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VIBRATION INSTRUMENTATION

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INTRINSIC SAFETY PROTECTION

Many applications require Intrinsic Safety (IS) protection. In some industries, machinery operates in the presence of hazardous and flammable gases. Any electrical equipment used or installed in these areas require protection to insure that they do not pose any potential of causing ignition of the gases. Commonly known as IS protection, the requirements vary depending on certifying agency and environment ratings. A list of Wilcoxon IS certified sensors and the certifying agencies can be found on pages 128 and 129. On specification sheets, products with IS certification will display the certifying agencies logo under "Options".

Often a barrier strip is required to be used for sensors permanently mounted in hazardous areas. These zener devices act as a fuse to limit the amount of energy that can be sent to the sensor. Wilcoxon offers two barrier strips, refer to the Mounting & Accessories section on page 121. For more information on Intrinsic Safety, consult Wilcoxon Customer Service .

1 IS A WIDER SENSITIVITY TOLERANCE BAD, SUCH AS ±15%?

Not necessarily, if trending on vibration levels then wider tolerances, such as ±15%, provides adequate, cost effective information for a successful monitoring program. Also, nearly all data collection boxes, analyzers and acquisition systems have the ability to enter the exact sensitivity of a sensor. In these cases, purchasing a sensor with a wide tolerance is acceptable as long as its sensitivity is appropriately noted. However, if the user is unable to enter the exact sensitivity and the acquisition equipment assumes a nominal sensitivity, then a precise measure of the vibration level may not be possible. For example, if the acquisition equipment assumes the vibration signal is obtained from a 100mV/g sensor and the actual sensor being used is 85 mV/g, the vibration readings will be 15% low. In this case, a tighter tolerance (±5%) may be more appropriate. If possible, enter the exact sensitivity of the sensor into the acquisition system to obtain the most precise measurements.

2 WILL A WIDE SENSITIVITY TOLERANCE (±15% VS. ±5%) MEAN A NARROWER FREQUENCY RESPONSE?

No. Sensor frequency response is based on sensitivity variation relative to the sensitivity at the 100 Hz reference point. Whether the reference sensitivity is 105 mV/g or 85mV/g, the frequency at which the sensor sensitivity increases/decreases by a specified amount (ie. 10% or 3dB) remains constant.

3 HOW OFTEN SHOULD AN INDUSTRIAL SENSOR BE RE-CALIBRATED?

With proper handling and usage, Wilcoxon industrial accelerometers do not need frequent re-calibration. Wilcoxon's proprietary crystal preparation stabilizes the ceramic crystals used within the sensors to minimize output drift due to aging. Maximum sensitivity drift is less than 1% over the life of the sensor. If exact accuracy of vibration levels is necessary, the sensors should be re-calibrated annually. Otherwise, Wilcoxon sensors need to be re-calibrated only if exposed to mistreatment (overshock, extremely high temperatures) or if required by regulations (ISO 9000, Nuclear Regulatory Commission). Wilcoxon offers calibration and testing services for any make sensor.

4 HOW LONG DO PIEZOELECTRIC SENSORS LAST?

Piezoelectric sensors are solid state sensors with no internal moving parts to wear or fatique. Mean Time Between Failure (MTBF) analysis for typical industrial sensors predicts a life of 12 years. However, many sensors returned to Wilcoxon for re-calibration are more than 30 years old and still operating. While many sensors do indeed last beyond a decade, empirical data suggests an average life of approximately 7 years. If a sensor is continuously operated to the full limits of their environmental specifications, then their life span can be decreased. Sensors exposed to high temperatures (> 200ºF) and rough handling are candidates for earlier failures than those permanently mounted in benign environments.

5 IS A SHEAR MODE SENSOR SUPERIOR TO COMPRESSION MODE?

What about flexure mode sensors? In recent years, shear mode sensors have gained popularity, while compression mode are often considered to be "old technology." Meanwhile, flexure mode sensors, once considered too fragile for industrial applications, are now making a comeback by incorporating special design techniques. Each construction method has inherent advantages and disadvantages. The construction method of a sensor is less important than its performance.

For each model, characteristics such as base strain and shock limits are quantified on the specification sheet and can be compared. For example, a well-designed compression mode sensor may have a lower base strain rating than a shear mode sensor. While this may be contrary to intuition, it can be verified by comparing the values of the 793 (compression) versus the 787A (shear). In today's advanced designs, the right sensor for an application is determined by the performance yielded by different design techniques.

