The official journal of the Vibrations Association of New Zealand

Spectrum

Summer 2026 | Issue 118

Control of Building Vibration with Dynamic Absorber

The lowdown on Brake Fluids

+ CONFERENCE 26

19th - 21st May 2026

Huntly Power Station...

Accelerometer Power Supply Error, *or* 'Don't make assumptions!'

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Plant Condition Monitoring

Plant Condition Monitoring | Network & Control | Process Sensors | Positioning

ifm offers a comprehensive range of industrial digital vibration monitoring equipment and field-bus interface modules. Ex-stock NZ! IO-Link technology provides 3-axis monitoring that can be turned into actionable insights using moneo your (AI) co-pilot. German quality - supported by local automation engineers. This solution is used by NZ's biggest exporters, who realise significant savings.

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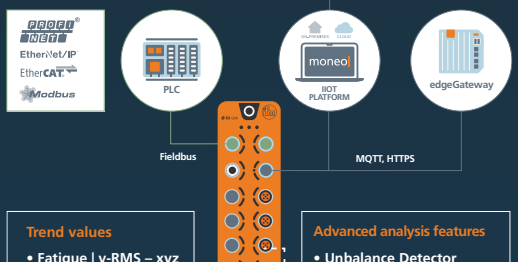

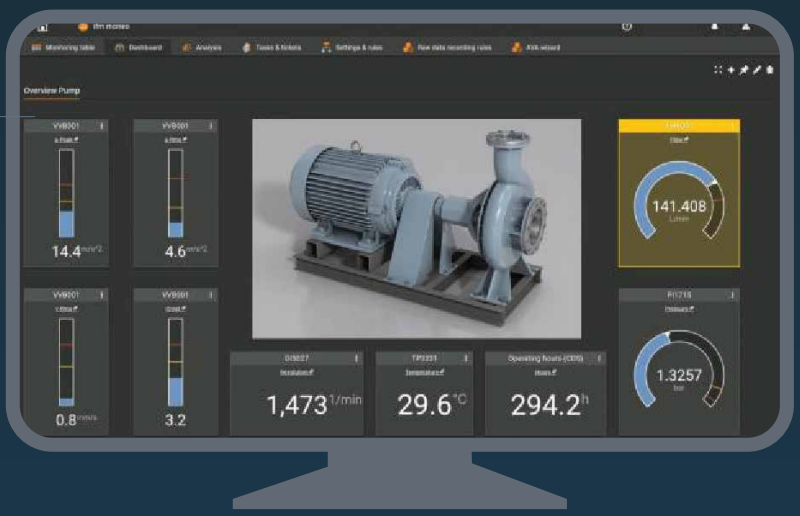

moneo: Your maintenance co-pilot

Trend values
- Fatigue | v-RMS – xyz
- Impact | a-Peak – xyz
- Friction | a-RMS – xyz
- Crest – xyz
- Surface temperature

Advanced analysis features
- Unbalance Detector
- BearingScout™*
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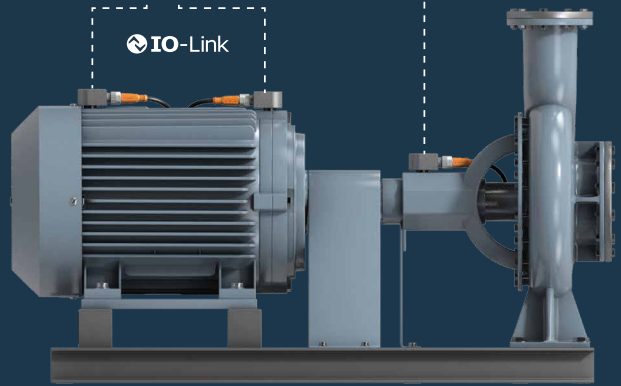

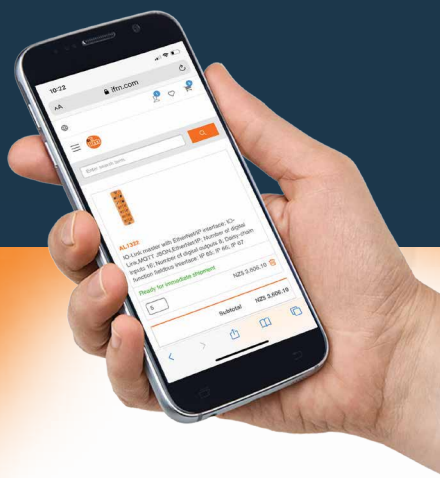

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Spectrum

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Spectrum is published by the Vibrations Association of New Zealand (VANZ). The magazine is produced in a quarterly cycle annually in both digital and printed mediums.

The magazine is designed to cover all aspects of the Vibration, Condition Monitoring, Reliability and the wider Predictive Asset Management field and distributed to all VANZ members, including corporate members.

Missed an issue?

Simply scan the QR code here to link your device directly to the VANZ website. There you will find Spectrum issues available to view or download*. You can also access previous issues by visiting our website online at: **www.vanz.org.nz**

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PRESIDENTS' REPORT

By Tim Murdoch | VANZ President

2026 Is upon us and for me it already feels like Christmas and the New year was some time ago. I trust that everyone enjoyed the recent Christmas and New Year period. A time to rest, celebrate, get outdoors and reconnect with family and friends. I hope you were able to take a well-deserved break and spend quality time with those who matter most to you.

Late 2025, we reached an important milestone with members gathering for a Special General Meeting to vote in our updated constitution. I'd like to extend my sincere thanks to everyone who attended and cast their vote. Especially thankful to our VANZ committee who worked hard to bring this all together. With the new constitution now formally agreed upon, we can reregister VANZ to comply with the updated requirements in the Incorporated Societies Act.

It is with profound sadness that we remember Simon Hurricks, whose recent passing has left a deep void in our community. Simon was a passionate advocate of VANZ, he even spoke at the first annual workshop May 1990 on balancing flexible rotors in low speed balancing machines. Almost every conference since then had a presentation by Simon, in fact I believe he may have only missed one conference. Simon also held Officer positions within VANZ. He always gave great advice on work issues raised by delegates and was always very engaged with delegates. Simon, you will be missed and thank you for your dedication to VANZ.

Just over 3 months away we will be holding our 2026 conference in Rotorua at the Rydges Hotel, 19-21 May. Have you locked in your ticket yet? Do you have a paper to present? Would you like to exhibit? If you do, please get in touch with Angie at secretary@vanz.org.nz.

This conference will be a fantastic opportunity to share knowledge, learn new things, meet new likeminded people, see new products exhibited and deepen our professional connections. Be sure to get in early!

Keep up to date with the latest announcements by connecting with us on LinkedIn and Facebook.

VANZ

PRESENTS

ROTORUA

AT RYDGES HOTEL

19–21 MAY 2026

THE NO.1 EVENT IN THE VIBRATIONS ASSOCIATION CALENDAR IS BACK IN 2026.

CONFERENCE 26

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CALL FOR PAPERS

ROTORUA 2026

The VANZ Conference is a place for learning and sharing!

- **Have you ever had an experience that you think others would benefit from?**
- **A case study that went right or wrong?**

We can all learn from our own experience, but we can avoid a lot of problems if we learn from other people as well!
That is what VANZ is all about.

You could talk for just 15 minutes (or longer if you like), we would love to hear from you.

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FOR FURTHER INFORMATION, CONTACT US TODAY:

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Conference'26

RYDGES ROTORUA

Registration Options

19th - 21st May, 2026

1-Day Registration — TUE 19th MAY 2026

All conference pricing excludes GST.

Package	PRICE PER PERSON
Condition Monitoring Hands On	$398
Condition Monitoring Hands On – Attendance to verified apprentices / trades trainees / university	FREE!
Asset Management	$398

2-Day Registration — WED 20th - THU 21st MAY 2026

Package	PRICE PER PERSON
1-Day Conference Pass – Wednesday ONLY	$510
2-Day Conference – Wednesday and Thursday ONLY	$1020
2-Day Conference – Attendance to verified apprentices / trades trainees / university	50% OFF! $510

3-Day Registration — TUES 19th - THU 21st MAY 2026

Package	PRICE PER PERSON
1-Day Conference Pass – Thursday ONLY	$510
3-Day Conference – Full access Tuesday, Wednesday and Thursday	$1,185

Booking is quick, easy and hassle free!
Visit our website www.vanz.org.nz
or simply scan the QR code below.

Note. Day 2 and 3 registrations includes the annual Wednesday dinner for the delegate.

There will also be provision for extra annual dinner attendee purchases at $140 per person.

- ***Complimentary parking available at venue.***
- ***All conference papers available to download from www.vanz.org.nz.***
- ***A one (1) year membership with VANZ is included with Main Conference (2 or 3-day) attendee pass.***

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A full year is still only $110/pp

It's really easy to renew your existing membership or join up with us for the first time too!
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Conference'26

RYDGES ROTORUA

Exhibitor Packages

19th - 21st May, 2026

All conference pricing excludes GST.

