ACCELEROMETER MOUNTING CONSIDERATIONS

Frequency Response

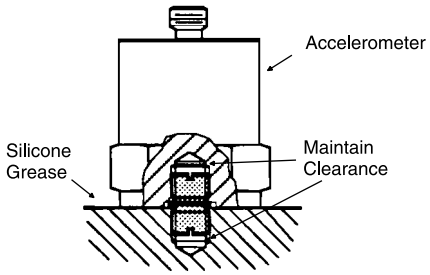
One of the most important considerations in dealing with accelerometer mounting is the effect the mounting technique has on the accuracy of the usable frequency response. The accelerometer's operating frequency range is determined, in most cases, by securely stud mounting the test sensor directly to the reference standard accelerometer. The direct, stud mounted coupling to a very smooth surface, generally yields the highest mechanical resonant frequency and therefore, the broadest usable frequency range. The addition of any mass to the accelerometer, such as an adhesive or magnetic mounting base, lowers the resonant frequency of the sensing system and may affect the accuracy and limits of the accelerometer's usable frequency range. Also, compliant materials, such as a rubber interface pad, can create a mechanical filtering effect by isolating and damping high-frequency transmissibility.

Surface Preparation

For best measurement results, especially at high frequencies, it is important to prepare a smooth and flat machined surface where the accelerometer is to be attached. Inspect the area to ensure that no metal burrs or other foreign particles interfere with the contacting surfaces. The application of a thin layer of silicone grease between the accelerometer base and the mounting surface also assists in achieving a high degree of intimate surface contact required for best high-frequency transmissibility.

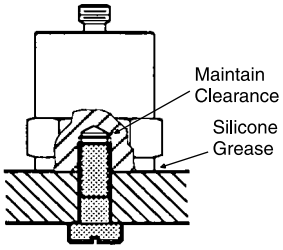
Stud Mounting

For permanent installations, where a very secure attachment of the accelerometer to the test structure is preferred, stud mounting is recommended. First, grind or machine on the test object a smooth, flat area at least the size of the sensor base, according to the manufacturer's specifications. Then, prepare a tapped hole in accordance with the supplied installation drawing, ensuring that the hole is perpendicular to the mounting surface. Install accelerometers with the mounting stud and make certain that the stud does not bottom in either the mounting surface or accelerometer base. Most PCB mounting studs have depth-limiting shoulders that ensure that the stud cannot bottom-out into the accelerometer's base. Each base incorporates a counterbore so that the accelerometer does not rest on the shoulder. Acceleration is transmitted from the structure's surface into the accelerometer's base. Any stud bottoming or interfering between the accelerometer base and the structure inhibits acceleration transmission and affects measurement accuracy. When tightening, apply only the recommended torque to the accelerometer. A thread-locking compound may be applied to the threads of the mounting stud to safeguard against loosening.



Screw Mounting

When installing accelerometers onto thin-walled structures, a cap screw passing through a hole of sufficient diameter is an acceptable means for securing the accelerometer to the structure. The screw engagement length should always be checked to ensure that the screw does not bottom into the accelerometer base. A thin layer of silicone grease at the mounting interface ensures high-frequency transmissibility.



Adhesive Mounting

Occasionally, mounting by stud or screw is impractical. For such cases, adhesive mounting offers an alternative mounting method. The use of separate adhesive mounting bases is recommended to prevent the adhesive from damaging the accelerometer base or clogging the mounting threads. (Miniature accelerometers are provided with the integral stud removed to form a flat base.) Most adhesive mounting bases available from PCB also provide electrical isolation, which eliminates potential noise pick-up and ground loop problems. The type of adhesive recommended depends on the particular application. Petro Wax (available from PCB) offers a very convenient, easily removable approach for

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Accelerometer Mounting Considerations

room temperature use. Two-part epoxies offer stiffness, which maintains high-frequency response and a permanent mount. Other adhesives, such as dental cement, hot glues, instant glues, and duct putty are also viable options with a history of success.

There is no one "best" adhesive for all applications because of the many different structural and environmental considerations, such as temporary or permanent mount, temperature, type of surface finish, and so forth.

A variety of adhesives are available from many manufacturers, who usually provide specification charts and application bulletins for their adhesives. A Consumer Report's article entitled "Which Glue for Which Job" (Jan. 1988) provides rating information on adhesives. A Popular Science magazine article, "Secrets of the Superglues" (Feb. 1989), provides informative data on the use of superglues. Loctite provides an adhesive "Selector Guide" for its products.

