

Vibration Transducer Mounting (what you don't know might hurt you)

The method of mounting contact-type vibration transducers (accelerometer and velocity transducers) can have a significant influence on the sensed vibration signals. The influence can be undesirable, as it may result in inaccurate data. We will briefly discuss important mounting considerations for contact-type vibration sensors as related to rotating machinery applications (most of the considerations apply to other applications as well). It will be assumed that a sensor suitable for the particular application has already been (correctly) selected.

Mounting methods

The recommended method for mounting the transducer (sensor) will depend on access, convenience and economic considerations, as well as technical considerations. Generally speaking, the mounting method will influence the frequency response (gain or accuracy versus frequency) of the sensor. In most cases, there will be a change in the high frequency response characteristics of the mounted sensor; for example, the sensor will provide inaccurate signal response to high frequency vibration. Based primarily upon this consideration, the recommended means of transducer mounting, in order of preference, are as follows:

Screw mount

Mounting by means of a screw or stud that threads directly into the desired machine surface usually provides the most accurate transducer frequency response.

Threaded mounting holes can be provided at various locations to enable temporary or periodic vibration measurements.



The machine mounting surface should be flat and smooth (an average grinding or machined surface finish is adequate). The threaded hole should be normal (perpendicular) to the mounting surface with its axis in some logical orientation (for example, on a bearing cap, the hole/transducer axis pointing toward the shaft/bearing centerline). The transducer should be torqued to a reasonable tightness (mounting torque recommendations are usually available from the transducer supplier). Inadequate or excessive mounting torque can result in inaccurate frequency response and/or damage to the transducer. Avoid material (paint, gaskets, adhesives, etc.) between the transducer and mounting surface, as this can dramatically reduce the upper frequency response limit. A thin coating of silicone grease, however, can increase mounting stiffness and provide enhanced frequency response. If gaskets or washers are required for electrical isolation, they should be as thin and hard as possible (mica is often recommended for this purpose).

Thicker, softer materials between the transducer and mounting surface will substantially reduce the high frequency response limit (possibly to around 1 kHz or below for an accelerometer).

Adhesive cement mounting

The same considerations about washer materials apply to adhesive materials. The adhesive material between the transducer and mounting surface should be as thin and rigid (hard) as possible. Additionally, the bonding force should usually be of a semi-permanent nature to enable future removal without damaging the transducer (twisting the transducer rather than impact affords less possibility of mechanical shock damage). For these reasons, the two adhesive materials most commonly used to mount vibration sensors are dental cement and cyanoacrylate (Eastman 910, Superglue, etc.) adhesives. Dental cement must be mixed and can be scraped or chipped away with relative ease. Cyanoacrylates do not require mixing and are applied as a very thin layer, but can be difficult to remove. Double-sided adhesive tape may also be used, but its “holding power” may be questionable. Always avoid rubbery or gummy adhesives. In any case, the upper frequency response limit will only be modestly reduced when properly using one of the above recommended adhesives.

Magnetic mounting base

Using a magnetic base with a threaded hole to accept a stud-mount transducer is often a convenient means of providing a quick or temporary mount. Again, the machine mounting surface should be relatively smooth and flat (and, of course, magnetic). This method will reduce accelerometer upper frequency response limits to a few kilohertz (for example, 1 to 5 kHz); this limitation varies considerably with transducer, magnetic base and machine mounting surface characteristics. Additionally, if the magnet is not mounted flush/flat in intimate contact with the machine surface and/or has inadequate “holding” force, the base transducer may “hop” or bounce under vibration, thus producing “false” vibration signals. In summary, a magnetic base will introduce some definite error in accelerometer frequency response above a few kilohertz (possibly above many hundred hertz for velocity transducer).

Handheld or probe-type mounting

Handheld vibration measurements, using a probe extension attached to the transducer, are very common. This method is rapid and convenient. However, it is subject to many sources of error that should be recognized. First, the probe contact method introduces upper frequency response error.

The degree of this error is usually more pronounced (it often happens at frequencies near or below 1 kHz) than when using magnetic bases. Secondly, the transducer/base axis orientation is crucial; tilting the probe slightly off the desired perpendicular (to machine mounting surface) orientation may introduce significant vibration amplitude error. Thirdly, the amount of contact force (hand induced pressure) can introduce significant error, particularly with accelerometers. Also, the measurements should be taken at the same precise location for comparison; moving the probe only a few inches away from the desired spot can produce drastically different vibration readings. Thus, it is imperative that personnel employing this method be thoroughly trained and monitored for consistency of readings. In the long run, errors can be held to about $\pm 15\%$, provided:

- 1 The readings are taken from the exact same spot (mark with permanent ink, or better yet, machine a shallow conical hole with a drill point).
- 2 The transducer/probe is always oriented perpendicular to the machine surface.
- 3 Even, consistent hand pressure is employed.

Mounting location

It is very common to mount vibration sensors oriented in a vertical, horizontal or axial direction, with the transducer axis pointing towards a machine shaft centerline, gearbox center, machine principal axis, etc. Vertical mounting is the most common. However, these orientations are somewhat arbitrary if no previous vibration data has been reviewed. The recommended method of selecting a mounting spot and axis orientation is to “map” or survey the surface(s) under consideration using a portable vibration instrument and a handheld probe or magnetic base mount. This will yield vibration readings enabling the selection of an optimum mounting location/orientation (remember that the vibration data above 1 kHz or so may be questionable when using a probe or magnetic base). Also, avoid locations where there are significant temperature variations and, in the case of accelerometers, significant windage or air (fluid) flow velocities upon the accelerometer. Excessive moisture is also undesirable.

Cable attachment

The electrical cables attached to the transducer should not be excessively tight (under tension), nor left loose to flop around. In both cases, mechanical forces and contact resistance and coupling capacitance variations can result in unstable and inaccurate vibration response readings. It is recommended that the cable be firmly clamped to the mounting surface (via tape, clamp, wax, epoxy, etc.) around six inches from the transducer; the cable run between the transducer and clamp should not be very loose nor under tension. Sealing the cable-to-transducer connector or attachment point with a silicone RTV type sealant (or equivalent) to prevent moisture intrusion may be advisable in some environments.

Covers and housings

Vibration transducers mounted on turbomachinery are likely to be exposed to a variety of different environments. Explosive, flammable, acidic/caustic, moist or wet, hot or cold, and other environments may necessitate a protective cover or housing for the vibration transducer. If possible, avoid attaching the transducer to or through the housing. Also avoid very thin sheet metal housings, as they may be an unwanted source of vibration signals.

In conclusion, most vibration transducers have frequency response and accuracy specifications available from the manufacturer. This information is valid; however, it is usually based on (laboratory) test conditions that are very different from most machinery applications. The transducer mounting method will almost always have some influence on the transducer accuracy and frequency response. In some cases, the influence is negligible; in other cases, the mounting method can have a significant influence. Many machinery applications are satisfied by vibration data below 1 kHz. All the recommended methods mentioned above have their place in machinery applications. Employ the mounting method that meets your need and provides the best results.

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