>
<td>Potter Place, West Pinbo, Skelmisla, 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</td>
<td>Riverside Park Road, Middlesborough, Cleveland TS2 1UT</td>
<td>01642 228141</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>
</tr>
<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>T I Protective Coatings</td>
<td>Unit 6, Lodge Bank, Crown Lane, Horwich, Bolton, Lancs, BL6 5HU</td>
<td>01204 468080</td>
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<tr>
<td>Torishima Service Solutions Europe Ltd</td>
<td>Sunny Side Works Gartsherrie Road Coatbridge MLS 2DJ</td>
<td>0123642390</td>
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<tr>
<td>Transvac Systems Ltd</td>
<td>Monsal House, 1 Bramble way, Alfreton, Derbyshire, DE5 4RH</td>
<td>01773 831100</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>Warrdle Painters Ltd</td>
<td>Unit 5, Winborne Building, Atlantic Way, Barry Docks, Glamorgan, CF63 3RA, UK</td>
<td>01446 748620</td>
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<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, Romford RM7 0HX</td>
<td>01708 749202</td>
</tr>
<tr>
<td>William Hare Ltd</td>
<td>Brandlesholme House, Brandleholme Road, Bury, Lancs, BL8 1J, 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>
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<tr>
<td>Xervon Palmers Ltd</td>
<td>331 Charles Street, Royston, Glasgow G21 2QA</td>
<td>0141 5534040</td>
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