CMVA ACVM Canadian Machinery Vibration Association / Association Canadienne en Vibration de Machines

CMVA MEMBERS' MAGAZINE

JUNE 2023
VOLUME 10 • NUMBER 2

# ViBs

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ACVM ATC CTA 2023 CMVA

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By Bernard F. Boueri

Tech Talk

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We support our members
in their pursuit of excellence and reliability

# ViBs

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**Optimizing Ultrasonic Noise Detection: Understanding Sound Reflection for Efficient Leak Detection in Industrial Settings**



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To submit a technical paper or a case study, or to buy advertising space in ViBs, or for any comment on ViBs, please contact Ken Keith.



COVER IMAGE: Photo provided by Inn at Laurel Point Hotel

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vibrations.machines.canada

# From the Chief Editor's Desk

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**Ken Keith** spent 30 years working at Irving Pulp & Paper (Saint John, NB), the last 18 years in the Reliability Department as a Vibration Specialist. In 2017, at the age of 55, Ken retired from IP&P and accepted the position of Executive Director of the CMVA. Since entering the reliability field, he has been passionate about the CMVA. He holds much respect for the members and volunteers who have created and maintained an organization that is driven to improve the skills and abilities of its individual members, and the viability and profitability of the businesses that these members are a part of. Ken holds both CMVA and Vibration Institute CAT III certifications and achieved his CMRP in 2017.

Hello CMVA members,

The ATC is quickly approaching. Make sure you book your rooms early as there is limited supply at the two hotels we are using. I would also like to mention that there will be a shuttle taking people to and from the hotel and conference, so no worries about transportation. Also note that there will be training pre-conference that counts towards your category III and IV hours.

There is still room for a few more presentations but please submit right away.

Our exhibitors are encouraged to take advantage of the sponsoring opportunities. Get you companies name in front of participants at the various conference events. See our Become a Sponsor section on page 25 for more information.

**KEN KEITH** | Executive Director
director@cmva.com

Inn at Laurel Point

# Word from the President

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**Matthew Holmes** is a Senior Reliability Engineer with Acuren since 2006 providing remote & onsite asset management & reliability programs across Canada and the US, including critical equipment diagnostics & monitoring. Matthew joined the CMVA national Board of Directors in 2015 and immediately set to work with the ISO 17024 committee for development of the Quality Management System and business processes.

Matthew also previously held the position of national Vice President from 2017 to 2019 before being elected to the positon of National CMVA President in the fall of 2019. Matthew has been practicing vibration since 2000 starting with the aerospace industry, and currently holds CMVA and VI CAT III certifications, and professional engineering licenses in Nova Scotia and Ontario.

Dear fellow CMVA members and supporters,

I hope all our CMVA members, product and service providers, certificate holders and supporters are preparing for summer and taking some time to enjoy it. It really is hard to believe that it is already time for another edition of ViBs Magazine. I would like to take a moment to acknowledge the loss that many Canadians have experienced during the start of the "2023 Fire Season." Let us all stay safe and adhere to local fire regulations to help reduce the fire risk in our changing climate.

I am however excited for the upcoming CMVA 2023 ATC / AGM in beautiful Victoria, BC this October! I have already booked my accommodations, as have many folks that I know who will be attending. I urge you to do the same as the number of rooms blocked by CMVA are limited and the pricing is exceptional for Victoria. I have submitted a topic for presentation to the Reading Committee, as many of you have as well, and as some are still considering. A large benefit of the annual training conference is the sharing of ideas and experience that I have always found helpful when digging into asset problems. There are also some great courses being offered on "resonance/modal testing" and "balancing" if you are looking to expand your skills and gain additional recertification points. There is a lot more information from the 2023 ATC committee in this magazine and on cmva.com, and feel free to contact our Executive director if you still have questions or concerns or wish to volunteer.

I would like to mention the national executive and chapter executive members have completed two meetings for 2023. There have been opportunities for one region to help another with expanding the CMVA profile through the use of the CMVA school presentation, discussion of concerns with recertification points, and, the opportunity to keep the communications flowing allowing members to support members. I encourage you to contact director@cmva.com or any member of your chapter executive (see cmva.com and select the CHAPTERS banner) if you have a question, concern, have training needs, etc.

Again, register for the CMVA 2023 ATC/AGM today and book accommodations and travel.

Happy and safe summer wishes to everyone!

**MATTHEW HOLMES**
President of the Board of Directors
mholmes@acuren.com

# Career Opportunities

## Looking for new challenges?

The CMVA website offers now a brand new section in which you will find interesting career opportunities from across Canada, in fields directly related to your industrial maintenance practice.

Whether you are a technician, engineer, mechanic, technologist, reliability engineer, plant manager, specialist or trainer in condition monitoring technologies, etc., sooner or later, you will find the right offer for you! Visit often

**cmva.com/career-opportunities/**

## Looking for competent personnel?

Share your job offers on cmva.com and find candidates whose skills are directly related to your needs! To do this:

1. Become a Corporate Member of the CMVA
2. Send us your offer!

**INFORMATION : Ken Keith | 416-622-1170 | director@cmva.com**

# Technical Committee

We are halfway through 2023 and the Technical Committee has met twice so far. The Cat IV sub-committee has been making progress with the latest push being the selection of reference materials. The Ultrasonics sub-committee is making steps forward as well; after setting up a development plan the second meeting of the group is planned for later in June.

The review of exam questions is a continuous effort, and another set of statistics has been pulled in order to select additional questions to analyze. A number of new questions have also been approved and added to the question bank, including questions in French.

We are eagerly awaiting the ATC in Victoria, which at this point is less than four months away. At this year's event there will be two different short course offerings: In-Situ Balancing; and Resonance Testing and Modal Analysis. We think these courses will be of great value for those looking to improve their skills in these areas. These courses will also count towards vibration certification prerequisite training and re-certification hours. Resonance Testing and Modal Analysis will count as 16 hours toward the 64 hours required for Category IV.

We would like everyone to enjoy a beautiful summer and hope you can make it to Victoria for the conference in October!

**JEFF DOWN** | Technical Committee Chairman
downyd@hotmail.com

**COMMITTEE MEMBERS**

**Jeff Down**
Chairman

**Grant Akitt**

**Bernard Boueri**

**Jonathan Dion**

**John French**

**Ken Keith**

**Joe Koncovy**

**Gilles Lanthier**

**Ron Newman**

**Dora Orchard**

**Janos Pattantyus**

**CONTRIBUTE TO KNOWLEDGE**

For almost 40 years, analysts, technicians, engineers, trainers and reliability managers have presented an impressive number of technical conferences at CMVA events, of which many are available in the knowledge database on the CMVA website.

We are always looking for technical articles, whether for our events, our online library or our ViBs magazine. **Submit articles and case studies** for the benefit of the vibration community to director@cmva.com and earn points toward certification renewal.

© Jordan Burns

**Lloyd Appelt** is President of Vibratech Solutions in Alberta. Vibratech Solutions does regular machine predictive monitoring and specialized analysis, along with dynamic balancing and impact testing. Born and raised in Alberta, with all his work experience there as well, Lloyd started his career as a machinist, then moved into millwrighting and shortly after into vibration work for the last 20 years. He is currently a CMVA CAT III certified vibration analyst.

Lloyd first joined CMVA in 2005 as a member, and is part of the national Board of Directors since 2015. In 2019, he became the chair of the ISO Accreditation Committee.

# ISO Accreditation Committee

The ISO committee continues to work hard at maintaining ISO 17024 accreditation which places us in a select group in North America and a unique position in Canada. Having a CMVA certification backed by our CMVA accredited ISO 17024 Quality Management System (QMS) is filling a real need in this current industrial landscape. Organizations looking to achieve ISO 55000 asset management status, and maintain ISO 9001 and ISO 14000 status, require documentation of qualifications held by specialist doing assessment, inspection or maintenance to their assets. What better way to do that than a CMVA certification that manages those qualifications to ISO 17024.

CMVA completed 2023 audit activities with the Standards Council of Canada (SCC) of our QMS, procedure and documentation with Ken Keith, Lloyd Appelt and Matthew Holmes this Spring. SCC auditor 2023 findings will require minor modifications to the CMVA quality program and will be reviewed at the next CMVA Board of Directors meeting (per our procedures). This attests to a sound program overall and our collective desire to continually improve.

It is worth highlighting our newest certification offering – Alignment Specialist Level 1 and Level 2. See the list of already certified Alignment Specialists at cmva.com under the certification tab. Stay tuned with CMVA.com for alignment certification application form(s) and further alignment training opportunities! If you or someone you know is interested in alignment certification training and / or certification please contact Ken Keith (director@cmva.com). Also, contact Ken if you're an alignment training provider and want to become a CMVA approved alignment trainer.

Efforts do not end here. We continue to improve the CMVA QMA, procedures and forms to reflect our recent offering of certified Alignment Specialist, while we also continue to advance Category 4 vibration specialist certification and ultrasonic emissions certification opportunities. We will continue to review and share changes with internal and external auditors as we gain enough data from certification of individuals for each offering.

I hope everyone enjoys their summer and hope to see you in October at the 2023 CMVA ATC!