Package	Gold	Silver	Bronze
Price	$3,455	$2,495	$1,815
Platinum naming rights of conference			
Platinum primary sponsorship on key online & offline promotional material before and during conference*			
Platinum official role at the opening of the conference and five minute speaking opportunity			
Trade stand that offers sponsors the opportunity to showcase products, services and ideas	Premium	Standard	Table
Signage opportunities at conference & dinner			
Pre conference Spectrum advertising opportunities (early registrations only)	✓		
Acknowledgement as sponsor & vendor	✓	✓	
Company literature in delegates goodie bags	✓	✓	
Brand on conference programme (early registrations 1 month before event)	✓	✓	✓
Sponsorship on key online & offline promotional material before and during conference**	✓	✓	✓
Logo on VANZ conference publications & website***	✓	✓	✓
Post conference Spectrum advertising opportunities	✓	✓	
Conference entry for staff	x2	x1	x1

Booth size (Platinum and Gold)	1.8 x 3.0 metres
Booth size (Silver)	1.2 x 2.4 metres
Table top size (Bronze)	1.8 x 0.6 metres

*Website** *Animated landscape panels @ 460px wide x 200px high*
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*Logo file**** *To be supplied as either a vector eps or hi res tif/png/jpeg*

Files to be supplied to specifications.

Further Sponsorship Options

Networking Session Sponsor (Tuesday night)	$2,000	Lanyard sponsor	$520 + lanyards
Networking Session Sponsor (Wednesday night)	$2,000	Bag sponsor	$520 + bags
Dinner Sponsor	POA		

Note. All exhibitors have the annual dinner included for the number of delegates associated with the respective category. *Example: Gold 2 delegates, Silver 1 delegate, Bronze 1 delegate.*

There will also be provision for extra annual dinner attendee purchases at $129 per person.

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Welcome to ROTORUA

Rotorua is host city for the VANZ Conference in 2026. Here is a bit of history about the region you may not know...

Rotorua is a city in the Bay of Plenty region of New Zealand's North Island. It is sited on the southern shores of Lake Rotorua, from which it takes its name. It has an resident population of approximately 60,000, making it the NZ's 13th largest urban area, and the Bay of Plenty's second-largest. Tauranga being larger.

Rotorua is a major destination for both domestic and international tourists. It is known for its rich Māori culture, geothermal activity and geysers – notably at Whakarewarewa, and hot mud pools. The thermal activity is sourced to the Rotorua caldera, in which the city lies. Rotorua in recent years has bcome a magnet for thrill seekers and adverturers alike with world renouned mountain biking trails and outdoor pursuits high on the agenda.

The Rotorua region has a total of 17 lakes, known collectively as the Lakes of Rotorua. Fishing, waterskiing, swimming, picnicing and other activities are popular in on these lakes year-round. Several of the lakes are stocked for sports fishing with trout released from the hatchery found at the neighbouring town of Ngongotahā.

HISTORY

The name Rotorua comes from the Māori full name for the city and lake, which is Te Rotorua-nui-a-Kahumatamomoe. Roto means *'lake'* and rua means *'two'* or in this case, *'second'* – Rotorua thus meaning *'Second lake'*. Kahumatamomoe was the uncle of the Māori chief Ihenga, the ancestral explorer of the Te Arawa. Rotorua was the second major lake the chief discovered, so decided to dedicated it to his uncle.

Te Arawa Māori first settled in Rotorua in the 14th century, and a thriving pā was established at Ohinemutu by the people who were to become Ngāti Whakaue. The city became closely associated with conflict during the Musket Wars of the 1820s. Ohinemutu was invaded by a Ngāpuhi-led coalition in 1823, commanded by Hongi Hika and Pōmare I.

In the 19th century early European settlers had an interest in developing Rotorua, because of its unique geothermal activity. Then, efforts by Māori and Europeans alike to establish Rotorua as a spa town led to a 99-year lease of land from Ngāti Whakaue to the Government. The city first became a major site of tourism due to the close proximity to the nearby Pink and White Terraces, until they were destroyed by the volcanic eruption of Mount Tarawera in 1886. Rotorua was elevated to borough status in 1922 and to city status 40 years later. ■

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A useful idiot's journey:

Lessons in humility, metal, and mistakes

By Conference '26 keynote speaker, Barry Robinson.

The organisers of the upcoming VANZ conference asked me to present my failure prevention and material awareness messages to their wider audience. I'm honoured and humbled by the request, because I know almost nothing about vibration. I know a little bit about metal stuff. Actually, I may only be a useful idiot.

As a clever young engineer, I tried to impress a girl by "fixing" her mother's washing machine that was not spinning. After tightening the loose bolts on the drive pulley I jammed out the switch on the lid so I could physically see the bowl spinning at high speed. But to test whether the pulley would work under load without slipping, I thought I'd drop in one of the heavy sodden towels I'd pulled out earlier. The problem was I decided to add the stationary load to the 1400 rpm bowl. It's true that violent accidents seem to happen in slow motion. It was frightening to watch the entire washing machine suddenly begin rotating in the small laundry space. The open lid snapped off at the hinges. I can still see the electrical faceplate snapping and TPS wiring ripping out of the wall as the entire machine rotated. It wasn't the outcome I had been hoping for, and I departed hurriedly minutes afterward feeling very stupid. I never saw the girl again.

Was I useful? Questionable. Idiot? Definitely!. Humility, I've slowly learned many times, is good. It's what keeps us open to learning new things.

I've learned a lot about making and breaking stuff in my career. About 19 years ago I realised that many of the costly mistakes engineers were repeating could be prevented by the things I'd learned through bitter experience and mistakes. It is those learnings and cross-connections that I will be sharing at VANZ 2026.

Experience is incredibly valuable. In my case, my qualifications have very little relevance to the last 30 years of my career. I am a trade-qualified Toolmaker who has done embarrassingly little toolmaking. I gained the industry-valued New Zealand Certificate in Mechanical Engineering (NZCE mech), but it's learnings have been of limited application to my career path. I gained a Marine Engineer 3rd Class qualification in Steam, but have never operated a boiler.

I have never been to university.

In 1985 I got escorted off my first job as a Design Engineer Cadet for NZ Steel at Glenbrook, because at 18 years old I already clearly understood the incredible value of hands-on experience. I defended my values and got walked off the job that same day. The agreement with their Design Engineer Cadet program was that after spending a year studying at a Technical Institute, Cadets would spend the next 2 years rotating in 3 or 4 month stints through each of the various plants around the Mill, gaining experience. This included the Iron Plant, Steel Plant, Rolling Mills,

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Coil Coating, Pipe Plant, the Design Office (a soul-stealing place for a keen young lad in 1984), and the Apprentice Training Workshop (a fantastic place run by the awesome Bill Bellian). In conjunction with the 2 years in the various plants, us NZCE students would also spend 1 day and 1 night a week at the Technical Institute.

Doesn't this sound like an amazing time and education for a keen young engineer? But in January 1985 when the time came to start my plant experience the management called me in for a meeting. They were cancelling the plant experience, and I would instead spend at least the next 2 years in the Design Office. Why? Because apparently when the Cadets got out into the plants they got into alcohol and drugs and gave up on the Cadetship. This was understandable, judging by some of the parties I had witnessed.

With several depressing weeks in the Design Office fresh in my memory, I explained that the loss of the hands-on experience would be very damaging to my education, and that the alcohol and drugs held no interest for me. It was a long discussion. I was told it was "not a negotiation". So I reluctantly tendered my 30-days notice of resignation. After a lot more discussion I was told "we don't need your 30 days, Barry. You can leave now". Oh. This was a classic unintended consequence, a fast-forward to the very thing the Steel Mill were trying to avoid.

I promptly joined my father's hot-forging and heat-treatment business full-time and continued my NZCE uninterrupted. I had been working in the plant occasionally since I was a wee lad of course, and not always voluntarily! Dad insisted I begin an Apprenticeship in addition to my NZCE. Unfortunately, Blacksmithing was no longer available as a Trade in New Zealand, so Toolmaking was chosen as it offered what we considered to be the next most suitable mix of skills.

The family engineering business in Drury (South Auckland Forgings Engineering or SAFE) was the absolute best place to learn about making things in metal. We operated big forging presses, drop hammer, power hammers, upsetters, rolling mills, swaging machines, a casting shop complete with centrifugal casting machines, lots of big heat-treatment furnaces and quenching tanks, high-frequency induction heating and melting furnaces, a metallurgical laboratory, toolroom, machining shop, and of course the welding bay. All of this was in the one modest-sized facility on the family farm in Drury, and run by between 5 to 12 people.

You can understand what an amazing place this was to learn in. We could (and frequently did) make almost anything. There is not an industry sector in NZ that we didn't supply. We did the hard stuff, things nobody else wanted to even consider. We almost always said yes to an enquiry, and then set about trying to figure out how. The method depended upon the quantity required. A new product meant only a few prototypes were needed now, with volume growing slowly. Often the manufacturing method changed completely as the quantities required increased. This was a great experience for me, figuring out methods and costings. It made quoting a real headache, because you had to spend hours thrashing out methodology just to be able to give a ball-park price.

Continued over page >

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Over the 4 decades of my manufacturing career I gained a lot of experience and a few skills in a great many areas. I am the classic Jack of All Trades, but master of none. I have spent my life in a hot-forging shop, but I'm a long way short of a Blacksmith.

