Trending Vibration Program Setup Guide

1. Understand Maintenance Types:

Not all machinery falls into Condition-based maintenance, such as vibration analysis.

Reactive	Preventative	Predictive	Proactive
			
Hysterical-based maintenance Run machine until fail Most Costly for most machine Best for throw-away equipment	Calendar-based maintenance Must know MTBF Cost to replace unnecessary parts Machine failure without warning	Condition-based maintenance Repair only as needed Avoid unnecessary downtime Required for trending program	Root-cause maintenance Requires Predictive maintenance Re-engineer to improve machine Best practice when possible

2. Determine Repeatable Test Operating Conditions:

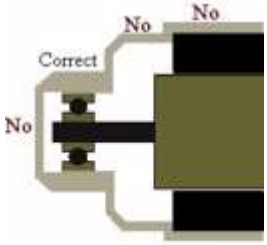
This is key to a successful, trending vibration analysis program. REAPEATABILITY!

What drives the machine?	How is driver controlled?	How is driven connected to driver?	What is the driven component?	How is the driven controlled?
AC Electric Motor DC Electric Motor Turbine Fluid Motor Diesel Engine	Motor Controller Governor Multiple Speed Variable Frequency Load controlled	Belt drive Chain drive Gearbox Coupling Clutch	Pump Compressor Fan Generator Blower	Valve lineup Controllable blades Variable displacement By load By demand

3. Establish Repeatable Vibration Test Locations:

Consistent, comparable data requires using sensor attachment mounting pad.

Choose Best Locations



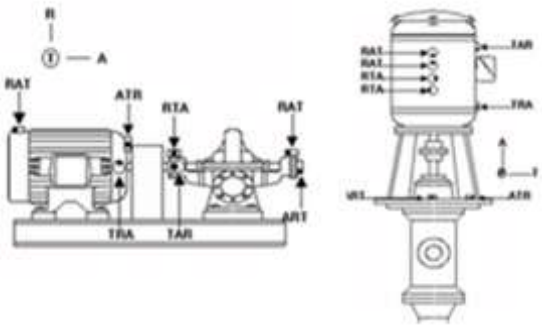
Accelerometer Location

As close to bearing as possible
Solid Metal Foundation

<u>Consider Vibration Path:</u>

> 40 HP or > 3' between bearings => test location needed at each bearing.

Understand Orientation



Use right-hand rule to relate three channels of triaxial sensor relate to the orientation of the attachment pad.

Channel 1 = screw and threaded hole
Channel 2 = in line with screw and notch
Channel 3 = perpendicular to screw and notch

Establish precedence for three orthogonal axes of machine. Determine axial, radial, and tangential or axial, horizontal, and vertical directions.

Use Right Adhesive

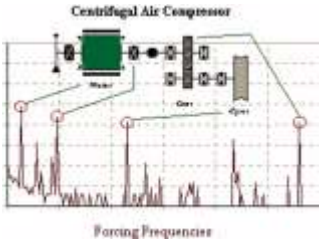
1. Identify location on machine for attachment pad.
2. Use file to remove paint at machine test location area.
3. Swab activator on machine area <u>and</u> back of pad.
4. Let activator set for 1 min.
5. Apply drop of adhesive to back of attachment pad.
6. Align pad to machine as previously determined.
7. Apply pressure until pad is set, approximately 1 minute.

Trending Vibration Program Analysis Guide

1. Understand Machine's Forcing Frequencies:

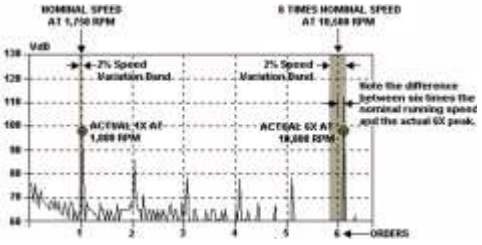
Must know frequency of vibration sources to establish correct collection setup and spectra display

Element Counts



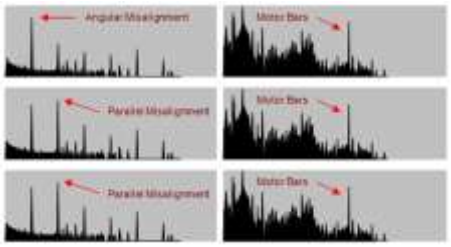
- Number of motor bars
- Number of turbine blades
- Number of teeth on each gear
- Number of blades, vanes, threads
- Distance and diameters of sheaves

Running Speed



- Trending programs demand repeatable running speed.
- Establish Test Operating Condition at running speed.
- Determine speed of each shaft if machine has speed changer (belts, gears, fluid coupling).
- Normalize graphs to running speed.

