AUSTRALASIAN INSTITUTE OF ENGINEER SURVEYORS INC.

GAZETTE

APRIL 2025
Volume 35 Issue 1

This Issue: COATINGS FOR PRESSURE EQUIPMENT

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All contributions should be sent to the Editor at the contact details above for compilation and presentation to the Editorial Committee for consideration.

Articles should be submitted in Word document format, with separate (not embedded) high quality jpg files. Captions for all images should be provided and images should be free of copyright or other restrictions.

Submissions may include technical papers, case studies, success stories, letters to the Editor, news or any items which would be of interest to AIES members and readers. If recommending material from another publication or source, please include the name of the source, date of publication and contact details so that permission to republish can be sought.

AIES would also like to establish a library of copyrightfree images for use in the Gazette, so please send to the Editor any that you are happy to share, and hold the rights to, with a brief description of the subject.

CLOSING DATE FOR NEXT GAZETTE:
11 August 2025

COVER PHOTOS:

Front cover: A large process vessel after repair to failed protective coating. The associated reducer was removed and re-coated while piping downstream was replaced.
(Photo: Bill Werdmuller)

Back cover: see article Nanotechnology in the coating industry page 18.

Statement of Objectives of the

AUSTRALASIAN INSTITUTE OF ENGINEER SURVEYORS INCORPORATED

ABN 52 887 542 957

The objectives of the Australasian Institute of Engineer Surveyors Incorporated (AIES) are to:

1. Promote the development and practice of inspection of plant and equipment and coordinate its activities throughout Australia and New Zealand. Equipment shall include boilers and pressure vessels.
2. Advance the interests of all those engaged in the profession and safeguard their status and character.
3. Establish, promote, form, regulate and control any division of the Association in each State or Territory of Australia or New Zealand pursuant to the objectives of the Association.
4. Foster fraternal sympathy amongst members and stimulate discussion of all matters related to hazardous equipment.
5. Promote a uniform standard for inspectors throughout Australia and New Zealand.
6. Promote self regulation by the adoption of relevant Regulations and Standards and recognition of those accepted as members of the Association.
7. Encourage industry in the use of member's services for hazardous equipment inspection and all related activities to ensure safety in the workplace.
8. Promote public and environmental safety in the design, fabrication, testing, installation and inspection of hazardous equipment.

Rob Svensk
AIES President 2024-25

PRESIDENT'S REPORT

MARCH 2025

In this issue of the Gazette, we offer a big welcome to two of our newest members, Christopher Ross and Dane Suckley. You can read about their careers and aspirations on page 10 and we look forward to their participation in AIES networking activities and forums.

In March AIES Members were invited to attend two on-line forums on standards relevant to inspection and the pressure equipment industry; one broadcast from Europe on the changes to DIS 17020 *Conformity assessment — Requirements for bodies performing inspection*, and the other a local webinar presented by the National Association of Testing Authorities (NATA) on updates to AS 3788 *Pressure equipment – In-service inspection*.

NATA Technical Assessor and AIES Member, John Garvey, shared insights from his extensive experience, explaining the updates to AS 3788 and how to prepare for them, with the support of NATA Technical Assessor, Robert Small. Those Members who were not able to attend on the day are able to access a recording of the event through AIES.

Some things I noted in the AS 3788 webinar were that: Table 4.1 is now called Time-Based Inspection Interval; NDT is now referred to as Non-Intrusive Inspection (NII); boiler safety valves must be tested in situ; and Inspectors must complete all functional testing to AS 2593 *Boilers – Safety management and supervision systems*.

There will be ongoing discussion of these two standards and ISO 17020, as well as AS 4343 *Pressure equipment—Hazard levels*, at our regular AIES networking meetings so watch out for notices of the Zoom links.

The next AIES Technical Forum is being planned for Tuesday 8 July, while the forum held on 8 April further explored the topic of this Gazette, Coatings for Pressure Equipment.

Should you wish to submit anything for upcoming Technical Forums, or to highlight any matters for future discussion, please contact me on Email: secretary@aies.org.au I encourage everyone to participate to enhance the industry and its services.

I would like to thank the continued efforts of our AIES team and committee for their ongoing dedication to our industry and this organisation. You may notice that this is a bumper issue of the Gazette. In line with modern trends, we have made the decision to no longer have a hard copy print of the publication, so we are liberated to include even more articles for your reading pleasure!

Finally, just on a personal note, I was lucky to marry the love of my new life, Virginia, in October last year so I am excited to embark on another 40 years of marriage.

Kind regards to all.

Rob Svensk

Protective Coatings for Pressure Equipment

Bill Werdmuller
AICIP In-Service Inspector

Of all the factors that can extend the life of a pressure vessel, application of protective coatings ranks at the top of the list. Protective coatings are the first line of defence against external adverse impacts from corrosion, chemical exposure and environmental damage as well as vessel internal damage due to corrosion, erosion, chemical attack and other aggressive service conditions.

There are a vast number of products available for general protection as well as for specific applications. Here is a broad list of available products and their intended uses.

- **Epoxy Coatings**: These coatings are renowned for their adhesion and resistance to chemicals and moisture. Ideal for vessel internal surfaces exposed to water, oils, or solvents, they provide long-term protection while maintaining structural integrity. Externally, epoxy primer coatings are ideal prior to application of other suitable coatings but are susceptible to degradation by UV radiation. A large number of epoxy coating products are currently available for a vast range of applications.
- **Polyurethane Coatings**: These coatings offer excellent resistance to UV radiation and wear as well as high resistance to corrosion and many chemicals. Frequently used for outdoor vessels, they are flexible and durable, making them suitable for environments with temperature fluctuations. Also suitable for pipe lining where continuous circulating water or slurry is not a factor. Foam polyurethane coatings are commonly used as an external insulating protective layer on piping and vessels for LPG and other subzero temperature products.
- **Zinc-Rich Primers**: Offering sacrificial protection, these primers cover steel surfaces with a layer of zinc which delivers galvanic protection. In simple terms, the zinc in the primer sacrifices itself by oxidising before the underlying metal does, ensuring protection of the metal for a more extended period. They often serve as a base coat beneath more durable topcoats for extended protection. The downsides of zinc primers are that they don't always mesh well with topcoats, acidic environments can potentially cause dissolution of

Figure 1. Inside the head of a heat exchanger showing failure of epoxy internal protective coating

Figure 2. Galvanised air receiver beginning to show deterioration due to sacrificial oxidisation of the galvanising zinc

the primers (also applicable to the zinc galvanise), and thin application of the primer diminishes its effectiveness considerably.

- **Rubber Lining:** Rubber lining is often used at vessel internal surfaces where abrasion, corrosion and shock impact are issues. Hard rubber linings are also highly resistant to a wide range of chemicals. Used in water treatment vessels, polishing spheres and process vessels, linings are commonly installed in sheet sections or segments using adhesives. It's important to evaluate the state of the metal to be lined. The metal should be thoroughly inspected for any pits and crevices that can cause blisters in the rubber lining. Any uneven surfaces on the metal should be dressed before application to prevent air from expanding during the curing process.
- **Ceramic Lining:** More a barrier rather than a protective coating. Ceramic linings are designed to withstand high flow rates and small particle impacts of dry and liquid materials even at high temperatures in process vessels, large bore pipes, as well as other non-pressure plant and equipment such as launders, underpans and curtains. Ceramic linings are used where extreme hardness and abrasion resistance are paramount.

Health and Safety Considerations

Epoxy Coatings

There are numerous health risks associated with coating products particularly in their liquid form.

Liquid epoxy resins in their uncured state are mostly classed as irritant to the eyes and skin, as well as toxic to aquatic organisms. Solid epoxy resins are generally safer than liquid epoxy resins, and many are classified non-hazardous materials.

One particular risk associated with epoxy resins is sensitisation. The risk has been shown to be more pronounced in epoxy resins containing low molecular weight epoxy diluents. Exposure to epoxy resins can, over time, induce an allergic reaction. Sensitisation generally occurs due to repeated exposure (e.g. through poor working hygiene or lack of protective equipment) over a long period of time. Allergic reaction sometimes occurs at a time which is delayed several days from the exposure. Allergic reaction is often visible in the form of dermatitis, particularly in areas where the exposure has been highest (commonly hands and forearms). Safe disposal also needs considering but usually involves deliberate curing to produce solid rather than liquid waste.