I've spent my life heat-treating and doing metallurgical investigations, but I'm miles short of knowing what a Metallurgist knows. It's true I'm a time-served and qualified Toolmaker, but I'm embarrassed to call myself a machinist. I can weld, sort of, but I would never ever call myself a welder. I'm pretty good on a hammer or press, I have to say. I just love making bent things straight – it's a special skill that I'm very proud of, but this skill has very limited demand! I've spent some years playing around with titanium powders and helping create some fun new technologies.

Out of that I'm incredibly proud to be a founding director of RAM3D who do full-strength metal 3D printing. This technology is seriously going places. Serious places. But after decades of making critical high-strength parts by hot-forging, I took a while to understand how the mechanical properties of RAM3D's printed metal could be on a par with forged parts. I'll explain how at the conference.

Over my 4 decades of making stuff I have learned a great many lessons about unintended consequences, how certain things we do to metal can have really bad results down the track. There's a huge amount of interconnectivity of actions and consequences. Here's a few examples:

Someone had a great idea to make the part thinner to create less drag, while increasing the strength of the material to compensate. But nobody thought about the major hassle that would create with welding the part into the vessel. That cost an extra 3 months on the project.

A method for making a metal part was chosen without being fully thought through. Much time and money was invested in the method, but it was a costly failure. It was never going to work, because the method simply was incompatible with the most important requirement of the finished part. The supplier swore their material certificate was legitimate (and they were correct), but the lab tests kept failing. What or who was the problem? That newly-welded part that's cracked already? It hasn't even been finished yet. Classic.

Some material was ground off brand-new metal parts, just to get them to fit on site, but after a short time in service they broke apart. The client blamed the supplier and refused to pay for them. But the investigation evidence clearly showed the grinding created microscopic cracks that became massive cracks in service. A powerful waterblaster was used to remove substandard concrete from a new structure, including around the reinforcing steel, ready to pour good new concrete. But one of the rebars broke off and many others bent, affecting their seismic properties. Those properties had to be restored in-situ.

I'm a slow learner, taking years to make some connections between action and results. But I really enjoy passing on my learnings to engineers. I'm passionate about it. ■

Barry Robinson is our Keynote Speaker at Conference '26. Be sure to register your place at the conference to hear more from him!

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EDITORS' CORNER

By Angie Hurricks | Spectrum Editor

A very Happy New Year to all our readers/VANZ members/advertisers and other supporters, we hope the festive season was a chance for a good break with fun, sun and family.

We are now gearing up for this years' conference with committee members buzzing around like busy bees trying to organise venues, accommodation, presenters and everything else that goes into putting together a conference.

One of our founding members Simon Hurricks passed away in December 2025, he was a Lifetime Membership recipient, presented a record number of conference papers, always put an article together when harassed by the Editor over the years, long time committee member serving as President, VP and Treasurer and Papers Organiser amongst other various duties. In tribute to him we're publishing a last article, Accelerometer Power Supply Error for our readers enjoyment.

In this issue you can also read up about Control Of Building Vibration With Dynamic Absorber from Ray Beebe, the words of wisdom for the New Year from our President Tim Murdoch and puzzle your post-holiday brain with the first quiz of the year from Carl. Many thanks go to our advertisers who continue to support us, it's very much appreciated as we head into 2026 and gear up for another amazing conference.

Best wishes for a prosperous year and happy reading.

> **We are gearing up for this years' conference with committee members buzzing around like busy bees organise everything.**

IN MEMORIAM

Simon Hurricks

26 September 1951 – 8 December 2025

The VANZ community would like to pass on their sincere condolences to Simon's extended family during this difficult time.

Simon was a devoted and active member of VANZ for many years, always willing to giving up his time for committee duties, conferences and much more. Simon's involvelmet with VANZ over the years was immense and his quick wit and sharing, caring nature and will be greatly missed by all.

Simon loved family time, his wife of 50 years - Claire, and was an avid fisherman. He was also the recipient of the Peter Burgess Award for Best Paper at the VANZ Conference in 2009.

Conference'26
SPEAKER BIOS

Speakers Mike Davis, Iain Epps and Julien Maffre give a little insight into themselves and the papers they will be discussing at the VANZ Conference 2026 in May.

MIKE DAVIS

PAPERS

"Inside the Electric Motor: Understanding Failure Before It Fails" Part 1: Anatomy and Failure Mechanisms
(30 minutes)

This session introduces the structure and operating intent of a typical slipring induction motor through an FMECA lens. It systematically breaks the machine down into its major electrical, mechanical, and auxiliary components—stator winding and core, rotor and sliprings, brushes and brush gear, bearings, cooling system and insulation systems—linking each component to its functional role in torque production, current transfer, thermal control, and mechanical integrity. For each component, the dominant failure mechanisms are explored, including insulation ageing, contamination, thermal overstress, mechanical wear, loss of contact pressure, vibration-induced damage, and environmental influences. The session establishes how these mechanisms initiate and interact over time, setting the foundation for understanding how apparently minor degradations can progress toward forced outages or catastrophic failure.

Part 2: "Detection, Degradation Tracking, and Mitigation"
(30 minutes)

Building on the failure mechanisms identified in Part 1, this session focuses on how developing faults can be detected early and managed effectively. It maps common degradation modes to practical detection methods such as visual inspection, insulation resistance and PI testing, impedance and balance measurements, thermal imaging, vibration analysis, partial discharge (where applicable), brush wear trending, and operational performance indicators. The session then links these detection techniques to targeted maintenance actions, ranging from condition-based interventions and consumable replacement through to design or procedural improvements that reduce recurrence. Emphasis is placed on using FMECA outputs to prioritise maintenance effort, align inspection frequency with risk, and shift from reactive repair to proactive control of failure mechanisms across the motor's lifecycle.

ABOUT MIKE

With over 50 years experience in rotating equipment, essentially centred on the repair, redesign and maintenance of electrical rotating plant, Mike has developed an intense academic interest in machine failure mechanisms and root cause analysis of electrical machinery failure and has presented papers throughout Australia, New Zealand, United States of America, South East Asia and South Africa. For more than 20 years Mike developed tailored machines training courses which were presented to end-users in USA, NZ, Australia, South Africa, Indonesia, Singapore and Malaysia.

IAIN EPPS

PAPERS

"AI: A Cynics Journey" Part 1: Understanding the Fundamentals
and
"AI: A Cynics Journey" Part 2: Getting the Most from Technology

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ABOUT IAIN

Iain is the Managing Director, Mobolo Technology Ltd, NZ, after completed a PhD in Vibration Monitoring of Rolling Element Bearings Iain embarked on a successful career leading software and new technology development in transport, finance, business services, agritech and hydropower.

In 2015 Iain returned to the area of his PhD research and formed Mobolo Technology to developed and commercialize an exciting new approach to severity measurement in rolling element bearings. Last year in 2025 he received a patent for his Bearing Monitoring Method and System.

JULIEN MAFFRE

PAPERS

1. AI won't replace maintenance... yet (But it will change how we think, decide, and perform)

Beyond the well-known predictive models used for vibration analysis, what can we expect from AI in the coming years (LLMs, robotics, expert systems, etc.), and what is the future of the maintenance team?

2. Anatomy of Asset Performance (Exploring the Brain, Nervous system and Muscle behind high performing maintenance team)

After decades of heavy focus on CMMS implementations, what do we understand about Asset Performance. How do we now integrate expert systems / monitoring platforms to work execution. How do we reflect, learn and drive strong Asset Strategies.

ABOUT JULIEN

A thought leader in Asset Management, Julien has accumulated a wealth of knowledge throughout his career – in a wide variety of industries including Dairy, FMCG, Water treatment, Petro chemical, Pulp & Paper, and Mining. He has a sound reputation for his expertise in the maintenance of physical assets.Improving maintenance processes and implementing new maintenance systems are his passion. He specialises in planning and scheduling, reliability analysis, preventive maintenance activities, and asset information management; while always striving to generate advancements in these fields with innovative ideas. ■

Brake Fluids

While everyone can recognise that brakes are important on our motor vehicles and the mobile equipment around the plant, it may not be so obvious that brakes, and brake fluid, are also critical to the safe operation of our overhead cranes.

Some things you should know about brake fluid...

- Brake fluid is made to a US Department Of Transportation (DOT) standard.
- The common fluids are DOT 3, DOT 4, and DOT 5.

	Fluid Type	Minimum dry boiling point deg. C	Minimum wet boiling point – 3% moisture
DOT 3	poly glycol ether	205	140
DOT 4	poly glycol ether with borate ester	230	155
DOT 5	silicone	260	180

While it is not important to understand what these compounds are, it is important to understand that they are DIFFERENT and are NOT interchangeable. The only exception is that Dot 4 can replace DOT 3 in some applications.

Note also that they are NOT compatible with mineral oils. Using a mineral oil or the wrong brake fluid will result in problems such as swelling of seals and ultimate failure of the braking system. On an overhead crane this may result in serious injury or damage.

At Western Port we use only DOT 4 brake fluid in our cranes.

