



## Corrosion Monitoring of High Voltage Transmission Power Lines

From February through to April, ATTAR's David Padfield has been working closely with the linesman of New Zealand monitoring High Voltage Transmission power lines for corrosion throughout the central North Island, from Wellington up through to Whangarei (north of Auckland).

Transmission power lines are typically suspended from steel lattice towers, or tall wooden poles, and form the major framework for power transfer from region to region. The transmission power grid is reaching an end-of-life cycle in Australia and other countries and companies are now faced with potentially extremely costly conductor replacements.

A significant portion of conductor types used here and overseas are of the type ACSR (Aluminium Conducting, Steel Reinforced). This type of conductor has aluminium strands on the outside (conducting electricity), wrapped around a steel core (providing strength over long spans). The internal steel strands are

typically zinc-galvanised in an attempt to delay galvanic (also known as dissimilar metal) corrosion between the steel and aluminium and a layer of grease is also applied to further inhibit corrosion.

Loss of zinc from the steel strands results in rapid corrosion between the steel and aluminium reducing the steel thickness which can cause a conductor to fail completely. The zinc loss can occur due to hostile environments (coastal or industrial areas) or premature loss can be due to inadequate greasing, leaving localised spots of conductor prone to corrosion, often small distances over kilometres of conductor.

ATTAR offers a unique opportunity to determine the thickness of the zinc galvanising coating on the steel without taking the line out of service by using equipment called an OHLCD (Over Head Line Corrosion Detector). The OHLCD measures the thickness of the zinc layer using a derivative form of the non-destructive testing method known as Eddy Current testing, whereby eddy currents are generated within both the aluminium and steel strands and measured for phase and intensity.

The OHLCD is placed onto a conductor and it's self-powered motor pulls it through to the following pole, allowing for complete-length conductor scanning (barring obstacles). Measurements of the conductor are made every 10 milliseconds, with a report indicating a length of conductor's overall condition and location specific results.

Recent testing by David Padfield has identified many areas where corrosion was occurring internally and unnoticed, preventing costly surprises. Of equal importance, the OHLCD has identified many spans that are at the end of their theoretical service-life, but have not yet displayed evidence of corrosion, allowing transmission companies to prioritise valuable resources.

Recent work has also involved the sole use of helicopters to place the OHLCD on and off the line, allowing for greater conductor distances to be tested, and access to areas which would be inaccessible via other means.

If you would like any further information regarding this type of testing, or provision of a sample report, please contact David Padfield on +61 3 9574 6144 or email [davidpadfield@attar.com.au](mailto:davidpadfield@attar.com.au)



The OHLCD.



The crew involved in this years testing.



Linesmen suspended 100 feet below the helicopter!



Linesman wearing special suits are able to handle live conductors at 220,000 Volts!

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# Slip Accidents



Many slip accidents occur under dry conditions. To assist in avoiding slip accidents in Australia floor testing is carried out to meet the requirements of Australian and New Zealand Standard AS/NZS 4663: 2004 Slip Resistance measurement of existing pedestrian surfaces. The objective of which is to provide users, maintenance organisations and facility managers with standardised methods of testing in situ pedestrian surface materials for determination of their slip resistance.

Thus the risk of slipping on a floor under dry conditions with a co-efficient of friction greater than or equal to 0.4 is less than 1 in 1,000,000.

To discuss your Slip Resistance Testing requirements either on site or for new flooring products please call Steven Potts on (03) 9574 6144 or email [stevenpotts@attar.com.au](mailto:stevenpotts@attar.com.au)

Or view our Slip Resistance Testing Video at [www.attar.com.au/attar\\_slip\\_resistance\\_testing.html](http://www.attar.com.au/attar_slip_resistance_testing.html)

Two tests are regularly used to assess slip resistance, they are the Tortus Floor Friction Tester, used under dry conditions and the Portable Skid Resistance Tester (Pendulum) used under wet conditions.

The following Table from AS/NZS 4663: 2004 estimates the contribution of floor surface only, to the occurrence of a slip under dry conditions.

**Interpretation of dry floor friction results (Table A)**

Floor friction tester mean value	Notional* contribution of the floor surface to the risk of slipping when dry
≥0.4	Moderate to very low
<0.4	High to very high

\* The term 'notional' has been used to highlight the need to consider all potential contributing factors to a slip incident.  
NOTE: For a 'moderate to very low' interpretation, each individual test result shall be equal to or greater than 0.35.

This table is for use in level areas (less than 2% slope) only, for sloped areas (greater than 2% slope), the results are corrected using formulas from Australian Standards HB 197: 1999 An Introductory Guide to the Slip Resistance of Pedestrian Surface Materials, Table A.

**(Table B)**

Risk of slipping	Straight walking	Turning left foot	Turning right foot
1 in 1,000,000	0.36	0.40	0.36
1 in 100,000	0.34	0.38	0.34
1 in 10,000	0.29	0.34	0.33
1 in 200	0.27	0.31	0.32
1 in 20	0.24	0.27	0.29

According to data published by Bowman in Slip Resistance Workshop, Standards Australia, Prepared and presented by Bowman, R. and Martin G., the risk of slipping is dependant upon the coefficient of friction as seen in Table B.