For most accelerometer adhesive mounting applications, PCB Series 080 Adhesive Mounting Bases are suggested. These mounting pads keep the accelerometer base clean and free of epoxy that may be very difficult to remove. Also, Series 080 Mounting Bases allow the accelerometer to be easily removed from the test structure without damage to either the sensor or the test object.

Surface flatness, adhesive stiffness, and adhesion strength affect the usable frequency range of an accelerometer. Almost any mounting method at low acceleration levels provides the full frequency range of use if the mounting surface is very flat and the sensor is pressed hard against the surface to wring out all extra adhesive. Generally, as surface irregularities or the thickness of the adhesive increase, the usable frequency range decreases.

The less-stiff, temporary adhesives reduce an accelerometer's usable frequency range much more than the more rigid, harder adhesives. Generally, temporary adhesives are recommended more for low-frequency (<500 Hz) structural testing at room temperature. Petro Wax is generally supplied with most of the accelerometers for a quick, temporary mounting method used during system set-up and check-out. When quick installation and removal is required over a wide frequency range up to 10 kHz, use a Series 080A Adhesive Mounting Base with one of the stiffer, more permanent adhesives. Also, consider a magnetic mount, using the Series 080A27 Super Magnet with Model 080A20 Steel Adhesive Mounting Pad for such measurements. For both, the mounting surface must be very flat to achieve accurate high-frequency information.

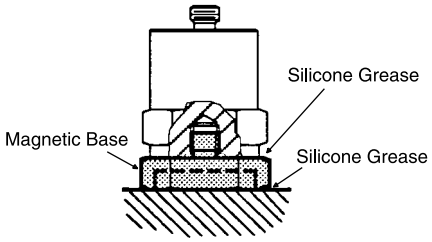
Care should be exercised in selecting and testing an adhesive when concern exists regarding the possible discoloration or damage to the test structure's surface finish. Test the adhesive first on a hidden location or a sample of the structure's finish. Temporary adhesives like Petro Wax or beeswax offer a good solution for quick installation in room-temperature applications. When higher temperatures are involved, apply a piece of aluminized mylar tape to the test structure and mount the accelerometer with adhesive base using one of the other types of adhesives. After the test, the tape can be easily removed with no damage to the surface finish of the structure.

	Mounting Surface Condition		Temperature		Availability	
Adhesives	Flat & Smooth Surfaces	Rough Surfaces (Casting, etc.)	Room Temp. Only	Elevated Temp. (see Mtg. Spec.)	Commercial	PCB Piezotronics (request sample)
Temporary/Easily Removed						
Petro Wax	■	■	■			■
Bee's Wax	■	■	■		■	
Duct Putty	■	■	■		■	
Two-sided Sticky Tape	■	■	■		■	
Semi-Permanent/Permanent						
Super Glue (Thin one part quick dry)						
Loctite® 430 Super Bonder	■			-65°F to +175°F	■	■
Eastman 910	■			-65°F to +180°F	■	
Super Glue-Gap Filling (thick liquid & gel)						
Pacer RX-50 "Gel"		■		-114°F to +180°F	■	■
Loctite® 498 Super Bonder		■		-40°F to +223°F	■	
Loctite® 422 "Gap Filling"		■		-65°F to +175°F	■	
Hot Glue (apply with hot glue gun)	■	■		Various Grades from +150°F	■	
Permanent						
Two Part Std Commercial Epoxies	■	■		to +250°F	■	
Loctite® 325 Speed Bonder	■	■		-65°F to +350°F	■	

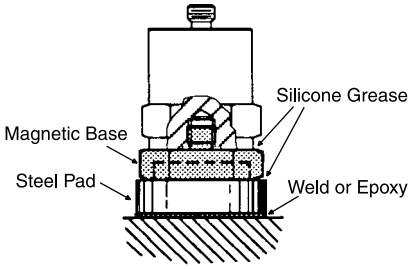
Magnetic Mounting

Magnetic mounting bases offer a very convenient, temporary attachment to magnetic surfaces. Magnets offering high pull strengths provide best high-frequency response. Wedged dual-rail magnetic bases are generally used for installations on curved surfaces, such as motor and compressor housings and pipes. However, dual-rail magnets usually significantly decrease the

operational frequency range of an accelerometer. For best results, the magnetic base should be attached to a smooth, flat surface. A thin layer of silicone grease should be applied between the sensor and magnetic base, as well as between the magnetic base and the structure. When surfaces are uneven or non-magnetic, steel pads can be welded or epoxied in place to accept the magnetic base. Use of such a pad ensures that periodic measurements are taken from the exact same location. This is an important consideration when trending measurement data.