**LLOYD APPELT** | ISO Accreditation Committee Chairman
lloyd@vibratechsolutions.ca

**COMMITTEE MEMBERS**

**Lloyd Appelt**
Chairman

**Matthew Holmes**

**Ken Keith**

**Joe Koncovy**

**BE PART OF THE ACTION**

**Do you have skills & interests** you wish to put at the service of CMVA? Several working groups are looking for wise and motivated members to bring solutions, projects and new ideas. Contact us to learn more at **director@cmva.com**. Our workgroups include :

ISO Accreditation Committee, Technical Committee, Communications Committee, Membership Committee, National Board of Directors, Chapter Executive Committees & Annual Technical Conference Host Committee.

© Colette Keith

**Jesse LaPaire** is the current Vice President of CMVA National and holds the Mentor position on the executive of the CMVA Atlantic Chapter. Jesse is a certified CMVA CAT III analyst, and a registered Professional Engineer in the province of New Brunswick. He works currently with NB Power (Corporate) to improve predictive maintenance programs and overall plant reliability in the generation division, while additionally supporting machinery diagnostics acquisition and analysis.

# Membership Committee

Valued members and community of the CMVA, in the previous edition of ViBs the membership committee took the opportunity to highlight the consistent and rewarding efforts surrounding membership retention. With this edition, our focus shifts towards the goal of consistent growth in our technical community and reaching even more reliability professionals looking for a community of their own to foster knowledge and experience sharing.

The CMVA Annual Technical Conference provides a perfect opportunity for active members to reach out to colleagues, old and new, and encourage them to engage with this fantastic technical community we call our own. This message should resonate particularly with members of the Prairie and British Columbia chapters, who haven't seen a CMVA ATC hosted in their neck of the woods since Edmonton's 2017 conference. Members are strongly encouraged to visit the CMVA website often to stay up to date on the conference offerings and get the word out!

Additionally, in the spirit of expanding the CMVA community, the membership committee has decided to revive a pre-COVID CMVA Atlantic Chapter initiative to foster growth and a more independent CMVA community in Newfoundland and Labrador. Unfortunately, the pandemic took quite a toll on this effort; however, with the commitment of the national membership committee, and the Atlantic Chapter alike, there is confidence this initiative will take some ground. The membership committee sees this as a great opportunity to increase membership numbers and tap into even more technical expertise and knowledge for the CMVA community. The committee is asking members with any ties to NFLD & Labrador to seriously consider joining in this effort and please reach out, as it is no small feat. What a great opportunity to make a mark in the history of the CMVA!

I personally plan on attending and presenting at the CMVA Annual Technical Conference in Victoria and am looking forward to seeing everyone there!

**JESSE LAPAIRE** | Membership Committee Chairman & National VP
JeLaPaire@nbpower.com

**Get involved!**

**We have a few vacant seats.**

**COMMITTEE MEMBERS**

**Jesse LaPaire**
Chairman

**Brent Gattoni**

**Ken Keith**

**Ted Pater**

**Charles Scott**

**Mark Shoup**

**BRING NEW INTERACTION**

Each new member joining CMVA adds a wealth of new knowledge, because we come from diverse backgrounds and encounter equally diverse technical situations.

**As a member, you are our best ambassador** and no promotion on our part can match your efforts to recruit new members. Let your colleagues, customers and suppliers know what the CMVA can do for them. Encourage them to create a user profile and become a member on **cmva.com**. After all, we are all looking for the same goal: excellence and reliability.

# Optimizing Ultrasonic Noise Detection: Understanding Sound Reflection for Efficient Leak Detection in Industrial Settings

By **Ken Keith**, Senior Reliability Analyst | k.keith48@yahoo.com

Tech Tip

In the industrial sector, identifying and addressing air and steam leaks is vital for cost savings and operational efficiency. Ultrasonic noise detection has proven to be an effective method for leak detection, allowing operators to locate leaks quickly and accurately. However, it is crucial to consider how ultrasonic sound is reflected off hard surfaces when pinpointing the source of the sound. This article aims to highlight the significance of understanding sound reflection and its impact on leak detection efforts, empowering operators to optimize their search for leaks and maximize cost-saving potential.

## The Role of Sound Reflection in Leak Detection

1. **Reflection Phenomenon:** Ultrasonic sound waves exhibit reflection when they encounter hard surfaces, such as metal, concrete, or glass. This reflection occurs due to the impedance mismatch between the medium through which the sound wave propagates and the surface it encounters. Understanding this reflection phenomenon is essential in determining the source of the sound and ensuring accurate leak detection.
2. **Reflection Challenges:** Sound reflection can present challenges during leak detection, as it can mislead operators into locating the leak in a different direction than the actual source. Reflection can cause the sound to bounce off walls, equipment, or structures, creating confusion and potentially leading to erroneous leak identification. Recognizing and accounting for sound reflection is crucial for improving the efficiency and effectiveness of leak detection efforts.

## Strategies for Accounting for Sound Reflection

1. **Systematic Approach:** When utilizing ultrasonic noise detection for leak detection, operators should adopt a systematic approach. Start by surveying the area methodically, focusing on potential leak points such as valves, flanges, joints, and connections. Take into account the layout of the facility and any structures that may influence sound reflection patterns.
2. **Multiple Detection Points:** To overcome the challenges posed by sound reflection, it is beneficial to utilize multiple detection points. By scanning from different angles and positions, operators can triangulate the sound source and minimize the impact of reflections. This approach helps differentiate between direct sound waves from leaks and reflected sounds.
3. **Utilize Sound Dampening Techniques:** In areas where sound reflection poses a significant challenge, and other known sources of sound are in the area, operators can implement sound dampening techniques. These may include using absorbent materials or installing sound barriers around known sources to reduce their interference.
4. **Operator Training:** Adequate training is crucial for operators to develop the necessary skills in interpreting ultrasonic noise signals and accounting for sound reflection. Training programs should emphasize the principles of sound reflection and provide practical exercises to sharpen operators' ability to differentiate between direct leak sounds and reflected sounds.

## Ultrasonic noise detection offers significant cost-saving potential in identifying air and steam leaks in industrial settings.

However, operators must consider how ultrasonic sound is reflected off hard surfaces when searching for the source of the sound. Understanding the reflection phenomenon, along with adopting a systematic approach, employing multiple detection points, analyzing reflection patterns, and utilizing sound dampening techniques, ensures accurate leak detection and maximizes the efficiency of cost-saving efforts. With proper training and a comprehensive understanding of sound reflection, operators can optimize their leak detection strategies and achieve substantial financial benefits for their industrial operations.

# News from the Chapters

## British Columbia


© Courtesy

The organization of the 2023 ATC being held on 12-13 October in Victoria BC is moving forward with the hotels, conference venues, social events and our keynote speakers confirmed. The call for papers has gone out and we are starting to receive submissions but still require additional papers. The tradeshow booths are all filled. To see who your exhibitors are, go to cmva.com, under the Annual Technical Conference tab. There will also be two training courses held on the two days prior to the conference. Please visit the CMVA website for updates on the training courses. The conference will be held at the University of Victoria in the Student Union building. The venue includes a large room for the exhibitors and two rooms for the technical presentations. Victoria is a great city with a lot of museums and tourist attractions so you should also plan for a little extra time and take advantage of the great BC weather in October and all the tourist attractions in the area. More information on the tourist attractions, museums and other venues will be posted on the CMVA website. Anyone in the BC chapter who would like to volunteer to help with the organization of the ATC can contact me.

See you in Victoria in October.

**COLIN OSTERGARD** | President
costergard@acuren.com

## Atlantic


© Courtesy

The Atlantic Chapter has been busy again this year making arrangements and presenting to students at NBCC. The intent of these presentations is to bring awareness of the CMVA to the next generation of analysts. Joel Hicks performed our first in person presentation to a class of mechanical technicians earlier this year. The presentation was well received and lots of interesting questions for Joel. Thanks, Joel, for putting in the time to do these presentations.

Kyle Arsenault, Chapter Technical Director, has also been busy planning for the 2023 Chapter ATC. This year's ATC will consist of a day of Technical Presentations performed by CMVA members. If you wish to put on a presentation, please reach out to a member of the ATL Chapter Executive.

The Chapter has voted to award 2-$1000 bursaries this year to students. The deadline for applications was May 20th. Decisions will be made in the coming weeks and successful candidates will receive and email on how to receive the Bursary. Thanks to all those who applied.

The Chapter has plans for 2 more meetings in 2023 including an ATC in December. The next meeting is proposed for September with hopes of a tour of Colson Cove Generating Station, in Saint John, NB.

On behalf of the Atlantic Chapter, I'd like to wish everyone a safe and happy summer and all the best for the remainder of 2023.

**MATT FIRTH** | President
mfirth@nbpower.com

## Prairie


© Colette Keith

Prairie Chapter is excited to be co-organizing the 40th CMVA Annual Technical Conference in Victoria with the British Columbia Chapter. A lot of work has gone into this event to provide great speakers, exhibitors, and learning opportunities.

This October 10th and 11th you will have the opportunity to take a 2-day in-situ Balancing course, or a 2-day Resonance Testing and Modal Analysis course. These training courses do not come around very often and are extremely valuable to vibration specialists and the industries that they support. Training hours in these courses contribute to the total number of hours required for Category II, III and IV (the number of hours credited for each is dependant upon the ISO 18436-2 subject requirements).

The Resonance Testing and Modal Analysis course aims to comply with ISO 18436-2 category IV training and all 16 hours count towards the total training requirement for this certification (8 hours count towards category III). CMVA expects to start offering Category IV exams in 2024, so are focused on providing the appropriate training through our training partners over the next year.

