Resonant Frequency versus Low Frequency Noise versus Q-Control

For low speed applications such as those in the Pulp and Paper industry and the rolling mills, the generation of low frequency noise in sensors and instrumentation is extremely critical. This is of particular importance when the sensors are operating at elevated temperatures in the 100 to 120 °C *(212 to 248 °F)* range or higher. Low frequency noise is influenced by a number of factors and it is the balance of these interacting factors that is critical in sensor design. One of the more important factors is the charge sensitivity of the sensor element (crystal design). The higher the charge sensitivity, the lower the noise because less amplification is required of the sensor amplifier.

The charge sensitivity of an annular shear or compression element built from a given material depends on the size of the element. The size of the element also defines the resonant frequency, the larger the element, the lower the resonant frequency. The higher the charge output (pC/g). the lower the conversion gain required for the amplifier. Therefore, the internally generated noise is amplified less, resulting in a lower noise output of the sensor.

As can be seen from above, there is strong interaction between the various factors. The ultimate design of the “**SKF Sensors**” was the result of compromise of these factors in order to provide a sensor that will perform to the highest of expectations for the core segment industries of SKF.

It was determined the low frequency noise inherent in many of the sensors on the market today was the most critical of the factors to control. It is the most important factor for sensor applications, particularly in those industries targeted by SKF such as Pulp and Paper, Petrochemical, Machine Tool, Metal Working and Mining, and Construction.

The new SKF sensors have a sensor element of appropriate size to minimize the gain necessary in the conversion amplifier. In this manner, the sensor noise is extremely low and is maintained at these low levels, particularly at the elevated temperatures. With this design it was necessary to accept a lower resonant frequency. Many of today’s sensors do not have any control over the resonant frequency and its influence on sensor signal generation. SKF believes it is important to control the resonant frequency to minimize the influence. To accomplish this, there was a Q-Control filter circuit incorporated in the sensor electronics.

The filters used in the design of the electronics are such that there is essentially a flat frequency response to 10 kHz, with the resonant frequency being dampened by the Q-Control filter to a maximum level of 15 dB above the 100 Hz sensitivity level.

What are the benefits of Q-Control?

Q-Control is applied to prevent sensor resonance from overloading and saturating the sensor charge amplifier. The level of signals of interest can then use the full amplification range of the amplifier without the generation of artificial signal defects in the receiving instrumentation. A better signal, a better analysis.

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