



# Spectrum

Spring 2020 | Issue 97

Solving hydro generation issues...

## 93m below water!

Full details inside...



Are you a  
**VANZ member?**

## Understanding pipe threads

*and more...*



# Machine Vibration & Plant Condition Monitoring Solutions



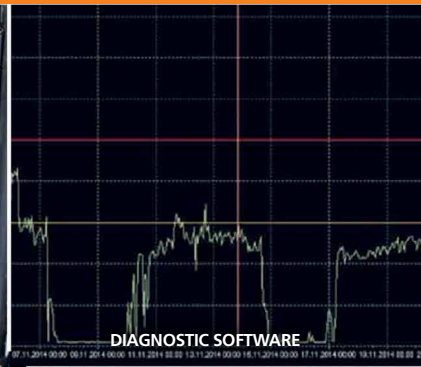
VIBRATION SENSORS



VIBRATION TRANSMITTER & SWITCH



VIBRATION MONITORING & DIAGNOSTICS



DIAGNOSTIC SOFTWARE



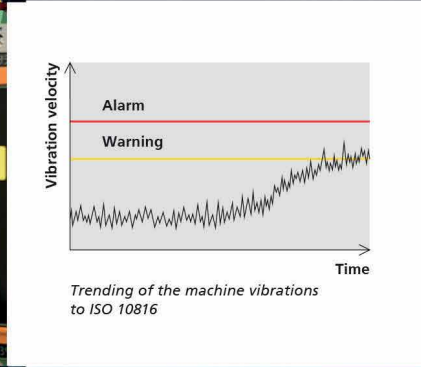
VIBRATION SENSOR WITH MEMORY CAPACITY



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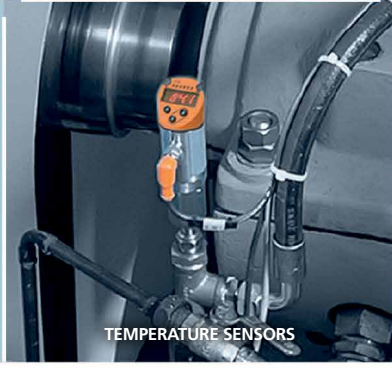
VIBRATION MONITORING & DIAGNOSTICS



Trending of the machine vibrations to ISO 10816



GAS FLOW / TEMPERATURE / PRESSURE



TEMPERATURE SENSORS



FLOW / TEMPERATURE SENSORS



PRESSURE SENSORS



Looseness, unbalance



Misalignment



Rolling element bearing



Gearbox Meshing, tooth fault



Pump Eccentricity, cavitation

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6



8



10

# CONTENTS Spring 2020

## Features

- Skills & Practice:** Pipe threads 6
- GVS help solve an unusual hydro generation issue...  
93m below water! 8
- B&K Vibro's digital transformation of a  
balance-of-plant monitoring 10
- Are you a VANZ member? 12

## Regulars

- From the president 4
- Editor's report 4
- Puzzle corner 13
- VANZ Trade directory 13
- Test your knowledge 14

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# Spectrum #97

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# PRESIDENTS' REPORT

By Rodney Bell, VANZ President

Hi everyone. As we all know it was necessary to cancel the 2020 VANZ Conference that was planned for Tauranga due to COVID-19 and it seems it's not finished with us just yet.

The Committee has spent considerable time working out where VANZ is positioned and what's next. The outcome of the meetings is we have decided that Conference 2021 is almost certain not likely happen as a typically 3-day event, but it is important to maintain Industry contact with as many as possible.

At this stage VANZ is proposing running one day Regional Technical Forums in Auckland, Tauranga, Hamilton, New Plymouth & Christchurch. What we need from you all is to complete the upcoming Survey (Survey Monkey) that will be sent to all in our VANZ database so we can gauge interest in these forums including, topics/formatting, and locations. Please as many of you who can assist here, give us your input. Once we have the necessary information, we will put a program together and run these forum's potentially from April through to June 2021. We will be also looking at live streaming

and possibly recording the sessions for those who cannot attend and to also give the opportunity of National/International Guest Speakers.



On a positive note all of New Zealand is now back to COVID-19 level 1 and within reason our private and working lives will resemble some form of normal, other than overseas travel.

