Field Application Note

STI Vibration Monitoring Inc.

Eddy Current Transducer Installation — Part 1-Radial Vibration

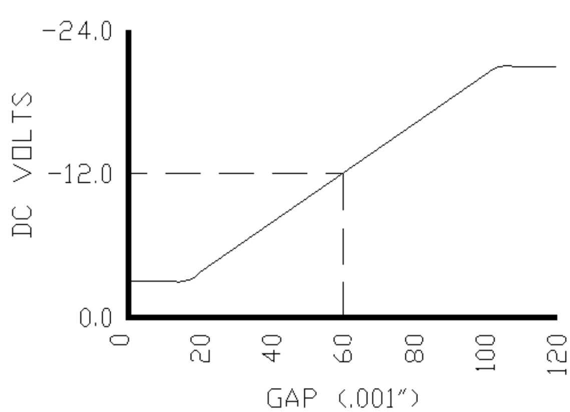
Eddy Current Transducers (Proximity Probes) are the vibration transducer of choice when installing vibration monitoring on Journal Bearing equipped rotating machinery. Eddy Current Transducers are the only transducers that provide Shaft Relative (shaft relative to the bearing) vibration measurement.

Several methods are usually available for the installation of Eddy Current Transducers, including internal, internal/ external, and external mounting.

Before selecting the appropriate method of mounting Eddy Current Transducers, special consideration needs to be given to several important installation considerations that will determine the success of your monitoring program.

Theory of Operation

Eddy Current Transducers work on the proximity theory of operation. An Eddy Current System consists of a matched component system: a Probe, an Extension Cable and an Oscillator /Demodulator. A high frequency RF signal @2 MHz is generated by the Oscillator/Demodulator, sent through the extension cable and radiated from the Probe tip. Eddy currents are generated in the surface of the shaft. The Oscillator /Demodulator demodulates the signal and provides a modulated DC Voltage where the DC portion is directly proportional to gap (distance) and the AC portion is directly proportional to vibration. In this way, an Eddy Current Transducer can be used for both Radial Vibration and distance measurements such as Thrust Position and Shaft Position.



Special Considerations

Number of Transducers

All vibration transducers measure motion in their mounted plane. In other words, shaft motion either directly away from or towards the mounted Eddy Current Probe will be measured as radial vibration.

On smaller less critical machines, one (1) Eddy Current Transducer system per bearing may be adequate for machine protection.

The single Eddy Current Probe will then measure the shaft's vibration in that given plane. Therefore, the Eddy Current Probe should be mounted in the plane where the greatest vibration is expected.

On larger more critical machines, two (2) Eddy Current Transducer systems are normally recommended per bearing. The Probes for this type of installation should be mounted 90^0 apart from each other. Since the Probes will measure the vibration in their respective planes, the shaft's total vibration within the journal bearing is measured. An "Orbit" or cartesian product of the two vibration signals may be viewed when both Eddy Current Transducers are connected to an SKF-CM Information System or an Oscilloscope.

Linear Range

Several versions of Eddy Current Transducers are available with a variety of Linear Ranges and body styles. In most cases, SKF-CM's CMSS68 with a linear range of 90 mils (0.090") is more than adequate for Radial Vibration measurements...

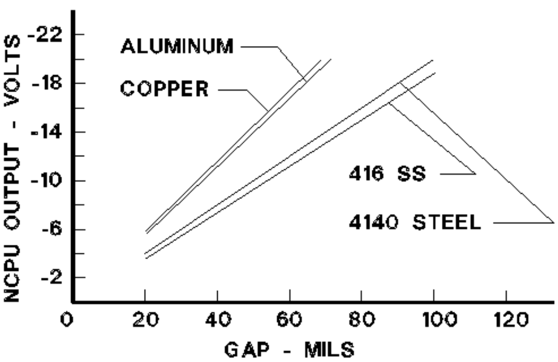
Model	Range	Output	Size
CMSS65	90 mils	200 mV/mil	1/4"x28 UNF 1" to 5" Length
CMSS68	90 mils	200 mV/mil	3/8"x24 UNF 1" to 9" Length
CMSS62	240 mils	50 mV/mil	1" x 12 UNF 1" to 5" Length

STI Vibration Monitoring Inc., 1010 E. Main St., League City, TX 77573
Phone: 281.334.0766 Fax: 281.334.4255 Web: www.stiweb.com

Target Material/Target Area

Target Material

Eddy Current Transducers are calibrated at the factory for 4140 Steel unless specified otherwise. As Eddy Currents are sensitive to the permeability and resistivity of the shaft material any shaft material other than 4000 series steels must be specified at the time of order. In cases of exotic shaft material a sample may need to be supplied to the factory.