Polyurethane Coatings

Fully reacted polyurethane polymer is chemically inert. However, polyurethanes are combustible and decomposition from fire can produce significant amounts of carbon monoxide and hydrogen cyanide, in addition to nitrogen oxides, isocyanates, and other toxic products. Due to the flammability of the material, it has to be treated with flame retardants, almost all of which are considered harmful. Exposure to chemicals that may be emitted during or after application of polyurethane spray foam (such as isocyanates) is harmful to human health and therefore special precautions are required during and after this process.

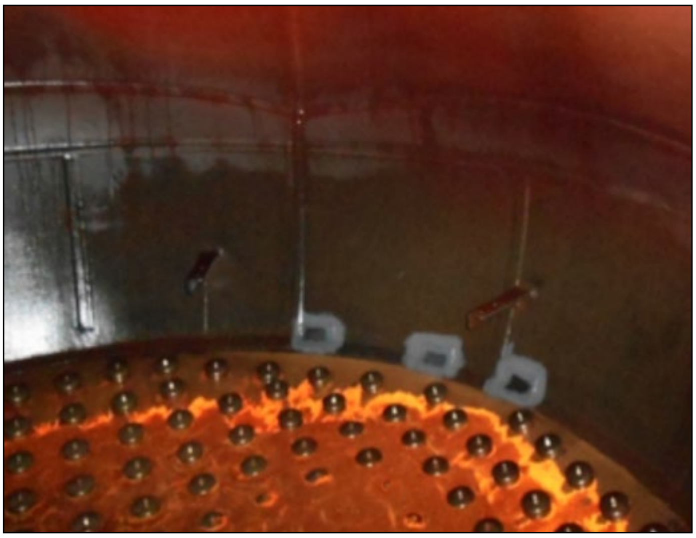

Figure 3. Rubber lined polishing vessel showing localised repairs where the lining was blistered

Figure 4. Floor area of a large process vessel showing typical internal ceramic lining installed for erosion and chemical attack

Zinc-Rich Primers

In liquid and vapour forms, zinc primers are highly flammable and may be fatal if swallowed. Inhalation of vapours may cause drowsiness and dizziness and may also be fatal. Zinc-rich primers can cause skin irritation and are very toxic to aquatic life with long term effects.

Rubber Lining

Rubber is a combustible material and once ignited, may burn rapidly and give off toxic fumes. Also, solvents and cements/adhesives used in the application of rubber linings may be flammable or combustible and may have other specific health hazards.

Ceramic Lining

With ceramic lining materials such as tiles and blocks, dust generated by cutting can cause significant respiratory issues as well as eye and skin irritations, with cements/adhesives also possibly causing significant issues. The other prominent issue is tiles/blocks which may become dislodged during service or inspection causing trip hazards, impact damage and physical injury.

Note that the abovementioned hazards are most likely to occur when applying, installing or repairing protective coatings and linings and may affect not only personnel carrying out these works but also others within the vicinity. Correct PPE must be worn, and appropriate safety procedures followed when these works are being conducted.

Figure 5. Top of a large process vessel showing attrition due to adverse weather conditions as well as chemical attack. The coating was previously extensively damaged but overlooked during a previous inspection

Pre-application Surface Preparation

Correct preparation of surfaces prior to application of protective coatings and linings is of utmost importance. Too often, damaged coatings can be linked directly to insufficient preparation such as incomplete grit blasting of all surfaces, incomplete removal of dust, debris and grit blast medium after grit blasting, and non-compliance to coating/lining manufacturer's specifications.

Of equal importance is the correct application/installation of protective coatings and linings as required by the coating/lining manufacturer's specifications.

Figure 6. A large process vessel after repair to failed protective coating. The associated reducer was removed and re-coated while piping downstream was replaced

Figure 7. Air receiver showing extensive internal corrosion due to unprotected surfaces

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Standards Australia Committee ME-001

In November it was announced that Mr Rob West would be retiring and stepping down as Chair of the ME-001 Committee, a role he has undertaken with great success since 2012. Under his leadership the committee has published many major revisions of important PE Standards. Rob successfully involved stakeholders and recruited industry associates to participate in the standards revision process. The role of Chair will be taken up by Mr Bruce Cannon, with Mr Joe Butros as Deputy Chair.

Current Projects

AS 4343-2014 *Pressure equipment – Hazard levels*

This standard is under revision. The committee endorsed Sub-committee ME-001-21 Chair, Brenton Watts and Drafting Leader, Dwayne Doherty. A kick-off meeting was held in June 2024.

ISO/IEC 17020 *Conformity assessment – Requirements for the operation of various types of bodies performing inspection*

This international standard was reconfirmed in 2017 and is currently under further review. The new revision is expected to have some important changes.

Review of aged Australian Standards

Designation	Title	ME-001 Review
AS/NZS 1200-2015	Pressure equipment	RECONFIRM
AS 1210-2010 AMDT 1 (2013)	Pressure vessels	RECONFIRM
AS 1228-2016	Pressure equipment – Boilers	RECONFIRM
AS 1271-2003 AMDT 1 (2004)	Safety valves, other valves, liquid level gauges and other fittings for boilers and unfired pressure vessels	RECONFIRM
AS 1358-2004 AMDT 1 (2007)	Bursting discs and bursting disc devices – Application, selection and installation	RECONFIRM
AS 1548-2008	Fine grained, weldable steel plates for pressure equipment	RECONFIRM
AS 1732-1997	Fusible plugs for boilers	RECONFIRM
AS 1796-2022	Certification of welders and welding supervisors	PUBLISHED in 2022

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Inspection of Protective Coatings

Post-application/installation inspection of protective coatings and linings usually involves thickness assessment of coatings through dry film thickness gauging and holiday/spark testing to ensure intrinsic coverage of coatings and linings as well as review of inspection test plans (ITPs) to ensure all application/installation steps have been followed. Often overlooked after installation of newly coated vessels and piping is the need to apply protective coating to associated bolting and to spot repair where coating is damaged during installation.

In-service inspection involves identifying any failures and degradation of coatings and linings. Causes of coating failure include but are not limited to:

- Accidental or intentional impacts causing coatings to crack and chip. Coating damage may be internal as well as external.
- Harsh environmental conditions including climatic impact such as extreme heat, rain and airborne missiles due to heavy winds and other factors such as chemical, acid and fire.
- Operational issues such as vibration causing rubbing and subsequent wearing of protective coating.
- Harsh processes which degrade and damage internal coatings and linings.
- Poor surface preparation/application of coatings and linings causing voids and blisters and subsequent coating/lining failure, particularly at internal surfaces.

In summary, protective coatings and linings are vital for maintaining and prolonging the life of pressure vessels and piping as well as other steel storage facilities and equipment within industry.

Designation	Title	ME-001 Review
AS 2129-2000	Flanges for pipes, valves and fittings	RECONFIRM
AS 2556-2000	Electric resistance welded steel air heater tubes	RECONFIRM
AS 2593-2021	Boilers – Safety management and supervision systems	PUBLISHED IN 2022
AS 2872-2000	Atmospheric heating of vessels containing fluids – Estimation of maximum temperature	RECONFIRM
AS 2971-2007	Serially produced pressure vessels	RECONFIRM
AS/NZS 3509-2009	LP Gas fuel vessels for automotive use	RECONFIRM
AS 3788-2024	Pressure equipment – In-service inspection	PUBLISHED in 2024
AS 3857-1999	Heat exchangers – Tubeplates – Methods of design	RECONFIRM
AS 3873-2001	Pressure equipment – Operation and maintenance	RECONFIRM
AS 3892-2001	Pressure equipment – Installation	RECONFIRM
AS 3920-2015	Pressure equipment – Conformity assessment	RECONFIRM
AS 3992-2020 AMDT 1 (2023)	Pressure equipment – Welding and brazing qualification	PUBLISHED 2020 (2023)
AS 4037-1999	Pressure equipment – Examination and testing	RECONFIRM
AS 4041-2006	Pressure piping	RECONFIRM
AS 4343-2005	Pressure equipment – Hazard levels	Currently under revision
AS 4458-1997 AMDT 1 (1999)	Pressure equipment – Manufacture	RECONFIRM
AS/NZS 4481-1997	Pressure equipment – Competencies of inspectors	RECONFIRM
AS 4728-2005 AMDT 1 (2005)	Electric resistance welded steel pipe for pressure purposes	RECONFIRM
AS 4942-2001	Pressure equipment – Glossary of terms	RECONFIRM
RUL PE.0-2002	Rulings to pressure equipment Standards – Part 0: Introduction and list of rulings	RECONFIRM
RUL PE.1-2002	Rulings to pressure equipment Standards – Ruling 1: Retention of backing strips in longitudinal joints in refrigeration vessels (Ruling to AS 1210)	WITHDRAWN
RUL PE.2-2002	Rulings to pressure equipment Standards – Ruling 2: Nonconforming longitudinal joints in refrigeration vessels (Ruling to AS 1210)	RECONFIRM
RUL PE.3-2002	Rulings to pressure equipment Standards – Ruling 3: Internally fitted doors for beer tanks (Ruling to AS 1210)	WITHDRAW (Superseded by latest AS 1210)
RUL PE.4-2002	Rulings to pressure equipment Standards – Ruling 4: Pressure containers for paint (Ruling to AS 1210)	WITHDRAW (Superseded by latest AS 1210)
RUL PE.5-2002	Rulings to pressure equipment Standards – Ruling 5: Sugar processing vacuum pans and evaporators – Tubeplate design and tube fixing (Ruling to AS 1210)	WITHDRAWN