Frequency Range



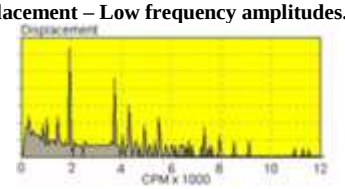
- Calculate forcing frequencies for each component
  Forcing Frequency = Number of Elements X Shaft Speed
- Use two ranges of spectra for trending analysis
- Ensure Fmax is great enough for all analysis
- Set resolution to show spectra detail

2. Determine Units:

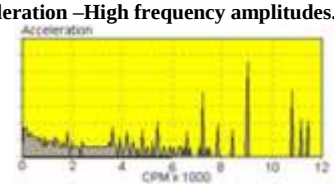
Spectral units must allow analyst to establish a pattern to trend faults from early detection.

Motion Units

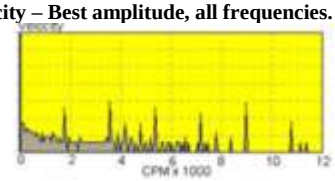
Displacement – Low frequency amplitudes.



Acceleration –High frequency amplitudes.

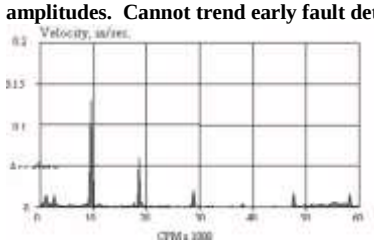


Velocity – Best amplitude, all frequencies.

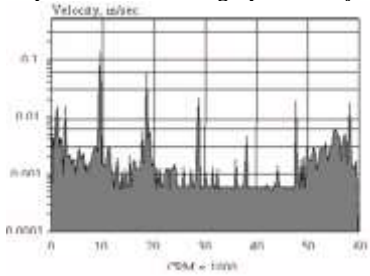


Amplitude Levels

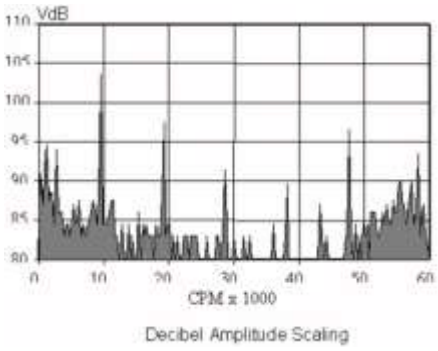
Linear – Does not show detail of low-level amplitudes. Cannot trend early fault detection.



Logarithmic – Scaled to see large and small amplitudes. Trendable graph for early detection.



Decibel Scale



Velocity Decibel (VdB) Scale is a logarithmic graph with a linear amplitude scale. Similar to scale and parameters used in sound-pressure (noise) measurements, this scale allows analysts to trend early faults but apply a measurable value to the trending progression of the fault.

3. Trend Analysis Results:

The goal is to find faults early enough to avoid unplanned downtime.

Find Faults	Trend Progression	Determine Root Cause	Repair As Necessary	Document Savings
1. Determine if valid data. 2. Ensure data is normalized to running speed. 3. Identify all forcing frequencies peaks and compare to average baseline. 4. Note peaks that exceed average as potential fault. 5. Add healthy machine to average baseline.	1. Set periodicity to collect vibration to determine fault progression. 2. Compare faults to average baseline and previous tests. 3. Increase testing periodicity as fault progresses. 4. Create work order.	1. Many faults are caused from other problems. Determine if root cause and repair as necessary. 2. Trend each fault independently to understand progression. 3. Perform visual and other technology tests to confirm findings.	1. Plan repairs in advance to ensure parts on order. 2. Schedule maintenance to have least impact on production. 3. Repair machine including root cause fault. 4. Perform quality assurance test following repair to ensure success.	1. Perform post repair cost justification. 2. Prove savings using simple cost of parts to elaborate no-loss-of-production. 3. Publish your findings. 4. Ensure program maintains a high return on investment.

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