Magnet Mounted Directly to Test Surface



Probe Tips

Handheld vibration probes or probe tips on accelerometers are useful when other mounting techniques are impractical and for evaluating the relative vibration characteristics of a structure to determine the best location for installing the accelerometer. Probes are not recommended for general measurement applications due to a variety of inconsistencies associated with their use. Orientation and amount of hand pressure applied create variables, which affect the measurement accuracy. This method is generally used only for frequencies less than 1000 Hz.

Mass Loading

The vibrational characteristics of a structure can be altered by adding mass to that structure. Since most measurements are conducted to quantify the structural vibration, any alteration of the vibration leads to an inaccurate evaluation of the vibration. An accelerometer that is too heavy, with respect to the test structure, may produce data that does not correctly represent the vibration of interest. Use care when selecting an accelerometer and mounting hardware to avoid the effects of mass loading.

Ground Isolation, Ground Noise, and Ground Loops

When installing accelerometers onto electrically conductive surfaces, a potential exists for ground noise pick-up. Noise from other electrical equipment and machines that are grounded to the structure, such as motors, pumps, and generators, can enter the ground path of the measurement signal through the base of a standard accelerometer. When the sensor is grounded at a different electrical potential than the signal conditioning and readout equipment, ground loops can occur. This phenomenon usually results in current flow at the line power frequency (and harmonics thereof), potential erroneous data, and signal drift. Under such conditions, it is advisable to electrically isolate or "float" the accelerometer from the test structure. This can be accomplished in several ways. Most accelerometers can be provided with an integral ground isolation base. Some standard models may already include this feature, while others offer it as an option. Optional ground-isolated models are identified by the prefix "J"; for example, Model J353B33. The use of insulating adhesive mounting bases, isolation mounting studs, isolation bases, and other insulating materials, such as paper beneath a magnetic base, are effective ground isolation techniques. Be aware that the additional ground-isolating hardware can reduce the upper frequency limits of the accelerometer.

Cables and Connections

Cables should be securely fastened to the mounting structure with a clamp, tape, or other adhesive to minimize cable whip and connector strain. Cable whip can introduce noise, especially in high-impedance signal paths. This phenomenon is known as the triboelectric effect. Also, cable strain near either electrical connector can lead to intermittent or broken connections and loss of data.

To protect against potential moisture and dirt

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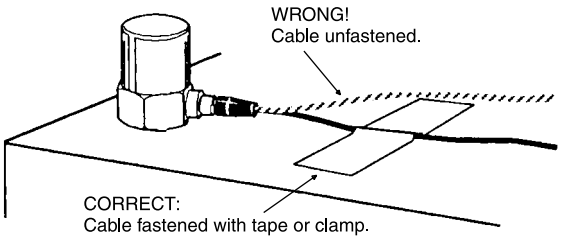
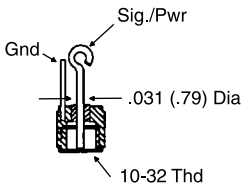


contamination, use RTV sealant or heat-shrinkable tubing on cable connections. O-rings with heat shrink tubing have proven to be an effective seal for protecting electrical connections for short-term underwater use. The use of only RTV sealant is generally only used to protect the electrical connection against chemical splash or mist.

Under high shock conditions or when cables must undergo large amounts of motion, as with package drop testing applications, the use of a solder connector adaptor and lightweight ribbon cables are generally recommended. These solder connector adaptors provide a more durable connection and can be installed onto the accelerometer with a thread locking compound to prevent loosening. Use of lightweight cables helps to minimize induced strain at the connector, which can create an erroneous output signal. Electrical connection fatigue is also minimized, reducing the possibility of intermittent or open connections and loss of data. Solder connector adaptors are installed onto the cable with solder. This easy connection makes this type of connector user- or field-repairable in times of crisis. Normally, a flexible plastic plug is placed over the electrical connections for protection, as well as to provide cable strain relief.

The solder connector adaptor provides an affordable and simplistic method for making cables in the field. Only solder and a soldering iron are required. No special tools or equipment are necessary for installation on a cable end. Because of the reliability and strength of this connection, these connectors are recommended for use in shock applications.



Solder Connector Adaptor