FLUKE Reliability

Vibration monitoring for peak asset performance

Speakers:
John Bernet, CMRP, Application and Product Specialist

Samantha LeSesne, Product Manager

Meet the Speakers

John Bernet, CMRP

- Mechanical Reliability Application Specialist at Fluke Corp. (10 years)
- Previously worked at Azima DLI for 18 years
- Served 12 years in U.S. Navy on cruiser & aircraft carrier as electrical technician
- Has 30+ years of experience in preventive and predictive maintenance
- Written many technical articles for global trade publications and a 240-page vibration training program

✓ **Certified Maintenance & Reliability Professional (CMRP)**

✓ **Thermal/Infrared Thermography Level I certified**

✓ **Vibration Analysis Level 2 certified**

Agenda

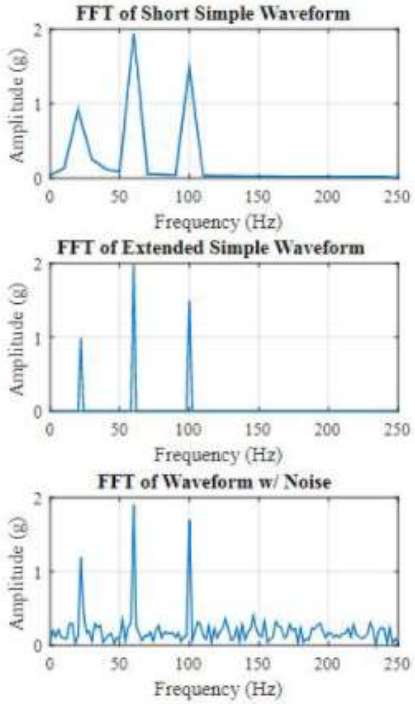
1. What is Vibration Monitoring?
2. What can be determined with vibration monitoring?
3. What are the benefits of vibration monitoring?
4. What machines are best monitored with vibration monitoring?
5. What tools a can be used for vibration monitoring?

What is Vibration Monitoring?

Vibration monitoring is a practice of performing condition-based maintenance of machines and installations based on reviewing vibration measurements to find early warnings of potential machine faults and failures.

Mechanics of vibration monitoring

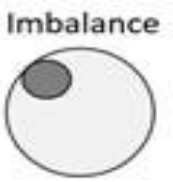
- All rotating equipment generates a unique vibration signal or **signature**.
- Unique signals are usually captured in series, with the signal's amplitude (y-axis) depicted over time (x-axis). This is called a **time waveform**.
  - The waveform contains information about the machine at the point of measurement. Vibration comes from the rotating shaft, adjacent machines, foundation, noise, rotating components, structural resonances, flow turbulences, and other sources.
- However, the patterns of different events are overlapped and jumbled together. Separating and isolating one vibration signal from another is complicated.
- Frequency analysis performed in the data collector simplifies the waveform into certain repetitive patterns. **Fast Fourier Transform (FFT)** is a mathematical algorithm performed by the vibration testing tool to separate individual vibration signals.
- **Spectrum** is the plot of each of these individual signals on a simple plot of amplitude (y axis) against frequency (x axis).



What can be determined with vibration monitoring?

Using vibration monitoring will allow you to receive early warning of potential machine failure. The vibration data received from vibration tools can be used to understand of the type of fault that will interfere with health of a machine.

The Four Most Common Faults to be aware



Imbalance – an unbalance is produced when the geometric center of a machine shaft and the center of mass do not coincide. An unbalance, such as with an industrial fan, is diagnosed most accurately by using vibration analysis. A heavy spot on the shaft causes forces in all radial directions that lead to excessive vibration and increases the wear of bearings, seals, etc.

Misalignment – misalignment occurs when two rotating shafts are not parallel to one another. Machinery misalignment is particularly common in rotating machinery and is often the root cause of asset failure. Machine vibration increases with misalignment and can cause defects in other machine components leading to premature machine failure.

Tip

With your vibration data, focus on:

1. **Identifying vibration peaks** as they relate to a source component on the machine.
2. **Looking for patterns** in the data based on vibration rules.
3. Measuring the amplitude of the vibration peak to **determine the severity** of the fault.

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What can be determined with vibration monitoring?

