TVM

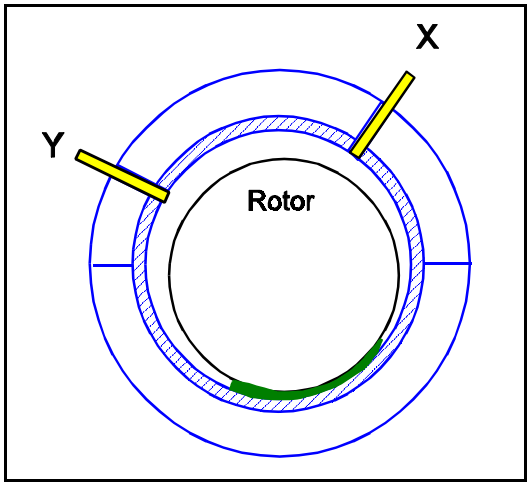
TUNED VIBRATION MONITORS

LCC LOVEJOY CONTROLS CORPORATION

Manufacturers of turbine controls and instruments since 1977.

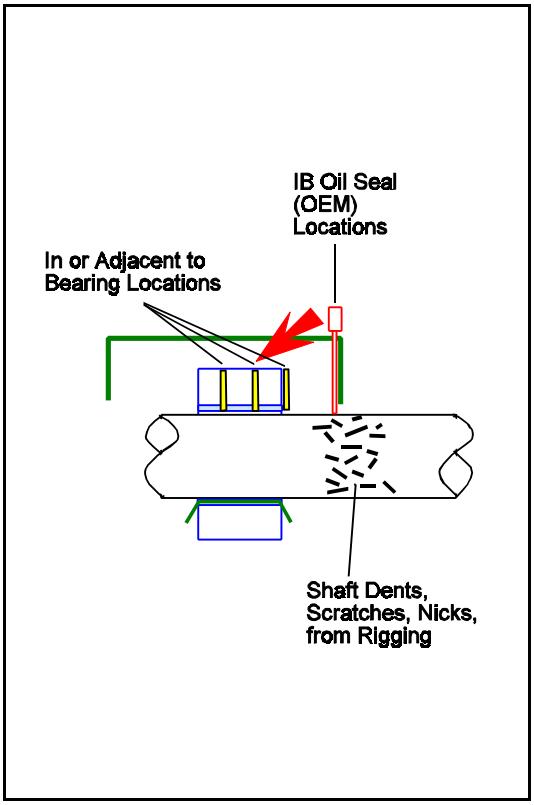
What your TSI is probably missing...

While effective for identifying the now rare phenomena of steam whirl and oil whip, X-Y configuration proximity probes within journal bearings neither detect nor warn operators of rotor unbalance or bow causing seal impacting, the most common form of turbine vibration damage.



Many cases have shown that locating the X-Y proximity probes at the bearing nodes fails to detect the most common shaft deflections and severely under-represents the vibration levels present.

Although turbine OEMs originally specified inboard oil seal locations for TSI monitoring points, instrument vendors have migrated the locations to within bearings to avoid rotor shaft rigging dents and scratches. This migration provided an unblemished surface but no significant normal vibration measurements, since turbine generator bearing locations are always deflection nodal points.



The practice of summing the bearing proximity probe signal with a case mounted velocity transducer (ill termed "absolute" monitoring) presents a vague resultant where only the velocity probe portion of the summation is potentially valid, and the proximity probe signal distorts the summed signal.

In each case of in-bearing proximity probe location the primary readings found are electrical runout due to false eddy current reflections, not true displacements.