Designation	Title	ME-001 Review
RUL PE.6-2002	Rulings to pressure equipment Standards – Ruling 6: Fusion-welded chlorine transport drums (Ruling to AS 1210)	RECONFIRM
RUL PE.7-2002	Rulings to pressure equipment Standards – Ruling 7: Small safety valves (Ruling to AS 1271)	RECONFIRM
RUL PE.8-2002	Rulings to pressure equipment Standards – Ruling 8: Seamless copper pipe joined by brazing (Ruling to AS 4041)	WITHDRAWN
RUL PE.9-2002	Rulings to pressure equipment Standards – Ruling 9: Design of pressure equipment using steel having bilateral thickness tolerances (Ruling to AS 1210 and AS 1548)	WITHDRAW (Superseded by latest AS 1210)
RUL PE.10-2001	Rulings to pressure equipment Standards – Ruling 10: Advanced design vessels – Use of joggled joints (Ruling to AS 1210 Supplement 1-1990)	WITHDRAW (Superseded by latest AS 1210)
RUL PE.11-2001	Rulings to pressure equipment Standards – Ruling 11: Advanced design vessels – Design strength valves (Ruling to AS 1210 Supplement 1-1990)	WITHDRAW (Superseded by latest AS 1210)
RUL PE.12-2004	Rulings to pressure equipment Standards – Ruling 12: Minimum nominal thickness of pressure parts (AS 1210-1997)	WITHDRAW (Superseded by latest AS 1210)
RUL PE.13-2004	Rulings to pressure equipment Standards – Ruling 13: Specified minimum tensile strength of steel for buried and mounded storage vessels (AS 1210-1997)	WITHDRAW (Superseded by latest AS 1210)
RUL PE.14-2008	Rulings to pressure equipment Standards – Ruling 14: Design strength for stainless steel materials (Ruling to AS 1210 – 1997)	WITHDRAW (Superseded by latest AS 1210)
MP 76-1997	Pressure equipment – Inspection bodies and personnel	RECONFIRM
MP 88-2000	Evolution of Australian Standard for pressure vessel steel plate	RECONFIRM

In May 2024 the committee held a meeting to review the status of all current publications, their use, concerns etc. The committee decision for the majority of the standards was to reconfirm, and several were marked to withdraw. The list is shown above. Standards Australia advised they are taking necessary arrangements in finalising the committee decisions for the 2024-2025 Aged Standards Review and will be closing the review.

Other Standards News

Safety in welding and allied processes. Part 1 Fire precautions

AS 1674.1:2025 specifies requirements for the reduction of fire and explosion risks associated with the performance of welding and other hot work activities in hazardous environments and was updated in January 2025.

Protective clothing for use in welding and allied processes

AS/NZS ISO 11611:2025 identically adopts ISO 11611:2024, which specifies minimum safety requirements and test methods for protective clothing.

Mobile elevating work platforms

AS 5247:2025 the performance requirements, location, marking and method of operation related to operator's controls on mobile elevating work platforms and was updated in February 2025.

Contributions and Comments

AIES members wishing to contribute comments or information to Standards Australia, the ME-001 Committee or its subcommittees are invited to contact David Ross, AIES Representative on ME-001, on Mobile: +61 (0)407 773 508 or Email: david.ross@srgglobal.net.au

AIES Member Profiles

Dane Suckley

AIES Personal Member number 428

Raised in the Wollongong area of NSW, Dane started his career path as a Boilermaker Welder, working from 2000 through 2012 in multiple positions in shutdown, construction and workshop environments after completing fabrication and welding trade and AS 1796 certifications.

A desire to see the world saw him then move to Western Australia to work with Monadelphous in Port Hedland, then the Wiggins Island coal export terminal in Queensland, before flying off overseas for a year.

Settling in the NSW Central Coast on his return, his first role was as a Boilermaker constructing, commissioning, repairing and maintaining tunnel boring machines as well as structural steel tanks and pressure piping involved in the construction of Sydney's underground transport links.

Gaining certification in railway infrastructure went hand-in-hand with his next move, in 2016, to roles with Sydney Trains' Blacktown and Gosford maintenance depots. As well as track and bridge infrastructure maintenance and repairs, Dane took on responsibility for QA/QC and welder certification roles including non-destructive testing of welded joints using ultrasonic testing.

Delivering training to both Sydney trains staff and sub-contractors in welding processes such as aluminothermic, flux core arc and robotic welding confirmed his enjoyment of teaching and strengths in leadership which were formalised with a Certificate IV in Training and Assessment in 2017. Moving back to the Illawarra, Dane spent the next two years as an Education Support Officer and teacher with TAFE, managing staffing requirements, purchasing, course development and delivering training in both apprentice and commercial courses.

Missing the hands-on roles, however, in 2021 he moved back on-site with BlueScope Steel at their Port Kembla steelworks. Scheduling maintenance and breakdown services to mechanical components in the raw materials area was one of his responsibilities as a Boilermaker Welder, before moving on to become a battery operator in a continuous production environment. Utilising his past experience and certifications, Dane moved to the Strategic Inspection Services department, firstly in an NDT role and now as an In-service Inspector.

He completed his AICIP In-service Inspector certification in 2024 and is looking forward to learning from the experienced members of AIES through the Gazette and online forums. "I'm sure they have a wealth of knowledge that could help newcomers like me establish themselves" he said.

Chris Ross

AIES Personal Member number 429

Growing up on cattle property, I spent a lot of time in the shed tinkering and building things as a kid. Learning to fabricate and assemble mechanical components early on sparked a love in me for all things engineering. I was fortunate to start a Fitting and Turning Apprenticeship when I was 15 in my hometown, at a coal fired power station, and from there has led to many fantastic experiences and opportunities working in the power generation industry.

After travelling and enjoying myself, I managed to secure a permanent position in my mid-20s back at the power station where I did my apprenticeship, and from there I transitioned into Engineering and Asset Integrity with internal opportunities. This introduced me into the world of pressure equipment and welding in a way I never knew before. I found the whole subject of in-service inspection and technical welding challenges extremely interesting and ever since I have been wanting to learn more. Determined to study and specialise in this field I completed a range of qualifications in quick succession; Advanced Diploma in Mechanical Engineering, Ticketed Pressure Welder, International Welding Specialist IIW-IWS, International Welding Inspector IIW-IWI Basic then IIW-IWI Standard as well as Pressure Equipment Inspector API-510/570.

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The economic and environmental costs of corrosion are considerable, estimated to be around 3% of the global GDP. For this reason, it is important to develop effective techniques for mitigating corrosion.

Recent scientific research has focused on developing new and improved techniques for preventing or slowing down the rate of corrosion. Some of the most recent scientific research on corrosion mitigation techniques includes:

- **Self-healing coatings**: Researchers at the *University of Illinois* have developed a self-healing coating that can repair damage caused by corrosion. The coating contains microcapsules filled with a healing agent that is released when the coating is damaged, repairing the damage and preventing further corrosion. In addition to preventing corrosion, self-healing coatings can also be used to repair scratches and other surface damage to materials such as paint and plastic.
- **Advanced monitoring systems**: Researchers at the *University of California*, San Diego have developed an advanced monitoring system that uses sensors and data analysis to detect and monitor corrosion in real-time. The system can identify potential problems before significant damage occurs, allowing for more effective preventative measures. Corrosion monitoring systems can use a variety of techniques to detect corrosion, including electrical resistance, ultrasonic waves, and spectroscopy.