Looseness – looseness can be caused by a structural defect such as a loose anchor bolt holding a motor to a mount, or by rotating elements such as bearings. Bearing looseness exhibits as a spectrum containing many frequencies related to the rotating frequency of the rotor. Structural and rotating elements each have their own characteristic vibration signal.

Bearing damage – rolling element bearings are present in most rotating machines. Their useful life is affected by many factors including load, running speed, lubrication, assembly, temperature, and external forces caused by misalignment, unbalance, etc. A Piezoelectric vibration analyzer increases the ability to recognize and identify a bearing defect, determine the root cause of chronic bearing failures, and eliminate it.

Tip

Additional faults to consider:

- Electrical faults in motors
- Bent shaft
- Gearbox failures
- Cavitation in pumps
- Critical speeds

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POLL QUESTION No. 1

Which of these measurements do you use to assess machine health at your facility? **(Click all that apply)**

- Thermography
- Vibration
- Oil Analysis
- Ultrasound
- Other

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Meet the Speakers

Samantha LeSesne

Product Manager
Fluke Reliability

- Product Manager for hardware and software solutions since 2019
  - Focusing on wireless sensors, condition monitoring solutions
- 2+ year experience as Product Marketing Manager with Fluke
- Held various marketing manager positions with responsibility for
  - Product management
  - Sales training and marketing support
  - NPI marketing campaigns
  - Market analysis

What are the benefits of vibration monitoring?

- **Predictability.** Give maintenance staff time to schedule required repairs and acquire needed parts.
- **Safety.** Take faulty equipment offline before a dangerous condition occurs. Use vibration sensors to monitor
- **Revenue.** Incur fewer unexpected and serious failures, helping to prevent production stoppages that cut into the bottom line.
- **Increased maintenance intervals.** Extend life of equipment and schedule maintenance by need.
- **Reliability.** Incur fewer unexpected or catastrophic failures because problem areas can be anticipated before failure.
- **Peace of mind.** Build confidence in maintenance schedules, budgeting, and productivity estimates.

Tip

A vibration monitoring program is only effective when it is manageable!
Think about what is the correct size and resource allocation for your program so that you and your team have the time to review data regularly and make necessary repairs and replacements based on that data.

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What are the benefits of vibration monitoring?

ROI calculator - use your own company numbers to customize the ROI

- Most companies do not have numbers available to make it easy to fill out these spreadsheets
- Use comparison charts to show how to achieve the best possible ROI

General case studies of savings available (see below)

Below are some general case studies typical for machines in all industries

Cost to Benefit Study – benefits of over 20 to 1 are common

A large company implemented a predictive maintenance program on hundreds of their motors, pumps, fans, compressors, and blowers

- This program has been successful for over 25 years
- They document the cost of the program and savings they enjoy
- Savings were many millions of dollars per year
- Every 2 years they conduct a Cost to Benefit study to compare the program cost to the documented savings
- The average Cost to Benefit ratio for the past 30 years has been over 20:1

The 6 benefits that tracked:

- ✓ Prevention of catastrophic failure due to early detection
- ✓ Ability to schedule repairs during plant shutdown periods
- ✓ Ability to order parts in advance of repairs
- ✓ Ability to repair exact fault instead of complete overhaul or replacement
- ✓ Planning of workers schedules
- ✓ Root cause analysis of recurring faults

Maintenance practices	Cost to maintain rotating machinery	Cost savings
Plants that are Reactive (Run to failure)	$17/HP/Year	No savings
Plants that are Preventive (Calendar-based)	$13/HP/Year	24% over Reactive
Plants that are Predictive (Condition-based)	$9/HP/Year	47% over Reactive

C. Case Study – even small companies can benefit

Over a 16-year period, a small company transitioned from Reactive to Preventive, and then to Predictive Maintenance:

- Unplanned failures dropped to almost zero
- Maintenance budget, on 600-critical motor/pumps, cut in half over 10 years
- Pumps running twice as long before repairs are needed
- Almost all maintenance is scheduled instead of reacting to emergencies
- Repairs planned during the day and eliminating the need for overtime

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POLL QUESTION No. 2

What is your biggest blocker to starting vibration monitoring at your facility?

(Click only one answer)

- Lack of leadership buy in
- M&R team culture
- Lack of resources / time / money
- Other

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What machines are best monitored with vibration monitoring?