Mechanical Runout

Eddy Current Transducers are also sensitive to the shaft smoothness for Radial Vibration. A smooth (64 micro-inch) area approximately 3 times the diameter of the Probe must be provided for a viewing area. The prepared journal area on most shafts are wider than the bearing itself allowing for Probe installation immediately adjacent to the bearing.

Electrical Runout

Since Eddy Current Transducers are sensitive to the permeability and resistivity of the target material and the field of the transducer extends into the surface area of the shaft by approximately 15 mils (0.015"), care must be taken to avoid non-homogenous viewing area materials such as Chrome.

Another form of electrical runout can be caused by small magnetic fields such as those left by Magna-fluxing without proper degaussing.

Perpendicular to shaft centerline

Care must be exercised in all installations to insure that the Eddy Current probes are mounted perpendicular to the shaft centerline. Deviation by more than 1-2 degrees will effect the output sensitivity of the system.

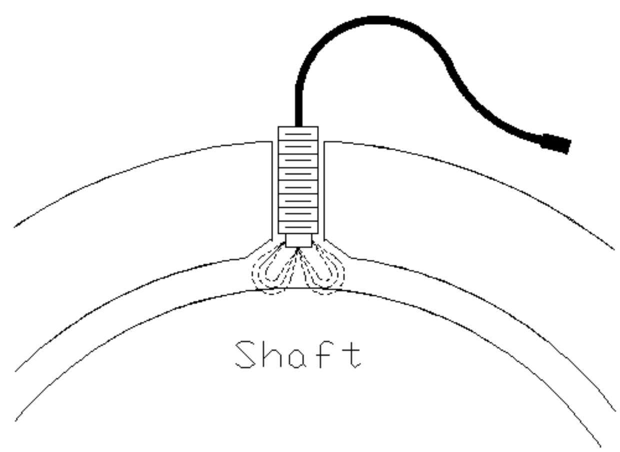
Orientation of Transducer(s)

As most machine casings are horizontally split, transducers are commonly found mounted at 45^0 both sides of vertical 90^0 apart.

If possible transducer orientation should be consistent along the length of the machine train for easier machine diagnostics. In all cases orientation should be well documented.

Transducer (Probe) side clearances

The RF Field emitted from the Probe tip of an Eddy Current Transducer in approximately a 45^0 coned shape. Clearance must be provided on all sides of the Probe tip to prevent interference with the RF Field. As an example, if a bearing is drilled to permit installation, the hole must be counter bored to prevent side clearance interference. Care must also be taken to avoid collars or shoulders on the shaft that may thermally "grow" under the Probe tip as the shaft grows from heat.



Eddy Current Probe tip-to-tip clearances

Although Probe tip to tip clearances are not normally an issue on most machines, it should be noted that Eddy Current Probes radiate an RF Field larger than the Probe tip itself. As an example, Model CMSS65 and 68 probes should never be installed with less than one (1) inch of Probe tip-to-tip clearance. Larger Probes require more clearance. Failure to follow this rule will allow the Oscillator/Demodulator to create a "beat" frequency, which will be the sum and difference of the two Oscillator/Demodulator RF frequencies.

System Cable Length and Junction Boxes

Eddy Current Transducer Systems are a "tuned" length, and several system lengths are available. Length is measured from the Probe tip to the Oscillator/Demodulator, and is measured electrically which can slightly vary the physical length. For example, the Model CMSS65 and 68 are available in 5 and 10-meter system lengths. Care must be taken to insure that the proper system length is ordered to reach the required Junction Box.

Grounding and Noise

Electrical noise is a very serious consideration when installing any vibration transducer, and special care needs to be taken to prevent unnecessary amounts of noise. As most plant electrical noise is 60 HZ, and many machines running speed is also 60 HZ, it is difficult to separate noise from actual vibration signal. Therefore, noise must be kept to an absolute minimum.