Now is the time for Prairie members to support the event by going to cmva.com and registering for this event and training. I look forward to seeing everyone at the conference. Please also consider submitting a presentation for this event, there is still room for a few more.

There is also an upcoming regular Prairie Chapter meeting being held on September 14, 2023, from 1 to 4:30 pm, at Spartan Centre, 8403, 51th Ave NW, Edmonton, AB, T6J 6Y8. Join us for a post meeting dinner at Earls, 4250 Calgary Trail NW, Edmonton, AB.

**GURWINDER BHAMBRA** | President
gbhambra@wajax.com

## Quebec

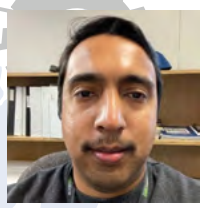

© Cindy Doucet

The Quebec chapter held its annual Technical Day and chapter AGM on June 15th. The main focus of the event was on electric motors, and we lined up four engaging technical presentations on this topic. Additionally, the AGM provided an opportunity for members to discuss important matters and make collective decisions.

Furthermore, the Chapter Executives have agreed to host the 2024 National Technical Conference. They will soon begin assembling a dedicated organizing team to ensure the success of this event. .

**PATRICE HUARD** | President
Huard.Patrice2@hydro.qc.ca

## Ontario


© Courtesy

Thank you to all participants and presenters at the Ontario Chapter technical conference on March 30, 2023. There were presentations by John Lambert (The Accumulated Effects of Machine Casing Stress and Shaft Deflection), Mohamed Ali (Utilization of Proximity Probes for Vibration Monitoring of Rotating Equipment), Dr. Morteza Zohrabi (ROI & Engineering Calculations), and Roy Zarieh.

Ontario Chapter also held chapter elections. Your new Executive Committee is : Andrew Ali (President); Theresa Girard (Vice President); Mohamed Ali (Technical Director); Brent Gattoni (Membership Director).

Come meet them at the next Ontario Chapter meeting tentatively planned for August (day and location TBD). We still have two vacant seats (Secretary and Treasurer), so if you are interested in joining the team, contact one of the Ontario executive members or Ken Keith (director@cmva.com).

I would like to thank Roy Zarieh and Behshad Sabah who are stepping down from the executive committee for their efforts for the past few years.

**ANDREW ALI** | President
andrew.ali@opg.com

# High Vibration On Hydroelectric Headgate Hoist During Commissioning

By **Bernard F. Boueri P. Eng.**, Machine Dynamics and Component Integrity, Ontario Power Generation | bernard.boueri@opg.com

**ABOUT THE AUTHOR**

© Colette Keith

**Bernard F. Boueri** is a vibration specialist with 25 years of experience in the field of vibrations and rotordynamics and their application in the diagnostics of rotating equipment. He received his B. Eng. from Imperial College in London and his MSc and PhD from the University of Florida, all in mechanical engineering. He works in the Machine Dynamics Group at Ontario Power Generation, he has been responsible for vibration diagnostics across the OPG fleet including steam turbine, hydro units and all rotating auxiliary equipment. He is a Category IV certified vibration analyst by the Vibration Institute.

*During commissioning of a new headgate hoist, high vibration levels were noted on the break fan bearings during emergency drop. The vibration levels were significantly higher than those measured during the factory acceptance test (FAT). In depth measurements indicated higher than expected running speed during the emergency drop, leading to excitation of shaft critical speed in additional to possible structural resonance. A detailed analysis will be presented on the vibration measurements and the findings including assembly issues of the entire hoist.*

## Introduction

A new headgate hoist was installed as part of a refurbishment of a hydro generator. As part of the commissioning, the Machine Dynamics (MD) group was asked to monitor the casing vibrations of the entire train. The hoist consists of a 1200 RPM motor, two gearboxes, a break fan, and the main drum. Figure 1 is the assembly drawing of the hoist. Factory acceptance test (FAT) vibration data did not indicate any issues. MD installed velometers and accelerometers on the motor, first gearbox and the break fan to measure casing vibration.

Testing was performed during normal and emergency drop operations. Casing vibration data on the motor and gearbox were acceptable and within specifications during both operating conditions and will not be discussed in this paper. However, the break fan casing vibration data during both conditions were higher than the measured casing vibration data during the FAT.

This paper will concentrate on the measurements and findings on the break fan and the discrepancies between the FAT and in-situ vibration data.

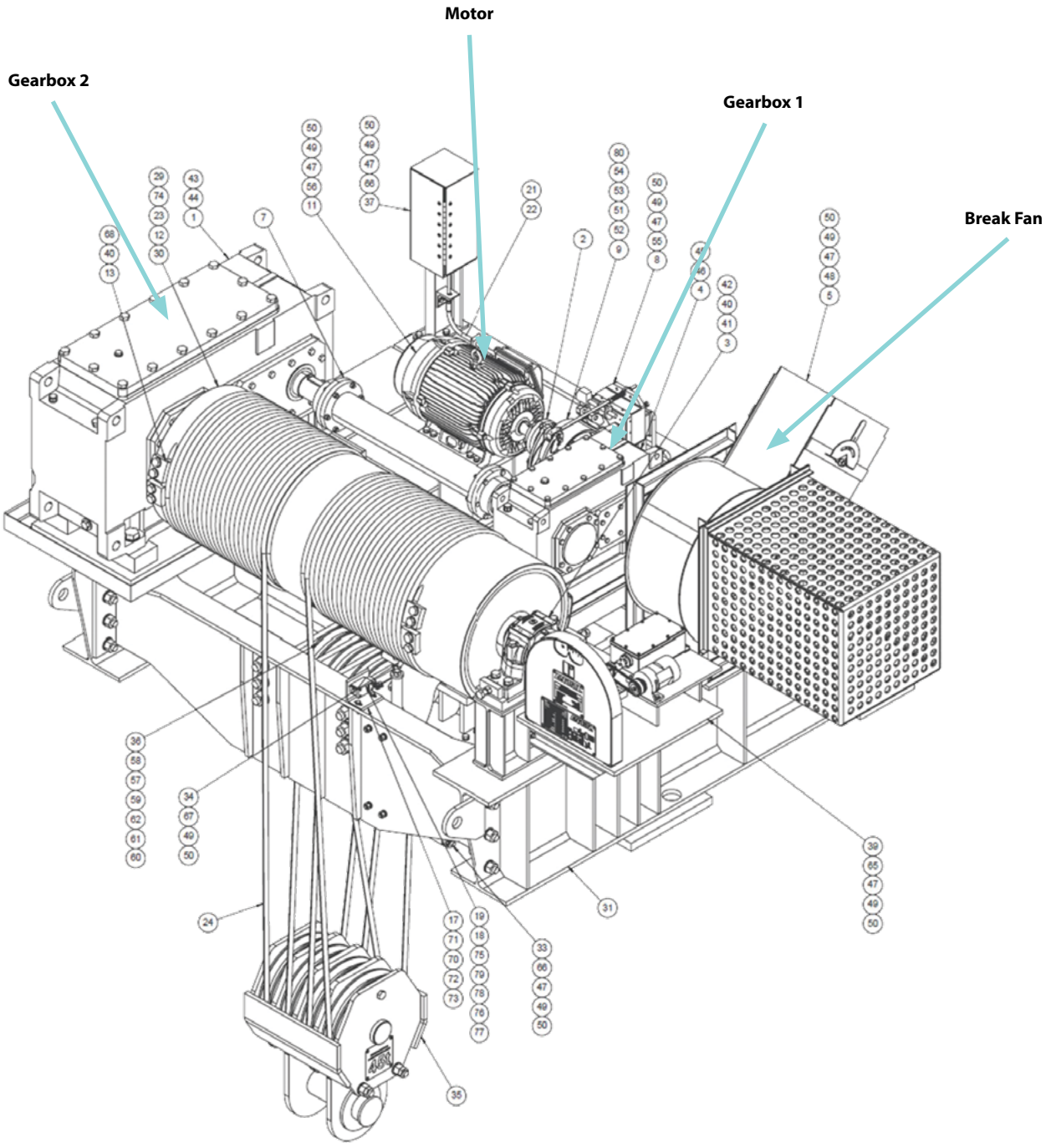



Figure 1: Hoist Assembly Drawing

# High Vibration On Hydroelectric Headgate Hoist During Commissioning

## Testing and results

Table is a summary of the casing vibration data during the FAT. The FAT vibration data indicated that the motor and gearboxes were within the acceptable ISO criteria. However, the break fan acceptance criteria were based on the balancing standard and not the overall vibration levels. This is obviously flawed and was misinterpreted from the headgate hoist specifications. The specifications were not implicit in mentioning overall vibration levels of the break fan but rather simply specify the balancing grade requirement. For this reason, it is imperative that vibration experts be involved in the vibration specification of the new equipment. Based on the overall vibration levels the break fan would not meet the acceptable levels.