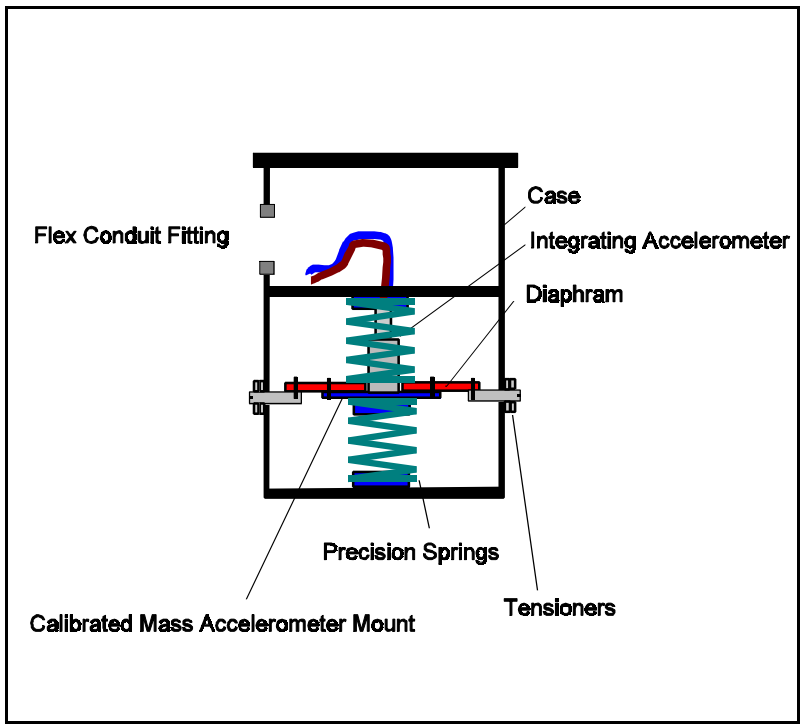
What's the Fix?

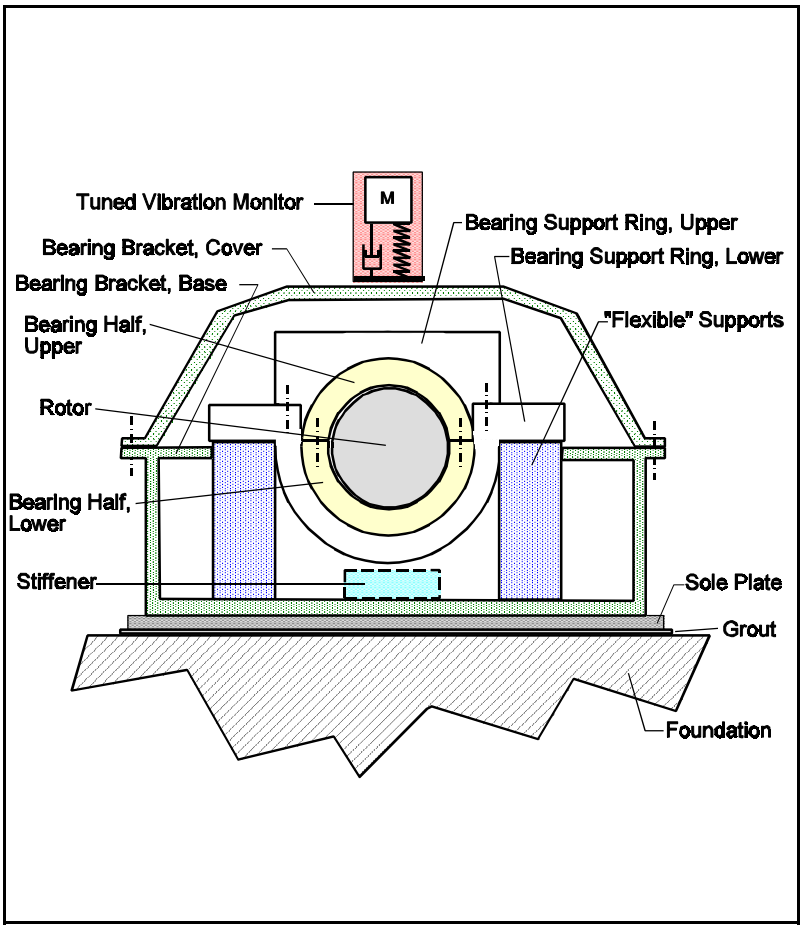
LCC's *Tuned Vibration Monitor* canisters mount on bearing bracket covers at strategic locations. They are "tuned" to accept energy at frequencies between the shaft running speed and three to five times (0.5x to 3x, 0.5x to 5x). The tuned system is sensitive to unbalance and bowed rotor manifestations where proximity probes in the bearings are not.

TVMs fill in the missing protection to guard against seal impacting and turbine damage during both startup and loaded operation.

