

Pump monitoring with piezoelectric accelerometers assures reliable measurements

Vibration monitoring of critical and auxiliary pumping systems helps improve machine reliability, safety, and production capability. Dynamic and positive displacement pumps produce vibrations indicative of running condition, incipient faults, and component failure. These vibrations appear at specific frequencies across a very wide spectrum. Reliable measurements of low frequency surge pulsations, running speed harmonics, and high frequency cavitation requires optimized vibration sensor technology.



Wilcoxon piezoelectric accelerometers provide the dynamic and frequency ranges required for complete industrial pump monitoring. Pump monitoring with PZT (lead zirconate titanate) piezoelectric accelerometers assures reliable measurements across the vibration spectrum.

Very low frequency pump monitoring

Most pumps operate from 450 to 3,600 cpm (7.5 to 60 Hz) depending on site power, drive, and gearing. Almost all vibrations sensors are adequate for these “mid-band” frequencies. However, many destructive system faults appear at very low frequencies and are not easily detected. For instance:

- >> Oil whirl, oil whip and rotor rub excite vibrations at 40 to 50% of running speed
- >> Hunting tooth faults on reduction gears can produce signals below 60 CPM (1 Hz)
- >> Destructive surge pulsations have been measured below 6 CPM (0.1 Hz)

Motion in terms of acceleration is very low at these frequencies. If low amplitude vibrations are measured near the electronic noise floor of the sensor (or monitoring instrument), signal corruption will occur. The common “ski slope” response results from electronic noise and can obscure the low frequency vibration information. PZT piezoceramic sensors are tailored to maximize low frequency vibration sensitivity while retaining high frequency capabilities. Given equivalent sensor resonances, the signal-to-noise ratio of Wilcoxon PZT accelerometers is twenty times (26 dB) better than quartz accelerometers.

Low frequency accelerometers and piezo-velocity sensors use PZT to provide higher output sensitivity for low- to mid-band measurements. This increases the signal voltage at the input of the monitoring instrument and further increases signal integrity.

Mid to high frequency pump monitoring

Most pump vibrations are directly related to the running speed of the pump and drive systems. These vibrations occur in the mid to high frequency range of 450 - 300,000 CPM (7.5 to 5,000 Hz). These include harmonics of:

- >> Drive motor and pump running speed
- >> Rolling element bearing fault frequencies
- >> Speed increaser/reduction gear mesh
- >> Vane pass on dynamic pumps
- >> Reciprocation impacts on positive displacement pumps

Signal-to-noise ratio problems are rare in this frequency range due to the strong vibration signal in terms of acceleration. In terms of signal strength, most general purpose vibration sensors are adequate at these frequencies.

Very high frequency pump monitoring

Very high frequency vibrations are sometimes present when monitoring pump installations. Generally, above 600,000 CPM (10,000 Hz), many high frequency mechanical events appear as a broadband noise signal. High frequency mechanical noise can be caused by:

- >> Pump cavitation
- >> Entrained gas (aeration or starvation)
- >> Bearing impact noise
- >> High pressure leaks

High frequency vibrations indicate incipient faults on bearings, casings, rotors, and piping. They are usually monitored using spike energy and other HFD (high frequency detection) techniques. High frequency noise, however, can overload the sensor and disturb low frequency data. High sensitivity, low frequency accelerometers are especially susceptible to high frequency overload. Sensor overload causes low frequency distortion and may obscure valuable sub-rotational and harmonic running speed information.

To solve this problem, Wilcoxon's PZT accelerometers are innovatively designed to greatly reduce high frequency overload. Higher resonance accelerometers are less susceptible to high frequency overloads reducing the chance of low frequency signal corruption.

Summary

When production depends on early fault detection, sensor selection becomes critical. In many pumping system applications, piezoceramic vibration accelerometers provide superior signal integrity and a clearer picture of the machinery health. Quality measurements begin with using the proper sensor for the job.