The FAT also shows that the maximum allowable speed during emergency drop down should not exceed 3600 RPM. The break fan vibration data seem to indicate a possible critical/structural resonance around 2400 RPM.

| Location | MEASURED RMS VELOCITY [mm/s] | | | Acceptance Assessment | | | |
|---|---|---|---|---|---|---|---|
| | | | | Technical Specification | | ISO 10816/20816 (Zone A/B)[1] | |
| | X-Axis [3] | Y-Axis | Z-Axis | Limit Value | Result | Limit Value | Result |
| Motor Casing | 0.31 | 0.68 | 0.15 | 1.80 | OK | 1.4 | OK |
| Primary Gear Casing | 0.44 | 0.94 | 0.16 | 2.70 | OK | 3.15 | OK |
| Secondary Gear Casing | 0.001 | 0.005 | 0.001 | 2.70 | OK | 3.15 | OK |
| Fan | 2.4 | - | 0.6 | Balance Grade G6.3 | OK[2] | 1.4 | OK |
| **2400 RPM (Short Term Operation)** | | | | | | | |
| Location | MEASURED RMS VELOCITY [mm/s] | | | Acceptance Assessment | | | |
| | | | | Technical Specification | | ISO 10816 / 20816 (Zone C) | |
| | X-Axis [3] | Y-Axis | Z-Axis | Limit Value | Result | Limit Value | Result |
| Motor Casing | 0.53 | 0.99 | 0.45 | 1.80 | OK | 2.8 | OK |
| Primary Gear Casing | 0.64 | 0.80 | 0.65 | 2.70 | OK | 5 | OK |
| Secondary Gear Casing | 0.001 | 0.002 | 0.000 | 2.70 | OK | 5 | OK |
| Fan | 11.0 | - | 1.7 | Balance Grade G6.3 | OK[2] | 2.8 | OK |
| **3600 RPM (Short Term/Test Operation)** | | | | | | | |
| Location | MEASURED RMS VELOCITY [mm/s] | | | Acceptance Assessment | | | |
| | | | | Technical Specification | | ISO 10816 / 20816 (Zone C) | |
| | X-Axis [3] | Y-Axis | Z-Axis | Limit Value | Result | Limit Value | Result |
| Motor Casing | 1.76 | 1.50 | 0.64 | 1.80 | OK | 2.8 | OK |
| Primary Gear Casing | 0.64 | 1.59 | 0.46 | 2.70 | OK | 5 | OK |
| Secondary Gear Casing | 0.018 | 0.040 | 0.008 | 2.70 | OK | 5 | OK |
| Fan | 5.3 | - | 1.9 | Balance Grade G6.3 | OK[2] | 2.8 | OK |

Table 1: Summary of Factory Acceptance Test Casing Vibration Levels at all Tested Speeds

Figure 2: Temporary Accelerometers Mounted on the Fan Outboard Bearing Casing

Figure 2 shows the temporary accelerometers mounted on the break fan outboard bearing (OB). Similar setup was installed on the inboard bearing (IB). The initial setup did not include a keyphasor®. Figures 3 and 4 are the overall casing vibration trends at the fan IB and OB, respectively, during normal and emergency operation.

The data indicate that the overall casing vibration are about 6 mm/s rms during normal operation. These levels are higher than those measured during the FAT (2.4 mm/s rms). Figure 5 is the fan IB and OB spectra during normal operation.

The spectra indicate a fundamental vibration component at 19.7 Hz (running speed of motor). The spectra also show harmonics of 19.7 Hz and a dominant 2x vibration component in the horizontal directions. This could indicate a possible looseness/misalignment.

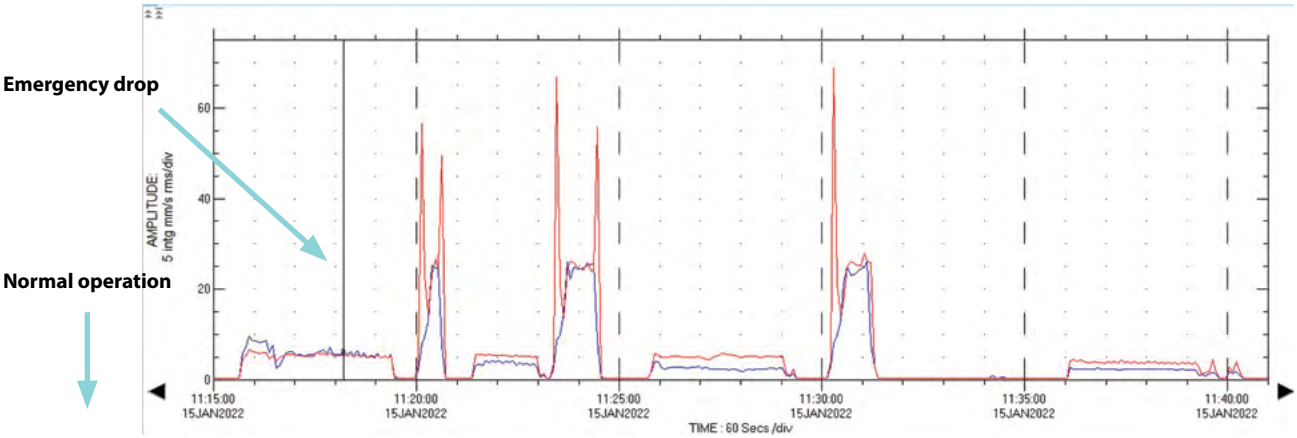



Figure 3: Overall Casing Vibration Trends at the Break Fan IB

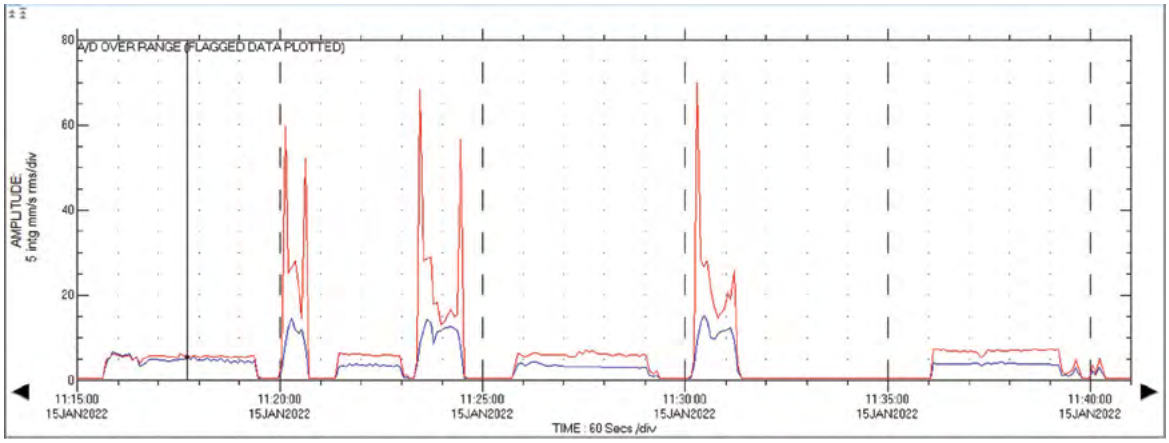



Figure 4: Overall Casing Vibration Trends at the Break Fan OB

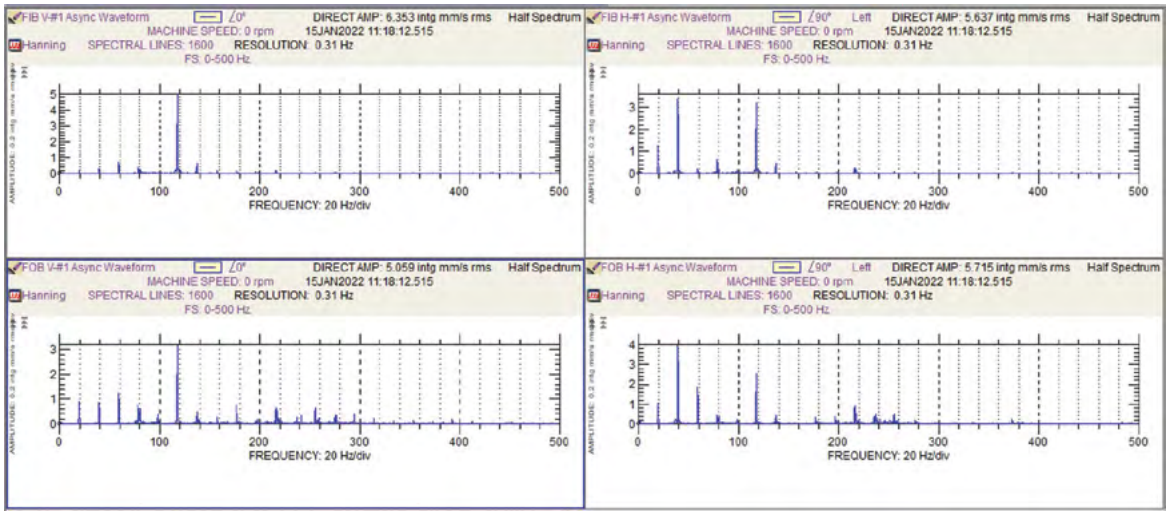



Figure 5: Break Fan IB and OB Spectra during Normal Operation

# High Vibration On Hydroelectric Headgate Hoist During Commissioning

Figure 6 is the break fan IB and OB spectra during initial emergency drop test. The spectra indicate that the highest speed attained was about 77.8 Hz (4668 RPM) with an overall vibration level of 41 mm/s RMS at the FIB bearing in the vertical direction. Preliminary investigation indicated that the break fan vanes were closed and should be fully opened during emergency drop.