Paints are a crucial material, integral to prolonging the lifespan of products from cars to wind turbines

- **Plasma electrolytic oxidation**: Researchers at the *University of Cambridge* have developed a new technique called plasma electrolytic oxidation, which can be used to create a highly corrosion-resistant layer on metal surfaces. The technique involves immersing the metal in an electrolyte solution and subjecting it to a high-voltage electric current, which causes a layer of oxide to form on the surface. Plasma electrolytic oxidation was first developed in Russia in the 1980s for use in the aerospace industry.

By Upender Reddy. Published with permission of the Australasian Corrosion Association

Understanding the fundamentals of how paint works

Sustainable Coatings by Rational Design (SusCoRD) is an academic-industry partnership between AkzoNobel and *The University of Manchester* that brings together academic experts from across the North of England to gain this underpinning know how, to enable industry to find ways to create paints differently.

The aim is pave the way to creating more sustainable coatings that last longer, delivering economic benefits to UK by prolonging the lifespan of the products they protect.

In an industry-first, the partnership looked to match a detailed scientific understanding of the mechanisms of coatings failure with state-of-the-art machine learning. The aim was to deliver a framework for developing more sustainable protective coatings and nanocomposite materials using digital design. This would help enable industry to replace the current trial-and-error and test new, sustainable materials, accelerating the formulation of new products.

Working across four specific workstreams, the teams drove discoveries across two main areas: analysis characterisation of coatings in the substrate, the polymer and interfaces; and digital technology, specifically predictive approaches, modelling and simulation, with the aim to ultimately producing digital twins.

Chris Ross

(Continued from page 10)

I have been working as the Asset Integrity Specialist for the last five years, with responsibility for pressure equipment and welding across multiple power stations. This ranges from maintaining compliance at a corporate and WHSQ level, to managing welder qualifications and coordinating/conducting pressure equipment inspections during outages of boilers and auxiliary plant.

My current venture is starting up my own company, working in the asset integrity field with intentions to stay in the power generation industry. I love that working in asset integrity I am constantly humbled and reminded of how much I don't know. This keeps me wanting to learn and develop in what I hope to be a long fulfilling career.

Standards for Inspection of Pressure Vessel Linings

By Willie Mandeno and Justin Rigby
Coatings Technical Group of the Australasian Corrosion Association

Continuity testing of a coating

The interior of a metallic pressure vessel is subject to a range of corrosivity factors. Linings may be used when required to protect the substrate from corrosion. However, severe pitting corrosion at defects, such as discontinuities in the lining, can occur unless detected and repaired before the vessel or piping is put into service. Therefore, it is important that linings are inspected to ensure that their protective coating system has been installed as specified.

To be effective, all barrier coatings used to protect both interior and exterior surfaces need to be a continuous non-conductive film that is free of defects such as voids and pinholes, known in the industry as 'holidays'. The common test method for coatings thicker than 150 µm is to create a voltage between the substrate and a test electrode that is passed over the surface. The voltage is set so that a spark will be created at any defect.

The value of the test voltage has been very controversial, with concerns that if set too high, it could damage a sound coating by burning through it.

However, several studies presented to Australasian Corrosion Association (ACA) Corrosion and Prevention (C&P) conferences have since dispelled some of the myths about the risk of coating damage. Unfortunately, many in the industry have forgotten them. Some key studies are shown below:

- Cope G & Luke A. recommended 15 V/µm in their publication entitled *Holiday Detection for Fusion Bonded Epoxy Pipeline Coating* presented in 1988
- Cope G. found variations on temperature and relative humidity play a minor role and that most coatings can withstand a substantial test voltage before breakdown, in their publication entitled *High Voltage Testing of Heavy Duty Coatings – Recent Advances* presented in 1991
- Edmond L., Cope G., Bryson A., Ackland B & Forsyth M., found saturated FBE could withstand greater than 13 V/µm in their publication entitled *An Evaluation of Holiday Detection Voltages for FBE Coated Pipe* presented at C&P 2009
- Cicak I, Tan M, Cope G & Jin L, recommended AS 3894.1 voltages for FBE and DLFBE be derated by 65% and that repetitive testing did not cause breakdown in their publication entitled *Determining the Required Voltages for Holiday Testing of Dual Layer FBE Coatings* presented at C&P 2018.

Review of International Standards

In 2012, at an ACA Coatings Seminar in Sydney, Ted Riding compared the test voltages versus dry film thickness (DFT) recommended by the following standards:

- AS 3894.1-2002 *Site testing of protective coatings, Method 1: Non-conductive coatings – Continuity testing – High voltage (brush) method*
- ASTM G62-23 *Standard Test Methods for Holiday Detection of Coatings used to Protect Pipelines*
- ASTM D1562-21 *Standard practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates*
- NACE SP0188-2024 *Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates*

- NACE SP0274-2011 *Standard Practice for High-Voltage Inspection of Pipeline Coatings*
- ISO 29601:2011 *Paints and varnishes – Corrosion protection by protective paint systems – Assessment of porosity in a dry film*

The controversy related to voltage seems to have been reflected in AS 3894.1, wherein the specified voltage is relatively lower than other standards' specifications, with the risk that some defects may not be identified.

AMPP Conference 2022 Paper

Paper No. 17662 by Walker C, O'Dea V, Bell J & Tormes J, *Why Voltage Matters for High Voltage testing on Steel,* that triggered the recent change to the widely used NACE Standard Procedure SP0188, was presented to the US Association for Materials Protection and Performance (AMPP) Conference in 2022.

Research by Walker et al. found no scientific basis for the 'rule of thumb' of 100 volts/mil (or 4V/ µm) that could lead to undetected holidays or discontinuities where dry film thickness (DFT) < 1500 µm. Also, that the dielectric strength of most protective coatings and linings for chemical containment or immersion service was generally >20 V/µm, with many greater than 40 V/µm.

They recommended a testing voltage of $1250\sqrt{t}$ (mils) = $250\sqrt{d}$ (µm) which is used in NACE SP0274-2011, *Standard Practice for High-Voltage Inspection of Pipeline Coatings* to achieve consistent holiday detection. This is the same formula as in AS 3894.1, but without the adjustment factor. They also noted that a 45% greater voltage was required when using conductive neoprene rubber electrode compared to the preferred wire bristle brush, and that a typical value for the di-electric strength of air was 78 volts/mil or 3 V/µm.

AMPP SP0188 revisions

NACE RP0188-1988 was first revised in 1999, then reaffirmed as NACE SP0188-2006. The latest revision was published in January 2024 and is based on research by Walker et al., and Paschen's Law that is used to calculate the voltage required to create a spark in air. It now specifies a test voltage that equals 1.5 x dielectric strength of air (calculated using Paschen's Law over the DFT distance), plus 1500 volts.

Table 1 shows examples from the range of thicknesses included in SP0188's Table A1, with recommended voltages compared with those in the now superseded 2006 version. Also included are the Voltage versus Thickness ratios, showing how they decrease as thickness increases. Note that all are above the old 'rule of thumb' 100 V/mil, especially for thinner coatings.

t (Mils)	d (µm)	Voltage (kV)	Volts/ mil	2006 (kV) (superseded)
10	254	4.1	410	*1.5*
40	1016	8.3	208	*3.0*
150	3810	21.3	142	*15*
274	6960	34.9	127	*N/A*

Table 1. Comparison of current and previous NACE SP0188 recommended voltages

Revision of AS 3894.1

The ACA Coating Technical Group is proposing that AS 3894.1 should be retained, with some technical and editorial changes, rather than adopting the AMPP or ASTM Standards.

They are recommending that test voltages should be set based on actual thickness being tested, if above the specified minimum. Alternatively specify a test voltage based on the expected DFT range as shown in Table 2.

Typical Thickness Range (µm)	Suggested Voltage (kV)
150 – 500	4.5
500 – 1200	8.0
1200 – 2500	15.0
2500 – 4500	20.0
4500 – 8000	30.0

Table 2 – Proposed change – Voltage vs DFT Range

In addition, they are recommending that multiple applications of the test probe should be encouraged to increase the probability of finding defects.