DOT3 and DOT 4 fluids are hygroscopic, which means that they absorb moisture. This results in the fluids boiling point reducing over time. This is a critical safety issue because if the fluid boils it becomes compressible and the brakes will fail to operate. Because of this moisture absorption issue, it is necessary to replace the brake fluid on a scheduled basis. At Western Port, the brake fluid on our cranes is replaced at the annual major service. Replacing the fluid also removes moisture that corrodes brake system components.

- Do not use brake fluid from containers that have been left unsealed.
- Brake fluid containers that have been opened and resealed have a shelf life of only 12 months.
- Brake fluid must be dispensed from the manufacturers original container directly into the brake system. Use containers that have small quantities of fluid, otherwise a lot of the fluid may end up going to waste. At Western Port we have 2 sizes in our stores system, 500ml (m/n 10172939) and 4 litres (m/n 10173378). We no longer accept 20 litre drums!
- Do not, under any circumstances, decant brake fluid from one container to another. It is essential to avoid contamination. Even dipping a greasy finger into the fluid is enough to contaminate the fluid and affect brake performance.

Above: Figure 1.

Right: Figure 2.

Other things to remember

- Clean the master cylinder BEFORE removing the cap. This must be done to prevent contamination
- Never reuse brake fluid.
- Never mix types or brands of brake fluid.
- Reseal the master cylinder and the fluid container as soon as possible in order to reduce moisture absorption.

Article prepared by Rod Bennett.

If you suspect that the fluid in your system has been contaminated, or that the wrong fluid has been used, there are a few simple field tests that can be applied.

The first test is to look at the colour of the fluid and compare it with a new sample. If they don't match, flush the system. If it is difficult to see the colour of the fluid, take a sample using a thief pump (m/n 10088473) and a clear sample bottle (m/n 10173508).

Another test is to compare the viscosity of your sample to that of fresh fluid. Viscosity is a measure of how thick the fluid is. Draw a small sample of both fluids into clear containers and observe whether there is a difference in how they flow. Brake fluid is very thin, whereas mineral oil is thicker and sticks more readily to the sides of the sample bottle.

If you allow your sample to stand for a short period and you find that you are getting 2 or more layers like in the coke bottle example at the top of this page, then you definitely have contamination.

It is also possible to tell whether you have brake fluid or mineral oil by the smell of the fluid. Brake fluid has a particular smell that is very different to mineral oils. ■

Above: Figure 3.

Above: Figure 4. Clean the master cylinder before removing the cap.

Right: Figure 5. Do not decant brake fluid from one container to another.

> **Viscosity is a measure of how thick the fluid is. Brake fluid is very thin. Mineral oil is thicker and sticks more readily to the sides of the bottle.**

FEATURE

Accelerometer Power Supply Error, or ‘Don’t make assumptions!’

In 1995 Huntly Power Station installed an “On-line” monitoring system (B&K Vibro Compass) on all four 250 MW turbo-alternators. All 12 bearings on the main machines and 8 bearings on the main boiler feed pump had standard 100mv/g accelerometers fitted. The accelerometers were powered by 8 channel constant current power supplies which feed the acceleration signal to the monitoring racks.

In 2010 the monitoring racks on Unit 2 and 4 were up graded to the new VC6000 system. As these racks did not provide accelerometer power the existing power supplies were retained.

In order to prevent spurious trips the DCS control system requires at least 1 other transducer to be in alarm before a trip is initiated. i.e. to ensure the problem is genuine and not just a transducer fault.

FAULTS

By 2016 a number of transducer faults occurred which manifested themselves initially as very high vibration levels which spiked to values of 400 mm/s and higher. This level of vibration is difficult to achieve especially when the unit was stationary. Investigations revealed that the spectrum of the defective channels had large amounts of low frequency “noise”. Fortunately, we had a number of spare channels and a number of spare power supplies from the decommissioned unit 3.

By 2017 we had not only used all the spare channels but the spare power supply modules as well. It was decided to replace the accelerometer power supplies with standard single channel modules on all three operational units, a total of 60 modules.

We installed these on unit 4 (which had the updated VC6000 monitoring racks). We immediately ran into a problem as the rack transducer “OK” indicators all showed the transducers as faulty. We then checked several channels using an independent instrument and

Continued over page >

Article prepared by Simon Hurricks.

EVIDENT

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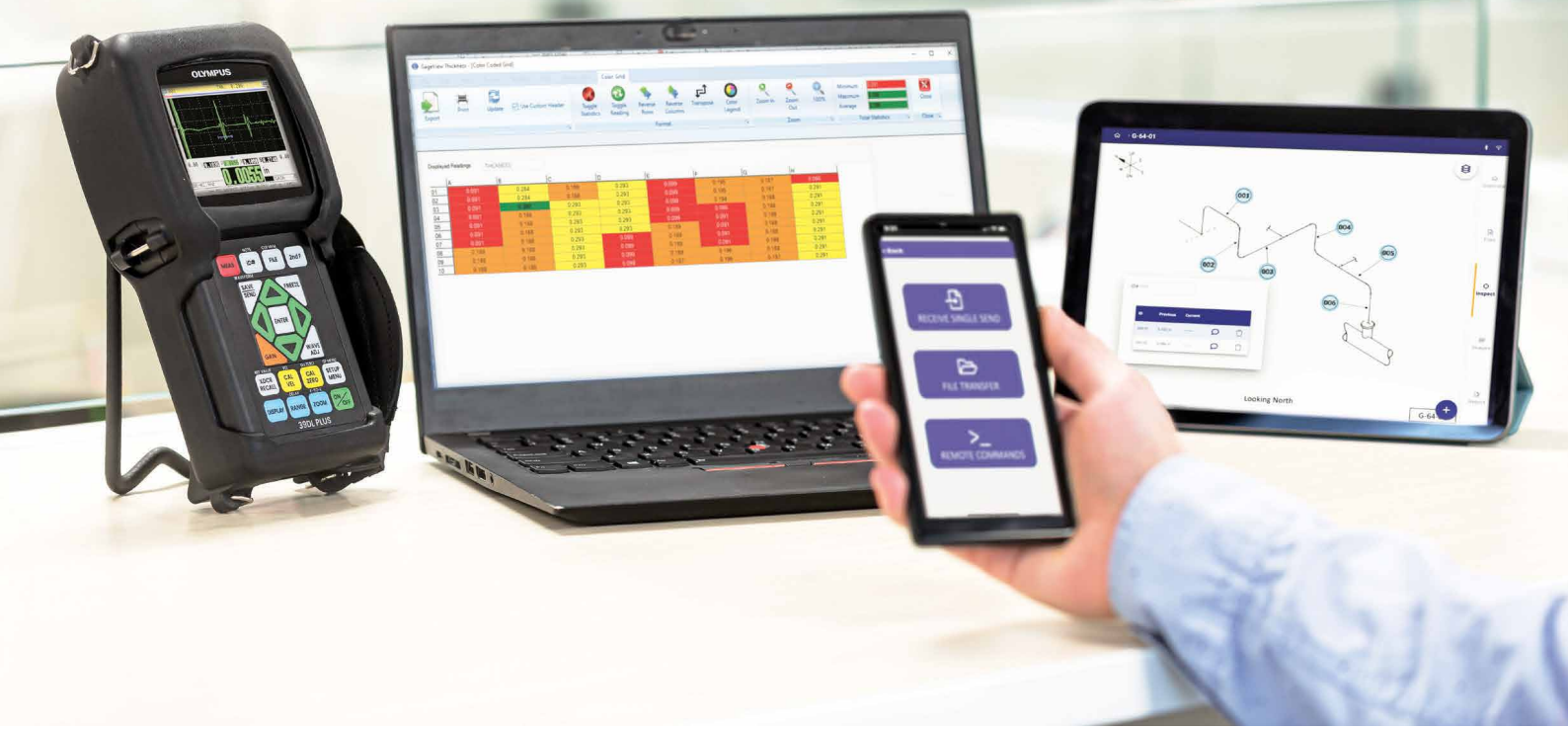

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this indicated that the accelerometers were all working normally. On checking the accelerometer set ups in the configuration it was found that the accelerometer channels required a DC offset voltage of between -5 and -10 volts. On checking the output of the old power supplies we found that they did indeed have a DC offset voltage of around -8 volts.

The reason for the offset voltage was to enable monitoring of a possible power supply fault.

TRANSDUCER BIAS VOLTAGE

Normal ICP (integrated circuit piezo-electric) accelerometers are typically powered with a 4ma constant current 18 Volt DC. The connection to the measuring instrument is normally AC coupled through a 10µF capacitor as per fig.2. The decoupling capacitor removes the DC bias voltage and the instrument is therefore only measuring the AC vibration voltage.

SIMPLE SOLUTION?

There was an obvious simple solution to our DC bias voltage problem, simply change the transducer configuration in software to allow a 0 Volt DC bias.

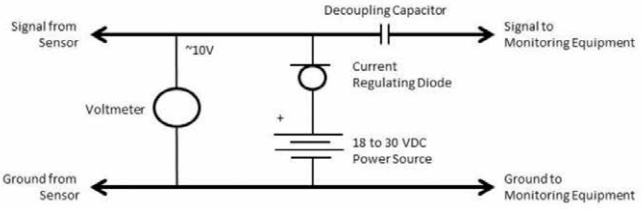
Unfortunately, the area in the setup was greyed out i.e. not changeable. On checking with the manufacturer, we found out that even if we upgraded the module firmware we would still have a problem as in our particular version of the module the bias voltage was set up in hardware. To remedy this, we would have to buy new modules or alternatively buy new multi-channel power supplies with the bias voltage. Both of these options were quite costly.