However, under such conditions the speed of the break fan should not exceed 3600 RPM as per OEM.

To reduce the speed of the break fan the vanes were fully opened and a keyphasor® installed to accurately measure speed.

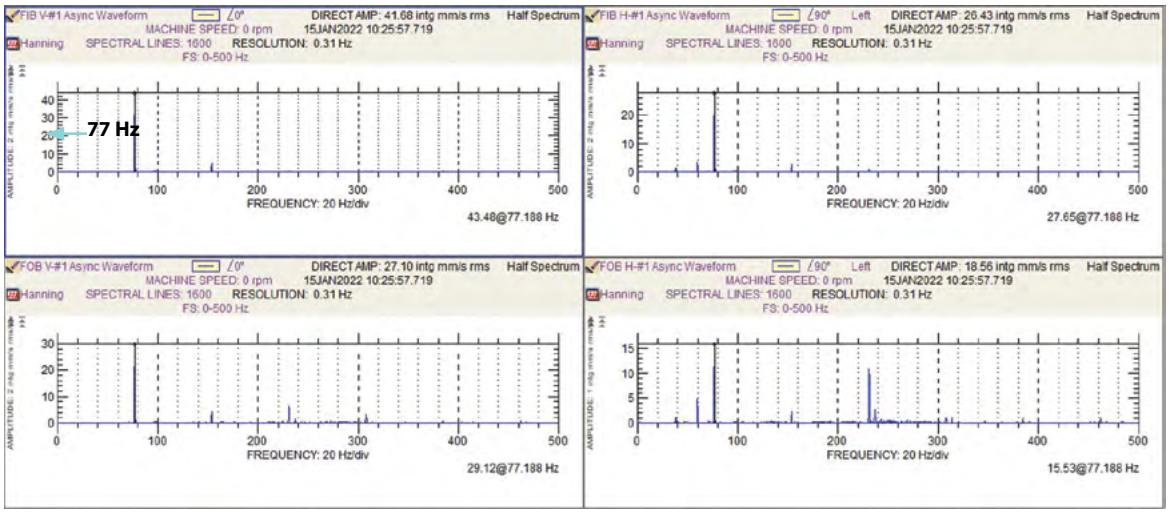



Figure 6: Break Fan IB and OB Spectra during Initial Emergency Drop

Figures 7 and 8 are the break fan IB and OB casing trends with the fan vanes fully open.

The data indicate that during normal operation, the break fan speed was about 1180 RPM and the highest overall vibration levels were about 5.0 mm/s RMS.

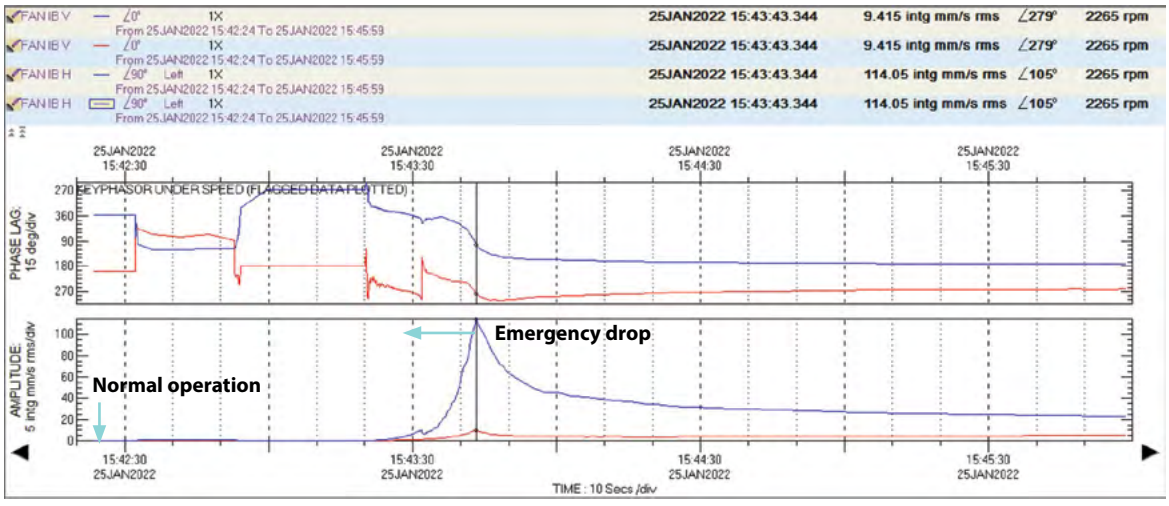



Figure 7: Break Fan IB Casing Trend during Normal and Emergency Drop with Fully Opened Vanes

During emergency drop the vibrations reached more than 100 mm/s rms at a speed of about 2265 RPM (possible critical speed). The highest speed attained was 2800 RPM and the vibration at that speed was about 23 mm/s RMS. The highest vibrations were recorded in the horizontal directions at both inboard and outboard bearings.

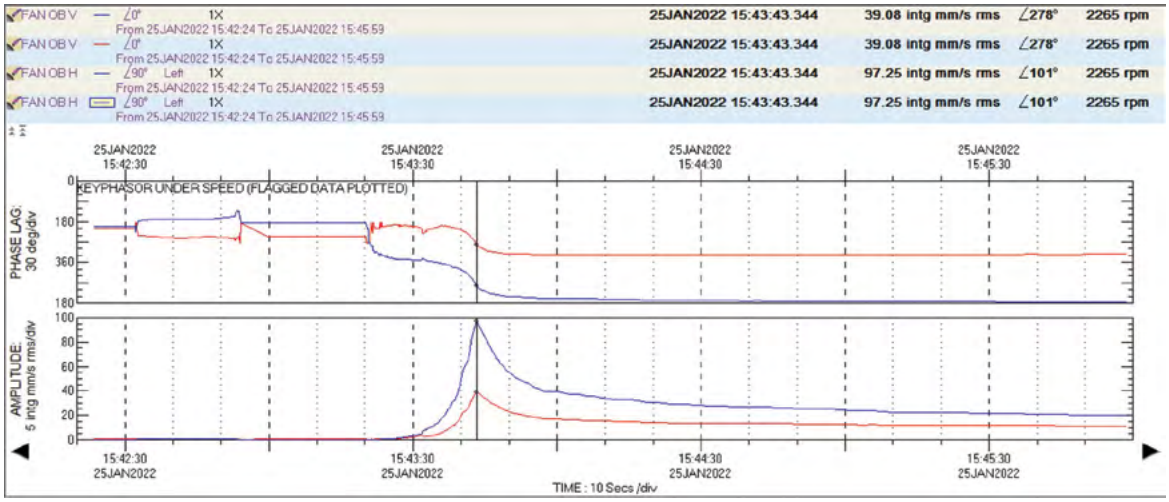



Figure 8: Break Fan OB Casing Trend during Normal and Emergency Drop with Fully Opened Vanes

The overall casing vibrations at normal operating conditions and during the emergency drop were still much higher than the FAT vibration data. The author requested detailed pictures of the measurement locations during the FAT and a detailed report including all time waveform and spectra. Figure 9 is a picture of the measured locations during the FAT. It is obvious from Figure 9, that the measured locations are unacceptable and no where near the bearings.

A detailed report with all the time waveforms and spectra was never received. The author now understood the discrepancy in the vibration measurements. This should be lesson learned that an experienced vibration analyst should always be present during the FAT vibration testing of all new equipment. To ensure that accurate and reliable data is collected.

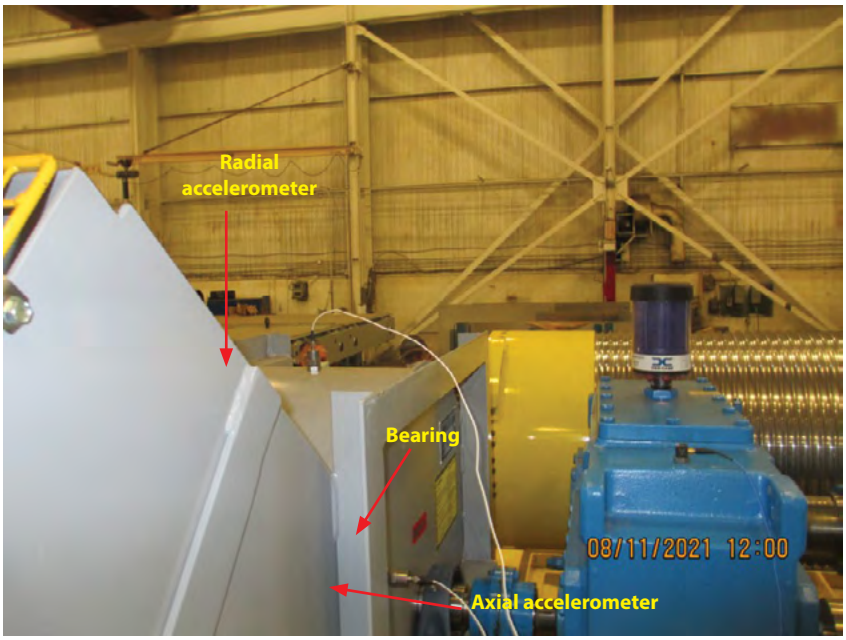



Figure 9: Break Fan Transducer Location during Factory Acceptance Test

# High Vibration On Hydroelectric Headgate Hoist During Commissioning

Figures 10 and 11 are the bode plot of the break fan at the IB and OB bearings, respectively. The data indicate a critical speed at about 2265 RPM. Calculating the Q-factor at the critical speed, gives an amplification factor (AF):