Willie Mandeno, Consultant, Retired
Justin Rigby, Principal, Remedy Asset Protection
This article is reproduced with permission from the Coatings Technical Group of the Australasian Corrosion Association (ACA)

The Coatings Technical Group, on behalf of the ACA is supporting Standards Australia's project to revise AS 3894.1-2002
To join CH-003 Working Group to revise AS 3894.1, contact Willie Mandeno, Email: wlmandeno@gmail.com

Combating Tank Corrosion Under Insulation

At a major global blue-chip nickel mine in Australia, authorised Belzona Distributor Rezitech provided a full turnkey solution to combat corrosion under insulation on an ammonium sulphate feed tank. Within the space of 24 hours, the 9.5 metre (31.2 ft) diameter tank (with a height of 2 metres (6.6 ft) from ground level) was repaired and protected against future corrosion with the industrial composite wrap system, Belzona SuperWrap II.

The Mine refines granulated nickel matte from their smelter into premium-grade nickel powder and briquettes containing 99.8% nickel. Nickel powder is further processed into nickel sulphate at a refinery in Australia. Nickel sulphate is an essential ingredient in the lithium-ion batteries that drive electric vehicles (EVs).

It could be argued that the increase in sales of EVs is one of the biggest climate wins of 2023. Indeed, according to the 2023 Report from Climate Action Tracker, of the 42 sectors which need to achieve net zero status by 2050, the only sector which is on track is the share of EVs in light-duty vehicle sales. Considering how road transport currently accounts for 11% of global greenhouse gas emissions, EVs play a vital role in reducing these emissions.

As such, the polymeric technology required to repair and improve assets within the EV industry equally plays a vital role in supporting the transition to net zero. By repairing damaged assets instead of decommissioning and sending them to landfill, this significantly reduces the climate impact that would otherwise be incurred in this process.

Case Study: Feed Tank Suffering from Corrosion Under Insulation & SCC

Tank Contents

Amsul	218-666 g/L (average = 530 g/L)
Chlorides	0.1-0.6 g/L (average = 0.3 g/L)
pH	3.0-9.0 (average = 6.6)

The customer's stainless steel feed tank was suffering from corrosion under insulation and chloride induced stress corrosion cracking. They required a solution that would not only restore the integrity on the substrate, but also protect the asset against future corrosion damage. Not only this, but as the tank operates at elevated temperatures of approximately 70°C (158°F) and processes highly corrosive medium, the repair solution would need to be able to withstand these harsh conditions.

Following an inspection by Heath Westell, Sales Engineer at Rezitech, the composite wrap system, Belzona SuperWrap II, was specified.

"This composite wrap system is comprised of a fluid-grade resin system, a bespoke hybrid reinforce-

Figure 1. Composite wrap system curbs corrosion under insulation at nickel mine

Figure 2. Stainless steel feed tank repaired and protected with Belzona SuperWrap II

ment sheet, based on fibre glass and carbon fibre, as well as a release film to compact and consolidate the application. The system is specially formulated to restore the strength of holed, weakened and corroded pipe and tank walls, making it the ideal solution for protecting the asset against corrosion under insulation for the long term. In addition, thanks to the cold-curing properties of the composite wrap system, this mitigates the need for hot work, making it a reliable alternative to welding."

Application Procedure

Firstly, all traces of oil and grease contamination were removed using a suitable degreaser. Following this, the surfaces were grit-blasted to provide a surface cleanliness compliant with ISO 8501-1 SA 2½ (ASNZ 1627.4 class 2.5) with a minimum 75 μm (3 mil) rough angular profile.

Once the surface was prepared, the Belzona 9381 reinforcement sheet was measured out and then wetted out with the resin system. The resin was then systematically applied to the areas to be repaired. Following this, the reinforcement sheets were then applied to the tank in three layers. The compression film was then added to the top of the application area. Next, using a roller, the Belzona SuperWrap II composite wrap system was then spread, rolled and compressed to the surface of the tank. The system was then left to cure for approximately eight hours.

Bypass the Need for Replacement with Polymeric Technology

Investing in the Belzona composite wrap solution enabled the customer to successfully bypass the need to replace the corroded asset, and instead prolong the lifespan of the asset for years to come. This enabled the customer to make significant savings in both time and money. In addition, given the important role EVs play in reducing global carbon emissions, it could be argued that polymeric technology also plays a fundamental role in supporting this transition by safeguarding the integrity of key assets within this industry.

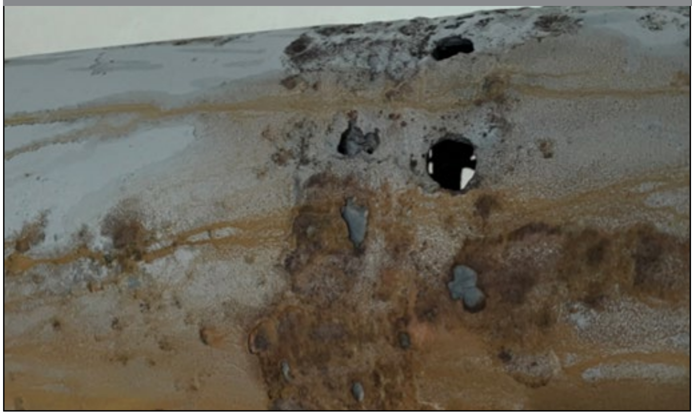
Established in 1968, Rezitech is the sole Australian Distributor for Belzona. Rezitech offers a comprehensive range of industrial protective coatings and epoxy metal repair composites to many different industries including: oil and gas, mining, power and facilities maintenance, amongst others. Phone: 03 8720 8600 Email: info@rezitech.com.au

Figure 3. Mitigating the need for replacement with polymeric technology

Corrosion and Coatings Gallery

The following images provide a guide to a range of corrosion types commonly found in pressure equipment and their possible causes. The explanations provided describe the primary degradation mechanisms but do not consider the additional factors resulting in the overall degradation. The root cause of each example of corrosion has not been fully investigated and often more than one type of environmental condition is observed.

1. Preferential Weld Corrosion



Knife-line attack (KLA) is a form of intergranular corrosion and is the accelerated corrosion of the heat-affected zone (HAZ) compared to the parent metal in a corrosive environment. It is often characterised by groove-shaped defects.

In this image the author identified KLA in stainless steel pipe where chromium has been depleted in the HAZ due to the formation of chromium carbides. In addition, microbiologically induced corrosion was occurring simultaneously.

2. Corrosion Tubercles

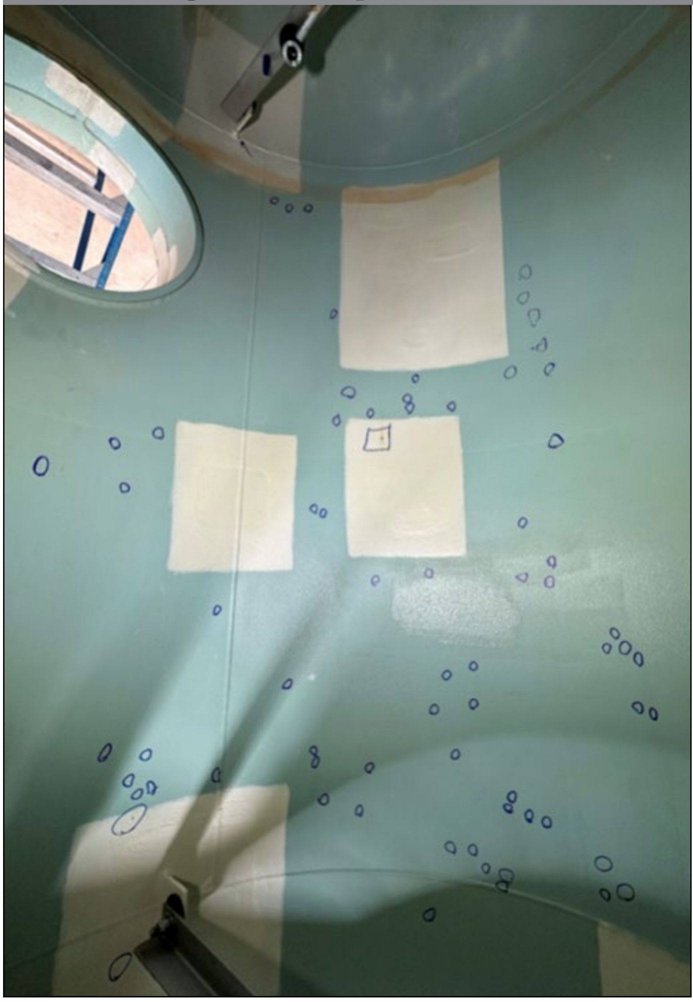
Iron oxidizing bacteria together with the ferric hydroxide can produce and form extensive deposits called tubercles. This growth depends on water chemistry, dissolved oxygen concentration, temperature, and flow and corrosion rates.