Rotor displacements between bearing spans apply dynamic loads to the lower bearing halves on each high-spot passage. These loads produce immediate compression of the "flexible" (steel vs. "inflexible" concrete foundation) supports through the Bearing Support Ring. Because the bearing bracket base is box-framed to the supports and the bearing bracket cover is securely bolted to the base, a forced coupling of the rotor dynamic loading is translated to the bracket cover. The correctly tuned spring/mass/damped LCC vibration monitor provides unidirectional integrated acceleration readings very linear with bearing loads. Due to the single plane of vibration freedom extraneous accelerometer motion is eliminated.

Adding one TVM to each bearing pedestal brings the TSI system up to the expected level of machinery protection.



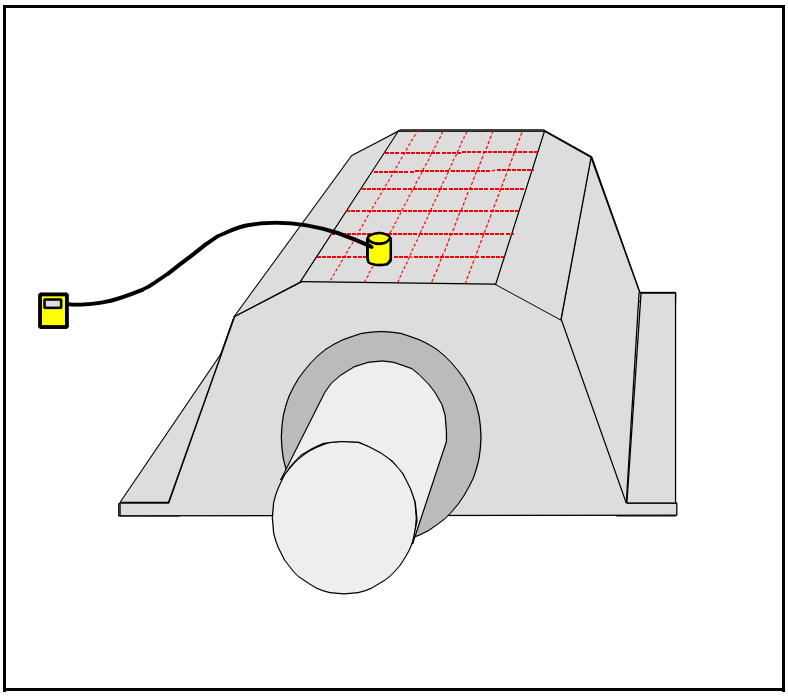


How are TVM Located?

A grid of 4-inch squares is chalked on each bearing pedestal cover. During unit operation a TVM fitted with a magnetic base is moved from grid intersection points while recording the measured velocities.

The resulting amplitudes are plotted at the grid offsets to yield a pedestal deflection diagram.

Grid locations of relatively high amplitude represent pedestal resonance and should be avoided. Grid locations yielding common low amplitude are acceptable.