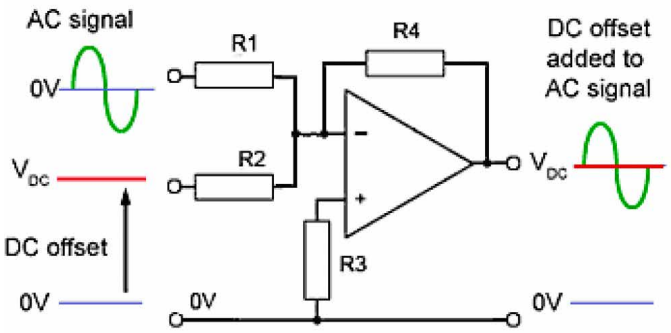
INTERNET SEARCH

An extensive Google search for "Adding DC bias voltage to an AC signal" revealed numerous options many requiring OP amp IC chips such as the one in fig.3.

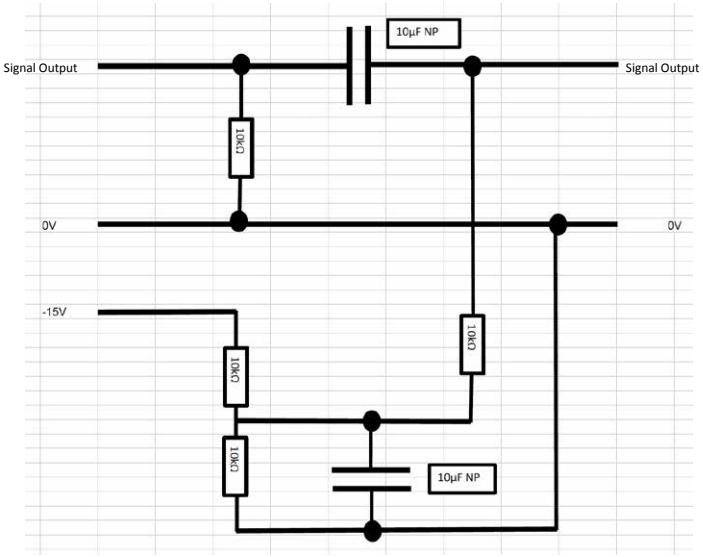
IP Turbine\Accel 3 (2A)	
Channel	
Machine Name	Turbo Alternator
Channel Name	Accel 3 (2A)
Input Socket Location	2A
Enable	Yes ☑
Channel Type	Case (Dual-ISO)
Additional Measurements	Rotor Dynamics
Sensor Settings	
Sensor Model	User Defined
Sensor Type	Accelerometer
Mounting Angle	-45 °
Sensitivity Unit	mV/m/s²
Sensitivity	10 mV/m/s²
Channel Unit	m/s²
OK High	-2 V
OK Low	-18 V
AC signal range	20 V
Zero Offset	-10 V

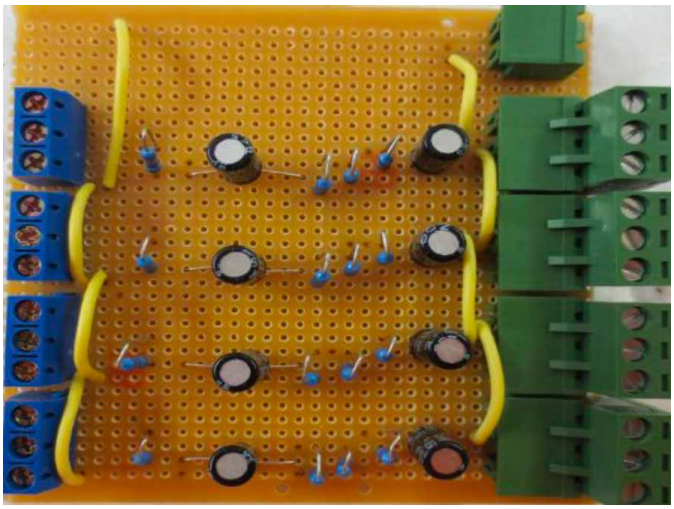
Above: Fig.1. Transducer set up window. Below: Fig.2.





Left: Fig.3. Below: Fig.4. Bottom: Fig.5. Finished 4 channel board.





As a one off circuit this would be feasible but we were requiring 60 identical circuits. One we did find is fig.4

This circuit has four 10K Ohm resistors and two non-polarised 10µF capacitors, component cost around $2. With a 15 Volt DC power supply this circuit puts a 7.5 Volt DC bias into the measuring instrument and also decouples this voltage from the accelerometer power supply.

We made up four of these circuits on a piece of Vero circuit board and made 5 boards for each unit which have the power supply daisy chained together. All connection are via plugs or screw terminals so easy to change out if required.

CALIBRATION CHECK

To ensure we were getting the same AC signal out as the one we were trying to measure we set up two accelerometers on a calibration shaker table, one measured using the above circuit and one directly into a data collector. Both outputs were identical in both amplitude and phase. ■

FEATURE

Control of Building Vibration with Dynamic Absorber

High beating vibration was evident in the structure of a large (350MWe lignite) boiler structure and associated buildings. Although the amplitude was well below that considered to be unacceptable for machines for their integrity, the level increased to became high enough to be annoying to workers in the vicinity. Vibration analysis was used to identify the frequency of the exciting vibration and its likely source.

As the vibration was concluded to be at the resonant frequency of the structure, reduction of the source was not a practicable to control the vibration. A vibration absorber system was designed. This paper describes the investigation, the identification of the source, and the successful control measure - design and installation of a series of dynamic absorbers. The feature used on later designs to avoid this problem is also described.

THE PROBLEM

An annoying vibration was present in the boiler steelwork structure of a large power generation unit. Although barely noticeable initially, this increased over some months to reach unacceptable levels from the viewpoint of its effect on people.

The structure also contained a chemical instrument room, the plant control room, and motor control cubicles. Initially, laboratory glassware left on a bench would eventually bounce off and break on the floor! Eventually, the vibration caused annoyance to the shift operating staff. The amplitude of vibration was low, and at no stage indicated a danger to the plant itself. However, vibration sufficiently high to be annoying to people is one of the valid reasons for eliminating or reducing it. (Ref 1.)

Vibration was measured at selected places on the structure, and analysed to find its frequency as close to 8Hz. It would behave in a cyclical fashion, increasing to a maximum, then decreasing to almost nothing, over a two-minute period. Such behaviour is typical of classical “beating” behaviour, where two frequencies that are very close together move into phase and out of phase, as described in texts on vibration such as Ref 2.

“The structure also contained a chemical instrument room, the plant control room, and motor control cubicles. Initially, laboratory glassware left on a bench would eventually bounce off and break on the floor!”

Having read that the natural frequencies of large steel framed structures can be in this range, it was suspected that this structure, some 90m tall, was being excited to vibrate at its natural frequency. The regular vibration condition monitoring of the low speed fan-type coal mills meant that their nominally constant speed of 465r/min, or

Continued over page >

Article prepared by Ray Beebe

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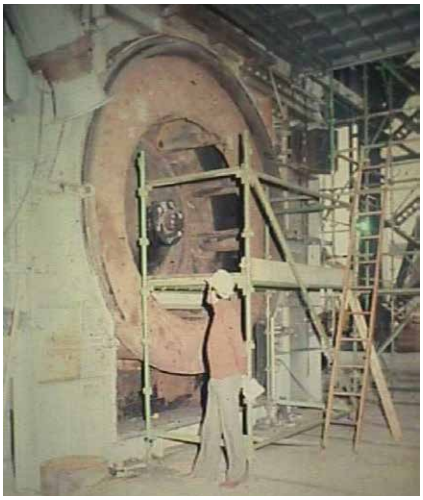

Above left: Figure I: fan-type coal mill, showing impeller. Above right: Figure 2: main corner column and the two adjacent mills.

7.8Hz, was well known, so they were quickly identified as the likely source.

The unit has eight such mills arranged around the boiler at ground floor level. These mills draw hot gas from the boiler at furnace exit level at a temperature of the order of 1000°C. The coal (lignite) is added just before entry to the mill, where it mixes with the hot gas as it impacts the blades of the mill wheel.

The fan action then conveys the pulverised coal and hot wet gas mixture at approximately 160°C to the burners. Shown opened up through its entry door in Figure I, the impeller has a mass of about 20t, and wear occurs on the impeller blades in a fashion that is not unevenly distributed around the wheel. Unbalance therefore increases with service.

Study of construction drawings revealed that each of the four corner columns of the main steel structure was supported on a concrete raft. Each of these rafts also supported two of the fan-type mills. This foundation arrangement was not readily evident to observers (mechanical engineers!), as the only visible floor concrete was clearly not connected structurally to the mill foundations.

