The official journal of the Vibrations Association of New Zealand

Spectrum

Summer 2020 | Issue 95

Key Guidelines on Condition Monitoring & Reliability of Rotating Equipment

Part 2 – The case studies

+

Skills & Practices

What is Soft Foot?

FSM Motor Terminal Tightening Exercise

and more inside...

VANZ
VIBRATIONS ASSOCIATION *of* NEW ZEALAND

ifm electronic

Vibration & condition monitoring solutions

Systems for condition monitoring of machines

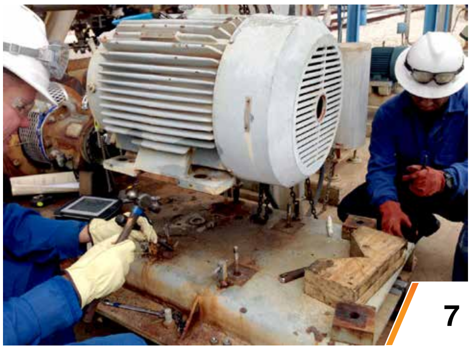
WARRANTY 5 years on ifm products

e shop
Order 24/7

Phone: 0800 289 436 | www.ifm.com/nz

5

12



7

CONTENTS Summer 2019

Features

Regulars

Missed an issue of Spectrum magazine?

Simply scan the QR code here to link your device directly to the VANZ website. There you will find Specturm issues available to view or download*.

A QR code reading app will need to be installed on your device first.

Spectrum #95

ISSN 1173-793X

Editor
Angie Hurricks
Ph 021 239 4572
Email: spectrumeditor@vanz.org,nz

Design
Eddie van den Broek
Flashpoint Design and Marketing
info@flashpoint.design

Spectrum is published quarterly in a digital medium and printed twice yearly by the Vibration Association of New Zealand (VANZ). 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. Contributions to Spectrum are welcome.
Please address material to:
Angie Hurricks
Spectrum Editor
c/o 358 Waerenga Road,
R.D.1, Te Kauwhata, 3781
Waikato, New Zealand

or email: spectrumeditor@vanz.org.nz

Please address all VANZ correspondence to:
VANZ
PO Box 2122
Shortland Street
Auckland

Web Site
www.vanz.org.nz

VANZ
VIBRATIONS ASSOCIATION *of* NEW ZEALAND

PRESIDENTS' REPORT

By Rodney Bell, VANZ President

Welcome all to the New Year, we hope 2020 will be a prosperous and enjoyable one for us all. Up to the end of 2019, the VANZ Committee had been working hard to arrange and confirm an exciting line-up and schedule for our upcoming 31st Annual Condition Monitoring & Reliability Conference on the 12,13&14 May 2020 at the 4.5* Trinity Wharf Hotel and Conference centre, Tauranga.

This includes an early bird special until 1st February 2020 for an all-inclusive 3 day Conference pass and 3 nights' accommodation which includes food and refreshments, all for $1500.00.

Day 1,12th now includes 3 separate streams to suit all from Apprentices, Plant Maintainers, Reliability Engineer's, Team leaders, Management & the advanced Condition Monitoring section to even the most suit experienced Technician's.

We have confirmed Keynote Speakers Randall Chitwood and John van Zwienen from BK Vibro, Guest Speakers include World Renowned Shaft Alignment Specialist John Piotrowski, and local expertise and insights from Iain Epps & Clyde Volpe from Australia.

The call for "Papers" has been received well, with more than 21 confirmed speakers at this stage, but there is still room for more, so don't hesitate to contact us if you have an interesting case history and learnings you think will benefits others and wish to share with us.

Planning is well underway for a partners program throughout the conference, more information on this and other exciting initiatives will be made available soon. We can now also confirm a site visit is planned for the end of the conference on Friday morning, 15th May at Ballance Agri-Nutrients, just across the harbour for those of you who wish to take advantage of the cheap accommodation rates and make themselves available for this.

For now, that's all from the Presidents desk and I ask you to strongly consider attending this years Condition Monitoring & Equipment Reliability Conference as I know the Learnings gained here are invaluable for your sites Reliability Programs.

Above: BK Vibro's Randell Chitwood.

EDITORS' CORNER

Happy New Year! Hope you all had a very Merry Christmas and safe celebrations. Our thoughts go out to the many people suffering through the horrendous bushfires around Australia and hope for a swift end to the nightmarish conditions.

We are now gearing up for this years conference as it's coming up quick! Our tireless voluntary committee members are buzzing around like busy bees trying to organise venues, accommodation, presenters and much, much more! Our sponsors for this year are CSE-W.Arthur Fisher, glad to have them on board again and many thanks for going platinum with us.

In this issue you can catch up with our next instalment of Carls Quiz and there are also some pearls of wisdom from our President included, read about the case study part II from Amin Almasi, as well as parts #3 and #4 from Rod Bennet. Don't forget to browse over the new products available from the different companies who continue to support us, many thanks go out to them all.

For registration forms head over to our website www.vanz.org.nz and go to our Conference page where you can download the PDF for conference attendees and also Trade Stand sign-up.

Prosperous wishes to all for the coming year and enjoy the read!

VANZ
VIBRATIONS ASSOCIATION *of* NEW ZEALAND

PRESENTS

BACK to the FUTURE
CONFERENCE 2020
'PREDICTIVE ASSET MANAGEMENT'

NEW ZEALAND'S PREMIER 3-DAY CONDITION MONITORING AND RELIABILITY CONFERENCE

Trinity Wharf Hotel, Tauranga, NZ

– 12th, 13th and 14th May 2020 –

Introducing... **Additional Technical Specialist Masterclass stream on the Tuesday 12th May to suit Advanced Condition Monitoring Specialists. Topics include:**

✓ Advanced Shaft Alignment ✓ ISO Cat 3&4 Vibration Analysis ✓ Insitu Dynamic Balancing

Plus... **World Renowned Shaft Alignment Specialist and Special Guest Speaker; John Piotrowski**

Key Note Speakers... Randall Chitwood and John van Zwienen, BK Vibro

FREE and HALF PRICE packages available for students/apprentices and trainees!

EARLY BIRD 'ALL-INCLUSIVE 3-DAY CONFERENCE PACKAGE'

LIMITED OFFER! GET IN QUICK!

Get 3-night 4.5 star accommodation with breakfast and all meals included! **Just $1,500**

Also for Early bird accommodation deals for student/apprentices and Exhibitors, go to **vanz.org.nz** registration page for more information or use contact number below.

For further information or to secure your position please contact our conference team, Leanne on **+64 9 296 1333** or Tim **+64 27 577 3592**, or you can email us at conference@vanz.org.nz | www.vanz.org.nz

2020 Principal Sponsors: CSE W Arthur Fisher; Brüel & Kjær Vibro

SKILLS AND PRACTICES

What is Soft Foot?

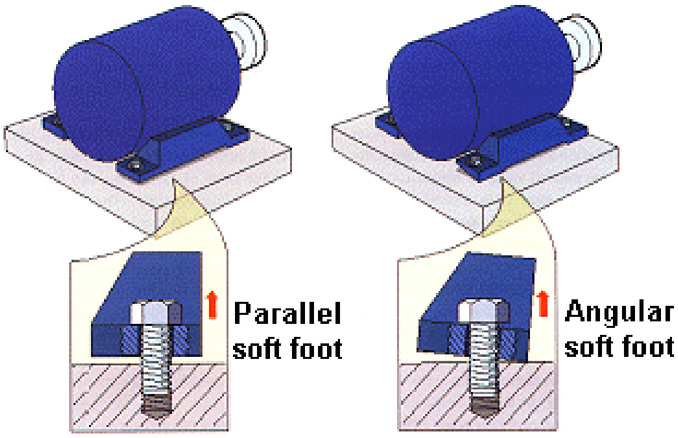
Soft foot is a condition that occurs when a machine does not sit squarely and evenly on its base.

This often occurs on electric motors, but can occur on any equipment that has rigid mounting points. Other examples are pumps, bearing housings, and, as we experienced recently, hydraulic cylinders.

The illustrations right show a motor that has 3 feet in the same plane, but the fourth foot is high or tilted. This foot is said to be "soft".