# Pressure Vessel Testing using Acoustic Emission (AE) Monitoring

Over the past year ATTAR have been kept extremely busy carrying out a large number of Acoustic Emission tests around the country on both trailer mounted and static banks of gas cylinders. The company is now preparing to visit Indonesia later this month to continue this important testing work.

Due to safety considerations, periodic examinations of vessels used in storage and/or transportation of industrial gases are now required. This introduces the challenge to safely maintain the vessel without incurring excessive inspection costs. The Acoustic Emission examination has become accepted as an alternative to the common hydrostatic proof test because it assesses the pressure vessel's integrity without taking it off line, filling it with corrosion inducing water, then having to dry it out before re-introducing the gas.

Low pressurization rates are used to promote safety and reduce equipment investment. The AE examinations should be performed with pressurization rates that allow vessel deformation to be in equilibrium with the

applied stress. Testing is carried out to ISO 16148 [1], and the results indicate that the cylinders meet fitness for purpose requirements of AS 3788 [2] or AS 2337.1 [3].

The advantages of an AE examination are its higher level of sensitivity to growing defects than conventional non-destructive testing and the inside of the cylinder is not exposed to water and potential corrosion.

AE is a very useful tool in determining the structural integrity of pressure vessels such as gas cylinders as the whole structure is assessed in one test, and only active discontinuities are located. AE is more than a go-no go test as it indicates active discontinuities and their location along the cylinder. These are then verified by conventional NDT techniques such as ultrasonics.

AE has a multitude of other applications which include monitoring the structural integrity of pipelines, bridge structures, fibre composites (eg Elevated Work Platform booms) and storage tank bottom testing for corrosion and leak detection. AE is a non invasive and non

destructive technique. It is extremely cost effective as test results can quickly evaluate the condition of many structures and prioritise upcoming costly inspections and maintenance.

To discuss how ATTAR can save your company time and money using Acoustic Emission testing please contact ATTAR on +61 3 9574 6144 or email [admin@attar.com.au](mailto:admin@attar.com.au)



*Trailer mounted bank of Hydrogen cylinders*



# Materials Failure Analysis Case Study

## Corrosion of Ride-on Lawn Mowers

A sealed shipping container of ride-on lawn mowers received via international sea-freight was found to contain one mower with corroded metal components. Corrosion identical to this has occurred numerous times before with only one lawn mower of thirty-eight individually sealed mowers being affected. Despite the mowers being produced in different regions within their country of origin there did not appear any correlation between location and corrosion nor any apparent reason for this corrosion to occur.

A visual inspection of eight or so affected lawn mowers revealed accelerated corrosion in the staples used for shipping crate construction, the metallic centre of the flywheel, the bolts used to attach the wheels, brackets and attachments and the steering column. Cutting/slashing blades were also heavily corroded, Figure 1, together with some areas of the surrounding housing. Also notable was the presence of a white/grey powdery deposit on the polyethylene wrap, Figure 2, and on the mower's components.

A chemical analysis was performed on the white powdery deposit and was found to contain predominantly zinc compounds together with carbonates and small amounts of aluminium and cadmium. Low levels of salts, such as chlorides and sulphates, and no specific acids or bases were present indicating sea water was not the leading cause of corrosion.

Scrapings from the bolt holding the wheel in place were found to contain zinc, iron and cadmium.

A thin layer of zinc is often used to coat steel components such as bolts and brackets to protect them from corroding. The layer of zinc corrodes preferentially to the steel underneath forming a thin oxide layer on the surface. It is this thin oxide layer which greatly retards further corrosion of the underlying zinc thereby protecting the steel.

Disruption or removal of the zinc oxide results in rapid corrosion of the underlying zinc ultimately exposing the steel bolt underneath.

As shown in Figure 3 it appears wetting of the corroded mowers has occurred before or during packaging allowing water to pool on the mower or even on the bottom plastic sheet. During shipment this water would have been heated sufficiently to form sweating in the packaged crates and condensation on the mowers. A combination of moisture, heat (crossing the equator) and poor ventilation may cause severe corrosion of zinc metal.

'Wet-storage stain' as found on the bolt head in Figure 4 is identifiable by bulky white deposits of porous zinc oxide or zinc hydroxide resulting from an electrochemical reaction with oxygen dissolved in droplets of water. Zinc oxide begins forming at the outer edges of water droplets where the concentration of dissolved oxygen is higher than in the bulk of the droplet.

Where corrosion in the absence of water droplets forms a uniform protective layer, corrosion at the edges of water droplets forms an uneven porous layer having a reduced ability to provide further protection and consequently corrosion ensues. Zinc oxide formed, quickly reacts with atmospheric carbon dioxide to form a basic carbonate commonly known as wet-storage stain.

The lack of any highly corrosive substances such as salts and acids together with water markings on some components suggests corrosion of the mowers is due entirely to the presence of water which appears to have been introduced prior to packaging.

