Predictive Maintenance with Multi-Channel Analysis in Route and Analyze Mode

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Traditional route-based vibration measurements are collected with either a single or dual channel analyzer.

Today's new generation of portable vibration analyzers offers up to four channels simultaneously for use in the field. This whitepaper describes the significant benefits that these multi-channel technology platforms provide over conventional analyzers, whether used in Route or Analyze Mode.

Introduction

Predictive maintenance – based on route-data collection – has proven its value over many decades.

Traditionally, vibration data is collected in every bearing plane in the horizontal, vertical, and axial directions. Often, a special measurement for early bearing defect detection is also measured.

As a rule of thumb, between 10 and 16 measurements are collected on a traditional four-bearing machine – such as a motor-pump combination or a motor-fan combination.

Typically most machines are monitored in Route Mode with an interval between four and 12 weeks (one and three months).

The installations are monitored to get an early indication of imbalance, misalignment, bearing, sleeve, gear, lubrication, and looseness conditions so corrective maintenance can be planned. The ultimate goal is to reduce maintenance costs, maximize throughput and avoid production shutdowns.

Vibration technologies are not the only technology that can be applied here. Other common technologies used include oil analysis and infrared.

But without a doubt, vibration analysis is the most popular form of analysis.

An Effective Use of Time?

On average, 80-90% of machines run without any impending issue. In fact, the vibration measurements do not provide any indication of an upcoming mechanical problem; they just confirm that the machine condition is fine.

Even if it is good to know that the machines are running fine, it is a huge task to collect the information and can be interpreted as a waste of time and energy.

Wouldn't time and effort be better spent in monitoring the 10-20% of troublemakers?

A good predictive maintenance policy is to take machine criticality into consideration and base the measurement intervals on that.

Despite all customizations of the predictive maintenance program, 80-90% of measurements are executed only to confirm that there is nothing wrong.

Improving Time and Effort in Route Mode

New generation data collectors with multi-channel functionalities in Route and Analyze Mode can deliver time savings.

New Generation Data Collectors

How long does it take to measure one vibration point? That depends on two things:

- The timed segment. If your record requires the machine to be measured for one second, it will take at least one second of your time.
- The processing time needed by the measurement device to manipulate and store the data digitally.

The latest data collector from Emerson – the AMS 2140 Machinery Health Analyzer – is on average 30% faster when used as a data collector than its predecessor the CSI 2130.

A big factor in the total time to complete route measurement arises from the time required to walk from machine to machine, or even from measurement point to measurement point. Faster data collection will not help you improve the time required to move from point to point.

Although data collection with the AMS 2140 is 30% faster, that reduces the total route time only by half – meaning 15%.

An improvement of 15% is good, but we can do better!

Multi-Channel Portable Data Collectors

Today, four-channel portable analyzers and triax sensors are available. A four-channel analyzer allows you to measure horizontal, vertical, axial, and early bearing detection simultaneously. However, it requires multiple sensors. In Route Mode, it is not very handy to use multiple sensors simultaneously.

A triax sensor (figure 1) assists in this situation, however, because it has three internal sensors built in – one for every direction. It creates the illusion of working with only one sensor, but it provides the same data as three separate sensors — much easier to use in the field.

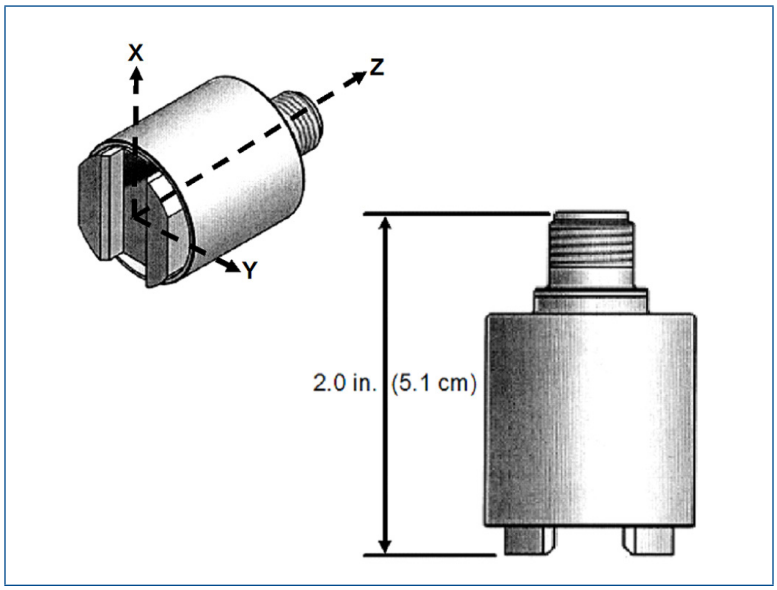

Figure 1: Triax sensor.

A latest-generation four-channel analyzer combined with a triax sensor not only offers 30% faster measurements, but will measure three directions simultaneously (figure 2). In the past you could measure only one channel, the new combination enables you to collect three channels.

Figure 2: Horizontal, vertical, axial, and special bearing measurements are collected simultaneously on the new four-channel AMS 2140.

That's about a 70-80% in time savings.

But in Route Mode we can't claim the entire time-savings number because a part of the time necessary to complete a route comes from the walking time between measurement points and machines. Typically, the time required to walk between machines reduces the 70-80% savings to a 50% savings.