**“ The Committee has spent considerable time working out where VANZ is positioned and what's next. The outcome of the meetings is we have decided that Conference 2021 is almost certain not likely happen... ”**

I encourage anyone who might have the opportunity to visit a part of New Zealand that you maybe have not yet experienced as I have recently done. We live in a beautiful Country go an explore and with Christmas now fast approaching this may be a good opportunity to do so while spending time with family and friends.

Our next edition of Spectrum is scheduled for February 2021 at which time we intend to have the Regional Technical Forum's scheduled. Until then I wish you all a safe and eventful festive season and I look forward to updating you all in the New Year.

## EDITORS' CORNER

As we continue to navigate the changes we have needed to make since our last issue in April, not only locally and nationwide but globally, we are continuing to take stock of how the industry is coping.

But Spectrum is back! We want to maintain the relationship we have with our valued members and those who continue to read and support us, thank you all for your contributions, especially financial commitments regarding sponsorship and advertising.

In this issue our new Quiz from Carl will keep the grey matter ticking, you can also catch up on the updates from our President Rodney Bell by reading his

report. Peruse the latest installment from Rod Bennet with Skills and Practices in Pipe Threads as well as an article from Matthew Fallow from Asset Quality Australia regarding a hydro generation issue.

If you are in area that continues to be affected by Covid-19 then please, continue to take all the measures to practice public health and safety along with common sense hygiene guidelines, we cannot become complacent as it's up to everyone to help protect the vulnerable before they are lost to us, take care of yourselves and each other.

Many Thanks and Happy Reading!

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## Pipe threads

The two main pipe threads in use at Western Port are: **British Standard Pipe (BSP)** - 55 degree included angle (*fig. 1a*) and **National Pipe Taper (NPT)** - 60 degree included angle (*fig. 1b*).



Above left: Figure 1a. Above right: Figure 1b.

Note that these threads not only have a different included angle and thread shape, they also have slightly different pitches (except for the 1/2" and 3/4" sizes). Because of these differences, these thread types must not be mixed, even if they appear to screw together. Mixing them would create a defect in your system, which may lead to a leak or fitting failure.

You are probably aware that BSP threads can be tapered (BSPT) or parallel (BSPP). But you may not be aware that BSP fittings can be manufactured to 2

thread With the use of a jointing medium such as teflon thread tape, this method is suitable for **medium** pressures.

**ISO 228-1** defines threads that seal through the use of a seal ring under the head of the fitting.

These G series threads are designated:

- G (internal parallel thread) - features a spotfaced area to mate with the seal ring on the male fitting.
- GA (external parallel, tight tolerance)

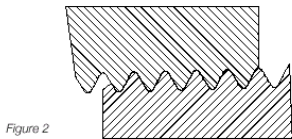


Figure 2

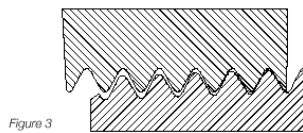


Figure 3

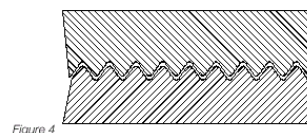
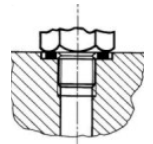


Figure 4



Above left to right: Figure 2, Figure 3, Figure 4 and Figure 5.

different and independent ISO standards.

**ISO 7-1** defines threads that seal through metal to metal contact of the threads.

These R series threads are designated:

- R (external taper)
- Rs (special external parallel)
- Rc (internal taper)
- Rp (internal parallel)

The seal can be female taper thread / male taper thread. With the use of a jointing medium such as teflon thread tape, this method is suitable for **high** pressures.

**OR**

The seal can be female parallel thread / male taper

- GB (external parallel, general purpose)

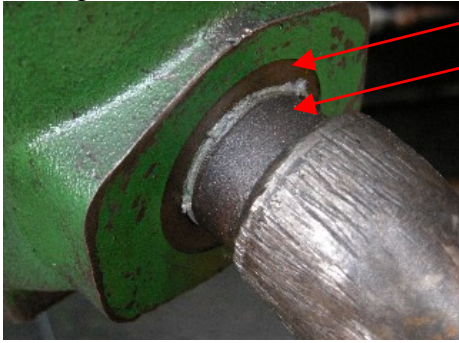
These parallel threads have no metal to metal contact. The use of a seal ring makes this method suitable for high pressures.

Both of these standards use the same "BSP" thread form, and will therefore mate together, but they have different tolerances and must not be mixed.