The drawings showed that this reinforced concrete paving had been laid over the rafts and the area between them, as in Figure II, and was designed to carry only the maintenance loads such as vehicles and cranes.
It was therefore likely that the vibration from two corner-adjacent mills would be very well transmitted into the boiler steelwork via the shared mill and column supports. It was decided to investigate further at its source how the vibration varied with time. Therefore, a vibration transducer was fitted at the same location on the bearing casings of a pair of these adjacent mills.

The time traces of the vibration were arranged to be viewed on a twin-beam oscilloscope. The time traces clearly showed as sine waves of approximately 8Hz. As the time traces moved into phase, the structural vibration was at a maximum, and vanished when the traces were in anti-phase. This was the classic case of “beating” as suspected.

The forces from the residual unbalance in each of the two impellers apparently balanced each other when in anti-phase, but added together when in phase to provide a large exciting force to the structure. It was also evident that the speeds of the mills varied slightly in service, possibly due to slight variations in the intensity of coal flow.

The levels of vibration as measured at the bearings of these mills were not high, and not of a concern for the condition of the mills themselves, according to available Standards (Ref 3). A common measure to reduce excessive vibration is to reduce the source, which in the case of

“It was decided to investigate further at its source how the vibration varied with time. Therefore, a vibration transducer was fitted at the same location on the bearing casings of a pair of these adjacent mills.”

rotating machinery usually means balancing. Balancing of these mills in-situ was possible, as it had been successful on smaller mills of a similar design, but here it was considered too lengthy and cumbersome a process. The state of balance would also be expected to decay as blade wear progressed, and frequent balancing was not practicable.

Given the large structure, the other common control measures of a change in system mass or stiffening were also not practicable. It was decided to try the use of a vibration absorber.

THE SOLUTION

A vibration absorber consists of a mass connected to the original system by springs, such that is free to vibrate independently of the original structure. The springs can be of any type. An absorber is useful where a structure or machine that can be considered to have a single-degree-of-freedom vibrates at its natural frequency, usually due to some forcing or exciting vibration.

The "absorber" adds a second mass-spring combination to the system, converting in into a two-degree-of-freedom system. This new combined system now has two new natural frequencies, one above and one below the original natural frequency.

When the absorber system is tuned to the driving frequency and has reached steady state, the force provided by the absorber mass is equal in magnitude and opposite in direction to the original disturbance force. With zero, or close to zero, net force acting on the primary mass, it does not move and the motion is "absorbed" by motion of the absorber mass.

For the method to be successful, the harmonic excitation must be known and not change much from its constant value. Damping must also be negligible. These conditions were considered to apply in this case. The theory behind the use of the vibration absorber is given in textbooks on vibration analysis, such as Ref 2.

Defining these terms:

- Ratio of mass of absorber to original system mass: μ (usually chosen in the range of 5% - 25% of the original system mass, where this is known)
- Natural frequency of the original system: ω_p (assumed here from the symptoms to be close to 7.8Hz)
- Natural frequency of the absorber system before it is attached to the original system

$$\omega_a = \sqrt{\frac{k_a}{m_a}} = \sqrt{\frac{Stiffness\ of\ absorber\ springs}{Mass\ of\ absorber}}$$

- Ratio of frequency of absorber system to that of original system: $\beta = \frac{\omega_a}{\omega_p}$ (which for a tuned system =1).

The equation relating these gives the values of the natural frequencies of the new system normalised to the frequency of the absorber system (Ref 2):

$$\left(\frac{\omega}{\omega_a}\right)^2 = \frac{1+\beta^2(1+\mu)}{2\beta^2} \pm \frac{1}{2\beta^2}\sqrt{\beta^4(1+\mu)^2 - 2\beta^2(1-\mu)+1}$$

The values that indirectly specify the mass and stiffness of an absorber system can be seen as the ratio of the absorber mass to the initial system mass, and the ratio of the natural frequencies of the absorber mass system and the original system. The greater the absorber mass compared with the mass of the original system, the wider the useful frequency range of the absorber.

In the more usual applications of a vibration absorber, where the masses of both original system and absorber are known, and hence μ is readily found, the useful frequency range of the new system can also be calculated equating the following expression to 1, and also to –1 (Ref 2). This results in four roots, the central pair of which define the useful frequency range.

As long as the exciting force remains inside the useful frequency range, the absorber will be effective. (If this expression is greater than unity, the absorber will in fact increase the force to the original system). With ω_{dr} as the frequency of the driving force:

$$\left[1-(\omega_{dr}/\omega_a)^2\right] \div \left[1-(\omega_{dr}/\omega_a)^2\right] - \mu(\omega_a/\omega_p)^2\left[1+\mu(\omega_a/\omega_p)^2 - (\omega_{dr}/\omega_p)^2\right]$$

As in this case the effective mass of the total system was not known, and was too complex and too large to consider a single absorber at any one position, the team did some initial experimentation at a point of relatively high vibration in the chemical instrument room. A combination of masses and springs tuned to as close to 7.8 Hz as could be obtained was tried and eventually the correct combination was found to minimise the amplitude of vibration at that point.

The same experimentation was applied at mid-span of the steel floor supporting beams under the control room. The final mass/spring system was designed as a frame holding lengths of scrap steel (a supply of worn mill lining plates was readily available). Several of these arrangements were installed in locations at about mid-span of the beams underneath the control room, with compression springs resting on the bottom flange of the beams as shown in Figure III.

Continued over page >

Another of a simple table design – a plate supported on springs - was installed in the chemical instrument room. The systems were successful in controlling the vibration in the areas where it had been causing annoyance. Detailed measurements of the amplitudes were not necessary, as the criteria for success was to remove the annoyance, and this was achieved. The systems have been operating successfully since.

Detailed measurements of the amplitudes were not necessary, as the criteria for success was to remove the annoyance, and this was achieved. The systems have been operating successfully since.

THE FUTURE DESIGN

The design of future boiler-turbine units was well advanced, and it was not possible to redesign the structures, which in any case were of a completely different arrangement to the earlier plant. The new mills were also to be variable speed.

It was decided to install the fan-type mills on vibration isolating foundations, designed by a specialist company. Each mill was mounted on its own concrete block foundation, but instead of being supported directly connected with the main structural system as in the plant described in this case study, the foundation blocks are supported on several large springs. Large simple dampers are also provided. The effectiveness of these proprietary systems in service is readily apparent when standing with one foot on the mill block and the other on the adjacent floor. It was not practicable to modify the initial plant to such an isolating system. ■

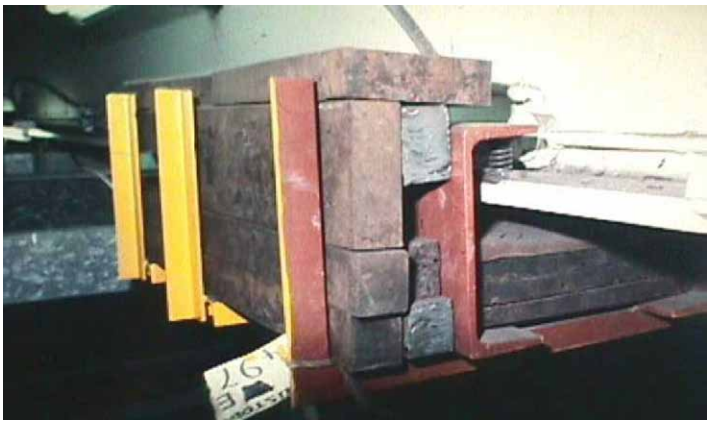

Figure 3: typical absorber supported on lower flange of control room beams.

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(2) Inman, DJ *Engineering Vibration,* Prentice Hall 1996
(3) ISO 18016, Series on vibration severity assessment.

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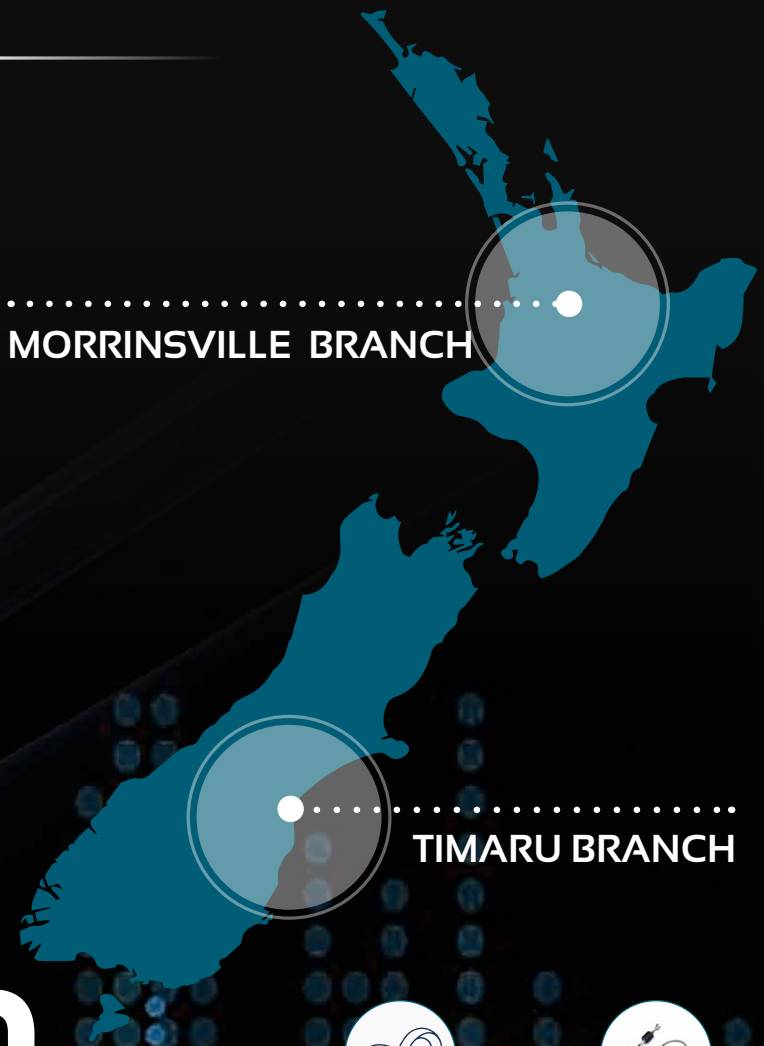