This condition is bad for the machine because when the hold down bolt for the soft foot is tightened, the frame of the machine is distorted. This is a defect that reduces the life of the machine, and makes alignment of shafts very difficult

.
Soft foot can also be caused by an uneven base, uneven mounting surfaces (such as the feet on a motor), using damaged or buckled shims, using



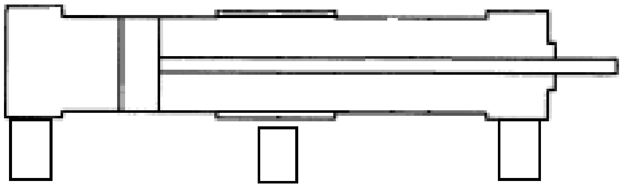
too many shims, foreign matter such as paint or dirt under a foot, or by piping strain. Consider the following hydraulic cylinder that mounts at 3 points

Continued on page 8 >

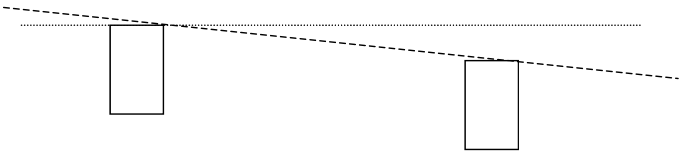
Prepared by Rod Bennett, Condition Monitoring Engineer.

Soft foot is a defect that can occur in many situations, and it has a number of different causes.

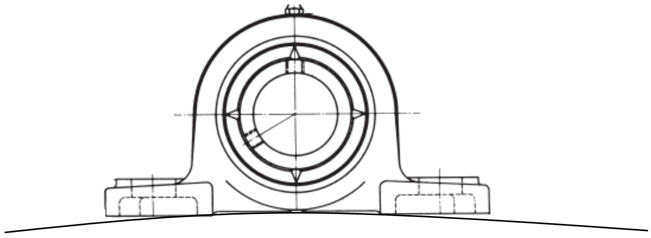
along its length. If any of the mounting points are low (or high) compared to the other two, then soft foot will result. The cylinder will fail prematurely and it may be difficult to operate.



Even if the cylinder has only 2 mounting points, soft foot can occur if they are not in the same plane. In the sketch below, imagine tightening the left hand hold down bolts first. This would tend to cause the cylinder to be horizontal. If you then tighten the right hand hold down bolts, then this will cause distortion of the cylinder and its mounts.



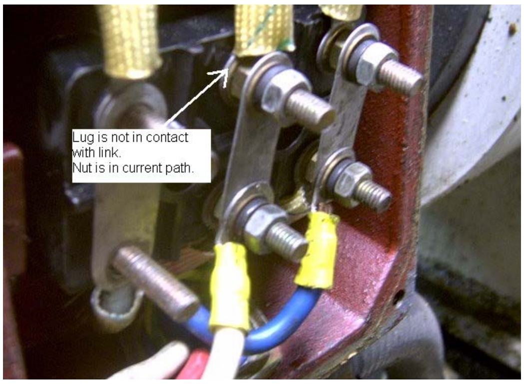
Consider the self aligning bearing shown below. It can cope with the shaft not being perpendicular to it, but if it is mounted, for example, on a fabricated base which is not flat, then the bearing and housing will be distorted when the hold down bolts are tightened.



In summary, soft foot is a defect that can occur in many situations, and it has a number of different causes. Machines and their bases must always be machined flat and/or shimmed correctly to avoid soft foot. If this is not done, the machine life will be significantly reduced.

Findings from first FSM Motor
Terminal Tightening Exercise

On the last FSM down day, we checked the terminations on 8 electric motors.



We examined the order of assembly of the parts and the tightness of the nuts. The findings are summarised below

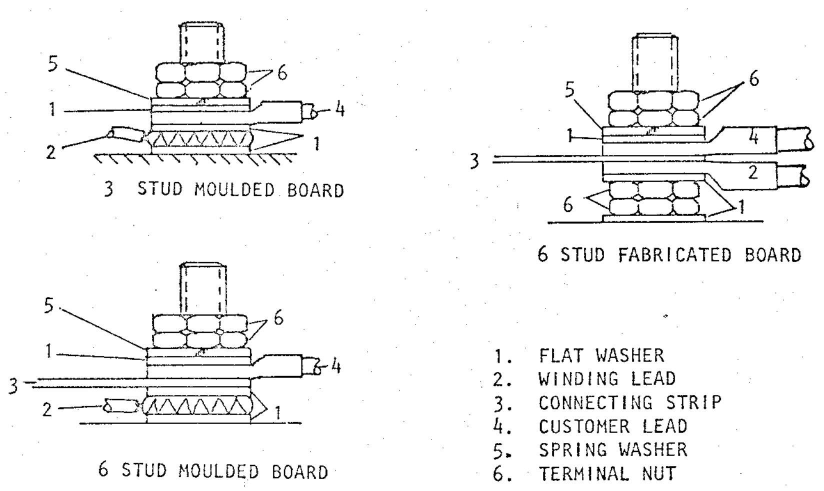
- 7 of the 8 motors were found to have loose connections.
- 1 motor had 4 (out of a possible 6) loose connections.
- The loose connections were typically the inner nuts, while the outer nuts tended to be tight.
- Not 1 phase on any of the motors was correctly assembled.
- Some motors had no spring washers fitted.

All of these issues were DEFECTS, which had the potential to cause failures and reduce UPTIME. We removed these defects by assembling the parts in the correct order and tightening the nuts to the correct torques using tension wrenches. The photo *(inset above)* is an example of the assembly errors that were found. Remember that all conductors should be in contact, and that the stud and nuts should not be in the current path. This initial experience shows that we are on the right track with this work, and that there are many more of these defects out there (waiting to bite us) that must be eliminated. The downside to this good news story is that in eliminating these defects, another defect was introduced.

As part of the reassembly process, the motors were tested at the completion of the job. This required the use of a test lead that was inadvertently left connected when the terminal box cover was replaced. The motor failed when it was started and had to be replaced.

Our test procedure will be reviewed as a result of this failure, in order to prevent a reoccurrence. This shows how much precision is required, and how fussy we have to be about every little thing we do, if we are to avoid the defects that cause us so many problems. On a positive note, the Uncoated Department have also embarked on this process. They have had a similar experience, in terms of the number of assembly problems found and rectified, but they have managed to do it without introducing another different defect!

Correct order of assembly



Stud Size	Tightening Torque in Newton Metres +- 10%	
	Brass	Steel
3 B.A.	1.19	2.1
3/16"BSW	1.7	2.8
1/4" BSW	4.4	7.0
5/16" BSW	8.8	14.9
3/8" BSW	15	25.76
9/16" BSW	44.8	100
M 16	83.4	137

Prepared by Rod Bennett, Condition Monitoring Engineer.

HDY2 CERAMIC COATED INSULATING BEARINGS

NSK's new ceramic coated insulating bearings are designed to support energy efficiency and the expanding adoption of inverter-controlled motors, while effectively contending with the associated risk of electrical current damage to bearings. With advancements in product design to optimize insulation and thermal conductivity characteristics, NSK's HDY2 series bearings deliver a reliable contribution to energy efficiency and reduced power consumption.

PROVEN BENEFITS

- Effective prevention of electrical corrosion damage
- Superior insulation properties, with performance improved greater than 10 times
- Improved durability, with new optimized coating demonstrating 3 times the shock resistance of conventional ceramic coated bearings
- Excellent heat dissipation
- Dimensionally interchangeable with standard bearings

CONDITIONS:

EC
ELECTRICAL CURRENT

HS
HIGH SPEED

Q
LOW NOISE

Key Guidelines on Condition Monitoring & Reliability of Rotating Equipment

Part 2 - The case studies

Modern condition monitoring methods are used to operate rotating equipment reliably and efficiently. Latest practical notes and recent lessons learned on condition monitoring techniques, condition-based maintenance, trouble-shooting techniques and smart operation are discussed. The focus is on new technical knowledge, latest experiences and recent lessons learned on these topics. Mathematical formulations or complex charts, diagrams or graphics are avoided. Latest guidelines, novel technical notes, new technical knowledge and recent case studies are discussed. Predictive maintenance (condition-based maintenance) and its benefits are also discussed. Optimum configurations of condition monitoring for various rotating machineries are addressed. Latest recommendations regarding bearing monitoring, integrated condition monitoring, trip levels, alarms, gear unit reliability, failure root-cause analysis, inspection tips, and reliability-centred maintenance (RCM) are discussed. Key part of this article is eight (8) important case studies which are presented.