If a male R series is screwed into a female G series, it may bottom out on the female thread and it will be impossible to create a seal.

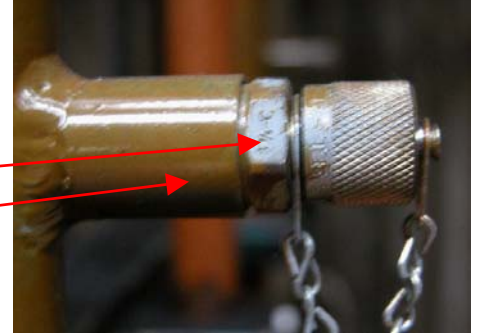
The top of the female thread may also engage on the washout section of the male thread, again making it impossible to create a seal.

## Examples of defects



*G series female and R series male locking up in the washout of the R series male thread.*

*G series male mated with an R series female. There is no machined face for the seal ring.*



In hydraulic systems, tapered threads are one of the biggest sources of leaks. Accordingly, only G series threads should be used. Another advantage of G series threads is that the torque required is easily controlled, as the fitting

## Summary

1. Do not mix thread types. (This creates a defect.) This is not as easy as it sounds, especially with tapered threads where you can expect some resistance when screwing parts together. If you



Above left to right: Figure 6, Figure 7, Figure 8 and Figure 9.

Over tightening can lead to fitting failure.

comes up against a dead stop when the shoulder of the male fitting touches the female fitting. The torque required for tapered threads is less easily controlled, and over tightening can lead to fitting failure.

2. Do not mix R series and G series BSP threads.
3. Use only G series threads for hydraulic systems.

## Interested in joining VANZ

Anyone with an interest in the area of mechanical and electrical machine condition monitoring, to facilitate predictive asset management is eligible to join VANZ.

In-house technicians, consulting engineers, suppliers and distributors of specialised equipment, engineering students can all contribute and gain from membership.

For more information about membership please contact the VANZ secretary by emailing [secretary@vanz.org.nz](mailto:secretary@vanz.org.nz)





# GVS help solve an unusual hydro generation issue... **93m below water!**

**GVS were approached by Matthew Fallow from Asset Quality who were engaged by a Hydro Generation company to solve an issue on their trash-rack screens. The site has 3 units with 28MW, 2 Penstocks and a 93m Dam wall.**

**T**he trash rack screens shown over these pages had been failing which resulted in broken bars being run through the turbine.

Work scope as communicated on site, was to carry out natural frequency 'bump' tests at 4 proposed accelerometer mounting locations on a spare penstock inlet trashrack screen. Later correlate this data with trashracks 'in service vibration' to assist with suspected vibration issues.

- Significant fatigue related cracks had been repaired in both screens.

- 2 trashrack screens on 'north' and 'south' penstocks service 3 turbine units.
- Catastrophic failure on one of two inlet trashrack screens had occurred.
- Screen pulled free from its anchor bolts/clamps, many welds failed throughout the screen bars.
- Screens are located 93m below water at the bottom of the dam wall.
- Large rocks passed had passed through all 3 turbines causing significant damage
- Steel was typically strewn and wrapped around the turbine wheels. Even an old FX Holden wheel and tyre!

■ Contact the team at [sales@gvsensors.com.au](mailto:sales@gvsensors.com.au) for any of your condition monitoring hardware requirements.

*"GVS are more than just a condition monitoring hardware supplier, they are experts in condition monitoring hardware. With their assistance in choosing the correct hardware I can proceed with confidence in my service work knowing that I have the right hardware"*

*– Matthew Fallow, Managing Director of Asset Quality.*





### The analysis

The site was required to bring in a decompression chamber so the divers could fit the Hansford Sensors HS-150S submersible accelerometers to the screen 93m below the surface. Once they were fitted data was taken from the screens in situ along with bump testing another screen in the workshop and a natural frequency of 30Hz and 97Hz is shown in the data