In this way, the route-based data collection time is cut in half. This time savings allows the vibration analysis person to focus more on what is more important: problematic machines.

Accuracy of Triax Sensors

Single sensors are normally placed first horizontal, then vertical, and then axial. But when using the triax sensor, it is installed for the horizontal measurement, and the vertical and axial measurements are taken from the same location. Therefore, the physical location of the triax is different than when using the single-channel approach.

This location change can have an influence on a trend plot. People might see a change on the day that the conversion to triax sensors is made. But after that, the triax will provide repeatable data and trend plots that can be trusted.

Typically, there is almost no change in the signal of a single sensor and the signal coming from the mounting direction of the triax. For the two other directions, especially in the higher frequency ranges, the signal can be a little damped.

A good practice is to collect the early bearing measurement from the signal that is also the mounting direction of the sensor. The fact that the accuracy in the higher frequency ranges in the two other directions is a bit damped is not important or relevant.

Conclusion for Multi-Channel Analyzers in Route Mode

Let us suppose that you change your predictive maintenance program to reflect the suggestions presented so far in this paper and continue with a four-channel portable analyzer and a triax sensor. As a result, you cut route-based data collection time by two and focus on the problem machines.

The next question is this: Can the new fast four-channel analyzer assist further? The answer is yes!

Improving Time and Effort in Analyze Mode

Are Four Channels Really Four Channels?

The most important information for every vibration program is the speed of the machine. Accurate speed information is the basis of every good vibration program. This data can be obtained by measuring and storing the speed. But to store the speed, a speed/phase input on the analyzer is required.

A good new generation data collector should have four channels. Traditionally, four accelerometers or four displacement probes are used.

Certain four-channel analyzers on the market are limited to four inputs. If you use that type of analyzer to collect speed on one of its channels, you are left with only three channels for vibration measurements. For practical purposes then, those analyzers are only three-channel analyzers.

Emerson’s AMS 2140 provides four channels for vibration signals and a separate independent speed/phase input. In reality, you have five channels – exactly what you need.

Turbines

Measurements taken during startups, shutdowns, and steady-state operations provide valuable insight into the condition of the turbine and help ensure safer operation of the machinery.

Turbines and other critical machines with sleeve bearings are often equipped with displacement probes in an X-Y configuration in every bearing plane. Using the AMS 2140 two planes can be measured simultaneously.

In addition, dual filtered orbit plots can be measured (figure 3). The AMS 2140 can even gather torsion information.

Figure 3: Dual Filtered orbit plot measured with the four-channel AMS 2140.

Resonance

Because resonance is highly directional, natural frequencies normally must be collected in three directions (horizontal, vertical, and axial). Now, with a new-generation four-channel analyzer, this information can be gathered in one measurement.

Using a force hammer with this measurement is a good practice so that transfer functions are also measured (force versus vibration). With a four-channel device, one channel is the force hammer and the other three channels can be used for accelerometers in the horizontal, vertical, and axial directions. Again, using a triax sensor for collecting these measurements will make the process easier.

Troubleshooting in the Field?

A predictive program with route-based vibration measurements will pinpoint your problem machines. More advanced diagnostic tools for troubleshooting are required for an efficient process.

Certain new generation four-channel analyzers (with speed input) are fully equiped to do the job. A good analyzer should be equiped with advanced troubleshooting functionalities like four channel plus tach osilloscope function, synchronous averaging, negative averaging, order tracking and long waveform recording (transient). And of course, all those functions should work on the four channels plus speed simultanously.

What to Look for in a New-Generation Analyzer

If you are looking for a new analyzer, make sure to verify that the following functions are available on the analyzer:

- The analyzer shall be lightweight, be battery-powered, have a built-in stand, and be portable.
- It shall be capable of collecting vibration (overall, spectrum, waveform, trend, and phase), temperature, AC current, speed, noise, and user-defined data.
- It shall be capable of simultaneous single, dual, and four-channel data collection.
- It shall be capable of simultaneous collection of spectra, waveforms, and 12 analysis parameters for both a standard vibration and a peak detection measurement for bearing analysis.
- The analyzer shall have a touchscreen user interface for easy navigation. The backlit keypad and auto adjusting display backlight should depend on ambient lighting conditions.
- The analyzer shall have wireless Bluetooth headphones capability for listening to the vibration data.
- The analyzer shall have wireless Ethernet communication with the database for uploading and downloading data from the analyzer.
- The analyzer shall also be capable of real-time spectral analysis, triggered data capture, synchronous time averaging, negative averaging, and have a full VGA display capable of displaying a 1600 line spectrum with no data compression.
- It shall have embedded intelligence, capable of providing automatic configuration of additional measurement acquisition when route data indicates a machinery problem.
- It shall be compatible with predictive maintenance software which can store and manipulate route-based data collected with the machinery analyzer as well as other predictive maintenance tools.
- The analyzer may be used to augment existing vibration/noise analysis programs and shall be compatible with voltage output vibration probes currently installed on various fans, pumps, motors, turbines, and compressors in the plant.

Conclusions

Many years ago, when you or your company started a predictive maintenance program, it had a very positive influence on your maintenance program, and even better on your machine availability and ultimately on your production.

Now, the technology is available – using a fully multi-channel technology – to bring your vibration analysis program to a higher level by collecting high-quality data faster.

When you begin using a multi-channel analyzer, a new world will open for you. Just like when you began your first predictive maintenance program, you will realize improvements to your maintenance program, machine availability, and production.

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