$$AF = \frac{37.75}{38.9 - 37.2} = 22$$

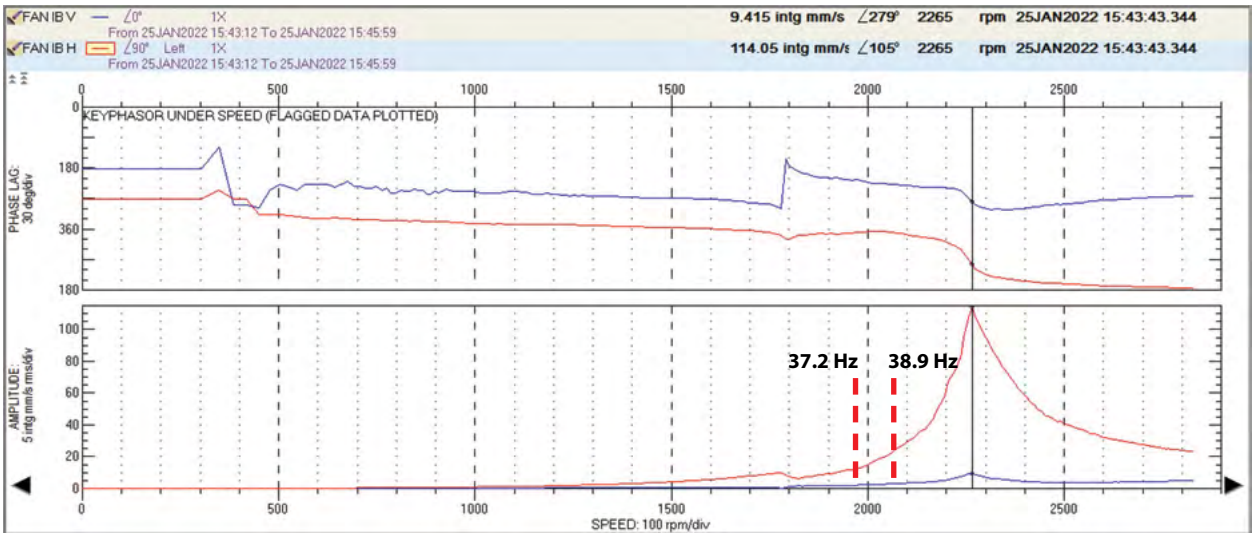



Figure 10: Break Fan IB Bearing Bode Plot during Emergency Drop

The increase in vibration from 5 mm/s RMS during normal operation to about 108 mm/s RMS at the critical speed during the emergency drop seem to be in agreement with the AF of 22.

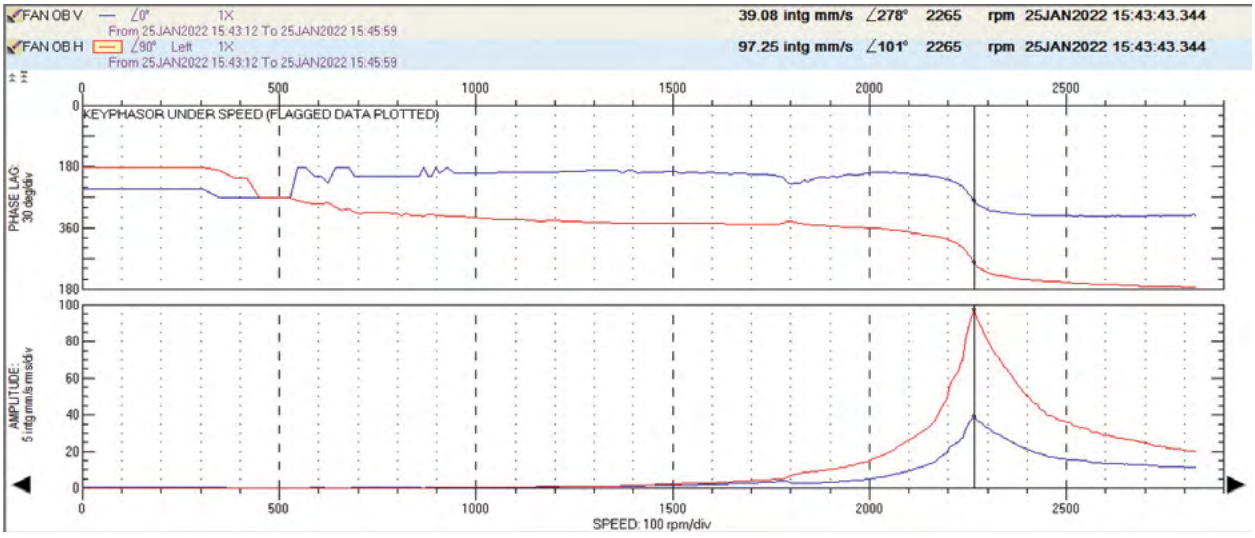



Figure 11: Break Fan OB Bearing Bode Plot during Emergency Drop

The vibration levels at about 2800 RPM was about 23 mm/s RMS, this is still considered excessive. An impact test was performed to determine the structural natural frequencies of the break fan at the IB and OB bearings.

Figure 12 is the FRF impacts at the fan OB and IB bearings. The data indicate a structural natural frequency at about 42 Hz (2520 rpm). The calculated AF = 8.5. This would also amplify the vibration levels.

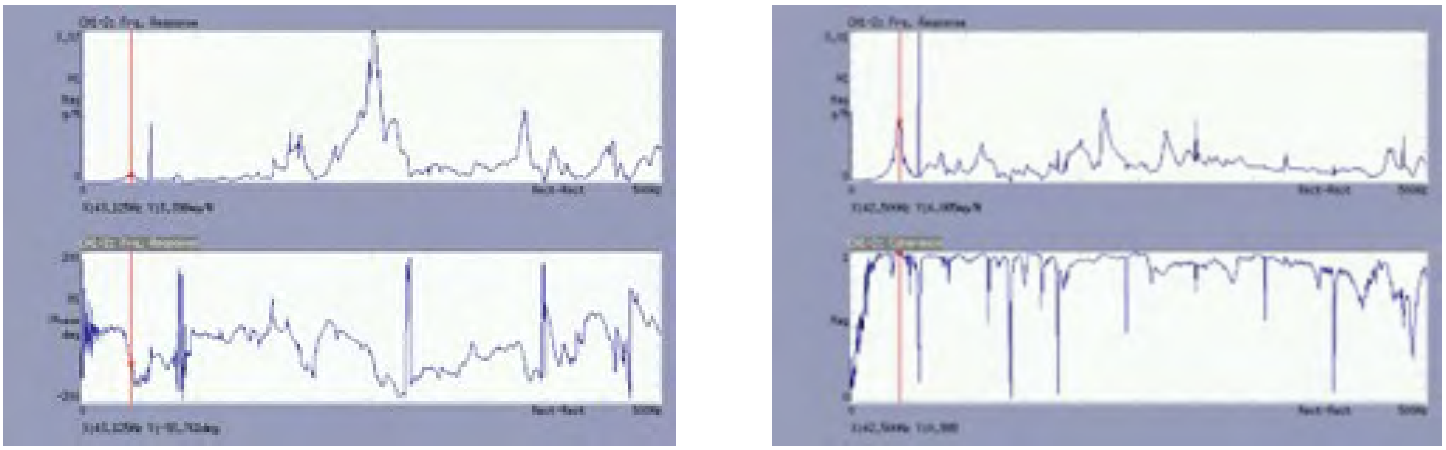


Figure 12: Impact FRF Response on the Fan OB and IB

Figure 13 is the spectra during normal raising operation of the gate at the fan IB and OB bearings. The recorded running speed was 1180 rpm, with a dominant vibration component in the horizontal direction at 2x RPM. The overall vibration levels were 5 mm/s rms at the fan OB in the horizontal direction. The presence of harmonics in the spectra could be a sign of possible looseness in the system.

Having noted these excessive vibration levels and higher than expected speed during emergency shutdown. MDCI inspected the fan and noted that the fan vanes were designed wrong (Figure 14) and were not providing the appropriate damping during emergency shutdown.