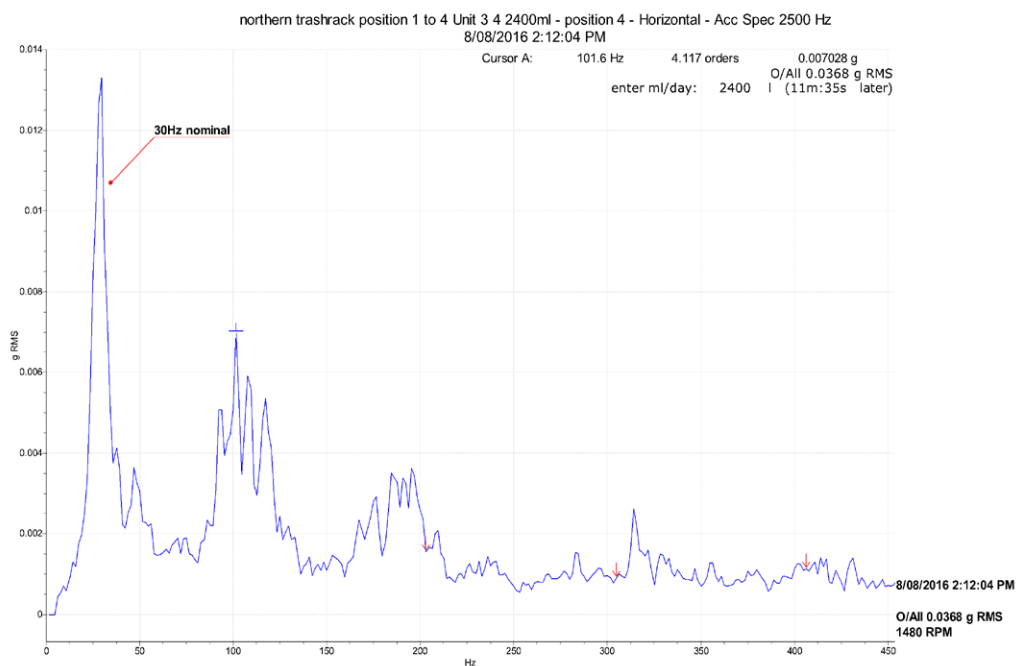
The next test involved opening a 90-inch valve and produce flows of between 1000MI/day to 5600MI/day. Data from the sensors 93m below water was taken and listened to via Asset Qualities portable vibration analyser. The results were very clear.

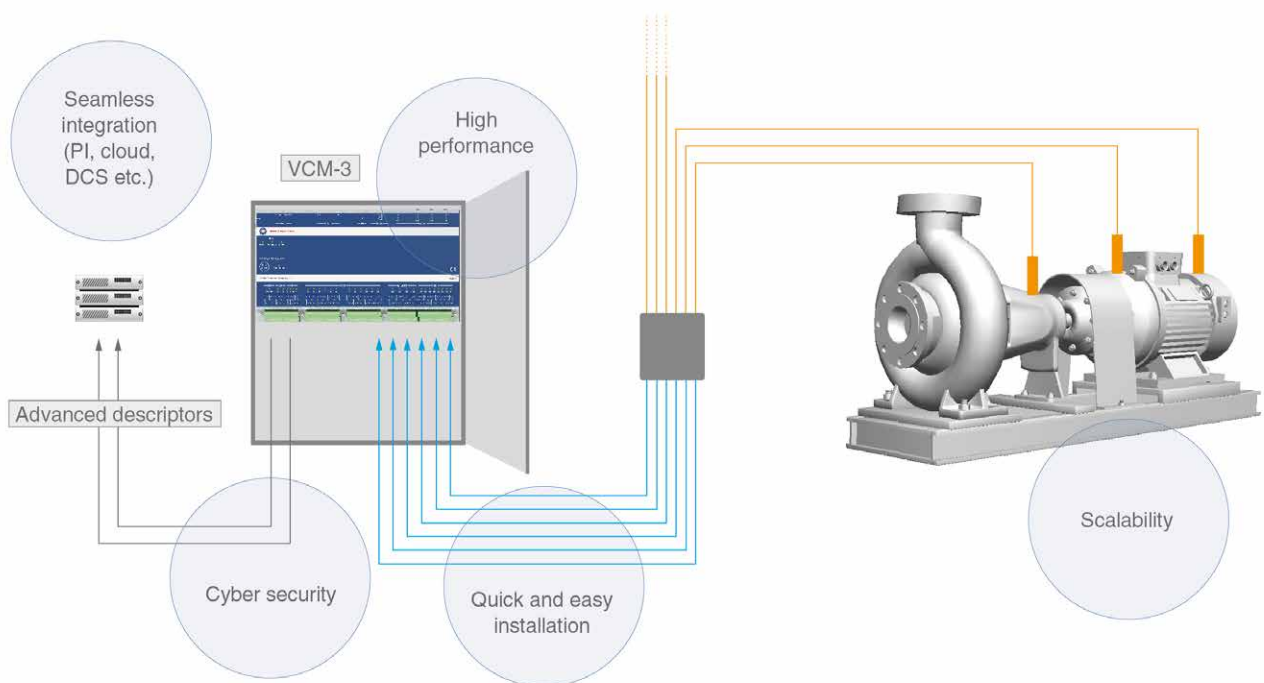
- **1000MI/day.** No clear audible signal typical of flow across the trash rack
- **2000MI/day.** No clear audible signal typical of flow across the trash rack
- **3200MI/day.** Flow induced vibration detected,