Case Study 1

Air Compressor – Change in Operation

The first case study is presented for a large instrument air 450 rpm reciprocating compressor for a large plant. This compressor supplied the instrument air to an air-receiver vessel at the downstream which fed instrument air for various continuous and intermittent requirements of the plant. The compressor train was started and stopped by the air pressure in the air-receiver vessel (instrument air volume remaining at the vessel). This has been a classic configuration which has been used for many units and plants. The compressor was used oil-free technology, the piston and packing worked without any lubrication oil. The crankshaft system required lubrication oil. A pressurized lubrication oil system using shaft driven oil pump was provided as part of the compressor skid. The compressor size was relatively large, and sleeve type bearings were used.

A few months after the start-up, the compressor suffered from bearing failures. On an inspection after the failure, bearings were totally black. "Babbitt" was not found on bearing shells. It was confirmed that bearings were correctly selected and installed. Extensive investigations showed actual instrument air consumption of the plant was increased more than five times compared to the predicted instrument air usage at the design stage. This increase was mainly due to the purge flow increase of major electrical machines of the plant. This resulted in the air compressor started and stopped five times more than the originally specified value. In other words, since the flowrate produced by the compressor was constant, increased consumption of instrument air reduced the pressure in air-receiver more rapidly and it resulted in more frequent stops and starts. This put bearings under more transient stresses, which resulted in more durations of transient lack of lubrication oil and excessive loads (during transient situations). This led to bearing failure.

This case study is in-line with majority of previous root-cause studies that point changes in process and operation as the main reason for machinery failure. Simply rotating equipment has been operated in conditions different than its design conditions.
The vendor of the compressor confirmed that this compressor model was originally designed for a continuous operation. It could be operated in long durations of intermittent operation, as proposed for specified conditions in the biding stage and purchase order, based on vendor's calculations and also available successful references. However, it cannot afford five times more starts and stops. Proposed solution was changing compressor control philosophy by eliminating the stop & start, operating compressor continuously and using a bypass control valve from the

Continued over page >

Amin Almasi is senior rotating equipment consultant in Australia. He is chartered professional engineer from Engineers Australia and IMechE and registered professional engineer in Australia (M.Sc. and B.Sc. in mechanical engineering). He specializes in rotating equipment, condition monitoring and reliability.

air-receiver to the compressor suction to maintain air-receiver pressure.

Case Study 2

Steam Turbine – Design Problem

The second case study is presented for oil contamination in bearings of a steam turbine. Water in the lubrication oil caused several bearing failure incidences. The source of water was from the carbon ring seal leakage of steam into the bearing bracket. Usually main reasons of machinery problems were changes in process condition, operation or assembly (installation) issues. Therefore, first, these potential causes were checked. A detailed analysis was confirmed that the root cause of failure for this machine was a design problem. The carbon ring seal system (carbon ring seals and bearing bracket isolator) was not designed to prevent the oil contamination in the bearing bracket. A bearing isolator was provided to positively prevent steam condensate from entering the bearing bracket.

Case Study 3

Steam Turbine – Steam Over-Temperature

The case study is related to the possible damage of a large steam turbine due to steam over-temperature. The operator team recommended to install temperature measurement sensor at the steam turbine inlet and define alarm and shutdown for steam inlet temperature. In any application, the steam turbine design and construction (including rotor) should be suitable for the rating (pressure and temperature) of the consumed steam. It was a good recommendation to install an online temperature measurement (monitoring) for the steam inlet temperature. However, this should only be used for monitoring and alarm. There is no need for trip (shutdown set-point) on the steam inlet high temperature.

The main thermal issue to a steam turbine can be a high temperature gradient (high thermal stresses) which usually occurs at a transient operation such as start-up or shutdown. The steam over-temperature (during continuous operation) usually cannot induce a higher temperature gradient compared to what the steam turbine could experience during worse case of a start-up or a shutdown. The over-temperature steam during operation can usually affect a steam turbine through creep process. This is usually a mid-term or long-term damage process. In certain conditions (for example, fluctuating patterns), the over-temperature steam during operation may result in fatigue which is again a mid-term or long-term damage process. Considering the above-mentioned, an immediate shutdown of the steam turbine was not required. Even an immediate shutdown, if implemented after over-temperature steam inlet, could result in very high temperature gradients and very high thermal stresses which can be risky. Generally, a shutdown in this case could be more damaging rather than over-temperature steam itself.

Another point, if there is a great concern about inlet steam over-temperature, it should be controlled at the steam generation source.

The finite element simulations were implemented for this steam turbine to properly assess the situation. Based on theoretical results, the rotor of steam turbine could be subject to life limitations due to creep and thermal fatigue. The creep might occur during steady state operation due to stresses sustained at high temperature while the thermal fatigue for this machine could only occur from cyclic thermal stresses set up during start-up and shutdown. It was confirmed that the fatigue cannot be an issue for this specific machine because of limited cycles of start-up and shutdown.
In some turbine stages, creep may cause complete lifting of the blade shroud bands, if steam temperature exceeds the limit. The main affected zones could be control stages of the high-pressure and intermediate-pressure sections where the steam temperature was the highest possible. Based on these results, the steam generation system was modified to avoid any possibility to have steam temperature above 440°C (with 12°C safety margin). A steam turbine inlet temperature transmitter was also provided for monitoring and alarm (not for shutdown).

Case Study 4

Centrifugal Compressor – Temperature Spikes in Bearings

Radial bearings of tilting-pad type in a critical compressor showed spikes in bearing pad temperatures every 1 - 4 hours. Measured temperatures went from 96°C (baseline) to 115-119°C (spike). The recommendation by operation team was to reduce the inlet lubrication oil temperature to limit the peak of spikes below high temperature limits.
The initial proposal was to reduce the temperature of the delivered lubrication oil (to the compressor) from 50°C to 45°C. It was implemented. However, the oil temperature reduction caused a higher temperature at bearing pads. This might be because of more viscosity of lubrication oil and consequently more friction. In this case, 5°C reduction in the lubrication oil supply temperature caused around 3°C increase in bearing RTD temperatures. The reduction of supply lubrication oil temperature could not reduce temperature spikes at RTDs. Root-cause of this issue should be identified and eliminated.

After thorough studies, the root-cause of temperature spikes was identified as the varnish in the lubrication oil. Every-time varnish settled on a bearing pad RTD, a

Continued on page 20 >

Back to the Future

Conference 2020

'Predictive asset management'

New Zealand's premier 3-day condition monitoring and reliability conference

May 12, 13 and 14th 2020, Trinity Wharf Hotel, Tauranga

VANZ

www.vanz.org.nz

CONFERENCE OPTIONS

Get in quick for our off-season price grab on our accommodation deal at Trinity Wharf Hotel

See page 3 for details.

TIMETABLE

** All prices exclude GST.*

Tuesday, May 12th	Wednesday, May 13th	Thursday, May 14th	Friday, May 15th

3 DAY – Technology Exhibition
Visit 20+ world-leading condition monitoring and reliability providers showcasing their latest technologies all under one roof over all-three days of the conference.

3 DAY – Three-Day VANZ Conference Pass
Condition Monitoring and Reliability Improvement/ Asset Management Conference & Technology Exhibition.
Also incl: Wednesday evening dinner. Additional benefits with 3-day registration. See over page for details.
$950/pp

Site Tour (Friday, May 15th)
Ballance Agri-Nutrients Site Visit
Mt. Maunganui
(08:30-11:30)
TBC

Tuesday, May 12th

1 DAY – One-Day - Opt.1
Practical Hands-on Awareness
$250/pp
or Student/Apprentice*
FREE!

1 DAY – One-Day - Opt.2
Reliability/Asset Management
$350/pp

1 DAY – One-Day - Opt.3
Technical Specialist Sessions
$350/pp

Networking

Informal Welcome Evening

Wednesday, May 13th – Thursday, May 14th

2 DAY – Two-Day VANZ Conference Pass
Case-studies, Presentations, Knowledge-transfer & Technology days
Also incl: Wednesday evening dinner.
$750/pp
or Student/Apprentice/Trainee: **$375/**pp**

Wednesday, May 13th	Thursday, May 14th
Networking	Networking
Main Conference Dinner	Social Activity

*pp = per person. * Student/Apprentice/Trainee ID required for eligibility.*
*** Cost all inclusive including the Wednesday night dinner. Student/Apprentice/Trainee ID required for eligibility. *** App download required for device in order to read QR codes.*

KEEP UP TO DATE!

Visit vanz.org.nz, or scan the QR Code*** above with a mobile device, to find out more about our special optional site visit, as well as up to date news, timetables and more.

Student/Apprentice/Trainee Details

ID number required below for day 1 and/or day 2 special offer eligibility..