3. Graphitisation

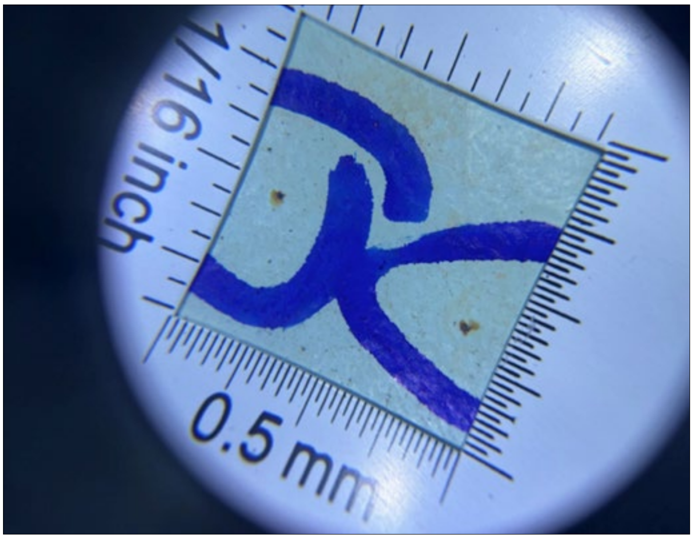
Graphitisation is a heat treatment process that occurs during manufacture of some iron alloys, such as cast iron, to improve their mechanical properties and machinability as required. During this process, the carbon dissolved in the iron alloy matrix separates and restructures as graphite, which gives the cast iron its specific characteristics, such as improved ductility and wear resistance. Gray iron is most susceptible to graphitisation.

Graphitic corrosion, on the other hand, refers to the deterioration of grey cast iron pipes, in which the metallic constituents are preferentially corroded, leaving a brittle graphite matrix.

4. Coating Porosity



Coating porosity refers to pinholes and defects in the coating. One test method, detailed in AS 3894.1-2002 *Site testing of protective coatings, Method 1: Non-conductive coatings – Continuity testing - High voltage (brush) method* (see article page 12), is used by coating inspectors to ensure the absence of these micro-defects, which not only affect the overall performance of the coating but will also be the starting point for coating failure and corrosion. In this image the author found the cause of corrosion spotting to be from non-visible coating porosity.



5. Galvanic Coupling of Dissimilar Metals

The corrosion of dissimilar metals in contact is sometimes known as bimetallic, galvanic or contact corrosion and occurs when two such metals are in electrical contact and bridged by an electrolyte to form an electrochemical cell.

In this image stainless steel is welded to a galvanized surface. The galvanized surface is corroding in preference to the stainless steel.

AS 4036 *Corrosion of metals—Dissimilar metals in contact in seawater* provides guidance on dissimilar metals.

For further information contact the author Justin Rigby, email justin.rigby@remedyap.com.au

Nanotechnology in the Coatings Industry

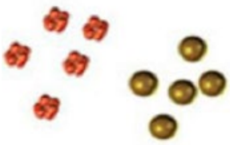
What was once considered a humble coat of paint has become a rapidly expanding global coatings market, with highly specialised applications that serve to reduce corrosion costs in nearly every industrial environment. Today, one of the fastest-growing trends in the coatings industry is nanotechnology.

Nanotechnology is considered to be the branch of technology that deals with dimensions and tolerances of less than 100 nanometres, especially the manipulation of individual atoms and molecules. In coatings, nanocomposites and nanostructures have applications that make surfaces scratch-resistant, waterproof, heat resistant, or self-healing. Hospitals are using nanocoatings to maintain sterile surfaces, while aerospace and automotive manufacturers have innovated applications for nanotechnology that makes materials stronger and more lightweight.

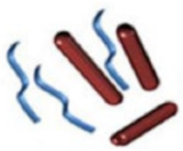
In the past decade, tens of thousands of patents have been issued for nanotechnology in the coatings industry alone. Tiny metallic or ceramic particles can be added to existing paint formulations to transform its properties, including corrosion resistance. The minute size of these particles ranges from 10 to 70 nanometres. For example, as explained in a report by IHS Markit, "at two nanometres, the conductivity of metal particles changes and at 20 nanometres, the transparency of ceramic particles changes. At 20 nanometres, particles of gold turn red and their plasticity disappears."

According to NACE's Nanotechnology and Corrosion Technology Exchange Group*, nanomaterials are classified as 0-, 1-, 2- and 3-dimensional structures where at least one dimension is less than 100 nm. The figure presents this classification and provides examples of each form of nanostructures, including clusters/spheres, nano wires, polymers, thin films and bulk specimens. Since the surface properties of nanomaterials dominate bulk, by controlling the surface/volume aspect (particle radius, film thickness or grain size), it is possible to develop materials whose physical properties will be related to surface.

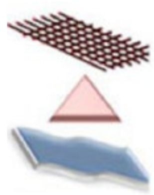
Nanomaterials Classification



0-d – Spheres and clusters



1-d – Nanofibres, fibres and rods



2-d – Thin films, plates

3-d – Bulk nanomaterials

This new technology is still expensive and thus limited to highly specialised applications, but new research is highlighting ways to decrease the cost of manufacturing and applying nanocoatings. In 2016, a team of *Australian National University* researchers developed a new protective coating with a range of potential applications, such as preventing ice from forming on aircraft or protecting boat hulls from corrosion. The team created a much more robust coating than previous materials by combining two plastics, one tough and one flexible. Furthermore, they created two methods for creating this material, both of which are cheaper and easier than current manufacturing processes.

NACE's Technology Exchange Group members are monitoring and analysing new developments in nanotechnology. The group was established in 2013 to discuss and promote the scope and implementation of this technology in various fields including military, oil and gas, semiconductors, and more.

NACE members with expertise in nanotechnology consider the study and application of nanomaterials in corrosion control still in their infancy, and an understanding of the relationships between their properties and their materials engineering on a molecular level seems to be key to the realisation of nanomaterials' full potential in corrosion control.

* NACE International and SSPC: The Society for Protective Coatings have merged to form AMPP, The Association for Materials Protection and Performance.

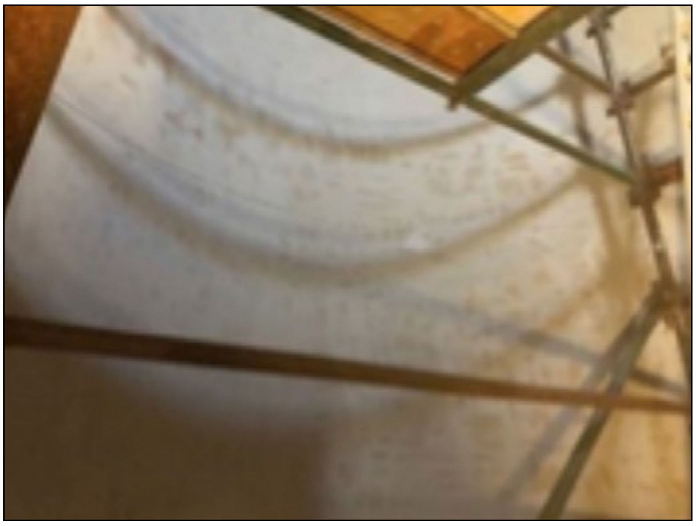
Source: The Association for Materials Protection and Performance (AMPP) October 2021 website blog

Presented with permission from Chemcote Specialty Coatings

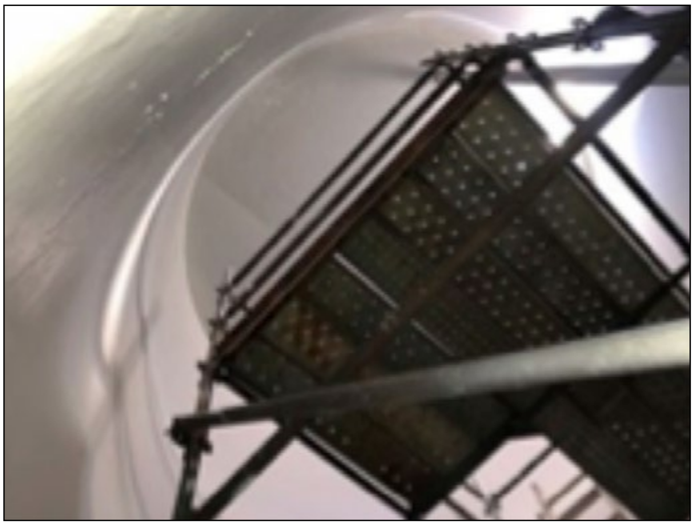
Chemical Storage Tank Relining

Site setup

Condition upon inspection



After blasting



Coating complete

OVERVIEW: When you're storing harsh chemicals like sulphonic acid, unfortunately deterioration, staining, and corrosion are inevitable. That's why relining storage tanks with high-performance anti-corrosion products is so important.