- similar to water flow, no anomalies
- **3900MI/day.** Clearly audible flow induced vibration/hum and a consistent rattle
- **4000MI/day.** Clearly audible flow induced vibration/hum and a consistent rattle
- **4300MI/day.** Flow induced vibration detected, similar to water flow, no anomalies
- **4800MI/day.** Flow induced vibration detected, similar to water flow, no anomalies
- **5600MI/day.** Flow induced vibration detected, similar to water flow, no anomalies

### Conclusion

Natural Frequencies identified during the workshop 'bump testing' were clearly evident in-situ at a depth of 93m. The client was able to avoid flow rates between 3900MI/day and 4000MI/day and prevent the natural frequencies being excited into damaging resonance which had been causing the screen trashracks to fail over time.





## B&K Vibro's digital transformation of balance-of-plant monitoring

**Critical machinery in industrial plants have enjoyed a surge in attention for improving predictive maintenance practices, machine reliability issues and life cycle costs over the last few years, and it is paying off.**

Advanced condition monitoring and diagnostic techniques have been developed and data is extensively shared and correlated through "Internet of Things" technology (IoT) to improve the reliability of making O&M decisions on the assets. Even statistical analysis and artificial intelligence is making inroads in optimizing diagnostics and life expectancy predictions. Critical assets such as steam turbines, gas turbines large compressors pumps are as a result, reliably and efficiently producing despite flexible demands on production and variable process conditions.

This sounds good for the critical machines, but what about the other machines in the plant that are not so critical, smaller and spared, are they enjoying this same level of success?

Traditional way of monitoring the BoP assets Balance-of-plant machines include smaller pumps, fans, compressors and the motors driving them, nearly all of which using rolling-element bearings. Because these machines are spared and

are so easy to replace with "minimal" downtime, many have never been monitored.

Other users chose to monitor their machines by handheld vibration instruments. This was sufficient for detecting rolling-element bearing faults, but not other faults that develop more quickly.

Therefore, others opted for field mounted devices, which could detect more faults earlier but offered only basic vibration measurements. Some even used their rack-based monitoring system for both critical machines and BoP, but this is very expensive.

“  
**Brüel & Kjær Vibro has recognised the on-line monitoring solution gap for balance-of-plant machines and therefore launched the VCM-3 field monitoring unit.**  
 ”

### Innovation in monitoring

Condition monitoring and IoT technology have both advanced over the years making machine health awareness and management much more reliable and effective.

Early fault detection and diagnostic techniques for rolling-element bearings and complex gearboxes have been optimized to a high degree. Moreover, as a result of the IoT and digital transformation, data is now more readily accessible.



It can reside in the cloud or a historian and be correlated and analyzed automatically by other systems or manually by service providers. This has been made possible by open communication protocols. Although information is “centralized” in a cloud or historian scenario, much of the processing can be decentralized in order to share resources. This is the case of an edge device, where onboard intelligence and processing power can be used for specialized diagnostics that other people and systems can use.

#### What is available today

Brüel & Kjær Vibro has recognised the on-line monitoring solution gap for balance-of-plant machines and therefore launched the VCM-3 field monitoring unit.

This device monitors 24-channels simultaneously for a wide range of sensor inputs, and has one of the most power data acquisition and processing field units in the market, making it ideal for powerful edge computing. In fact, it has just as powerful condition monitoring and diagnostic functionality and data interface capability of an advanced rack-based system, but at a fraction of the cost and much easier to install and commission.