Student/Apprentice ID Number:
(If applicable)

For further information or to secure your position please contact our conference team, Leanne on +64 9 296 1333 or Tim +64 27 577 3592 or you can email us at conference@vanz.org.nz | www.vanz.org.nz

2020 Principal Sponsors:

CSE W Arthur Fisher

Brüel & Kjær Vibro

Back to the Future

Conference 2020

'Predictive asset management'

New Zealand's premier 3-day condition monitoring and reliability conference

May 12, 13 and 14th 2020, Trinity Wharf Hotel, Tauranga

VANZ

www.vanz.org.nz

PRICING

* All prices exclude GST.

CONFERENCE ENTRY

1 DAY

Practical Hands-on Awareness Day - Tue 12th May 2019

FULL DAY ENTRY to the **Practical Hands-on Awareness Day.** See below for extra benefits (1).

NZ$250 Qty $

FREE!

Special Offer - No Cost! – Open to all students/apprentices and trainees with ID

Full Day entry to the **Practical Hands-on Awareness Day.** See below for additional benefits (1). Student ID Required. See page 1.

Sign up online. www.vanz.org.nz

Enter the code: STUAPP to automatically receive discount!

FREE! Qty

1 DAY

Asset Management/ Reliability Implementation Day - Tue 12th May 2019

FULL DAY ENTRY to the **Asset Management/ Reliability Implementation Day.**

See below for extra benefits (1).

NZ$350 Qty $

1 DAY

Technical Specialists Sessions - Tue 12th May 2019

FULL DAY ENTRY to the **Technical Specialists Sessions.** See below for extra benefits (1).

NZ$350 Qty $

2 DAY

Main Conference - Wed 13th and Thu 14th May 2019

Conference attendance for two days.

Includes 1x ticket for each dinner event! See below for additional benefits (2).

NZ$750 Qty $

1/2 PRICE!

Half Price Offer! – Open to all students/apprentices and trainees with ID

Full Day entry to the **Practical Hands-on Awareness Day.** See below for additional benefits (2). Student ID Required. See page 1.

Sign up online. www.vanz.org.nz

Enter the code: STUAPP to automatically receive discount!

NZ$375 Qty $

BEST VALUE

3 DAY

Full 3-Day Attendee - Tue 12th, Wed 13th,Thu 14th May 2019

Full conference entry to Awareness Day/ Asset Management/ Technical Specialists Sessions.

Includes 1x ticket for each dinner event! See below for additional benefits (2).

NZ$950 Qty $

Additional benefits

1. *Entry to the Awareness Day afternoon networking session. All Awareness Day papers will be available to download from www.vanz.org.nz. One day complimentary parking at the venue.*

2. *Complimentary parking at the venue. One Wednesday evening dinner ticker per registration. All conference papers will be available to download from www.vanz.org.nz. One year membership of VANZ included with attendance.*

For further information or to secure your position please contact our conference team, Leanne on +64 9 296 1333 or Tim +64 27 577 3592 or you can email us at conference@vanz.org.nz | www.vanz.org.nz

2020 Principal Sponsors:

CSE W Arthur Fisher

Brüel & Kjær Vibro

ACCOMMODATION

Use VANZ booking discount code: vanz2020

LIMITED OFFER!

SPECIAL

Early Bird 3-Day All Inclusive Accommodation Deal!

All-inclusive 3-day Conference pass and 3-Nights' accommodation offer, including breakfast at the 4.5 Star Trinity Wharf Hotel. *Offer only available before 1st Feb 2020.* Subject to room availability so don't delay, first in get the best Deluxe rooms.

NZ$1,500 Qty $

Early bird accommodation deals available for student/apprentices, go to vanz.org.nz registration page for more info or use contact number below.

For the conference, we've secured all the rooms at Trinity Wharf Hotel in Tauranga for a great rate if you need to book accommodation seperately, but it's only for a limited time and availability will reduce closer to the conference date. Don't delay. To make it easy to reserve your room(s), simply visit www.trinitywharf.co.nz/#make-booking, or scan the adjacent QR code*** with a mobile device, or go to to book and secure. There is limited rooms available, so first in will be first served. Alternatively, there is also a list of other accommodation contact options online for you to also consider if you're from out of the region.

CONFERENCE EVENING EVENTS

We will be hosting two event evenings. Tuesday night is a welcome to the 2020 Conference, and Wednesday night is a dining experience. One dinner pass is included with each 2-day or 3-day conference attendance pass purchased. The evening event dates for 2020 are:

FREE!

TUE

Informal Welcome Evening - Tue 12th May 2020

Trinity Wharf Hotel - FREE for conference attendees

Complimentary light food and refreshments included. Please advise attendance numbers for catering.

Attending: Qty

WED

Main Conference Dinner Event (Additional Tickets) - Wed 13th May 2019

Special event in planning

Extra tickets are available at $125 each. Please fill out if applicable.

NZ$125 Qty $

MEMBERSHIP

VANZ 2020-2021 Membership only

Full year. Otherwise included in the main conference attendee pass. Pricing excludes GST.

NZ$100 Qty $

TOTAL PAYABLE

Don't forget to add the GST content (+15%) to your total. $ incl. GST

PAYMENT DETAILS

MAKE YOUR PAYMENT ONLINE

NEW!

Simply scan the QR code*** to the right with a mobile device, or go to www.vanz.org.nz to make your payment quick and easy online.

PAYMENT DETAILS:

Pay by Cheque to: Vibrations Association of New Zealand.

Postal Address: P.O Box 2122, Shortland Street, Auckland 1140, New Zealand.

Account details: Vibration Association of NZ Inc Conference. No, 06-0329-0706287-01. Please use your name and/or company purchase order as reference.

PAYMENT OPTIONS: ☐ Cheque ☐ Credit Card* ☐ Direct Credit ☐ Company Purchase Order ____

CREDIT CARD NUMBER: ☐☐☐☐ - ☐☐☐☐ - ☐☐☐☐ - ☐☐☐☐ CARD TYPE: ☐ Visa ☐ Mastercard

EXPIRY DATE: ☐☐ / ☐☐ CVV** No. ☐☐☐☐ NAME ON CARD: ____

SIGNATURE: ____

** 3% surcharge applies. **3 or 4 digit number printed on the back of your card.*
**** A QR Code reading app is needed on your mobile device to scan the code.*

For further information or to secure your position please contact our conference team, Leanne on +64 9 296 1333 or Tim +64 27 577 3592 or you can email us at conference@vanz.org.nz | www.vanz.org.nz

2020 Principal Sponsors:

CSE W Arthur Fisher · Brüel & Kjær Vibro

Back to the Future Conference 2020

'Predictive asset management'

New Zealand's premier 3-day condition monitoring and reliability conference

May 12, 13 and 14th 2020, Trinity Wharf Hotel, Tauranga

VANZ

www.vanz.org.nz

CONFERENCE ATTENDEES

☑ Tick the option that best suits your requirements.

1ST ATTENDEE

Tick applicable:

- Awareness (Day 1) > ☐
- Asset Management (Day 1) > ☐
- Technical Specialist (Day 1) > ☐
- Main Conference > ☐
- Exhibitor > ☐

First Name: Title:

Surname:

CONTACT DETAILS:

Phone: Mobile:

Company:

Website:

Work P.O Box Address:

State/Region: Country: Postcode:

Home Address:

2ND ATTENDEE

Tick applicable:

- Awareness (Day 1) > ☐
- Asset Management (Day 1) > ☐
- Technical Specialist (Day 1) > ☐
- Main Conference > ☐
- Exhibitor > ☐

First Name: Title:

Surname:

CONTACT DETAILS:

Phone: Mobile:

Company:

Website:

Work P.O Box Address:

State/Region: Country: Postcode:

Home Address:

3RD ATTENDEE

Tick applicable:

- Awareness (Day 1) > ☐
- Asset Management (Day 1) > ☐
- Technical Specialist (Day 1) > ☐
- Main Conference > ☐
- Exhibitor > ☐

First Name: Title:

Surname:

CONTACT DETAILS:

Phone: Mobile:

Company:

Website:

Work P.O Box Address:

State/Region: Country: Postcode:

Home Address:

For further information or to secure your position please contact our conference team, Leanne on **+64 9 296 1333** or Tim **+64 27 577 3592** or you can email us at conference@vanz.org.nz | www.vanz.org.nz

2020 Principal Sponsors:

CSE W Arthur Fisher Brüel & Kjær Vibro

BACK to the FUTURE
CONFERENCE 2020
'PREDICTIVE ASSET MANAGEMENT'

New Zealand's premier 3-day condition monitoring and reliability conference

May 12, 13 and 14th 2020, Trinity Wharf Hotel, Tauranga

VANZ
www.vanz.org.nz

EXHIBITOR INFORMATION

** All prices exclude GST.*

PACKAGE ☑ Tick the option(s) that best suits your requirements.	Platinum POA ☐	Gold $2,950 ☐	Silver $2,100 ☐	Bronze $1,450 ☐
Naming rights of conference	●			
Primary sponsorship on key online & offline promotional material before and during conference*	●			
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	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	x4	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
*Website*** Animated landscape panels @ 460px wide x 200px high - x1
*Logo file**** To be supplied as either a vector eps or hi res tif/png/jpeg

Files to be supplied to specifications - enquiries to conference@vanz.org.nz

For any assistance or enquiries, contact Leanne on +64 9 296 1333 or conference@vanz.org.nz

ADDITIONAL SPONSOR OPTIONS AND INFORMATION

☑ Tick if applicable

Lanyard sponsor	$500 + lanyards	☐
Bag sponsor	$500 + bags	☐
Dinner sponsor	POA	☐
Informal Welcomw Event (Tues night)	$2,000	☐

LIMITED OFFER!

