

# Guide to Accelerometer Installation

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Technical Paper 319  
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## Guide to accelerometer installation

### Transducer mounting

Mounting of the transducer is as important as the selection of the transducer in many applications. If the motion of the test structure is not accurately transmitted to the transducer, it cannot be accurately measured. Any mounting method different from that used for calibration should be characterized for its dynamic characteristics over the intended frequency and amplitude range. The recommended mounting method for shock and vibration measurements is that used for calibration.

### Surface preparation

Transducer mounting technique and surface preparation can affect the amplitude frequency response of the measurement, particularly at high frequencies.

Care should be taken to ensure a flush mating with a smooth, flat surface. Nicks, scratches, or other deformations of the mounting surface or the transducer will affect frequency response. Good machine shop practices are usually adequate:

Surface flatness	0.0003" TIR
Surface roughness	32 micro inch
Perpendicularity of hole:	1 degree $\pm$ .5°
Tap class	2

A thin application of a light lubricant will improve transmissibility, filling voids with nearly incompressible fluid and thereby increasing compressive stiffness of the joint. This is particularly important for measurements above 2 kHz, at which any changes in resonance have significant effect on measurements.

### Mounting using threaded studs

The best way to mount a transducer is using the recommended mounting stud. Stud mounting provides higher transmissibility than any other method. The transducer should be mounted with the specified stud or screw, so that the entire base of the transducer is in intimate contact with the surface of the test article. For

a mounting stud, it must be of the correct length and incorporate a flange to prevent "bottoming" of the stud in the accelerometer, which may cause strain induced errors. A torque wrench should be used to mount all accelerometers to ensure repeatability in the installation of the transducers and to prevent thread damage. The mounting torque recommended by the manufacturer should be followed. Endevco offers standard anodized aluminum cementing studs for adhesively mounting a stud mount accelerometer at a minimal cost. For higher

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temperature requirements, models 2985 and 2986 stainless steel studs may be required. Contact Endevco application engineers to review the multitude of mounting studs available.

### Mounting using adhesives

Most miniature accelerometers can only be mounted using an adhesive, which becomes part of the structure being measured. The stiffness of the cured adhesive is critical to the measurement performance of the total system. No adhesive is as stiff as a normal mounting stud. The more adhesive joints there are between the test structure and the accelerometer, the greater will be the degradation of transmissibility.

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Since the manufacturer calibrates its transducer using a specific mounting adhesive, following the manufacturer's recommendation is critical in obtaining the intended performance. Different adhesives should be evaluated over the intended frequency and amplitude range. Figure 1 shows the affects different adhesives have on the frequency response of a 10-gram accelerometer performed at 10 g's. At room temperature, cyanoacrylate has the best

coupling characteristics over a wide frequency range. Hot glue (glue gun) seems to be least effective, but it can be easily applied and removed. Dismounting an adhesively mounted transducer must be carried out with great care. It should not be removed with impacts, but instead with solvents, allowing softening of the bond, supplemented by light shearing torque. All traces of adhesives should be removed using recommended solvents only. Most damages to miniature accelerometers are caused by improper removal techniques. Endevco provides mounting and removal instructions with each accelerometer designed for adhesive mounting. These recommendations for mounting and removal will ensure continued error free operation of the accelerometer.

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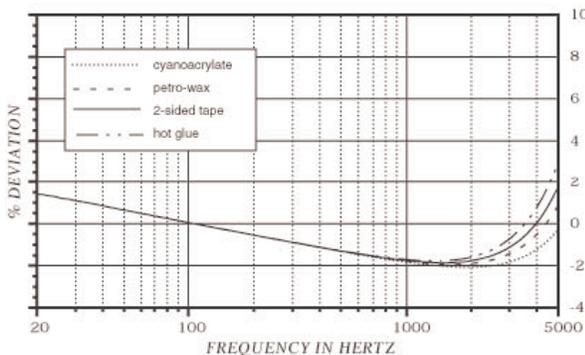