Instrument Wire

A 3-wire twisted shielded instrument wire (i.e.; Belden #8770) is used to connect each Oscillator/Demodulator to the Signal Conditioner in the Monitor. Where possible, a single run of wire from the Oscillator/Demodulator (Junction Box) to the Monitor location should be used. Splices should be avoided.

The gauge of the selected wire depends on the length of the instrument wire run, and should be as follows to prevent loss of high frequency signal:

Up to 200 feet 22 AWG
Up to 1000 feet 20 AWG
Up to 4000 feet 18 AWG

The following wiring connection convention should be followed:

Red -24 VDC
Black Common
White Signal

Common Point Grounding

To prevent Ground Loops from creating system noise, system common, ground and instrument wire shield must be connected to ground at one location only. In most cases, the recommendation is to connect commons, grounds and shields at the Monitor location. This means that all commons, grounds and shields must be floated or not connected at the machine.

Occasionally due to installation methods instrument wire shields are connected to ground at the machine case and not at the monitor. In this case, all of the instrument wire shields must be floated or not connected at the monitor.

Conduit

Dedicated conduit should be provided in all installations for both mechanical and noise protection. Flexible metal conduit should be used from the Eddy Probe to the Oscillator /Demodulator junction box, and rigid bonded metal conduit from the junction box to the monitor.

Calibration

All Eddy Current Systems (Probe, Cable and Oscillator Demodulator) should be calibrated prior to being installed. This can be done by using a SKF-CM CMSS601 Static Calibrator, -24 VDC Power Supply and a Digital Volt Meter. The Probe is installed in the tester with the target set against the Probe tip. The micrometer with target attached is then rotated away from the Probe in 0.005" or 5 mil increments. The voltage reading is recorded and graphed at each increment. The CMSS601 Calibrator will produce a voltage change of 1.0 VDC +-0.05 VDC for each 5 mils of gap change while the target is within the Systems linear range.

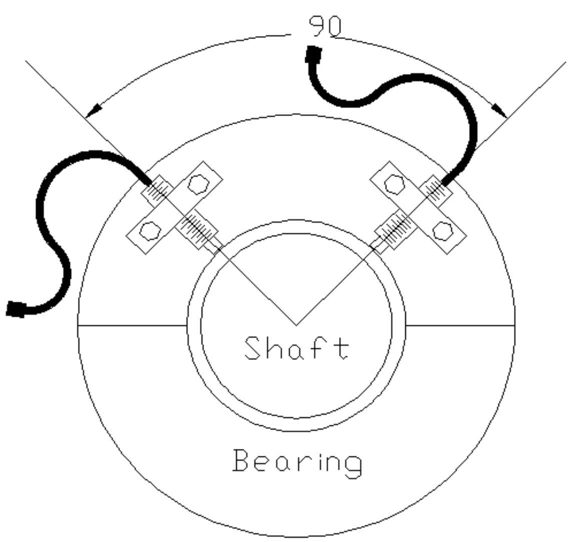
STI Vibration Monitoring Inc., 1010 E. Main St., League City, TX 77573
Phone: 281.334.0766 Fax: 281.334.4255 Web: www.stiweb.com

Gap

When installed, Eddy Current Probes must be gapped properly. In most Radial Vibration applications, gapping the transducer to the center of the linear range is adequate. For the Model CMSS65 and 68 gaps should be set for -12.0 VDC using a Digital Volt Meter (DVM), this corresponds to an approximate mechanical gap of 0.060" or 60 mils. The voltage method of gapping the Probe is recommended over mechanical gapping. In all cases, final Probe gap voltage should be documented and kept in a safe place.

Internal Mounting

Internal Mounting is accomplished with the Eddy Current Probes mounted internally to the machine or bearing housing with a SKF-CM CMSS903 Bracket or with a custom designed and manufactured bracket. The Transducer system must be installed and gapped properly prior to the bearing cover being reinstalled. Provisions must be made for the transducer's cable exiting the shields are connected to ground at the machine case and not at the monitor. In this case, all of the instrument wire shields must be floated or not connected at the monitor.