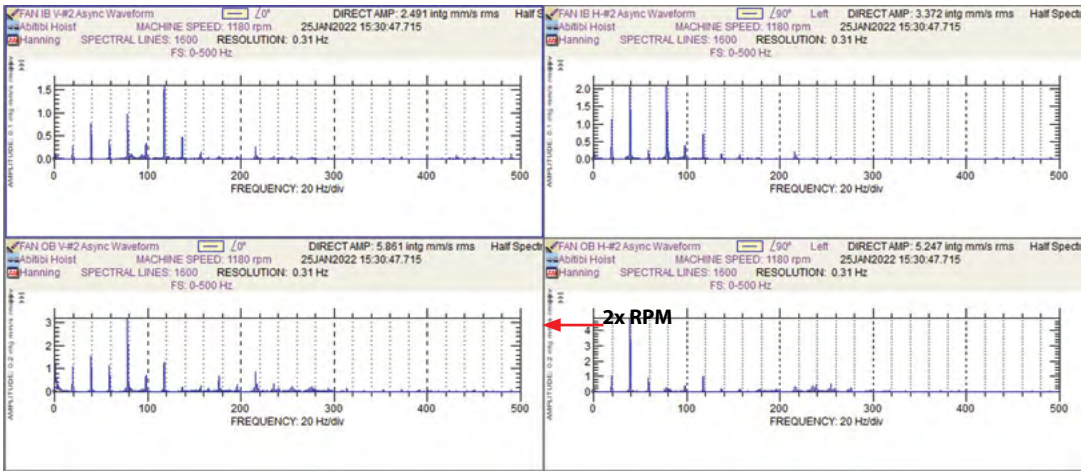



Figure 13: Fan IB and OB Spectra during Normal Raising of Gate

# High Vibration On Hydroelectric Headgate Hoist During Commissioning


Figure 14: Brake Fan Vanes Designed with Rotation of Shaft

MDCI raised concern of the excessive speed and vibration levels during emergency shutdown, and the wrong design of the brake fan, to the OEM. The OEM inspected the fan assembly and confirmed the findings about the fan vanes. In addition, it was noted that the coupling was loose on the shaft (Figure 15).

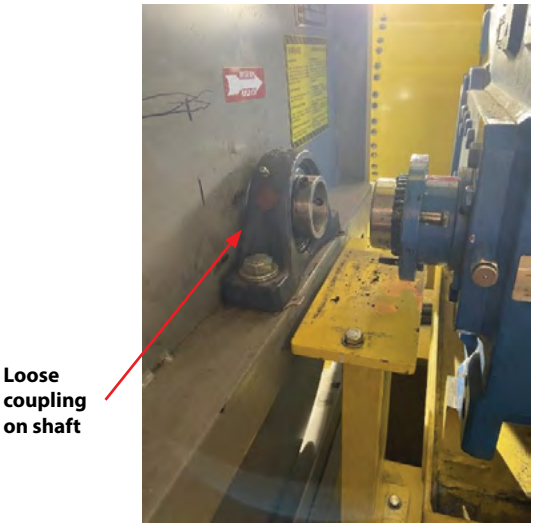



Figure 15: Removed Coupling

A new fan with proper vane design was ordered. However, the delivery would be about three months. As a temporary fix the OEM decided to further balance the fan to G1 grade and stiffen the fan casing at the inboard and outboard Figure 16.

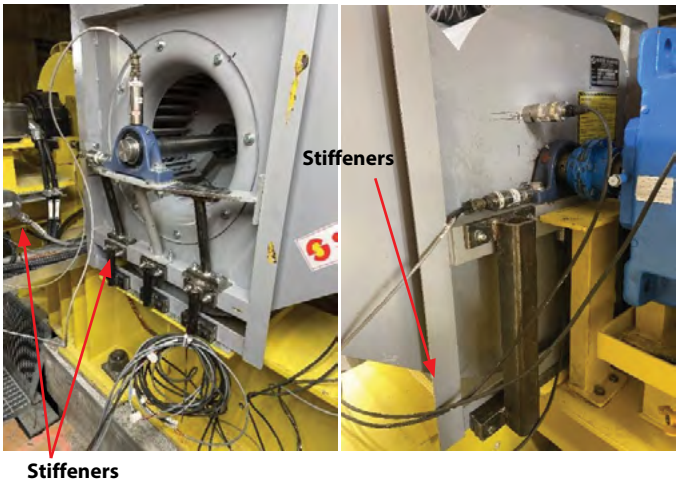



Figure 16: Fan IB and OB with Stiffeners

## Conclusion

In-situ vibration measurements during commissioning of the head gate hoist, identified several issues that were not identified during the factory acceptance test. In addition, it was noted that specifications were misinterpreted by the OEM. In-situ vibration data indicated the break fan vibration data was much higher than the data measured during the FAT, in both normal and emergency operations. Data also showed higher than expected rotating speed during emergency operation. Vibration data indicated possible looseness and break fan design issues. In-situ investigation indicated coupling looseness and that the design of the break fan vanes in the wrong direction.

This paper also show the importance of having knowledgeable vibration experts, involved in the vibration specification of new equipment and present at the FAT to ensure proper and acceptable vibration data is being collected. ◀

# Did you know that...

- CMVA has collected articles and presentations by qualified speakers and authors for years?
- This knowledge database covers a multitude of topics in vibration analysis and predictive maintenance?
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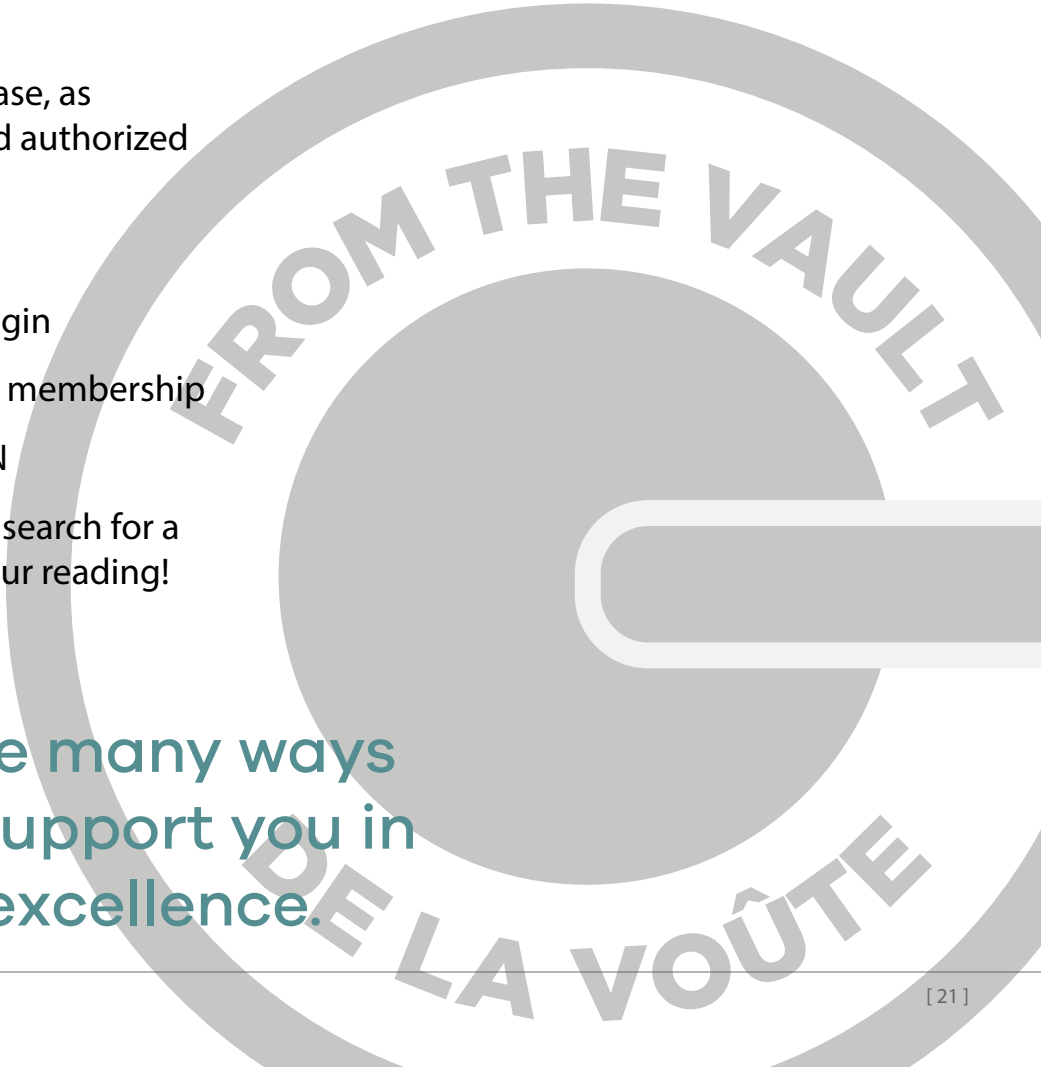


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# OCT 12 & 13

# UNIVERSITY OF VICTORIA BC

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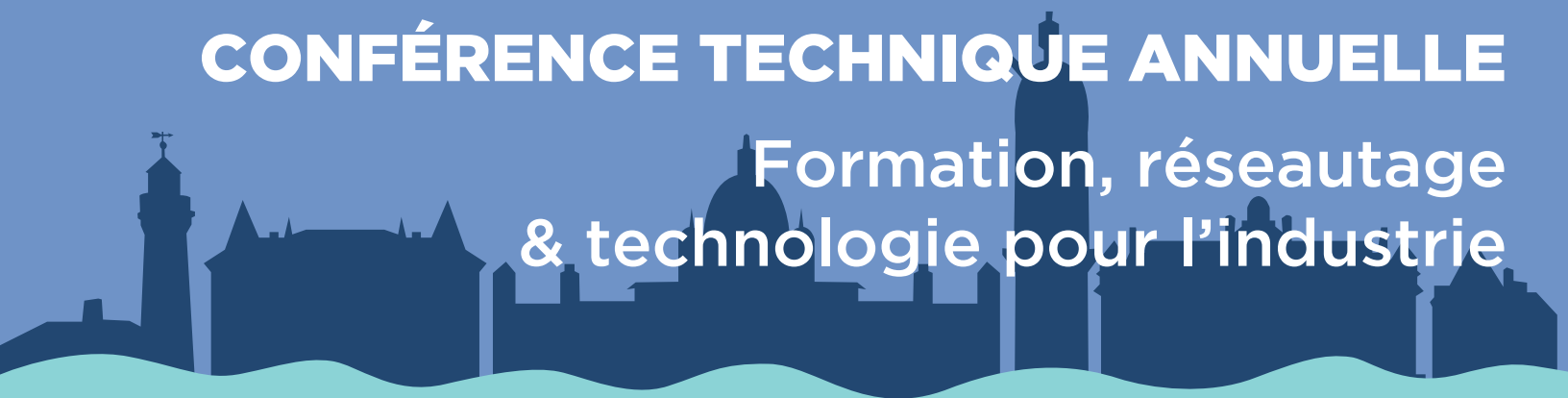

REGISTRATION | INSCRIPTION

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## 2-DAY

### PRE-CONFERENCE TRAINING

**On October 10 & 11**, courses will be held at the Inn at Laurel Point, one of our two suggested hotels. Contact CMVA to suggest topics!