The built-in OPC UA server enables the VCM-3 data to be seamlessly integrated to your DCS, SCADA, data historian, enterprise systems and more, including cloud solutions.

In summary, an effective monitoring solution for BoP is now available for the industry.



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# Are you a VANZ member?

**You could be.** Anyone with an interest in the area of mechanical and electrical machine condition monitoring, to facilitate predictive asset management is eligible to join VANZ. In-house technicians, consulting engineers, suppliers and distributors of specialised equipment, engineering students can all contribute and gain from membership.

Technology, materials and manufacturing processes are continually developing. And so too has the engineer skills and knowledge developed. Today the engineering role has evolved to where the analyst, by diligent use of multiple Condition Monitoring tools and principles, can empower Predictive Asset Management. But it is a challenging role! So much is at stake with the high cost of downtime, equipment replacement costs, and the potential safety risks. The future of the business can hinge on the Predictive Asset Management achieved by this special group of people. Yet detecting, diagnosing, and preventing these faults takes training, knowledge, skill and experience. And that is why VANZ exists, and why VANZ constantly evolves!

VANZ recognises that the engineers who apply the technology are one half of the equation. Equally important are the industries and businesses served by it, with their varied experiences and evolving requirements.

The size of the operation and the machinery it runs are not an issue either. VANZ membership ranges from a business with a line of small water pumps to personnel from some of the largest plants running million dollar machines.

## For Analysts and Predictive Asset Management specialists

VANZ is a volunteer-run, not-for-profit, membership group of like-minded people from New Zealand and Australia. VANZ as an organisation evolved from a Workshop Conference held in New Plymouth in 1989. From this Workshop Conference the Vibrations

Association of New Zealand was registered as an Incorporated Society and the first annual technical conference held in Rotorua 1990. From this beginning VANZ has continually developed to provide a platform for people to discuss their challenges with their fellow analysts and learn from their peers and industry experts.

## Annual conference for networking and learning

The core function of VANZ is the annual conference held every year in May. Like a family reunion, over 100 people gather in a friendly environment to participate in technical presentations, round-table discussions, and at times debate. Keynote speakers from Australia, Europe, America, and Turkey have, and continue to present technical papers at conference. And importantly New Zealand presenters add a New Zealand context.

VANZ is quite a unique society – it has withstood the ‘test-of-time’ – and has every year, for twenty-nine years run an Awareness Day training for apprentices and trainees. It is a reasonable ‘track-record’ which VANZ has consistently promoted for New Zealand and Australian industry.



**For more information about membership please contact the VANZ secretary by emailing [secretary@vanz.org.nz](mailto:secretary@vanz.org.nz)**



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## 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 | 26+ - Excellent

A	T	R	L	I
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### 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 are approx. **104** words (four letters or more) that can be made from the combination of letters below. How many can you make?

*Solution on page 15.*

W	A	S
R	A	S
E	N	E

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.

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

## TEST YOUR KNOWLEDGE - PART 61 OF A SERIES

- 1 A rolling element bearing has 8 balls. Its BPFO is 3.05 orders. How many orders will the BPFI be?**

  - a 3.95
  - b 4.95
  - c 5.95
  - d 6.95
  
- 2 When choosing HP filter settings for demodulation, peakvue etc measurements, what must the relationship be between the maximum frequency of the resulting spectrum, and the HP filter setting?**

  - a The HP filter must be lower than the maximum frequency of the spectrum
  - b The HP filter must be greater than the maximum frequency of the spectrum
  - c The HP filter must be 2 x greater than the maximum frequency of the spectrum
  - d The HP filter must be 2.5 x greater than the maximum frequency of the spectrum
  
- 3 A transducer has a sensitivity of 10.2 mV/(m/s<sup>2</sup>). What type of sensor is this ?**

  - a Eddy-current probe
  - b accelerometer
  - c Velocity sensor
  - d proximator
  
- 4 Subtle changes in low-level vibration signals might be the first indication of deterioration in an asset. These changes might occur well before the overall vibration level shows any meaningful change. How might you detect these changes to the low-level signals?**

  - a Use statistical alarms on the overall level
  - b Use statistical alarms on band sets
  - c Applying meaningful envelope alarms to spectral data
  - d B or C could be effective
  
- 5 What type of wave carries information about signals that are of a lower frequency than itself ?**