SPECIAL

Early Bird Exhibitor Accommodation Special!

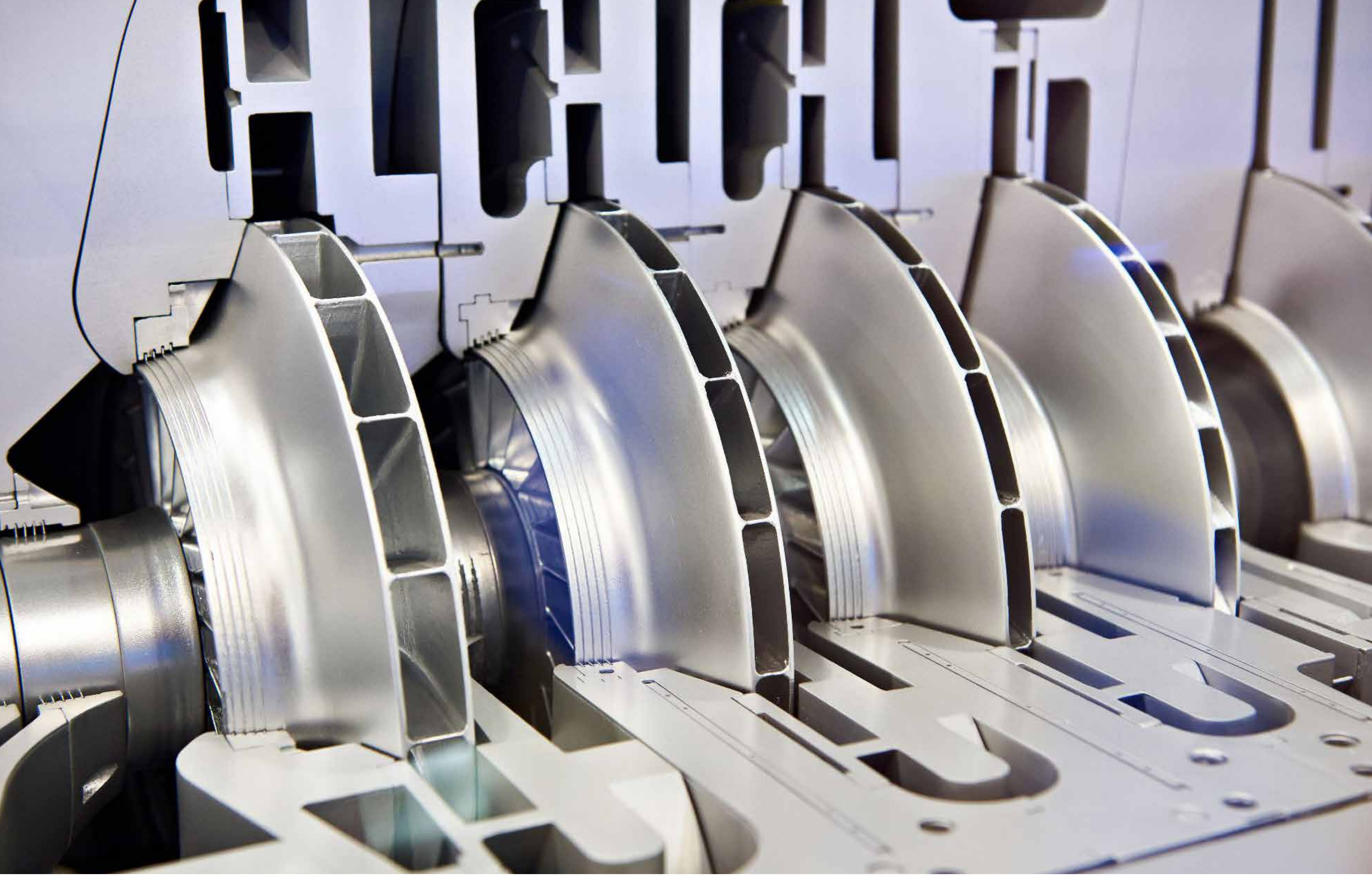
3 nights/ 4.5 star accommodation incl. breakfast at special exhibitor price of $550 per room.
Offer only available before 1st Feb 2020. Subject to availability. Book fast!

NZ$550 Qty $

For further information or to secure your position please contact our conference team, Leanne on +64 9 296 1333 or Tim +64 27 577 3592 or you can email us at conference@vanz.org.nz | www.vanz.org.nz

2020 Principal Sponsors:

CSE W Arthur Fisher Brüel & Kjær Vibro



Above: A centrifugal compressor.

spike in the bearing RTD temperature was recorded. One of indications that helped to correctly identify the root-cause of this problem was a simple test of switching the lubrication oil filter to see if spike patterns change. The switch of lubrication oil filter reduced the varnishes deposited on bearings temporarily and this reduced spikes in RTD bearing temperature and changed its patterns.

Investigations showed one of additives in the vendor selected lubrication oil interacted with compressor's process gas and produced some kind of varnish. On this basis, it was decided to change the lubrication oil type of this compressor. This oil type change was done. The operation of compressor has been smooth and satisfactory after the change of lubrication oil.

Case Study 5

Centrifugal Compressor – New Pressure Ratio

For a critical process centrifugal compressor, pressure ratio was changed because of the change in gas composition and new operating conditions (due to changes in plant operation). The pressure ratio (discharge pressure to suction pressure) could move theoretically from "2.25" to "2.61" because of these changes (gas composition change, higher required discharge pressure, etc). The compressor was initially rated for the pressure ratio of around "2.39". Operators raised this as an important limitation which can probably over-load the thrust bearing of this compressor.

The compressor data including compressor map, design conditions, compressor details, thrust bearing data, etc were carefully reviewed. The issue was thoroughly studied. Rises in differential pressure and load on thrust bearings were accurately determined and verified. Based on studies, it was confirmed that there was no issue for the thrust bearing regarding this differential pressure rise. A thrust bearing should often be sized to absorb this kind of change. In this case, these changes were within thrust bearing limits. In addition, there were temperature measurements and vibration monitoring for the thrust bearings. These could show any malfunction in this regard. The conclusion was there was no concern for this compressor. It has been operated safely and reliably with the modified operating conditions. The condition monitoring system could provide a good opportunity, in addition of all above-mentioned calculations and verifications, to make sure about trouble-free and reliable operation of the compressor.

Case Study 6

Centrifugal Compressor – Oil Accumulator & Rundown Tank

For a medium-size centrifugal compressor in a critical process service, it was decided to install a lubrication oil accumulator and a lubrication oil rundown tank. However, there were confusions and concerns

Continued on page 22 >

WIRELESS - RANGER PRO PREPARING FOR THE FUTURE

Ranger Pro delivers:

Simplicity - Compact, wireless design coupled with extended battery life

Cost Efficiency - By eliminating "reporting by walking around" via accurate, real-time data collection

Full integration with System 1 software - Expand balance of plant monitoring with the integration of Ranger Pro and System 1

Easily and quickly expandable - Wireless (star or mesh), battery-powered, compact and configured over the air

NVMS SOLUTIONS

Ben.Heywood@nvms.co.nz
+64 274 664 810
nvms.co.nz

Investigations showed one of additives in the vendor selected lubrication oil interacted with compressor's process gas and produced some kind of varnish.

about how to install all these. Specifically, there were questions on required valves and configuration as well as alarm and shutdown set-points for proper monitoring and operation.

