Wireless Vibration Sensor Selection Guide

IMPORTANT Battery Powered Vibration Sensors CONSIDERATIONS

The ideal location to mount a vibration sensor is at the point of machine friction (heat) between the rotating element (shaft) and the stationary support (bearing).

To get good vibration results mounting the sensing axis perpendicular to the shaft centerline in the horizontal plan is important. Resolution, accuracy and repeatable results are the key to success.

Battery life (1 year 2 year etc..) is specified at 75°F (24°C). When you use the battery at hotter or colder temperatures outside of 75°F (24°C0 the specified lifetime is reduced – for every 15°**F (8°C) over 75°F (24°C)**, battery life is reduced by 10% - 20%

Per SKF bearings, normal motor bearing internal operating temperatures range is from 140°F (60°C) to 160°F (71°C)

The typical discharge temperature for specialty industrial batteries such as lithium-ion (Li-ion) is 140°F (60°C). The maximum is 257°F (125°C) for specially produced batteries.

The challenge for wireless vibration sensors is the process liquids and air moving through machines such as pumps and fans are often very warm where the vibration sensors should be mounted.

CONSIDER THE TOTAL COST OF OPERATING A BATTERY-POWERED VIBRATION SENSOR

The batteries will not all fail at the same time, so you are replacing batteries frequently or you are replacing many batteries at once before some need to be replaced.

Time and labor cost to purchase the replacement battery, (b) the cost of the battery, (c) accessing the physical location of the mounted vibration sensor, (d) labor to replace the battery, and (e) disposing of the battery in an environmentally and earth friendly manner.

Onboard battery-powered vibration sensors compromise performance in attempting to get longer battery life and reduce manufacturing cost

Typical areas of limited performance:

• Lower sample rate = Less resolution poorer data quality

• Shorter sample time = Less resolution poorer data quality

• vibration recorded on fewer axis (1 or 2 instead of 3) = You may miss a critical event

• Min/Max operating temperatures = Increased cost and maintenance hassles

• Shorter on time = Less resolution poorer data quality

• Less on times = missed problems, downtime and machine loss

• No remote configuration = Increased cost and maintenance hassles or you miss an event due to performance issues

• Frequency response

• Poor low frequency response = Less resolution poorer data quality

• High end frequency response to at least 4KHZ or greater? =required to catch machine condition issues related to roller bearings, gear teeth, cavitation and mechanical looseness.

• Velocity output = Velocity with a minimum frequency response from 2Hz – 1000Hz is good because velocity is constant measurand for many typical rotating machines. When setting alarms velocity is an excellent choice because a rough vibration level at 300RPM or 3000RPM is the same.

• Acceleration output = Acceleration provides excellent vibration data at higher frequencies such as gearbox, ball or roller bearings, pump cavitation or mechanical looseness.

• Dynamic data output (FFT, Spectrum, time waveform)

• One large g range (not selectable) = Less resolution poorer data quality

• No internal low, high & band pass filters = more difficult to separate process vibration from machine fault frequencies

• Vibration sensor size

• Sensor temperature rating

• Battery power storage (mAh)

• Battery location

• Battery temperature rating

• Beware of the Swiss army knife sensor snake oil salesman promises (6 in 1) The problem is mounting the sensor in the correct location is #1 and different functions require different mounting locations on the machine to get quality actionable data. Garbage in garbage out.

• Case-mounted vibration sensors work on smaller machines (<1000HP) with an anti-friction ball or roller element bearing. For larger sleeve or oil-lubricated bearings on large machine (>1000HP) case mounted vibration sensors will detect the vibration after the damage is severe. This is because the larger machines with oil-lubricated sleeve bearings have wider tolerances between the rotating shaft and the inner bearing. There is quite a bit of damping also because of the much larger case mass relative to the lighter internal rotor mass. The vibration inside could be damaging but undetectable in this case. For this purpose, the industry uses inductive non-contact proximity sensors to detect the vibration on centrifugal compressors, large turbines, and large motors, pumps, fans, and gearboxes.

Vibration industry expert tips to find the best wireless vibration sensor.

