Reading accelerometer specifications

Wilcoxon Research accelerometer specification sheets follow a standard format. However, specification sheets may vary slightly from one specification to another. The following gives a basic description of each specification used on Wilcoxon Research accelerometer data sheets. These specification descriptions use the English units of measure. Wilcoxon specifications may also provide the metric equivalent.

Dynamic specifications

Sensitivity

This specification shows the “nominal” sensitivity. This is the voltage output per engineering unit; for example, 100 milli-Volts per g (100 mV/g) will yield an AC voltage output of 100 milli-Volts per g of acceleration. The AC voltage will alternate at frequencies corresponding to the vibrational frequencies. The amplitude of the AC signal will correspond to the amplitude of the vibration measured. All frequencies will be present simultaneously. This is what creates a vibrational signal spectrum.

Sensitivity tolerance

The tolerance of the sensitivity is the maximum allowable deviation between the nominal sensitivity for a model type and the actual measured sensitivity of a particular sensor, as measured at room temperature at 100 Hz.

The exact sensitivity of production accelerometers may vary from the nominal sensitivity within the specified tolerance range. The exact sensitivity of each unit is listed in the calibration data (test data) provided with each sensor. Internally amplified accelerometers are specified in “milli-Volts per g”. Internally amplified velocity sensors are specified in “milli-Volts per inch per second”. Non-internally amplified, charge mode type, sensors are specified in picoCoulombs per g, or “pC/g”.

Electronic noise

This is the electronic noise generated by the amplifier circuit. Noise is specified as either “broadband,” or “spectral.” The broadband measurement is a measurement of the total noise energy over a specified bandwidth (typically 2 - 25,000 Hz). Spectral noise is the

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noise measured at a specific frequency. This energy may be specified in equivalent units of vibration, “g”s.

Typically, the measured noise decreases as frequency increases. However, because lower acceleration readings are normally associated with lower frequencies, noise at low frequencies is more often a problem than noise at high frequencies.

Peak amplitude

Peak amplitude defines the maximum amplitude vibration that can be measured by a sensor before distortion occurs in the amplifier due to overloading. This can be estimated roughly as follows:

a) calculate the difference between the power supply voltage and the BOV
b) calculate the difference between the BOV and ground (0 V)
c) take the smaller of the value in (a) or (b) above and subtract 2 Volts.
d) take this value and divide it by the sensitivity (in Volts) of the sensor
e) the resulting number is a good approximation of the maximum amplitude signal (expressed in “g”s) that may be measured before distortion occurs.

Peak amplitude is a function of the sensitivity of the sensor, the power supply voltage and the BOV of the sensor. This is the same for all 2-wire IEPE type sensors.

The laws of physics are the limit here, and apply equally to all sensor manufacturers. If the maximum amplitude of a given sensor is not sufficient for the application, the solution is to use a sensor with a lower sensitivity, or in some cases it may be possible to use a sensor with a higher BOV and power supply voltage.

Frequency response

The frequency response specification shows the maximum deviation of sensitivity over a frequency range. Remember, the nominal and actual sensitivity for a sensor are measured at a specific frequency; normally 100 Hz for most industrial sensors.

The frequency response specification shows a range at +/- a percentage (example, +/- 5%, or +/- 10%), or it may show a range for +/- 3 dB. The +/-

percentage means that over the specified frequency range the sensitivity will be within the percentage stated. The 3 dB range is generally used in military or scientific specifications, 3 dB is approximately 30%. So +/- 3 dB is approximately +/– 30 %.

The frequency response of a sensor is typically governed at the high frequency end primarily by the mechanical resonance of the sensor. Low-end frequency response limitations are the result of low frequency “highpass” filtering used by all manufacturers to reduce the amplifier noise at low frequencies generally caused by thermal events.

In some cases, primarily low frequency sensors, there may also be high frequency “low-pass” filters used to eliminate unwanted signals and interference from high frequency vibration signals.

Resonance frequency

This is the primary (largest) mechanical resonance of the sensor. However, there may be sub-resonances present at lower frequencies.

Temperature output sensitivity

This is the voltage output change per degree of measured temperature. The temperature circuit is separate from the accelerometer circuit. The temperature circuit is powered by the same type of power supply as an internally amplified accelerometer. The temperature circuit “biases” this power supply voltage down to a voltage that corresponds to the accelerometer case temperature.

Some older models (793T-1) provide an output in volts per degree Celsius. This limits the usable range to a low temperature of 0° C. Newer models provide an output corresponding to degrees Kelvin (K). Zero degrees Kelvin equals a zero Volt output. Zero degrees Kelvin equals –273°C.

Temperature output range

The temperature output range for units measuring in Kelvin is –50°C to 120°C. The limiting factor is the operating range of the accelerometer.

Electrical specifications

Power, voltage

The maximum and minimum input power voltage that should be supplied to the sensor is important to the user. Over voltage powering may damage the sensor. Under voltage powering may result in poor amplifier performance and signal distortion due to overloading the amplifier with vibration signals that exceed the maximum peak amplitude as discussed above.

Power, constant current

The input power current must be regulated to protect the amplifier from damage. This current regulation is normally done by a constant current diode (CCD) in the data collector or analyzer power supply. Bias Output Voltage (BOV) is set by the amplifier circuit "biasing" the input power voltage down to a preset level. The normal range for BOV of a good sensor is typically the nominal value specified on the data sheet, +/- 2 Volts.

Turn-on time

The time required by a sensor to reach 90% of its final BOV after initial powering is provided because it is important for walk around data collection or other applications in which the sensors are not powered until the time when data is to be taken.

Shielding

Sensors are either base isolate, case isolated, or case grounded. A case isolated sensor has the signal return and ground circuit isolated from the external case of the sensor. A case grounded sensor has the signal return and ground circuit electrically connected to the external case of the sensor. A base isolated sensor is not grounded at the sensor's mounting location, but the body of the sensor is usually grounded to the connector's shield. A Faraday shield is used to shield the amplifier circuit from electro-magnetic interference. Practically all Wilcoxon Research sensors (except for some special laboratory models) have protection against mis-wiring and electrostatic discharge (ESD).

Mechanical specifications

Temperature range

This is the temperature range over which the sensor is designed to operate. It is also the maximum and minimum storage temperatures. Permanent damage may result from exposure to temperatures outside of those specified. Normally, exposures to temperatures outside of the specified range for brief periods of time will not result in damage to the sensor.

Weight

The weight of sensor is given excluding any external cabling.

Sensing element material

All Wilcoxon Research sensing elements are PZT ceramic, Lead-Zirconate Titanate, but this is listed in the specifications to differentiate from other manufacturers who may use different materials.

Sensing element design

The sensor design – shear, compression, or flexure – is distinguished on many specifications.

Sealing

Sealing is either hermetic or epoxy. The I.P. rating is provided in some cases.

Case material

Most industrial housings are corrosion resistant, non-magnetic, 316L stainless steel.

Mounting

Stud, captive bolt, or epoxy are the most common sensor mounts for Wilcoxon accelerometers.

Other information on data sheets

In addition to the above items, Wilcoxon Research data sheets also include typical curves showing frequency response and temperature response.

The list of “accessories supplied” are items that are furnished with the accelerometer as standard practice at no extra charge. The “optional accessories” are items that are available for an additional charge.

The revision level is shown in the lower right hand corner of each data sheet. It is important to check this to make sure that you are working with the latest information.