For an oil accumulator to work effectively, it should be installed and connected close to the main lubrication header (close to bearings). A check valve should also be installed on the main lubrication oil line between the accumulator connection point and the upstream lubrication oil system, downstream of lubrication oil filters as the last part of the lubrication oil system. The rundown tank connection should be upstream of the check valve (the check valve close to the accumulator) and downstream of lubrication oil filters. This is an emergency system and it should be connected close to bearings. On the other hand, all lubrication oil sub-system connections should be at the upstream of the check valve related to the oil accumulator.
As soon as there is a fault or a malfunction (for instance, a lubrication oil problem) on lubrication oil system, the lubrication oil flow will reduce (too often it stops in a short time). This could result in pressure reduction in the lubrication oil header and small amount of lubrication oil will be displaced from the accumulator to lubrication oil header. However, this initial supply of the lubrication oil by an accumulator should not result in a delay of the start of an auxiliary lubrication oil pump. The key-point is an oil accumulator system should be designed and sized correctly (N2 pre-charge pressure, the accumulator sizing, etc) to let all systems work properly in transient situations. The oil accumulator system should supply oil as soon as the pressure reduced until auxiliary lubrication oil pump comes online. There is always discussion about N2 pre-charge pressure setting of a lubrication oil accumulator. Some engineers recommended N2 pre-charge pressure setting around 85% of the normal oil pressure, some experts recommended a value about 65-75% of the normal oil pressure for this pressure. Majority suggested a value around 70% of the normal oil pressure. Often, a value between 65% and 80% of the normal oil pressure is specified.

The oil pressure alarm set-point is usually selected around 70-78% of the normal operating oil pressure. The oil pressure shutdown limit is defined based on bearing requirements, but often it is around 50-55% of normal operating oil pressure. The alarm and trip set-points should be selected carefully. Normal operating variations should always be considered. On the other hand, limits should not be too low to result in a risk or damage. For many medium-size centrifugal compressors, oil normal operating pressure is around 2.1 Barg and the alarm set-point and trip set-point are often around 1.6 and 1.1 Barg, respectively. In many large API centrifugal compressor trains, oil normal operating pressure is around 2.5 Barg, and alarm set-point and trip set-point are often approximately 1.8 and 1.3 Barg, respectively.

For this medium-size centrifugal compressor, lubrication oil normal operating pressure was around 2.2 Barg. There was a recommendation by operation team to increase the alarm point to 1.9 Barg (more than 86% of the oil normal operating pressure). This was not done because of very narrow operating range. In this machinery, alarm set-point and trip set-point were set around 1.65 and 1.15 Barg, respectively.

Case Study 7

Refrigeration Centrifugal Compressor - Potential of Liquid Carryover

The potential of liquid carryover to a refrigeration centrifugal compressor was raised by operation team in a plant. Operational recorded data showed that prior to start-up of the compressor, suction line was at 6.5 Barg and 5°C. Under these conditions, the refrigeration gas was theoretically liquid and could damage the compressor, seals and inlet strainer, when it started

Continued on page 24 >

Spectrum

The official journal of the Vibrations Association of New Zealand (VANZ)

Get your business noticed with our all new

Spectrum Trade Directory section!

VANZ
VIBRATIONS ASSOCIATION of NEW ZEALAND

Dear Spectrum reader.
From issue 95 (our next one), VANZ will be running a brand new Trade Directory section in the magazine. This is a great opportunity for all the small (and larger) businesses out there to let readers know who you are and what you do in a cost efficient smaller sized advertisement. To get the ball rolling, we're offering our members an introductory offer!

Place your Trade Directory advertisement in the next issue of Spectrum for half price*!

SAVE $45!

Only $45+GST for a placement (normally $90+GST). Advert supplied. That's great value!
So, what are you waiting for, send us your advert today. Spaces will be limited to first in first served. Please see below for specifications.
Advert deadline for issue 95 will be DATE HERE...

* - Special offer available for issue 95 of Spectrum only.

ACTUAL SIZE EXAMPLE

90mm

48mm

CD ENGINEERING
(2019) LIMITED
For all your civil engineering requirements. Call the experts
Freephone: 0800 123 456
123 Smith St, Downtown 6789
www.cdengineering.co.nz

Size and Price:

Size	Price
Advert area (width x height) 90mm x 48mm	$90+GST per issue insertion
Text area (width x height) 80mm x 38mm	

How to supply an advert:

All advertising copy to be supplied in **high-res PDF format** at the correct size required. Files to be supplied press ready at 300dpi ideally with all fonts converted to paths (outline) and all colours converted to CMYK with no spot/pantone colours used.

For text in the advert, we also suggest allowing 5mm inside each edge of the advert. This eliminates the risk of any text being cut off the advert when the advert is placed within the boundaries of the ad space in the magazine. (See sizing requirements right).

Size Specifications

Advert Size
90mm (wide) x 48mm (high)

Text Area
80mm (wide) x 38mm (high)

For further information on advertising, please contact our editor for Spectrum magazine, on spectrumeditor@vanz.org.nz
Visit our web site: www.vanz.org.nz

VANZ

with liquid flowing through the centrifugal compressor. It was recommended by operation team to depressurize refrigeration gas to below 4.5 Barg prior to the start-up. In addition, they asked to investigate possible solutions to detect or automatically drain liquid refrigeration from the inlet piping at pre-start.
Investigations showed that the liquid carryover was a false alarm. The temperature transmitter range was up to 5°C (it showed 5°C for any temperature above 5°C) and the actual temperature in the suction line before the start-up was above 20°C. Theoretically there was a little chance for refrigeration gas conditions to reach the saturation point during a shutdown.

It was decided to change the temperature transmitter with a new one with the measurement range up to 40°C. There might be a remote chance that the gas condition during a shutdown reaching the saturation point. The draining of the collected liquid would be necessary. The operation procedure was corrected and a necessary step for the drain of liquid at suction drains prior to the compressor start-up was included.

Case Study 8

Centrifugal Compressor with Side-Stream

The case study is for a centrifugal compressor with a high-flow side-stream. The compressor was at the downstream of a complex gas drier system. The side-steam flow was around 3.5 times the main suction flow. Because of a malfunction of the gas drier system, the gas temperature was increased around 40°C compared to the normal operation. The compressor experienced a sharp increase at the suction temperature. As the result, compressor vibration reading was increased around 10% (on average) which was an event that required operation team and machinery engineer attention. A large flow of gas with relatively low temperature came from the side-stream nozzle and cooled the compressed gas at the mixing section inside the compressor. The suction temperature sharp rise of around 40°C caused just a small increase of about 9°C at the discharge. However, the gas temperature increased at the discharge of the first section (before mixing section) inside the compressor.

Based on measured data, operating parameters were not passed limits except the suction temperature alarm. However, there was a concern about high temperatures inside the compressor. A recommendation by an operator was to trip the compressor to prevent any damage due to high internal temperatures. The trip was not approved by the machinery engineer and shift operation team leader. The assessment was the internal temperature was not passed the limit and also any trip could cause a thermal shock in compressor internals. A great temperature difference from a high temperature to an ambient temperature after a shutdown could potentially cause a thermal shock this case. Also, a trip was an unnecessary production interruption. Operation team acted quickly and they corrected the problem in the gas drier system which resulted in the suction temperature returned to normal level within 7 minutes. When the temperature reduced to normal level, the vibration was also reduced to normal patterns. All parameters were returned to normal levels and there was no sign of damage or malfunction.

The measurement of gas temperature inside the compressor (discharge of first section) was neither feasible nor possible, but estimations showed that the first section discharge temperature was just a few degrees centigrade below the maximum operating temperature allowed by compressor manufacturer. Compressor temperature limits depending on the compressor design, material selection, different component manufacturing and process gas properties. Mechanical considerations usually different from compressor to compressor. As a rough indication, temperature limits associated to mechanical design could be about 210°C. However, sealing elements and non-metallic components might limit the gas temperature to around 175°C. Some gases should be kept lower than above-mentioned temperatures based on process requirements, for example, to prevent polymerization, decomposition, reaction and similar. The polymerization could be a concern for some gases. If the gas temperature passes the limit, the polymerization can result in fouling or unbalance masses on impellers which could cause performance deteriorations, long-term vibration issues and operation problems. For some process gases, the process limit could be 80-140°C. For instance, temperatures of hydrocarbons most often should be limited to around 130°C based on process requirements.