6 WHY DON'T ALL VIBRATION SENSORS HAVE LOW FREQUENCY RESPONSE?

A high pass filter is inherent to electronics of all piezoelectric accelerometers. The filter has a resistor and capacitor in series and the value of these components, RC, determines the low-end cut-off. Also known as the discharge time constant (DTC), the larger the RC value, the lower the frequency response. The DTC also defines the sensor response to abrupt changes in sensor powering such as turn-on and signal overload. When the sensor is turned on or begins to recover from an overload, the time it takes to become usable is directly related to the DTC value. Therefore, the low end cut-off is inversely proportional to the turn-on time (and shock recovery time). In other words, the lower in frequency the sensor measures, the longer it takes to turn-on or recover from an overload. For general-purpose sensors, the low-end frequency performance is sacrificed in favor of better turn on and shock recovery response.

7 DO 500 mV/G SENSORS JUST HAVE MORE INTERNAL ELECTRONIC GAIN THAN A GENERAL PURPOSE (100 mV/G) SENSOR?

No. A sensor with additional electronic gain will produce the desired effect of increasing the amplitude of vibration output of the low level signal. However, this technique will also produce the undesired effect of increasing the level of the noise within the sensor. The only technique to increase the sensitivity without increasing the noise is to mechanically gain the signals. Mechanical gain is accomplished by increasing the sensor mass (low frequency sensors are generally heavier than other sensors) and /or using a higher output sensing crystal. All Wilcoxon low frequency, high output sensors use mechanical gain.

8 WITH THE HIGHER OUTPUT SENSITIVITY, WON'T A LOW FREQUENCY SENSOR OVERLOAD EASILY?

With their high sensitivity output and consequently lower amplitude range, low frequency/ high output sensors are vulnerable to overload especially in the presence of significant high frequency vibration. For this reason, Wilcoxon includes a low-pass filter within the electronics of these sensors. This filter controls the high-end frequency cut-off and attenuates the high frequency signals. By not processing the high frequency (and often high vibration level) data, there is less chance of sensor overload.

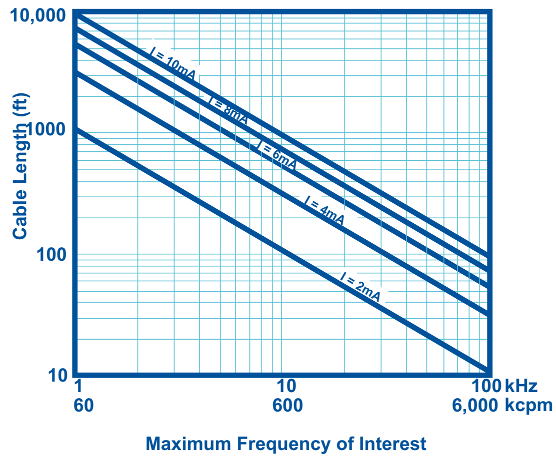
9 AN INCREASE IN THE 4-20MA VIBRATION TRANSMITTER MAY INDICATE A MECHANICAL PROBLEM. BUT HOW CAN THE SPECIFIC FAULT BE IDENTIFIED, SUCH AS WHETHER IT IS THE INNER RACE OR OUTER RACE?

The job of the 4-20mA Vibration Transmitter is to indicate a machinery problem, like an early warning alarm. Specific details require a higher level of vibration data collection and analysis. If needed, a good extension to the 4-20mA vibration monitoring is the use of sophisticated condition monitoring systems such as, vibration data collectors and analysis software.

10 HOW FAR CAN I RUN AN ACCELEROMETER CABLE WITHOUT LOSING SIGNAL?

Generally, at least a couple of hundred feet. The exact length can be determined knowing the cable capacitance (30 picoFarads per foot is common) and the available voltage swing (typically at least 5V peak to peak). Given these values, the length is a function of supply current and highest frequency of interest. Figure 1 shows a chart that helps determine maximium cable lengths.

MAXIMUM CABLE LENGTH vs. FREQUENCY AND SUPPLY CURRENT



NOTE: Values assume cable capacitance of 30pF/ft and an available voltage swing of 5Vp-p. (I) represents current available to power the sensor.

11 CAN I INSTALL INDUSTRIAL VIBRATION SENSORS IN A HIGH RADIATION ENVIRONMENT?

Yes. However, it is important to use those sensors that have been designed for high radiation environments. Wilcoxon manufactures many accelerometers that are designed to survive high radiation environments and give long service life. Special provisions are made in the manufacture of these accelerometers to allow them to perform well in high radiation environments. Radiation rated accelerometers have been tested to radiation levels as high as 10,000,000 rads and found to continue performing within specified tolerances.