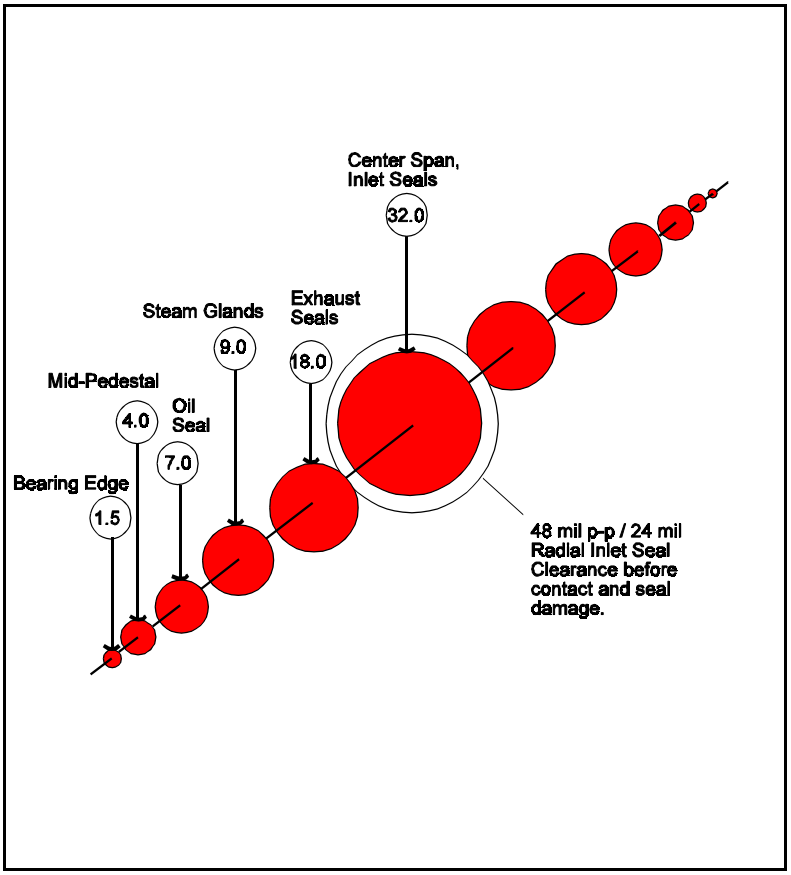


How are Alarm Levels Determined?

The rotor clearance drawing is examined for the modal deflection magnitudes which will result in seal impact and damage. The TVM velocity data is correlated to provide an operator alert when two-thirds of the allowable deflection occurs.

Upon subsequent start ups the operator is alerted by the TVM alarms if rotor deflections are approaching the seal impact level. Depending upon the cause, a short period of hot roll or corrective balancing eliminates the threat.

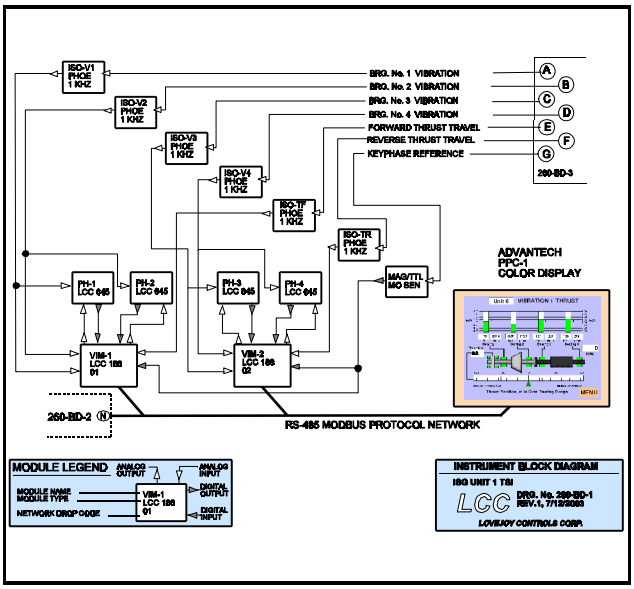
The alternative is seal damage, loss of efficiency, and high rotor stress all unknown in operation.



Is a New TSI System Needed?

Probably not. If your existing system has unused input channels or offers expansion channels that can be configured for velocity signals (500 mV per inc/second typical) the TVMs can be wired directly and provide immediate protection.

If your existing system is not expandable a simple stand-alone supplementary system can be supplied by LCC to add TVM protection.



Order Information

LCC's TVM are ordered based upon turbine normal (synchronous) operating speed, and harmonic range which determine the tuned limit frequency. The chart on the following page provides the standard models. The ODF (One Degree Freedom) cutoff frequency represents the highest linear detection frequency.

How to Get Started

You don't need a large investment to prove the addition of TVM will improve your TSI system. By adding the suffix "-TPK" to each TSM part number a magnetic base, mating cable, excitation power supply, transmitter, and signal jacks for DVM/Analyzer input are all supplied as a Test Package.

Move the test TVM around your units. See what you've been missing.

TVM for SYNCHRONOUS GENERATION UNITS

Model No.	Synchronous Speed, RPM	Machine Top Range Hz.	ODF Tuned f Hz.
TVM10-3	< 1000	50.0	55
TVM10-4		66.7	73.4
TVM10-5		83.3	91.6
TVM15-3	1500	75	82.5
TVM15-4		100	110
TVM15-5		125	137.5
TVM18-3	1800	90	99
TVM18-4		120	132
TVM18-5		150	165
TVM30-3	3000	150	165
TVM30-4		200	220
TVM30-5		250	275
TVM36-3	3600	180	198
TVM36-4		240	264
TVM36-5		300	330