BALANCE - OVERVIEW

Recommendations

After the motor is disassembled, the rotor should be checked for balance and shaft runout. It is suggested that balance values be established with the service shop. NEMA specifies minimum balance levels. Reputable motor manufacturers will balance to a much higher degree than the NEMA minimums. It would be prudent to specify the IEEE 841 specs for balancing if the highest level of balance is desired. The NEMA and IEEE 841 specifications are as follows:

Motor Speed (RPM)	Unfiltered Vibration NEMA MG 1-7.08.1 (in/sec peak velocity)	NEMA Max. Amplitude (P-P Mils)	Unfiltered Vibration IEEE Std 841-1994 (in/sec peak velocity)
3600	0.15	1	0.08
1800	0.15	1.5	0.08
1200	0.15	2	0.08
900	0.12		0.06
720	0.09		Not spec'd
600	0.08		Not spec'd

All testing is with a half key located in the shaft extension.

The IEEE spec. is based on a fully assembled motor that is tested at no load on an elastic mounting per section 12.08 of NEMA MG1-1993. In addition to the above, IEEE specifies that Motor filtered vibration at rated voltage and frequency shall not exceed 0.05 in/sec at frequencies of 2n (twice speed) or 2f (twice frequency). Also, motor unfiltered axial vibration shall not exceed 0.06 in/sec. peak on bearing housings. This limit shall not apply to roller bearings.

Rotor being balanced at the factory

Displacement versus Velocity

Attached is a chart which allows conversion between vibration displacement in mils peak to peak versus **filtered** vibration. This allows a conversion between the two methods of measuring and reporting vibration. Velocity in inches per second is becoming more widely accepted than displacement. The same value of velocity at various speeds is the same degree of vibration while the same value of amplitude from one speed to another is not.

Bearing Vibration Readings

Bearing vibration readings are normally taken on three planes – vertical, horizontal and axial. Excessive vertical vibration typically indicates a mounting or base problem. Abnormal horizontal vibration generally means a balance problem. Axial vibration should normally be less than either vertical or horizontal vibration levels. Axial vibration greater than 0.10 in/sec often indicates a bearing problem. (A new Toshiba motor will normally have an axial vibration of 0.020 to 0.030 in/sec peak.)

Full Key-way Fill

Great care is taken by manufacturers or rewind shops to balance a motor for smooth operation and reliable bearing life. Once the motor gets to the field, however, the same care in attention to detail must also be observed. Even though the motor is balanced with a half key inserted **all the way** along the keyway slot, when the motor is installed, the keyway is often not completely filled. As an example, the keyway of a 444T frame motor is 6.91" long. If a sheave or coupling is put on this shaft which has a 4" long keyway, usually a 4" long key is used. This leaves 2.91" of keyway which doesn't have a ½ key in it. The remaining 2.91" long keyway slot should be filled with key stock cut down to ½ key size. If not, the motor / sheave assembly is no longer balanced.