  - a Carrier wave
  - b Long-period wave
  - c Seventh wave
  - d Could be A or B
  
- 6 A non-synchronous peak has emerged in the spectrum of a routinely-tested measurement point on centrifugal pump which has ball bearings to support the shaft. The peak is about 2% away from the calculated BPFO (4.2 orders) for one of the bearings entered in the database for this pump. What conclusion might you draw from this?**

  - a The peak is a result of something other than a bearing fault
  - b The bearing entered in the database has a different number of balls than the installed bearing
  - c The contact angle of the installed bearing might vary slightly from the design contact angle due to wear
  - d The 2% variation means that the peak is due to resonance
  
- 7 Four beams of differing mass and stiffness are simply supported on trestles. Which of the following four beams will have the lowest natural frequency?**

  - a Beam A – high stiffness, high mass
  - b Beam B – high stiffness, low mass
  - c Beam C – low stiffness, high mass
  - d Beam D – low stiffness, low mass
  
- 8 You undertake phase analysis to determine the source of vibration on a 2-pole electric motor. When doing this you notice that the phase angles are varying. What might this indicate?**

  - a There might be some interaction of electrically and mechanically sourced vibration
  - b There might be looseness present
  - c There could be the influence of resonance effects
  - d Any or all of the above are possibilities
  
- 9 What might sidebands of shaft speed around a gearmesh frequency indicate?**

  - a Tooth wear
  - b A broken tooth
  - c A bent shaft

Answers on page 15

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



d Any or all of the above

**10 The 2020 VANZ conference is the first one in the history of VANZ to be cancelled. What was the reason for the cancellation?**

- a Lack of interest
- b The Covid-19 pandemic
- c The damage to the Auckland harbour bridge and the impact it would have on travel arrangements
- d Timaru was experiencing a heat-wave

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## 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: <b>\$550+GST</b>	Single issue rate: <b>\$350+GST</b>	Single issue rate: <b>\$300+GST</b>	Single issue rate: <b>\$250+GST</b>	
4-issue (1 year) rate: <b>\$500+GST</b>	4-issue (1 year) rate: <b>\$315+GST</b>	4-issue (1 year) rate: <b>\$270+GST</b>	4-issue (1 year) rate: <b>\$225+GST</b>	

### The small print...

#### How to supply an advert:

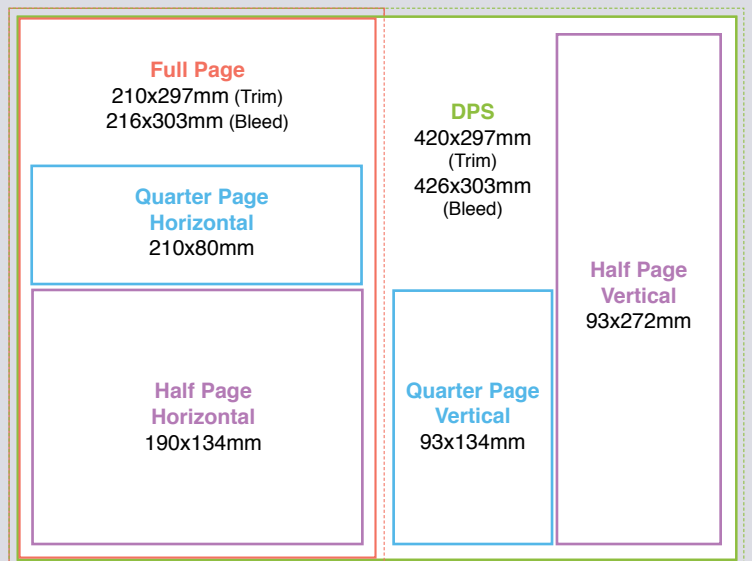
All advertising copy to be supplied in high-res PDF format at the correct size required. Files to be supplied press ready at 300dpi with 3mm bleed for full page and DPS advertisements. The special 4-issue rates are for advertising in 4 consecutive issues. i.e. Issue 91, 92, 93 and 94. **Save up to \$200 on your advertising in Spectrum!** Email Angie at [spectrumeditor@vanz.org.nz](mailto: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](mailto:spectrumeditor@vanz.org.nz) with your submission or should you require further information.



Answers to Word March #97: Awareness  
1B, 2B, 3B, 4D, 5A, 6C, 7C, 8D, 9D, 10B

MOTION & CONTROL™

**NSK**