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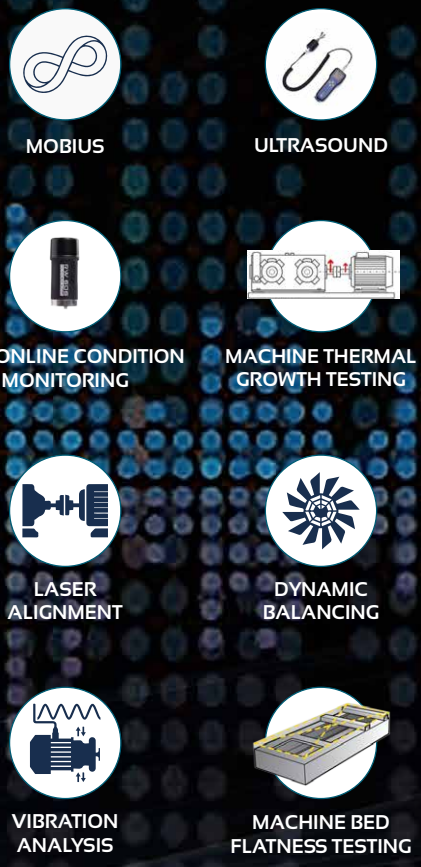

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Solutions on page 32

WORD BUILDER

How many words of **three or more** letters can you make using the six letters below? You can only use each letter once. Plurals are allowed, but no foreign words or words beginning with a capital.

Word scores expected...

14 - Good | 20 - Very Good | 26+ - Excellent

R	M	M	S	E	U

There's 32 possible three or more letter words to find.

WORD LADDER

A Word Ladder has two words in the ladder, one at the top and one at the bottom. You must form a sequence of words going down. On every step of the ladder (1-6), you must unscramble and create a new word that only differs by one letter from the word above it until you reach the destination word on line 6.

1 FIRE

2

3

4

5

6 HEAT

SUDOKU

To solve, each number from 1 to 9 must appear once in:

- **Each of the nine vertical columns**
- **Each of the nine horizontal rows**
- **Each of the nine 3 x 3 boxes**

No number can be repeated twice in a box, row or column. Difficulty: **Next Level**

Only 39.5% of puzzlers can solve this. Can you?

					1			
6						9		5
						4	2	7
	4		2	6			7	
	2			1				9
	9	1		3	4			6
		9	8		6	1		
1				4				
		8				7	6	

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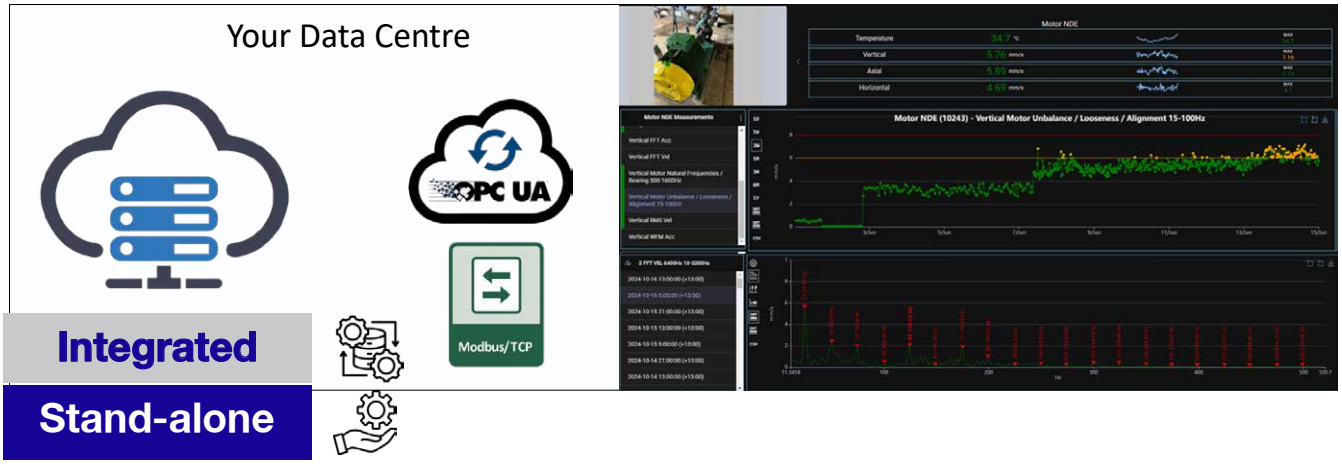

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TEST YOUR KNOWLEDGE - PART 82 OF A SERIES

1. An operator reports squealing noises of unsteady amplitude coming from a twisting machine used in cable manufacture. The rotor runs at 1750 rpm and has cylindrical roller and angular contact bearings in the pedestals. Greasing the bearings made the noise disappear. What (most-likely) would have caused the noise?

A. Possibly the rollers or balls in the bearings skidding
B. A clearly defined spall on the outer race of one of the bearings
C. A clearly defined spall on the inner race of one of the bearings
D. A clearly defined spall on one of the balls or rollers of the bearings.

2. You wish to dynamically balance a rigid rotor. What is the maximum number of correction planes you would need to do this?

A. 1
B. 2
C. 3
D. 4.

3. A mechanical seal has started leaking on a centrifugal pump. The pump has ball bearings in an oil bath. The manual for the mechanical seal lists a pump bearing rotating in the housing as a possible cause for a leaking mechanical seal. How might you confirm whether or not the bearing is turning in the housing?

A. Compare high-frequency signals on this pump to a neighbouring pump of the same type and duty
B. Drain the oil of the pump and examine the removed oil for evidence of wear debris
C. Carry out a lift check of the pump shaft, and compare the result to the mounted internal clearance of the pump bearings
D. All of the above could be useful diagnostic tests.

4. A manufacturing facility has a row of tanks. Each tank has a vertical agitator shaft, driven by a motorgearbox combination atop the tank. All are identical. One of the gearboxes exhibits higher levels of gearmeshing vibration compared to its neighbours. Why might this be so?

A. One or more of the gears might be worn
B. One or more of the gears might have been poorly manufactured
C. The oil level, quality, viscosity etc in the problematic gearbox might be incorrect
D. Any or all of the above could be causative of the elevated gearmesh vibration.

5. You are outdoors on a windy day carrying out vibration tests. Your accelerometer cable blows around in the wind, and this causes false signals in your data. Which of the following is the name given to this signal

A. Triboelectric noise
B. Piezoelectric noise
C. RF interference
D. It could be any or all of the above.

6. A centrifugal fan is used to transport fines material at a plant. The fines material is abrasive in nature. Why would it be inadvisable to substitute regular wear inspections of the impeller blades with continuous monitoring of the 1 x vibration levels on the fan?

A. The impeller might become dangerously worn without a resultant increase in the 1x vibration of the fan if the impeller wear occurs evenly
B. Uneven wear of the impeller could potentially lower the fan's 1x vibration level if the impeller had some residual unbalance to start with
C. Vibration at 2 x fan speed would be a better indicator of impeller wear
D. A and/or B could be correct.

7. The wheels of a horizontal bandsaw in a sawmill have become unbalanced due to a heavy and uneven build-up of sawdust. The vibration levels of this machine increase at one part of the speed-range when the bandsaw is slowing down after being turned off. Which of the following statements is true?

A. The vibration noticed during run-down is unlikely to be related to the sawdust build-up because vibration energy caused by unbalance only reduces when the speed reduces
B. It's possible that the machine is running down through a resonance which (combined with the unbalance due to the sawdust buildup) is causing the vibration
C. Cleaning the sawdust off the wheels is unlikely to improve the vibration that occurs during run-down
D. None of the above is true.

TEST YOUR KNOWLEDGE

Further enquiries can be directed to: Carl Townsend at Carlton Technology Ltd.
Phone: 64-6-759 1134 • Email: ctownsend@xtra.co.nz

8. A vibration level of 2.56 mm/s peak is measured at 48.75 Hz. When converted to acceleration, what will the level be in g's peak?