Vibration monitoring focuses on common rotating equipment found in industrial plants and facilities

Examples:

- Generators
- Extruders
- Agitators
- Mixers
- Compressors
- Refiners
- Pumps
- Rotary pumps
- Fans
- Blowers
- Electric motors

Tip

Use asset criticality to determine your specific machines that should be monitored.
An assessment of your assets' criticality will help to determine which machines should be monitored continuously with a wired or wireless sensor or with a handheld tool.

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Questions to consider for what tools are best for you?

- Which of my machines would be best served with a handheld vibration tool and which would be best with a wired or wireless vibration sensor?
  - An asset criticality assessment would be help

- Does my super critical machine warrant continuous monitoring with high-resolution data for sophisticated analysis of more than routine faults?
  - High performing wired sensor are designed to measure vibration data to the second and can provide high-resolution data

- What infrastructure needs to be in place in my facility for the machine to operate?
  - Wireless sensors may require network connections
  - Wired sensors may require tethered connection via the ethernet to ensure no loss of data

- Where does my data need to integrate with one of our systems to be effective? What data needs to be sent? What actions should be triggered in those systems?

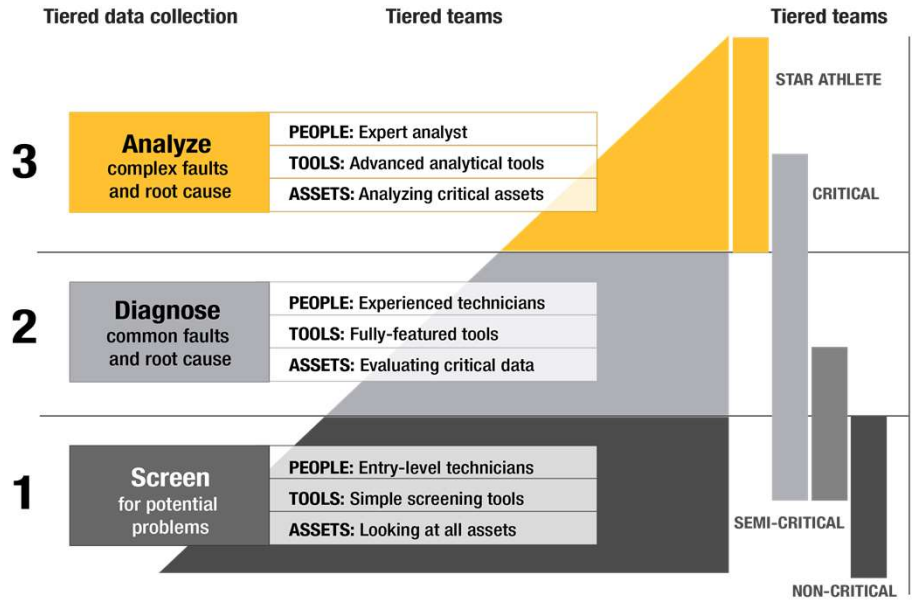
- Which machines warrant the cost of individual sensors? Can those machines be monitored with handheld tools when a technician's time could be spent elsewhere?

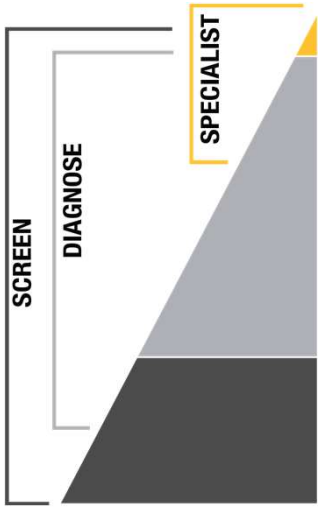
Tip

You're not looking for the tool that will give you the most amount of data. You are looking for the tool that will give you the right data.

Questions to consider for what tools are best for you?

Classifying your rotating equipment into 3 major categories will help to determine asset criticality





Top 10% Production Critical

- Top Tier Machines
- Fewer in Number
- Main Turbine
- Paper Machine
- Machining Tools

Middle 60% Vital/Important

- Middle Tier Machines
- Hundreds/thousands
- Vital motors, pumps, fans, blowers, compressors, etc.

Bottom 30% Less Critical

- Bottom Tier Machines
- Hundreds/thousands
- Non-vital motors, pumps, fans, blowers, compressors, etc.

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Questions

QUESTIONS?

Thank you!