## 2-DAY

### TRADESHOW

**On October 12 & 13**, during the conference, more then **15** exhibitors will hold a booth with their most recent products and services offering!



Dear Colleagues and Friends of the CMVA,

The organizing committee of the CMVA ANNUAL TECHNICAL CONFERENCE is delighted to announce this highly anticipated event!

We will be receiving proposals for technical presentations, workshops and short training sessions at this Technical Conference to be held October 12&13, 2023 at University of Victoria, in the Student Union Building.

## Student presentations

A low student registration fee has been set in order to encourage as many students as possible to attend this meeting. Two (2) Student Awards of 350$ each will be awarded for the best presentation (judged by a Peer Panel), as well as a CMVA student membership for the year 2024. Only articles written and presented by students as first author will be eligible for ***Student Awards***, which will be granted during the Happy Hour on Thursday.

**YOU SHOULD NOTE THAT STUDENTS WHO PRESENT, GO TO THE CONFERENCE FOR FREE!**

## Submit conference, a short training or a workshop

Please go to www.cmva.com under ***Annual Technical Conference*** **tab** to download the Call for presentations registration form containing useful information.

## Suggested themes

This communication is an invitation to seize the opportunity to present your ideas, expertise and case studies to your peers across Canada. We look forward to your proposal, and here we suggest some themes:

- Vibration monitoring and analysis (basic to advanced)
- Precision maintenance
- Video based vibration analysis
- Acoustic and ultrasonic monitoring
- Infrared thermography
- Lubrication and oil analysis
- Motor current and power analysis
- Data-driven predictive maintenance (e.g. advanced pattern recognition, artificial intelligence, Internet of things, etc.)
- Reliability, uptime & cost efficiency
- Innovation: techniques & tools

**FOR ADDITIONAL INFORMATION**
Contact Anne-Marie Samson
at **acvm@cmva.com** or **438 821-5912**.


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|---|---|---|---|---|
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| Booth including 1 attendant | $ 1210 | $ 1520 | $ 1520 | $ 1895 |
| Supplementary booth attendant | $ 310 | $ 390 | $ 310 | $ 390 |
| Guest one-day Trade Show pass * | $ 250 | $ 310 | $ 250 | $ 310 |
| Networking event at Swans Brewery | $ 70 | $ 75 | $80 | $90 |
| Presenter | $ 280 | $ 280 | $ 280 | $ 280 |
| Participant - Standard fee | $ 655 | $ 825 | $ 825 | $ 1030 |
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*** One-day trade show pass for Trade Show Exhibitors guests** : includes breakfast, coffee breaks and lunch at Trade Show Hall. Must be paid prior to event by the exhibitor. Pass holder must be identified with CMVA prior to event. Not interchangeable with another person on site. This pass does not give access to presentations.

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**(1)** Main Presenter banner at entrance of event venue. Your logo linked to the event logo on site signage, conference schedule, email and social media promotion, CMVA website, with the mention «Event presented by». **(2)** Total value of 500$ - no more than 3 items.

**Ken Keith | 416 622-1170 | director@cmva.com ■ Anne-Marie Samson | 438 821-5912 | acvm@cmva.com**

# About Membership

## Benefits

- Free certification renewals if a member for entire period of certification ($450 value);
- Through CMVA membership, corporations and individuals are able to communicate and network with workers in the field of machinery vibration, especially at local and annual meetings;
- Chapter and National meetings focus on relevant case studies and training sessions;
- Consult with colleagues on projects;
- Get referrals from people who have experience;
- Annual National Conference presentations;
- Technical presentations available our website in the Members section;
- Quarterly ViBs Magazine;
- Certification Exams following ISO 18436 Guidelines;
- Recognition as major contributor to the technology if your company is registered as a Corporate Member;
- The CMVA works with industry and users to establish a Canadian position in the formulation of both national and international standards;
- The CMVA may recommend the adoption of ISO standards as national standards, where appropriate.

## Duration of membership

Most important of all, CMVA enhances the visibility and importance of the technologies, and therefore contributes to machinery reliability throughout Canada.

- Membership year is January 1st to December 31st;
- Memberships purchased between October 1st and December 31st are valid for the remainder of that calendar year and the following year;
- Multiple year memberships are available. A discount applies, but mostly, they allow you to reduce your paperwork and avoid potential price increases.

## Individual membership

Individual benefits includes an access to the Members Section of CMVA's website where you can find a knowledge center, lists of members, trainers, financial reports and technical information.

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Sooner or later, you will need condition monitoring and the personnel capable of using it effectively. Corporate membership is for those forward thinking companies who recognize that fact, and are proud to support the only association in Canada that fosters machinery condition monitoring technologies and certifies the people who use them.

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- Your company name and website address listed in Corporate members under www.cmva.com;
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- List your organization as a trainer, on CMVA's website;
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Sign in and make sure your personal information is correct so we can join you and you don't miss anything. We also list certification and membership details in your user's profile. If you are not already listed, please create an account. Once you are logged in, click **Join CMVA** and follow the prompts.

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CMVA is a Certification Body accredited by SCC according to ISO 17024 and ISO 18436-1

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- Better job opportunities;
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- Present in detail what is required to properly perform the duties of your position;
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  - » Define hiring criteria;
  - » Establish salary scales according to skills.
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**For each level:**

- Demonstrate that you have completed the minimum number of hours of appropriate training required by ISO 18436-2;
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*If you do not have this experience, you can take your course, write the exam, and if you are successful, CMVA will issue your certificate when you can demonstrate that you have the required experience.

## Apply for exam

To apply for a certification exam, please go to this page and complete the registration form:

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Due to COVID-19, you may decide to take an online course. Chances are you will need the service of remote exam proctoring. To know more about this service:

**https://cmva.com/remote-proctoring-of-online-examinations/**

## Certification renewal comes in two steps

1. The analyst must provide verifiable evidence of continued satisfactory work activity without significant interruption. For this CMVA uses a point system, awarding points for different activities. There are multiple ways to earn the points needed to renew your certificate. You have 5 years to gather the necessary points (20 points for CAT I and 30 points for CAT II-III-IV). Otherwise, you will have to rewrite an exam. A successful review in a higher category also prolongs your certificate for another five years.
2. Pay the $450 certification renewal fee. If a certified analyst has been a CMVA member for the full 5 year term of certification, the renewal fee will be waived.

Many people wait until the last minute to remember all the activities in which they participated and which account for the renewal of their certificate. It is easy to forget activities that would have qualified. The best way to avoid search time, that could be long and complex after 5 years, is to use the form provided for that purpose and to fill it gradually over time.

Download and complete the certification renewal form:

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Once completed, submit to director@cmva.com.

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## Are you considering registering for a course leading to certification?

Because we support our members in their pursuit of excellence and reliability, CMVA provides ***ISO 17024 accredited certification for vibration analysts*** and approves trainers upon their engagement to provide ISO 18436-2 & ISO 18436-3 compliant training courses.

CMVA also provides ***ANSI/ASA S2.75-2017/ Part 1 - Shaft Alignment certification Level I*** and approve trainers upon their engagement to provide training courses compliant to this standard.

CMVA has prepared documentation entitled ***Performance objectives*** for each level. These performance objectives define what an individual certified in a specific category should be able to do, on the job. They are based directly on the standards concerned and were prepared by members of CMVA's Training and Certification Committee.

To obtain full text of the ISO Standards, you may buy an individual copy or an annual subscription on www.iso.org.

**Learn about the ISO and ANSI based performance objectives on cmva.com.**

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For more information. contact Ken Keith at director@cmva.com.

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**CATEGORY I**

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Live class, Edmonton AB
September 11 to 14

**Vibratech (French)**
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October 2 to 5

**Vibelube (English)**
Live class, Toronto ON
October 16 to 20

**Flowstar (English)**
Live class, St. John NB
October 16 to 20

**CATEGORY II**

**Flowstar (English)**
Live class, St. John NB
September 11 to 15

**PDM Technologies (English)**
Live class, Burlington ON
October 16 to 20

**Vibratech (French)**
Live class, Montreal QC
November 6 to 10

**CATEGORY III**

**Vibelube (English)**
Live online
September 11 to 15

### OTHER TOPICS

**IN SITU DYNAMIC BALANCING**

**Navajo (English)**
Instructor Ron Newman
Live class, Victoria BC
October 10 &11

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