To discuss your materials analysis needs please call Trevor Rowlands on +61 3 9574 6144 or email [trevorrowlands@attar.com.au](mailto:trevorrowlands@attar.com.au)

Please click here for further information:  
- [Materials Failure Analysis](#)



Figure 1: Severely corroded mower blades



Figure 2: White deposit found on polyethylene packaging wrap also seen on numerous corroded components

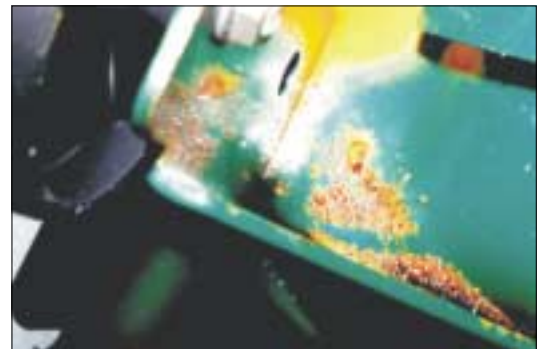


Figure 3: Corrosion products found on mower housing. Note the light markings indicating that water actually sat in this area of the housing.

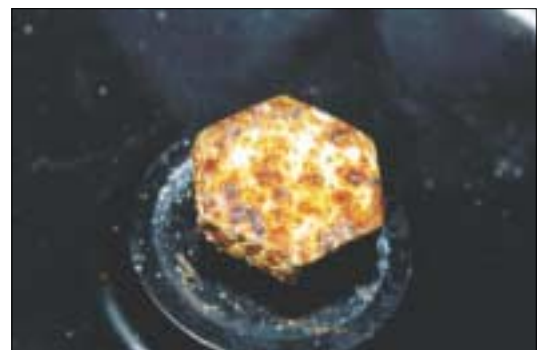


Figure 4: Corroded Bolt head together containing a white deposit together with brown coloured rust.

# Staff on View

## Steven Potts - Slip Testing Technician

We would like to welcome and introduce to you our newest member of the ATTAR team. Due to the increased demand for ATTAR's independent slip resistance testing services we have recently appointed Steven Potts in the full time role of Slip Testing Technician.

Steven has joined ATTAR after completing his Advanced Diploma in Engineering Technology. He has a very technical mind with a keen interest in understanding how things work. This is highlighted through his

passion for cars and motorsport. In addition to working as an official at various motor racing events such as Phillip Island and Sandown, Steven can be found in his off time tinkering on his pride and joy, his old and rare 1964 Mini Van.

For all of your Slip Testing requirements Steven can be contacted on +61 3 9574 6144 M. 0434 674 626 or [stevenpotts@attar.com.au](mailto:stevenpotts@attar.com.au)



## Jon Fedje - NDT Trainer and Consultant

Hi, my name is Jon Fedje and I've recently joined Attar as an NDT Trainer and Consultant.

I was born in Chicago, USA and travelled extensively whilst growing up as dad was in the U.S. Navy. Having spent my teenage years in the tropics (Hawaii), the ocean is my first love, so if an opportunity to windsurf comes up, and my loving family agree to cut me loose, you'll know where to find me.

My working life has been rewarding and diverse. I began working as a Violin Bow maker in Portland, Oregon and trained under a famous Frenchman.

I have put my hand to a variety of tasks over the years, including some specialised roles as a welder, and I also became involved in a business partnership developing and fitting

out Australian Embassy's and Consulates throughout the world with physical, bullet and attack resistant barriers. This was a very rewarding and fulfilling occupation with the added benefits of seeing parts of the world I never would have otherwise visited.

My welding experience payed off when I was asked around six years ago to carry out some NDT as a contractor. From that day on I have found it a fascinating occupation, packed with challenges, and one that I am constantly learning from. I have obtained AINDT qualifications in four methods whilst working for Bureau Veritas (formerly Intico).

I have settled in Berwick, with my wife Lyn and 2 daughters; Eden 9 and Sasha 6 – plus I have a son Luke 24 and another daughter Pam 21, from my first marriage. My son



Luke is a qualified electrician, and father to Austin, 3, making me a Grandad, which I still have to pinch myself about.

Joining ATTAR as a Trainer is very exciting and I look forward to getting my teeth into this role and the challenge ahead to ensure I can deliver the same quality training ATTAR has provided me with over the years.

## Baby News!

### Another addition to the ATTAR family

Malcolm and Carol are proud to announce the safe arrival of Montgomery Kenneth Oakey on January 13th 2009. Being two weeks overdue Monty weighed a very healthy 9 pounds 14 ounces and we are told he is growing rapidly.

Congratulations from all the team at ATTAR.



## Happy Trails Update

You will remember from our last newsletter that ATTAR's Marcus Braché and his four man team "A Short Stroll" was training hard for the Oxfam Trailwalker 100km charity team event on 27th March 2009. The team goal was for all four walkers to complete this gruelling challenge in under 24 hours. We are happy to announce that Marcus and two of his three team mates successfully completed the walk in 22 hours and

43mins and managed to raise just under \$3,000 in the process for this worthy cause. Marcus is back on his feet, albeit a bit shakey and informs us that the blisters are healing nicely.

The final result was that "A Short Stroll" were placed 139/714 teams. Congratulations to Marcus and the team for a fantastic effort.



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