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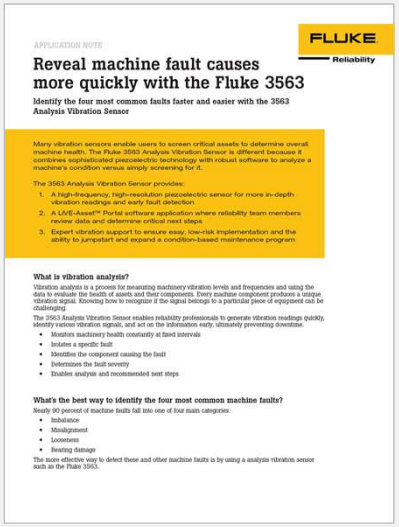
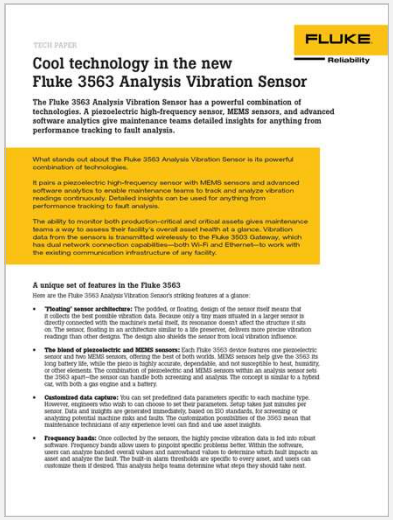
More Information

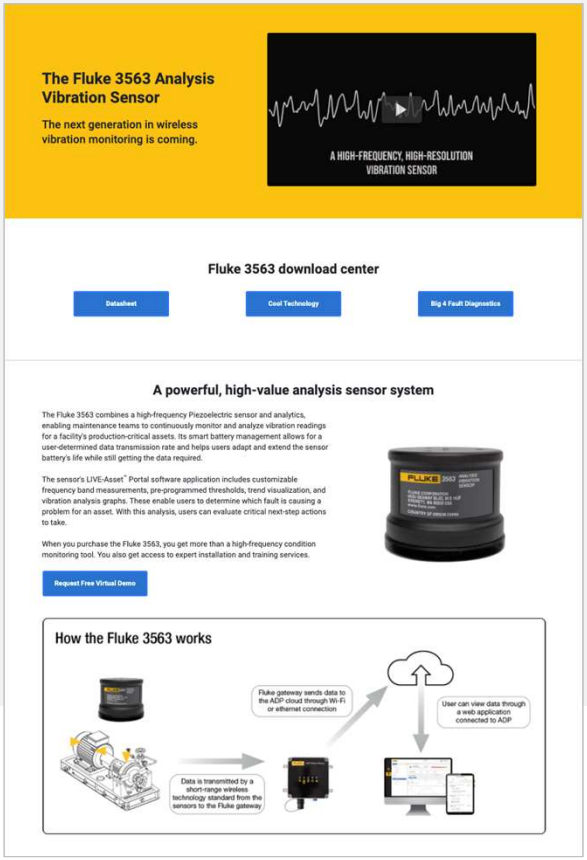
Data sheet: Fluke 3563 Analysis Vibration Sensor



Application note: Reveal machine fault causes more quickly with the Fluke 3563



Technology backgrounder: Cool technology in the new Fluke 3563 Analysis Vibration Sensor

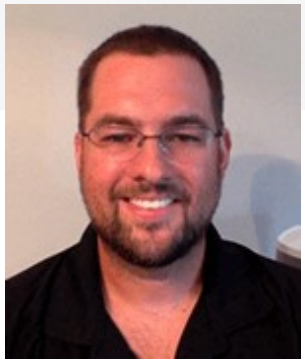


Landing page: https://info.fluke.com/fs-3563-teaser-0321-lp-1-a

Next webinar June 2

BEST PRACTICE WEBINAR

Wednesday, June 2, 11 a.m. ET



Managing cybersecurity risk in maintenance and reliability

Maintenance and reliability teams increasingly utilize a range of technologies, systems and devices & all of which can present cybersecurity risks. For this presentation, cyber expert Matthew Hudon and CMRP Frederic Baudart are joining together to outline which cybersecurity risks M& R teams should pay particular attention to and what preventive actions make the most sense to implement.

Topics include where to involve IT (and how), training the team to avoid phishing and other human-centric breaches, and how to effectively manage the inherent risks of introducing IIoT and SaaS solutions into the Maintenance and Reliability workflow.

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