Use of Vibration Measurements for Diagnostic Purposes

The wiper motor is manufactured on a transfer line. If an assembly fault occurs, it is usually subtle and does not result in the stopping of the line or the rejection of the part. For example, if a magnet is slightly misaligned, the assembly may not be rejected. Upon completion, however, the motor will not run to specification. One method that can be used to diagnose such a fault and locate the suspect transfer line station makes use of vibration analysis.

The simple, but, unfortunately, ineffective way of accomplishing this is to place an accelerometer on the motor at selected locations and to use the captured signal for diagnostics. However, this signal is often not very useful because it can result in the misdiagnosis of motors.

Variations in "Identical" Motors

We have found from statistical evaluation of data that seemingly "identical" castings may show up to a 40 dB variation in transfer function magnitudes at any one frequency, and resonant frequencies may vary as much as ±10% from motor to motor. The resonances may dominate an acceleration signal and yet not be related in any way to a suspected fault.

Blocked Force

These issues are avoided if a blocked force measurement is done. Blocked force is defined as the force that the motor applies through its mounting feet to a very heavy base (the electrical equivalent is open circuit voltage). To make this measurement, a special fixture is designed to permit the motor to be run under normal operating load. Note that the motor cannot be run unloaded because, in order to reveal faults in component parts such as gear teeth, it is essential that they operate under normal loading forces. A typical test fixture is shown in the figure.

Recording Data

The diagnostic procedures that were developed by RH Lyon use not only signals from the force gauges, but from the motor current and voltage signals as well. All signals can be recorded on a digital tape recorder for subsequent analysis.

Related Areas of Interest

Further details on vibration diagnostics can be found in various RH Lyon technical papers. Additionally, several digital signal processing techniques applicable to vibration diagnostics are in part:

- cepstral analysis
- frequency demodulation
- amplitude demodulation