Technical Brief No. 10

All Technical Briefs are based on past projects at RH Lyon Division

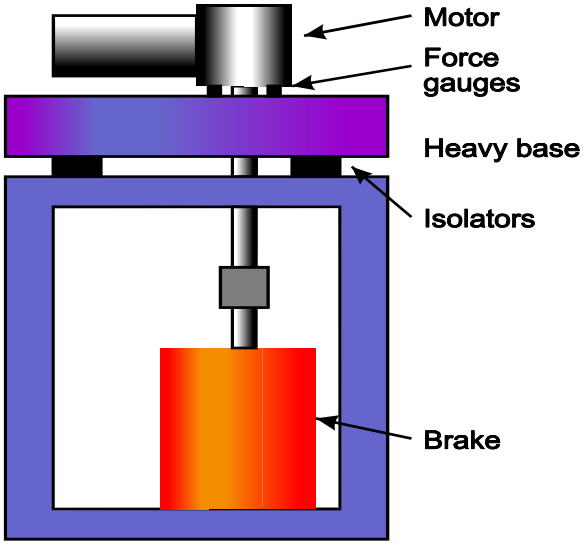
Automotive Motors Components

Windshield Wiper Motors
Diagnostic Techniques

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 readily result in the misdiagnosis of motors.



Wiper Motor Test Fixture

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.

Fixture Design

The motor is mounted through its feet to three force gauges which, in turn, are mounted to a heavy steel block. The mass and form of this block are selected such that its first resonance frequency is above the upper frequency of interest from the force gauge signals. This base is resiliently mounted both vertically and torsionally to a sub-base. The motor is connected via a resilient drive to a dynamic brake in the sub-base. The load applied to the motor is controlled by varying the brake current.

Feedback Control

The speed of the motor is controlled through a feedback loop. The motor speed is sensed by measuring the AC component of the commutator current, passing it through a frequency to voltage converter and comparing the result to the set speed voltage. The motor DC supply is adjusted for zero speed error. When necessary, the system can be computer controlled for fully automated operation.

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