ENVIRONMENT: Sulphonic Acid Storage at 50°C

SUBSTRATE: Chemical Storage Tank – Mild Steel, with External Cladding

CHALLENGE: The existing epoxy lining in the chemical storage tank which housed sulphonic acid at 50oC was in poor condition. Large sections had suffered extensive deterioration alongside staining and corrosion of the tank wall. This had subsequently stained the finished product, which prevented its use until a long-term solution was found.

SOLUTION: Scaffolding was set up inside the tank, and efficient surface preparation techniques were utilised in order to minimise mobilisation of blasting costs, while still achieving an ideal surface for effective coating adhesion.

The team started with abrasive blasting of the steel tank in accordance with AS 1627.4 – 2005 to class Sa 2.5 60 µm surface profile.

One coat of Epo-chem™ RS 500P was applied to a nominal thickness of 100 µm, followed by a single coat of Epo-chem™ RA 500M to a nominal dry film thickness (DFT) of 350 µm. The flanges were then sanded and internals finished off, before carrying out an internal QA and DFT check.

Corrosion Protection of Super Duplex Mineral Processing Vessel against Sulphuric Acid

Above: Before blasting and coating

Right: Vessel after blasting and coating

OVERVIEW: Critical minerals such as nickel are often processed in industrial environments where exposure to chemicals and by-products are far from conducive to corrosion prevention. Combatting the elements like acid rain and atmospheric corrosion can be detrimental to plant equipment, subsequently impacting productivity and operational costs.

ENVIRONMENT: Nickel Laterite mine operating at 100°C. Vessel is required to contain and hold Sulphuric Acid Slurry as part of the leaching process.

SUBSTRATE: Super Duplex Steel

CHALLENGE: The project required Chemcote to treat a super duplex steel vessel that held sulphuric acid slurry as part of the leaching process in a nickel laterite mine. Achieving adequate adhesion on super duplex steel at temperatures of 100°C was a key consideration.

The internals of the vessel had previously been coated with an epoxy that had failed within months of application, causing the substrate to corrode and pitting to occur. The externals required protection against acid rain and atmospheric corrosion, while also producing a durable hard-wearing finish.

SOLUTION: Following abrasive blasting with aluminium oxide to class Sa 2.5 90 µm surface profile, several products were selected due to their adhesive properties and ability to create an impermeable barrier between the environment and substrate.

Chem-tect™ RC 364 was applied to a DFT of 400 µm on both the internals and externals. The next step involved the application of Chem-tect™ RB 364CS to a total DFT of 1 mm on the internals, then a final coat of Chem-tect™ RB 300TC to a total DFT of 400 µm on the vessel exterior.

Refurbishment of a Power Station J Strainer using Vinyl Ester

OVERVIEW: After 15 years of Chemcote Coatings providing long term protection on other strainers and their backwash covers within the power station, Chemcote was enlisted for repairs to the two large strainers to one of the main condenser units.

ENVIRONMENT: Sea Water

Needle gunning to minimise abrasive blasting costs

First coat applied after abrasive blasting

Pitfilling to ensure coating continuity

Reassembly on site

SUBSTRATE: Austenitic Iron Body

CHALLENGE: Strainer has been in service for 30 plus years. Inspection of the strainer body, back wash covers & critical dimensions found the substrate to be severely corroded, illustrated by the extent of graphitised iron, holes through the casting and diminishing wall thickness

SOLUTION: Composite materials were chosen to rebuild the metal loss. We then applied RB 364 series, a glass flake filled vinyl ester consolidated with composite reinforcing to return the casing to its original strength.

The project included the protection of threaded holes using backing rod, abrasive blasting and treatment to reduce metallic salts by hot washing and re-abrasive blast, then application of Chem-tect™ RB 364 in two coats where required to obtain minimum thickness of 1,000 μm.

Pitfill was needed to reduce the sharp edges and pit depth allowing a smooth uniform coating to be applied. QA included spark testing and DFT to confirm coating integrity before applying a coat of RL 500 PF to external.

ACA Coatings Technical Group

Founded in 1996, by the Australasian Corrosion Association (ACA), the Coatings Technical Group (CTG) mission is:

To share ideas, project studies, technologies and market trends amongst asset owners, designers, manufacturers, suppliers and equipment providers to the protective coating industry that serve the protection or restoration of corrosion affected structures throughout Australasia including New Zealand.

Volunteers contribute to the committee through reviewing award nominations, reviewing standards, developing technical content and events.

Current projects

The past year has been active for the CTG where members have been actively working on latest innovations, product developments, industry issues and specifically:

- Development of AS/NZS 2312.3 *Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings – Part 3: Thermal spray coatings.* A draft of this document has completed its Public Review stage and is now likely be published in early 2025.

Air receiver showing degradation of external protective coating most likely due to impact damage or poor coating application

Unpainted flange bolting at a large air receiver

Better late than never! Another heavy walled large process vessel after coating repairs were conducted where coating had failed due to weather conditions and chemical attack

(Continued from page 22)

WHS Spotlight

In December, Safe Work Australia launched a collection of new reporting tools to help users more accurately assess, measure and report data on WHS performance.

This new approach delivers more information on how to use data to inform WHS reporting. While the Lost Time Injury Frequency Rate (LTIFR) calculator is useful for drawing conclusions about the impact of poor WHS on productivity, there are limitations when it is used in isolation to measure WHS performance.

With the creation of more holistic data and tools, the LTIFR calculator will be retired from the data website in March 2025.

Any saved LTIFR calculator webpage links should be updated with the new workers' compensation injury frequency rate dashboard and WHS data reporting tools.

Explore the new WHS performance reporting tools at: data.safeworkaustralia.gov.au/interactive-data/whs-data-reporting

If you need assistance in navigating the new tools, you can email StatsOnline@swa.gov.au.

ACA Coatings Technical Group *(Continued from page 21)*

Process vessel showing corrosion at internal surfaces where protective coating has failed

Prominent corrosion due to protective coating failure by chemical attack and harsh environment

- A review is in progress of AS 3894.1 *Site testing of protective coatings. Non-conductive coatings – Continuity testing – High voltage (brush) method.* This was last reconfirmed 2013.
- Association for Materials Protection and Performance (AMPP) revised their equivalent standard in 2024, SP0188 *Standard Practice for Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.* Comments from industry suggested AS 3894.1 also needed a revision.
- A project has been established to review 143 aged Australian Standards that align under Standards Australia committee CH-003. These include the AS 1580 series, 3730 series, 3750 series, 3894 series, 4049 series, 4361 series, 4548 series and a few others.

The group also contributed to a strong representation of coatings related technical presentations and conducted an industry forum at the Corrosion and Prevention conference in Cairns recently.

Nomination forms to join our committee are available at Join a Technical Group – The Australasian Corrosion Association Inc.

Justin Rigby
Chairperson – ACA CTG

Inspectors Offer Insight into Workflow Best Practices

Mark Mooney, *NBBI*
Director of Operations – Software and Services

The following article is reproduced with permission from the National Board BULLETIN Summer 2024. The National Board of Boiler and Pressure Vessel Inspectors (NBBI), an AIES Affiliate Member, was established in 1919 to promote greater safety to life and property through uniformity in the construction, installation, repair, maintenance, and inspection of pressure equipment.