For this case study, it was confirmed that the process gas was not polymerized and the temperature did not pass the process gas limit. Operation team was asked to prevent such an incident. These high temperature events could result in compressor deterioration and degradation and it should be seriously avoided. Operation procedures of the gas dryer system were modified to prevent such incidences.

Many centrifugal compressors incorporated alarm for gas suction temperature and alarm and trip for gas discharge temperature. The shutdown limit should be sufficiently high to avoid an unnecessary trip.
A lesson learned from this event: for a centrifugal compressor with side-stream (particularly when the side-stream flow is considerably higher than the main flow), the suction temperature alarm requires careful attention since there could be a possibility that internal temperatures (specially the discharge temperature at the first section) reaches very high level and passes

When the temperature reduced to normal level, the vibration was also reduced to normal patterns. All parameters were returned to normal levels and there was no sign of damage or malfunction.

the temperature limit whereas the final discharge temperature just shows a small rise (even not showing an alarm for the discharge temperature) due to cooling effects of the incoming large volume of side-stream flow. For an alarm case when the assessment is all compressor operating parameters are still within allowed limits, the general recommendation is "do not shutdown compressor". For example, in case of an increase of a gas suction temperature for a short time when no parameter passes its limit, the recommendation is to continue operation unless there is a reason or a reasonable evidence for a shutdown.

Conclusion & Final Notes

Worldwide installed rotating machineries with modern condition monitoring are increasing particularly in critical plants and remote locations. Well-designed condition monitoring, predictive maintenance strategies and failure root-cause analysis offer high reliability and vast technical and commercial benefits. These condition-based methods have been necessary for critical rotating equipment trains installed without spare. For an alarm case, when the assessment is all machinery operating parameters are still within allowed limits, general recommendation is "do not shutdown machinery". It is wise to continue operation unless there is a scientific reason or a reasonable evidence for a shutdown.

Radial bearings of modern turbomachineries are mainly sized based on rotordynamics. They should not normally be affected by minor machinery load changes or slightly modified operating conditions unless there is a link to lubrication oil conditions or machinery rotordynamics. On the other hand, thrust bearings are designed based on machinery loads (with respect to balance piston(s) and impeller arrangements) and they can be affected by machinery load changes and new operating conditions.

The lubrication oil analysis is a very effective tool to evaluate the health of bearings. As an indication, for turbomachineries, if for a given flowrate and shaft speed, produced head falls below 90% of the value predicted, this might be an indication of a problem.

REFERENCES

1 Forsthoffer, W. E., Forsthoffer's Rotating Equipment Handbooks Volume 5: Reliability Optimization through Component Condition Monitoring and Root Cause Analysis, Compressor, first edition, 2005 (Elsevier, Oxford, UK).

2 Forsthoffer, W. E., Forsthoffer's Best Practice Handbook for Rotating Machinery, First edition, 2011 (Elsevier, Oxford, UK).

3 Bloch, H. P. A Practical Guide to Compressor Technology, 2nd edition, 2006 (John Wiley, New Jersey, USA).

Continued on page 26 >

4 Bloch, H. P. Compressor and Modern Process Application, 2006 (John Wiley, New Jersey, USA).
5 Davidson, J., Bertele, O., Process Fan and Compressor Selection, pp 47-68, 1996 (Mechanical Engineering Publications Limited, London, UK).
6 Brown, R. N. Compressors Selection and Sizing, Third edition, pp 120-220, 2005 (Gulf Publishing Company, Houston, USA).
7 Bloch, H. P., Soares, C., Process Plant Machinery, second edition, 1998 (Butterworth Heinemann, Oxford, UK).
8 Rangwala, R. S. Turbo-machinery Dynamics Design and Operation, 2005 (McGraw-Hill, USA).
9 Rao, J. S. Rotor dynamics, Revised third edition, 2007 (New Age International Publishers, India).
10 Jingtan Cui, J., and Wang, S., Health Monitoring and Continuous Commissioning of Centrifugal Chiller Systems, Proceedings of the Fourth International Conference for Enhanced Operations, pp 31-38, October 18-19, 2004 (EBO, Paris, France,).
11 Kacprzynski, G. J., Gumina, M., Roemer, M. J., Caguiat, D. E., Galie, T. R., McGroarty, J. J., A Prognostic Modeling Approach for Predicting Recurring Maintenance, Proceedings of ASME Turbo Expo, 2001-GT-0218, pp 11-17, 2001, 4-7 June 2001, New Orleans, LA USA.
12 Kurz, R. and Brun, K., Degradation in Gas Turbine Systems, 2001, ASME J. Eng. Gas Turbines Power, 123, 70–77, USA.
13 Syverrud, E., Brekke, O., and Bakken, L. E. Axial Compressor Deterioration, 2005, ASME Paper No. GT2005-68701, USA.
14 Syvverrud, E. and Bakken, L. E., The Impact of Surface Roughness on Axial Compressor Deterioration, 2006, ASME Paper GT2006-90004, USA.
15 Kurz, R., Brun, K. and Wollie, M. Degradation Effects on Industrial Gas Turbines, Journal of Engineering For Gas Turbines and Power (ASME), November 2009, 131(6), USA.
16 Jia. Y., and Agami., T., Characteristic Physical Index Approach to Modeling Compressor Suitable for Fault Detection, Diagnosis, and Evaluation. Journal of Solar Energy Engineering, Transactions of the ASME, pp 258-265, 125(3), 2003 (ASME, USA).
17 Kim, T. and Lee, H., Failure analysis of MVR Compressor Impeller Blade, Journal of Engineering Failure Analysis, pp. 307–315, 2003.
18 Hershko, E., Mandelker, N., Gheorghiu, G., Sheinkopf, H., Cohen, I., and O. Levy, Assessment of Fatigue Striation Counting Accuracy Using High Resolution Scanning Electron-microscope, Journal of Engineering Failure Analysis, pp. 20–27, 2008.
19 Hurley, P.J., Whittaker, M.T., Webster, P., and Evans, W.J., A Methodology for Predicting Creep/Fatigue Crack Growth Rates, International Journal of Fatigue, pp. 1702–1710, 2007 (Elsevier, Oxford, UK).
20 API 613, Special Purpose Gear Units for Petroleum, Chemical and Gas Industry Services, Fifth Edition, February 2003 (American Petroleum Institute Publishing, Washington, USA).
21 Girodin, D. and Dudragne, G., Bearing Steels for Aerospace Applications, 3rd Symposium Ascometal, Arles, June 2000 (Arles, France).
22 Joly, P., Frey, J., Lafleur, B., Dulcy J. and Gantois, M., New developments in Nitriding Steels and Associated Nitriding Process Control, for very Deep Nitrided Cases," ATTT/AWT – Journées franco-allemande, Aachen, 2002 (Aachen, Germany).
23 Jacques, C., Nélias, D., Normand, G., Vincent, A. and Dudragne, G., Rolling Contact Fatigue of Nitrided Steels, Congrès Leeds-Lyon, June 2002 (Lyon, France).
24 Dehner, E. and Weber, F., Experience with Large, High-Speed Load Gears, Gear Technology, pp. 42-52, www.geartechnology.com, July 2007 (Randall Publications LLC, Elk Grove Village, IL, USA).

NOTATION

FEA	finite element analysis
ppm	part per million
RTD	resistance temperature detector
Impro	An advanced seal for positive protection against vapour or gas transfer into the lube system
HRC	Hardness in Rockwell scale
BHN	Hardness in Brinell scale.

TRADE DIRECTORY

PUZZLE CORNER

WORD BUILDER

How many words of three or more letters can you make, using each letter only once? Plurals are allowed, but no foreign words or words beginning with a capital. There is at least one 5 letter word.

15 - Good | **20** - Very Good | **25+** - Excellent

T	S	E	E	A

WORD MARCH

Draw a path from one square to another to find the secret nine letter word. You may move in any direction. Each square can only be used once.

There is **512** words (three letters or more) that can be made from the combination of letters below. How many can you make?

Solution on page 31.

A	E	S
C	G	H
T	L	I

Nine letter word is...

SODUKU

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.

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

Carlton Technology Ltd
PO Box 18046, Merrilands, New Plymouth 4360
Ph: 64 6 759 1134 • Fax: 64 6 759 1184
Email: ctownsend@xtra.co.nz

TEST YOUR KNOWLEDGE - PART 59 OF A SERIES

1 In which of the following situations is there the greatest likelihood of EDM damage to rolling element bearings?

a In a centrifugal pump that is cavitating
b In a gearbox that has been over-filled with oil
c In a standby machine where its neighbour runs with high vibration
d In a high-powered induction motor powered by a VSD drive.