Size matters – You want the smallest vibration sensor physical size for these important reasons.

1) More mounting location options. To get the best results with the fewest number of installed sensors you want to mount the vibration sensor on the machine's drive end or driven end bearings. The driven or drive end bearings get the most wear and tear and typically have the greatest load and or are more likely to provide important failure related data sooner than the outboard bearings. When the vibration sensors are large the best mounting location to get the best data may not be possible due to a safety shield or limited physical mounting space. You want to mount the vibration sensor on a flat spot perpendicular to the shaft centerline on the horizontal plane on the side of the machine on the drive or driven bearings.

2) The smaller the vibration sensor the higher the resonant frequency. Every mass has a resonant frequency (think of a tuning fork). If your vibration sensor has batteries on board the sensor and is as large as a doorknob then the resonant frequency could be in the middle of the range you want to be monitoring. For this reason many wireless vibration sensors may not state the

bandwidth of the vibration sensor or they may limit the top end at 1000Hz because the large sensor rings above 1000 Hz and say per ISO 10816 our frequency response is from 10Hz to 1000Hz

3) The smaller the vibration sensor the wider the frequency response capability. This small vibration sensor size is important so the different machine frequencies like a low speed fan (2Hz) and the ball bearing frequencies in the fan motor (2000Hz) may be accurately sensed and accurate vibration data collected. Another application would be a pump where the rotational frequency is (30Hz) and the mechanical and destructive cavitation of the pump impellers occurs at (4500Hz)

WHAT TO WATCH OUT FOR! Be an informed buyer of wireless vibration sensors:

Watch for specifications that do not monitor frequencies below 10Hz because you miss everything that happens up to 600 RPM

If you only need an alarm, it is ok for sensors to leave out time waveform data. However; it is not possible to diagnose machine failures with only overall trend data. So, we recommend purchasing sensors that **have time waveform data outputs**, not just overall vibration amplitudes over time.

Watch for specifications that **do not monitor frequencies above 1000Hz** because you miss early warnings for ball and roller bearings issues, gear problems and mechanical rubbing, cracks and cavitation on pumps.

Watch for specifications with one high g range such as **+/- 40g or +/- 30g** because you will not have the resolution required to detect the slow machine anomalies. Example a machine at 300RPM has a problem developing. That "ROUGH" vibration at 300 RPM is 0.03g if you have a 30g range then you are at 1% of full scale at the time you need to repair you machine to prevent a catastrophic failure.

Watch for **specifications that do not include power storage** such as ____mAh (milliamp hour) or ____Ah (amp hour). Would you buy a car with a 1-gallon gas tank or a EV with a small battery? Know your battery storage capacity—if it is left off the spec it means it was not adequately thought out in the design.

Know your battery type and battery temperature specification. In today's wireless world you typically cannot easily change batteries with the over-the-counter variety because batteries have performance characteristics now that improve the transmission capability with short pulses of energy or can handle extreme temperatures longer (-40C +125C).

Please note that if your battery is specified for +125C or -40C it does not mean that it will last 10 years at these extreme temperatures it only means it can survive at those temperatures. At the time of the writing of this document the battery life is still greatly reduced.

Mems vibration sensors technology has not been successful and is not intended for early detection of machine vibration problems for oil lubricated sleeve bearings in machines >1000 horsepower such as large centrifugal compressors, motors, pumps, fans, steam turbines, hydro turbines, gas turbines and large gearboxes. For these larger machines >1000HP non-contact inductive proximity sensors are required for early detection of problems. This is due to damping between the rotor and the stator. The internal problems of the machine cannot be detected on the machine case vibration sensor until serious damage has already occurred.

SUMMARY:

THE BEST WAY to get a long reliable battery life is to install the wireless vibration sensor battery at the location on or near the machine closest to 25°C (75°C).

THE BEST WAY to get the best vibration data and subsequently keep your machine up and running longer is to install the vibration sensor at the location of the drive or driven bearing perpendicular to the shaft centerline.

The best location for the (1) battery, the (2) vibration sensing element and (3) great wireless transmission are not the same location.