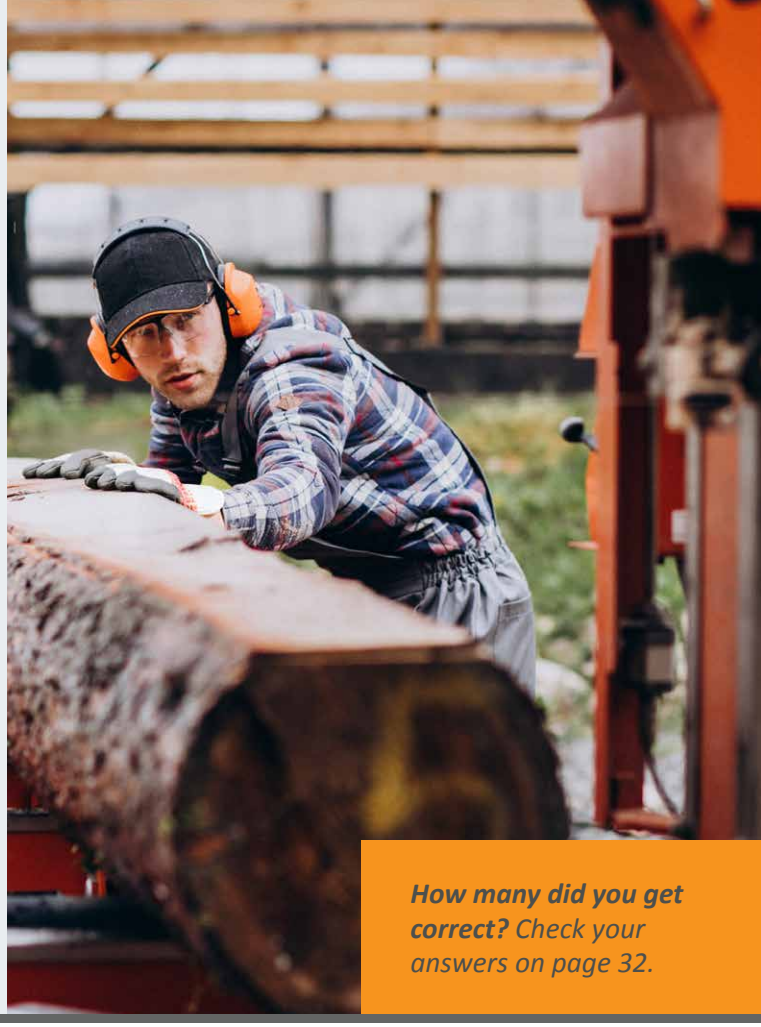
A. 08 g
B. 8 g
C. 8 g
D. 80 g.

9. A multi-stage pump assembly is "component balanced". The three different impeller stages all have different masses, but each is balanced to G2.5, as is the shaft. When assembled, what will the resultant balance grade be?

A. G 2.5
B. G 5.0
C. G 7.5
D. G 10.

10. A dynamic absorber can be used to reduce vibration levels on a machine. On which of the following machines would you most-likely see this type of solution applied?

A. A variable speed vertical pump
B. A fixed speed vertical pump
C. A variable speed horizontal pump
D. A fixed speed horizontal pump.



How many did you get correct? *Check your answers on page 32.*

Spectrum

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Size *(width x height):* 420x297mm *(Trim)* 426x303mm *(Bleed)*	Size *(width x height):* 210x297mm *(Trim)* 216x303mm *(Bleed)*	Size *(width x height):* 190x134mm *(Horz)* 93x272mm *(Vert)*	Size *(width x height):* 190x80mm *(Horz)* 93x134mm *(Vert)*	$100 per page or 50% discount if bought in conjunction with a full page colour advert.
Single issue rate: **$615+GST**	Single issue rate: **$395+GST**	Single issue rate: **$330+GST**	Single issue rate: **$275+GST**	
4-issue (1 year) rate: **$550+GST**	4-issue (1 year) rate: **$355+GST**	4-issue (1 year) rate: **$295+GST**	4-issue (1 year) rate: **$250+GST**	

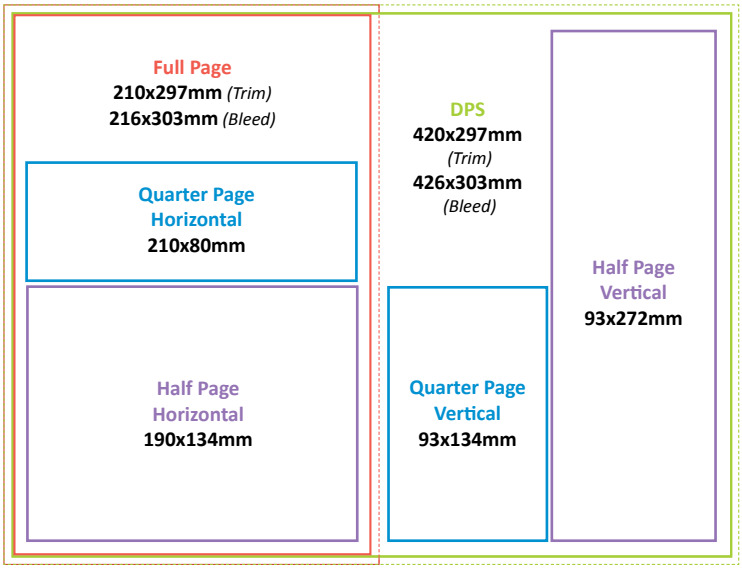
The small print...

How to supply an advert
All advertising copy to be supplied in high-res , press ready (300dpi) PDF format at the correct size required. Files to be supplied in CMYK colour mode, with 3mm bleed for full page and DPS advertisements. Ideally any fonts contained in the advert should also be converted to paths/outline. All adverts should be emailed to Angie at **spectrumeditor@vanz.org.nz.**

Save up to $200 on your advertising in Spectrum!
Our special 4-issue rates is for advertising in 4 consecutive issues. i.e. Issue 120, 121, 122 and 123. Email us to confirm your advert(s) and method of payment as soon as possible.

Publishing
Each SPECTRUM will be distributed as an epub document and available for download and printing by VANZ members. Previous issues are also available.

Article submissions
Articles for upcoming issues of Spectrum are welcomed by the editor. Copy to be supplied preferably in Microsoft Word, but PDF file format is also acceptable.



Contact us today...

Please email **spectrumeditor@vanz.org.nz** with your submission or should you require further information.

VANZ VIBRATIONS ASSOCIATION of NEW ZEALAND

CarltonTechnology
vibration · noise · reliability / engineering support

Further enquiries can be directed to:
Carl Townsend, Carlton Technology Ltd
Merrilands, New Plymouth, New Zealand
Phone: 64-6-759 1134
Email: ctownsend@xtra.co.nz

QUIZ + PUZZLE CORNER

ANSWERS

Carlton Technology Quiz 82: 1A, 2B, 3D, 4D, 5A, 6D, 7B, 8A, 9A, 10B
Word Builder Solution: SUMMER
Word Ladder: 1. FIRE, 2. HIRE, 3. HERE, 4. HERD, 5. HEAD, 6. HEAT.

Be seen! Advertise your business in

Spectrum

MAGAZINE

** Quarter page advert on a 4-issue (1 year) contract. Price does not include GST.*

From as little as $250.00* you can have your business advertised in official journal at the forefront of our industry!

Spectrum is published quarterly and has advert sizes available to suit any requirements. Book now!

To find out more, email: spectrumeditor@vanz.org.nz

VANZ
VIBRATIONS ASSOCIATION of NEW ZEALAND

The official journal of the Vibrations Association of New Zealand

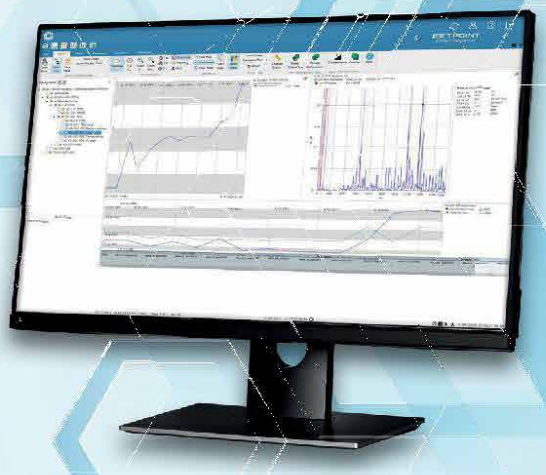
Brüel & Kjær Vibro

A member of the NSK Group

CSE W.ARTHUR FISHER

Unleash the benefits of SETPOINT®

CONDITION MONITORING WITH SEAMLESS CONNECTIVITY



SETPOINT® software effortlessly integrates with your AVEVA™ PI System™ for powerful plant-wide machine analysis. Monitor asset health and fix faults before they cause damage or downtime.

Use a wired connection

SETPOINT® links directly to our VC-8000 machinery protection system and VCM-3 condition monitoring unit for data acquisition, without the need for additional hardware.

Or connect wirelessly

Now SETPOINT® can securely connect to our wireless BKV Collect sensors and BKV Connect gateways, eliminating unnecessary infrastructure and freeing up resources.

▶ Learn more: **www.setpoint.bkvibro.com**

Enquire Now: sales@cse-waf.nz