For added safety and reliability, all fasteners inside the bearing housing should be safety wired, or otherwise prevented from working loose inside the machine.

Advantages of Internal Mounting

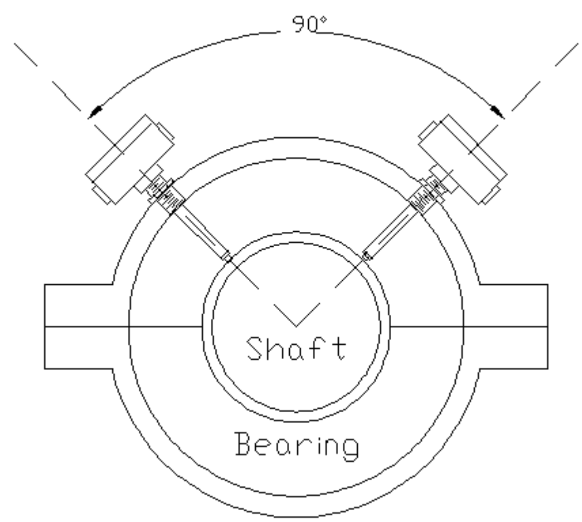
1. Most economical installation.
2. Less machining required.
3. True bearing relative measurement.
4. Usually good viewing surface for Eddy Probe.

Disadvantages of Internal Mounting

1. No access to Probe while machine is running.
2. Cables must be tied down due to "windage".
3. Transducer cable exits must be provided.
4. Care must be taken to avoid oil leakage.

External/Internal Mounting

External/Internal mounting is accomplished when the Eddy Probes are mounted with a Mounting Adapter (SKF-CM CMSS911 or 904). These adopters allow external access to the Probe yet allows the Probe tip to be internal to the machine or bearing housing. Care must be taken in drilling and tapping the bearing housing or cover to insure that the Eddy Probes will be perpendicular to the shaft centerline.



In some cases due to space limitations External/Internal mounting is accomplished by drilling or making use of existing holes in the bearing itself, usually penetrating at an oil return groove.

Advantages of External/Internal Mounting

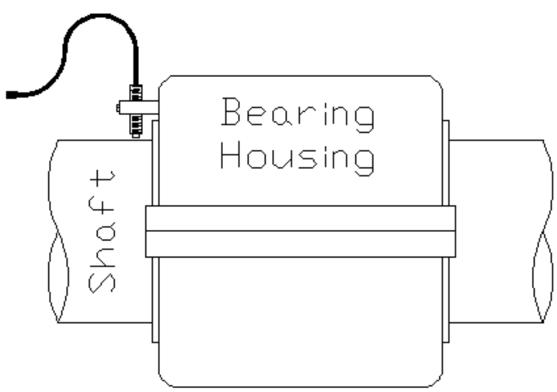
1. Eddy Probe replacement while machine is running.
2. Usually good viewing area for Eddy Probe.
3. Gap may be changed while machine is running.

Disadvantages of External/Internal Mounting

1. May not be true bearing relative measurement.
2. More machining required.
3. Long Probe/Stinger length (Resonance).

External Mounting

Pure external Eddy Probe mounting is usually a last resort installation. The only valid reason for using this method is inadequate space available within the bearing housing for internal mounting. Special care must be given to the Eddy Probe viewing area and mechanical protection of the transducer and cable.



Advantages of External Mounting

1. Most Inexpensive Installation.

Disadvantages of External Mounting

1. May be subject to "Glitch" or Electrical/Mechanical runout.
2. Requires mechanical protection.

Installation Checklist

1. Mounting Type, Internal, External/Internal or External
2. Number of Transducers, X or X&Y
3. Target Material, 4140 or Other
4. Smooth Target Area
5. Size of Target Area
6. Junction Box Location(s)
7. Metal Conduit (Junction Box to Monitor)
8. Flexible Conduit (Junction Box to Probe)
9. Correct Instrument Wire
10. Shielding Convention, Monitor or Machine
11. Calibration
12. Gap Set

STI Vibration Monitoring Inc., 1010 E. Main St. League City, TX 77573
Phone: 281.334.0766 Fax: 281.334.4255 Web: www.stiweb.com