Frequently Asked Questions About Enveloping

Using an Accelerometer Transducer

QUESTION: What does acceleration enveloping technology detect?

ANSWER: Enveloping technology detects rotational impact defect signals. It enhances repetitive phenomena, such as:

- Bearing defects
- Gearbox defects
- Flow (solids in liquids)

Since enveloping enhances repetitive signals of the impact type, it allows early warning of developing component damage.

QUESTION: What bearing damages generate an acceleration enveloped signal?

ANSWER: Bearing problems such as:

- Holes
- Cracks
- Spalls
- Dirt

Other defects in:

- Belts
- Felts
- Felt Rollers
- Chains

And even chipped teeth in gears.

QUESTION: Can acceleration enveloped readings be trended?

ANSWER: Yes, keeping in mind that amplitude readings may decrease as damage becomes severe due to smoothing of crater edges with a corresponding improvement in lubrication flow. At the early stages of damage, however, readings should be trendable.

QUESTION: Do larger acceleration envelope readings imply higher impact force?

ANSWER: A larger enveloped reading implies a stronger impact force than a smaller reading. Again, keep in mind that amplitude readings may decrease as damage becomes severe due to smoothing of crater edges with a corresponding improvement in lubrication flow.

QUESTION: On what applications should acceleration enveloping measurements be performed and on which ones can it not be done?

ANSWER: Enveloping measurements are most significant on gear tooth fractures and repetitive bearing defects of the impact type – especially with low-force impacts. Enveloping measurements do not reflect significant readings in applications that look at other things besides impact defects, such as misalignment, gear backlash and applications on very slow speed machinery.

QUESTION: In which applications does an acceleration enveloped signal give sufficient information about rolling element bearing condition and in which applications is enveloping not enough?

ANSWER: Since enveloping measurements are vibration measurements, and since enveloping enhances repetitive impact phenomena, enveloping gives excellent information in the early warning stages of bearing defects. If these measurements indicate an incipient failure, an enveloping spectrum analysis would confirm the diagnosis.

Acceleration enveloping measurements are not sufficient with very large (stiff) machinery, such as large gearboxes, which give too small vibration readings. (Use a SEE (Spectral Emitted Energy technology) sensor for early warning on these types of machines.)

QUESTION: How should acceleration enveloping measurements with a fixed sensor be performed?

ANSWER: Place the sensor in the load zone of the bearing under test – radially for a radial bearing and axially for a thrust bearing.

Consider the stiffness of the machine so as to select the best axis for the measurement. The sensor should be installed in an approved, workman-like manner (solidly and to a clean surface). More important is that the sensor surface should conform to the machine surface. Many test POINTs have machine surface flats to obtain optimum vibration coupling.

QUESTION: How should acceleration enveloping measurements with a handheld sensor be performed?

ANSWER: Enveloping measurements with a handheld sensor must be consistently applied to achieve consistent readings. A stable point measurement requires a constant pressure (2.2 lbs. or 1 kg force) of the sensor against the machine, the same angle of attack (90°, ±10°), consistent type of probe coupling (magnetic versus non-magnetic), clean measurement area (surface dirt and paint can be a problem), and at the same place on the machine each time.

QUESTION: Is there a difference between handheld and fixed sensor acceleration envelope readings?

ANSWER: Yes. Because the efficiency of the coupling interface for handheld and fixed sensors differ, their amplitude readings may differ by a factor of two or three. However, absolute amplitudes are not as significant as changes in amplitude measured over time by the same sensor (trend). The readings for both the SEE and accelerometer sensor are very much dependent on the transmission path. If the measurement is performed within normal statistical variation of parameters such as pressure direction and coupling efficiency, then statistical trending is a viable method without regard to absolute levels.

QUESTION: What training and knowledge is required to take measurements and to interpret acceleration envelope readings?

ANSWER: Virtually no training is required to take the readings, except to minimize the variables such as care and consistency in setting up and taking measurements: location of points on the machine to be measured, direction to hold the sensor and pressure of the sensor against the machine. Experience and practice will ensure measurement accuracy and stability.

The interpretation of envelope spectrums requires a knowledge of machine components and their defect frequencies. You could plan to attend a formal training session by SKF where you will learn basic bearing fundamentals and the fundamentals of the equipment, such as signals in which frequency content is important, how to be consistent, what envelope readings mean, trending, limitations of the technology, and so on.

Subscribe to and read as many industry publications as you can. Attend as many industry sponsored conferences and seminars as you can.

Your return on the use of this acceleration enveloping tool is directly proportional to your efforts to learn about it.

QUESTION: How do acceleration envelope readings correlate with normal vibration measurements?

ANSWER: Normal vibration measurements allow you to isolate low frequency vibration signals for predicting machine problems in the 1x to 10x range. In the early stages of bearing and gear problems, enveloping will provide indications of some defective performance. In the more advanced stages of bearing and gear degradation, normal spectrum analysis might reveal some insight as to the extent of damage.

Because acceleration envelope and normal vibration measurements have different goals, they measure different things. You should use both technologies in your predictive maintenance program to maximize your ability to predict problems and to maximize your cost savings.

If your normal vibration measurements correlate very strongly all the time with your enveloping readings, you should be suspicious of your envelope filter setting. The low-end filter setting should be above 10x rotational speed. The high-end filter setting should be six orders of the outer race frequency (about 200x rotational speed).

QUESTION: What bearing defects generate only low frequency signals?

ANSWER: Non-impact type bearing signals, such as pure tone/waviness types, generate only low frequency signals and are not candidates for enveloping technology.

QUESTION: What sensitivity is required for an acceleration enveloping sensor?

ANSWER: The recommended accelerometer sensor sensitivity to optimize the signal-to-noise ratio lies in the range from 10 to 500 mv/G (centered around 50 to 100 mv/G). Higher sensitivities are needed in very low frequency applications, such as in the slow rollers of a paper machine.

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