2 A cantilevered beam vibrates at 1 mm/s close to its anchoring point, and 15 mm/s at its free end. How will you know whether or not the beam is in resonance?

a Plot phase and amplitude at regular intervals along the beam. If in resonance there will be phase changes between the points which, when plotted will show shapes typical of resonance
b Conduct an impact test on the beam (using negative averaging if the source of the vibration cannot be removed). The results should reveal whether the beam is vibrating at or near its natural frequency
c Fit a variable-speed shaker to the beam and observe phase and amplitude as the speed is changed
d Any of the above could be useful.

3 An electric motor has been installed with precision; there is no soft-foot. However its 1 x vibration levels reduce when the mounting bolt on one of the feet is loosened. What is this most-likely to indicate?

a There is a possible resonance problem
b The motor is unbalanced
c The motor bearings are in need of lubrication
d Either b or c could be correct.

4 In order to safely measure vibration levels on a bearing that is 3 metres off the ground, an analyst makes up a 1 metre extension to fit on the end of his existing 1 metre probe; both have the same diameter. How might the use of the extension affect his measurements?

a The vibration levels as measured will reduce at all frequencies
b The natural frequency of the combined probe and extension will be lower than that of the probe alone, and this is likely to influence the measured amplitudes at some frequencies
c The vibration levels as measured will increase at all frequencies
d Only high-frequency signals will be affected.

5 Routine monitoring of machines that run at variable speeds can be challenging. What can the

Answers on page 31

Further enquiries can be directed to: Carl Townsend at Carlton Technology Ltd.
Phone: 64-6-759 1134 | Email: ctownsend@xtra.co.nz | Address: P.O. Box 18046 Merrilands, New Plymouth 4360, NZ

analyst do that will assist in his/her confidence in understanding the condition of the machine?

a If possible, ask the operators to run the machine at the same speed each time for the duration of the tests

b There might be value in having duplicate (or multiple) machines set up in the vibration database, each having a specified machine speed range at which it is tested

c Ensure that other variables such as transducer placement are controlled as well as possible

d Any of the above might be very helpful.

6 Which of the following changes will increase the storage space of a vibration database over time?

a Increasing the number of lines of resolution for the measurement points

b Increasing the Fmax of the spectral data

c Setting the data-collector to auto-range.

d Both b and c.

7 A non-synchronous vibration has shown up in the velocity readings taken on a centrifugal pump. What might this indicate?

a A bearing defect might have developed

b The vibration might originate elsewhere – i.e. from a neighbouring machine

c The vibration might indicate a flow-related problem

d Any of the above could be valid causes of the vibration.

8 A rolling element bearing has 11 balls, and the ball-passing frequency of the outer race is 4.559 orders. What is the BPFI likely to be?

a 7.665 orders

b 6.882 orders

c 2.761 orders

d 6.441 orders

9 An electric motor runs at 1470 rpm. A strong vibration is measured at 24.5 Hz. This vibration is ….

a Sub-synchronous

b synchronous

c asynchronous

d Non-synchronous

10 The 2020 VANZ Conference will be held in which New Zealand city?

a Tauranga

b Rotorua

c Hamilton

d Auckland

CALL FOR PAPERS

The VANZ conference is a place for learning and sharing

- Have you ever had an experience that you think others would benefit from?
- Something 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 too! That is what VANZ is all about. If you could talk for just 15 minutes (or longer if you like), please write to
Simon.Hurricks@genesisenergy.co.nz

VANZ
VIBRATIONS ASSOCIATION *of* NEW ZEALAND

Advertising Rates

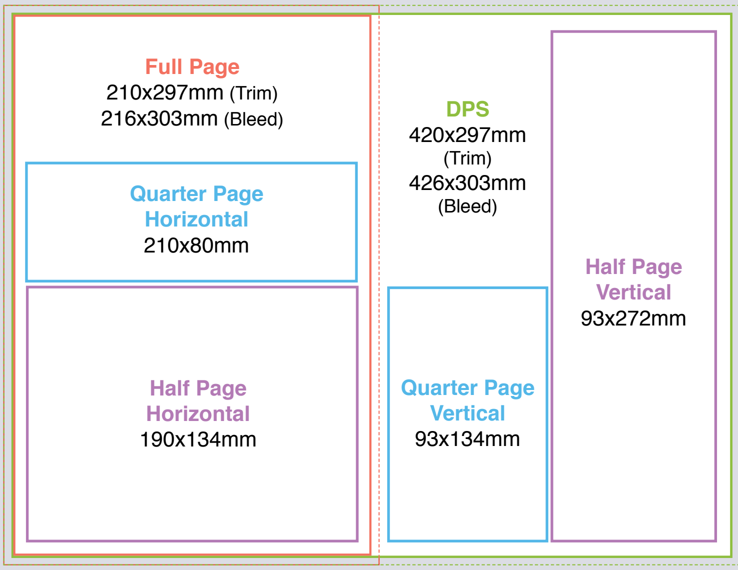
DPS	Full Page	Half Page	Quarter Page	Advertorial
Size (width x height): 420x297mm (Trim) 426x303mm (Bleed)	Size (width x height): 210x297mm (Trim) 216x303mm (Bleed)	Size (width x height): 190x134mm (Horz) 93x272mm (Vert)	Size (width x height): 190x80mm (Horz) 93x134mm (Vert)	$100 per page or 50% discount if bought in conjunction with a full page colour advert.
Single issue rate: **$550+GST**	Single issue rate: **$350+GST**	Single issue rate: **$300+GST**	Single issue rate: **$250+GST**	
4-issue (1 year) rate: **$500+GST**	4-issue (1 year) rate: **$315+GST**	4-issue (1 year) rate: **$270+GST**	4-issue (1 year) rate: **$225+GST**	

The small print...

How to supply an advert:
All advertising copy to be supplied in high-res PDF format at the correct size required. Files to be supplied press ready at 300dpi with 3mm bleed for full page and DPS advertisements. The special 4-issue rates are for advertising in 4 consecutive issues. i.e. Issue 91, 92, 93 and 94. ***Save up to $200 on your advertising in Spectrum!***
Email Angie at spectrumeditor@vanz.org.nz 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 will become available on the public domain.

Article submissions:
Articles for upcoming issues of Spectrum are welcomed by the editor. Copy to be supplied preferably in Microsoft Word, but PDF PDF file format is also acceptable.
Please email spectrumeditor@vanz.org.nz with your submission or should you require further information.



Answer to Word March #95: Lichgates

1D, 2D, 3A, 4B, 5D, 6A, 7D, 8D, 9B, 10A

Answers to Carlton Technology Quiz 59:

SETPOINT™ by Brüel & Kjær Vibro

CSE W Arthur Fisher
a division of CSE New Zealand

Machinery Protection & Condition Monitoring System

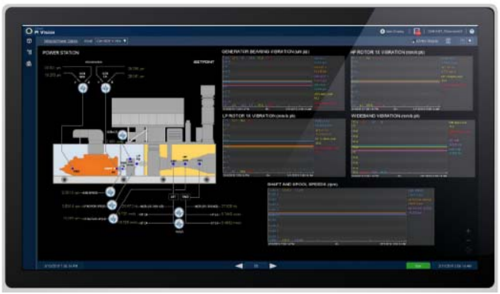
Key Features:

- Full API 670 compliance
- Totally open data access
- Native to OSISoft – PI historian
- 19” rack or bulkhead mounting
- Up to 56 channels
- On-board flight recorder mode with 32GB SD card and 32GB solid state HDD as default option
- Multiple, segregated processors
- Can be retrofitted to replace existing system
- IIoT and EIoT Enabled Solution

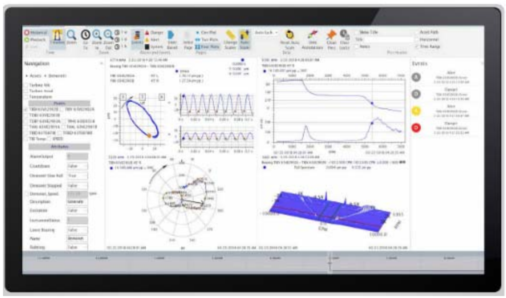
Applications:

- Gas, Steam and Hydro Turbines
- Generators, other Rotating Machineries
- Reciprocating and Radial Compressors
- Balance of Plant – Pumps/Fans/Others

PI Process Book
PI AF Client



SETPOINT®
CMS Clients



www.cse-waf.co.nz