In a recent initiative to streamline and support the entire boiler and pressure vessel safety workflow into a centralised system, NBBI has developed a Jurisdictional Reporting System (JRS). JRS Inspect is the first module to be released. This module supports in-service inspection workflows for jurisdictions, insurance carriers, and inspection companies by standardising forms and data capture when working across multiple jurisdictions and supporting the entire in-service inspection workflow from permitting to issuance of the certificate of operation.

This article introduces the concepts behind this system and discusses best practices for inspection workflow – ideas which could be of value to those concerned with pressure equipment inspection, compliance and registration and interested in potential development of a shared national pressure vessel inspection database.

As the Jurisdictional Reporting System (JRS) continues to be developed, the team of NBBI employees, JRS advisers, and other industry stakeholders are building a system that brings uniformity across jurisdictions and embraces and improves upon industry best practices.

The first product in the suite, JRS Inspect, which supports boiler and pressure vessel inspections, is operational.

Four jurisdictions are using JRS Inspect, and eight others are in the queue, with two expected to begin using it this year and four or five next year. In addition, four insurance carriers have signed on, and two are expected to implement the system this year.

Development of JRS Register, the second product in the suite, has begun. It supports equipment registration and repair workflows for manufacturers and repair companies. JRS Certify, which supports accreditation and certification workflows for businesses and individuals, will be developed once JRS Register is operational.

While JRS will bring uniformity to the process of inspections, another key to safety in the industry is the actual inspections, and I recently spoke with a group of inspectors willing to share their field experiences and best practices.

This article won't explore what should be inspected but it will look at inspection workflow and provide insight into developing best practices with that workflow.

Best Practices: Inspecting

The obvious questions are how long an inspection should take and what is considered too much time at a location. A good inspector is cognisant of the arrival time at a location and the time spent inspecting.

The inspectors interviewed consistently said the time to do a proper inspection is "whatever it takes to do it right."

The best practice is to refrain from allowing the clock to take precedence over performing a thorough inspection. Customer service is also essential, and communication with the customer throughout the process of planning and inspecting is where we see opportunities for best practices. Top inspectors prioritise informing clients about why a violation or recommendation was made rather than having nonessential discussions.

A manager can find it easy to praise the inspector with a territory in a densely populated area when it's possible to inspect more objects in the same time frame as an inspector with a territory in a more remote region; therefore, it's not fair to use inspections performed as the sole metric.

Also, an internal inspection on a utility boiler will take considerably longer than an external inspection on a small cast-iron boiler or air tank. In addition, an air tank inspection in a jurisdiction that requires ultrasonic thickness testing will take longer than in a jurisdiction that does not. This is universally understood.

Best Practices: Scheduling

Companies generally have two options when it comes to scheduling – a centralised scheduling process that schedules the work for the inspectors or the inspector territory system, which allows the inspectors to manage their territory and workload.

Scott Dosser, a jurisdictional specialist for FM Global, said communication is the key to the centralised system.

It may be more convenient for the inspector to accept the schedule and arrive at the location without calling the customer, but Dosser said the best practice is to remain in communication with both the scheduler and a representative from the location being visited.

"When you have a scheduler and a customer reaches out to you to schedule an internal inspection, you forward it to the scheduler to get it done," he said. "The key is to stay connected to the client and the scheduler to make it work well."

A benefit for companies that use the inspector territory method is that the inspectors are likely to better understand their territories.

Because inspectors better understand how long it will take to perform an internal inspection, they are better positioned to quickly determine what other inspections are due in that area to make the best use of their time. A good inspector who is responsible for the territory will take personal responsibility for overdue inspections and will tend to work to minimise them. Managers still will monitor the inspector's productivity and workload but place the responsibility on the inspector to complete the job.

John Ezernack, a risk control consulting director for CNA, said claims are a priority regarding scheduling. "Scheduling your work depends on many things, from geography to what is going on in the territory," he said. "If there are no claims, locations requiring an internal inspection will take next priority, followed by risk evaluations, and then you fill the remainder of the day with other inspections due in the same area. "The intent is to schedule internal and external inspections, minimising travel time between inspections coming due."

Yu Shen, a risk control specialist for CNA, looks "two to three months ahead and groups locations together and schedules a week ahead. I consider the traffic and schedule a location for the first inspection that does not have a big traffic issue and schedule higher traffic areas to times of the day when traffic is lighter," she said. "Knowing my area and the traffic is important for me to be most efficient."

Sometimes, an inspector can have a large territory with considerable travel time.

"I have my territory broken up by the road systems, and I put them into a query," said Mark Williams, a senior risk engineering specialist for Liberty Mutual. "I will do everything in that query, then look 30 or 60 days out and do as many locations as possible during that day. If I am driving more than two hours away, I want to make sure that there are no over-dues when I'm going into remote locations. If it means I must work a little longer in a day to complete those, sometimes you have to take that time to do it right. "The goal is to have zero over-dues all the time."

Grouping inspections near each other will reduce time and help eliminate over dues. Although jurisdictions do not want to see any overdue inspections, focusing and scheduling strictly on over-dues can have a reverse effect by increasing driving time, which decreases efficiency and the number of inspections completed.

Therefore, it can be argued that fewer proper inspections result in decreased safety. Even the best inspectors can have overdue inspections; again, they must become a priority when scheduling.

"If you get to the end of the month and there are two or three locations that did not get done, I will plan those first in the next planning cycle and plan other inspections around them," Williams said. "This keeps the attention on striving to have zero over-dues all the time."

Best Practices: Time to Inspect

When looking at just time spent at a location, the focus is not on the time it takes to do the inspection *but* on how the time per type of inspection falls in line with the industry average.

Air tank inspections can run about 15 minutes, and cast-iron boilers can run 15-30 minutes on average. They can take longer if they are larger and ladders are necessary for access or if there are unexpected conditions. It is perfectly reasonable for larger boilers to take an hour or more and utility boilers to take several hours.

Inspecting with the primary mindset of "getting it done fast" may be suitable for the numbers, but it can result in an inspector missing things or failing to take the proper time to ensure the owner understands any recommendations or violations.

Best Practices: Top Inspectors

Technical knowledge and code competency are among the top answers when asking inspectors about what it takes to be an excellent inspector. Justin Swap, a senior risk control consultant for CNA, added "integrity is high on the list. Just do the right thing when no one is looking," he said. "Get the owner to be a good partner in the inspection process. It happens when you have good communication."

Williams said taking the time to do thorough inspections is essential. "Let's do the hard work and do the inspections properly and give the owner the proper guidance to ensure the boiler or pressure vessel is safe as the code dictates," he said.

Regardless of the scheduling system, implementing these best practices can help inspectors perform their duties to the best of their abilities and achieve the ultimate goal – safety.

FOR YOUR DIARY

NOTE: Please confirm event schedules and delivery methods with the event organisers

RISK 2025 **May 21-23 2025, Melbourne, Vic** https://www.engineersaustralia.org.au/learning-and-events/conferences-and-major-events/risk	**8th Pan-American Conference for Nondestructive Testing** **June 9-12 2025, Niagara Falls, Canada** www.panndt.org/panndtconference
33rd ASNT Research Symposium **June 23-27 2025, Indiana, USA** asnt.eventsair.com/rs2025	**9th International Symposium on Life-Cycle Civil Engineering (IALCCE 2025)** **July 15-19 2025, Melbourne, Vic** www.ialcce2025.org
Climate Smart Engineering **August 27-28 2025, Adelaide, SA** https://www.engineersaustralia.org.au/learning-and-events/conferences-and-major-events/climate-smart-engineering	**C&P 2025: Materials Protection for the Future** **November 9-13 2025, Melbourne, Vic** conference.corrosion.com.au/
AINDT Summit 2025: The Power of Inspection **November 18-20 2025, Newcastle, NSW** aindt.com.au	**17th Asia Pacific Conference for Non-Destructive Testing: Breaking Barriers – NDT Solutions for a Changing World – Innovate, Adapt, Transform** **May 11-14 2026, Honolulu, Hawaii USA** www.apcndt2026.com

Did You Know?

The Association for Materials Protection and Performance, AMPP, is the world's leading organisation focused on the protection of assets and performance of materials. AMPP was created in 2021 when NACE International, The Corrosion Society, and The Society for Protective Coatings merged after more than 145 combined years of corrosion control and protective coatings expertise, and service to members worldwide. Today, AMPP is active in more than 130 countries and has more than 40,000 members.

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