Figure 1 Frequency response curves with various adhesives

For applications at temperature extremes, there are commercially available adhesives that are specifically formulated to handle the hot or cold environments. For cryogenic applications, a room temperature cure, two component polymer epoxy resin system has been proven to be effective down to  $-200^{\circ}\text{C}$ . It is important for a low temperature adhesive to be able to withstand cryogenic thermal shock without showing signs of cracking. For applications at very high temperature (up to  $700^{\circ}\text{C}$ ), ceramic based adhesives are typically used due to their

heat resistant properties. Ceramic adhesives also require a high curing temperature, which prevents its use in most transducer mounting applications. At lower temperatures (from a maximum of  $200^{\circ}\text{C}$  to  $300^{\circ}\text{C}$ ), a few commercial suppliers offer proprietary modified epoxy resins that are room temperature cured, and can operate up to  $260^{\circ}\text{C}$ .

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**Mounting using magnetic adapters**

Magnetic mounting adapters are popular in industrial vibration monitoring applications where quick point to point measurements are to be made periodically. Most magnetic adapters are massive, and they are only useful for low frequency measurements below a few hundred Hertz. Figure 3 shows a typical response of an accelerometer mounted on a magnetic mounting adapter running at 10 g's. Note that the accelerometer in this example is relatively lightweight ( $<10$  grams). With heavier units, such as those designed for industrial applications, the frequency response degradation would be more pronounced. Endevco's magnetic mounting adaptor, model 2988M7, is recommended for general purpose 10-32 tap accelerometers.

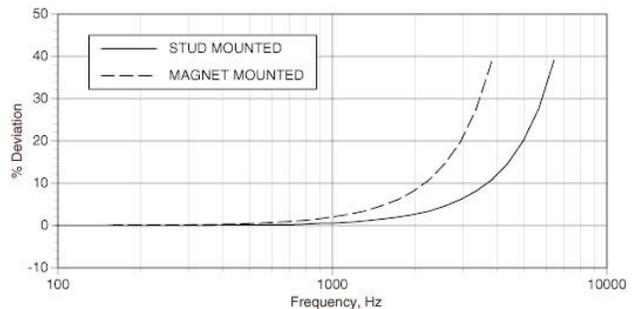


Figure 3 Sample frequency response curve, stud vs magnetic mount

Special attention is required when using a magnetic mounting adapter. During installation, the magnetic force

that pulls the adapter/accelerometer assembly towards the mounting structure often induces an unexpectedly high level of shock input to the accelerometer at the time of contact, causing damage in the sensing elements or the internal electronics. Effective use of magnets for mid-level frequencies requires detailed surface preparation, which may extend the overall test timeframe.

## Most magnetic adapters are massive, and they are only useful for low frequency measurements

### Triaxial mounting blocks and isolation adapters

Many installations require the transducer to be mounted on an adapter block for triaxial (three orthogonal axes) measurement, or for electrical ground isolation purposes. The block itself becomes part of the structure being measured, and acts as an additional spring mass system, whose transfer function needs to be defined before use. To maximize transmissibility, a good mounting block or adapter should be as small, light weight, and stiff as possible. The ideal material is beryllium, but it is not commonly used due to safety regulations and cost. Other materials, such as magnesium or aluminum are widely used with some compromise in transmissibility above 10 kHz. It is therefore recommended that the accelerometers be calibrated together with the mounting block or adapter. There are triaxial accelerometers on the market that come in a single housing, designed to minimize mounting block related effects. There are also transducers that feature built-in electrical ground isolation, which eliminates the use of an isolation adapter.

## A good mounting block or adapter should be as small, light weight, and stiff as possible.

Endevco triaxial blocks are precision machined with tight tolerances for optimum mounting. Endevco model 2950, with an anodized aluminum surface, enables

the user to electrically isolate three accelerometers from the measurement surface. This triaxial block also has counterbored holes for installing cap screws, for accelerometer taps, from the opposite side, thereby enabling orientation of side connector accelerometers for common cable exit direction of all three accelerometers. Contact Endevco application engineers for the mounting block most appropriate for your specific requirement.



Figure 4 Various Endevco triaxial mounting blocks and mounting studs

For additional information on accelerometer mounting, contact Endevco Communications Department and request the following technical papers: TP218 (Effects of mounting on accelerometer response) and TP312 (Guide to adhesively mounting accelerometers).