

Techniques for Attaching Leadwires to Unbonded Strain Gages

Introduction

Strain gages must sometimes be installed in areas where it is impossible, or at least very difficult, to attach leadwires after gage bonding. Examples include:

- Deep holes or recesses where gage tabs cannot be reached with a soldering iron.
- Poor-heat-conducting materials such as plastics, where soldering heat may damage the gage or specimen.
- Explosive or inflammable environments where appliances such as soldering irons are not permitted.

Under these and similar conditions, attaching leadwires to the gage before bonding will greatly simplify gage installation. This Tech Tip outlines recommended procedures. The various installation accessories referred to throughout this Tech Tip are Micro-Measurements Accessories, listed in our Strain Gage Accessories Data Book and available directly from Micro-Measurements.

Strain Gage Selection

The use of gage types with preattached terminals is preferred in order to minimize chances of heat damage to unbonded gage backings during soldering. In addition, flexible backings are preferred to reduce chances of breakage during handling and cleaning steps.

Recommended Micro-Measurements types (in order of preferred selection):

1. E-backed gages with Option W
2. CEA-Series gages
3. W-backed gages with Option W

Consult Micro-Measurements Precision Strain Gages Data Book and Tech Note TN-505 for detailed gage descriptions.

Solder Selection

Any of the soft solders listed in our Strain Gage Accessories Data Book can be used for preattaching leadwires. In general, solders having the lowest melting point which satisfy test temperature *and* adhesive cure temperature requirements should be selected. This is because an unbonded strain gage backing has a much lower tolerance for high soldering temperatures.

Leadwire Selection

Ideally, the smallest practicable diameter leadwire should be soldered to the gage to reduce solder connection height and its effect on uniform clamping pressure. This is not without limitation since the smaller the leadwire the greater its resistance and corresponding effect on circuit stability and sensitivity.

As a general guideline, no larger than stranded 30 AWG wire, 0.031 in (0.8 mm) overall diameter including insulation, should be used with the 100%-solids epoxy adhesives. These include M-Bond AE-10, AE-15, GA-2, and GA-61 Adhesives.

With solvent-thinned adhesives such as M-Bond 43-B, 600, and 610, attainment of uniform clamping pressures is more critical. The maximum recommended leadwire diameter for these adhesives is 0.01 in (0.25 mm) including insulation. Leadwire types with film insulation, such as 130-AWN or 134-AWP are preferred.

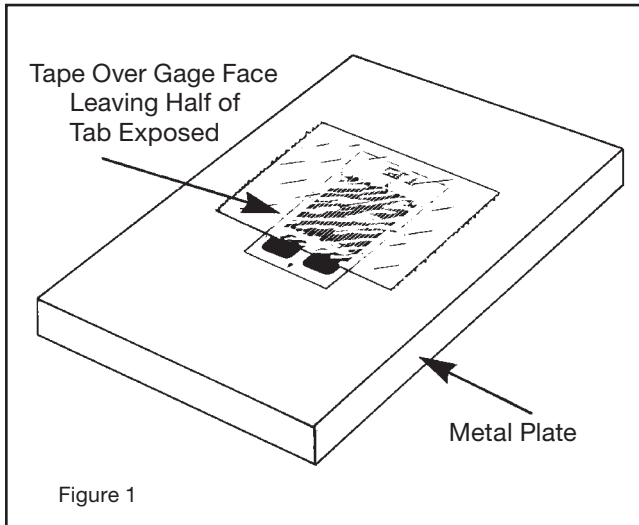
Soldering Preparation

1. Using gauze sponges and CSM Degreaser, thoroughly degrease the surface of a smooth, clean, steel or aluminum plate at least 1/8 in (3 mm) thick.
2. Using blunt-nose tweezers which have been cleaned with Neutralizer 5A, remove the gage from its mylar folder and place on the cleaned plate. Tabs on the gage should face up.
3. Place a short piece, 1 to 2 in (25 to 50 mm), of PDT drafting tape over the grid area of the gage, leaving one-half of the soldering tabs exposed.
4. Press tape over gage and onto work surface (Figure 1). If the gage does not have good thermal contact with the surface, a weight can be applied to hold gage in place.

Leadwire Preparation

1. Select wire type and size to be used according to recommendations outlined in *Leadwire Selection*.
2. Thermally strip approximately 1/4 in (6 mm) of insulation from end of wire to be attached to gage. (Thermal stripping prevents broken or nicked wires often resulting from mechanical stripping methods.)

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3. Tin exposed wire with solder selected.
4. Trim tinned conductor so that approximately 0.1 in (2.5-mm) extends from end of insulation. Longer tinned conductor length is not advisable since it may extend beyond gage backing and contact specimen during gage bonding and clamping.

Note: Whenever possible, a three-leadwire system should be employed on single gage (quarter-bridge) installations. The use of two-wire systems should be limited to dynamic-only strain measurements or in static measurements where the two-lead system is not more than a few inches long and can be connected to a three-lead cable for routing to the measuring instrument.

Soldering – General

The use of a temperature-regulated soldering iron is always recommended for strain gage soldering. This is particularly critical when soldering is to be done on unbonded gages. Unbonded gages have less capacity to dissipate soldering heat.

Soldering stations having variable heat control should be adjusted to a tip-temperature high enough to allow quick melting of the solder without vaporizing the flux or hindering proper cleaning and tinning of the iron tip.

Note: On the Mark V Soldering Unit, this adjustment is automatically accomplished by turning heat selection on the front panel to the range of the solder being used.

When using soldering irons without heat controls, they should be powered through a variable transformer. A setting of 70 to 75% of line voltage is a good starting position for adjusting tip temperature.

Soldering Procedures

The object of these procedures is to attach the leadwire to the gage tab with the least amount of solder practicable.

1. Adjust tip temperature as described in *Soldering – General*.
2. Clean and tin the soldering tip, adding enough solder to form a small pool. A screwdriver-shaped tip is preferred.
3. Place one drop of M-Flux AR on gage tab or terminal to be wired.
4. Hold tinned wire in place on tab. Drafting tape is often helpful to keep wire from moving during soldering.
5. Without adding more solder to iron, firmly press flat surface of iron tip onto wire and tab and hold for one second.
6. Repeat steps 3 to 5 on each tab to be wired, adding small amounts of solder to *iron* when necessary before each tab is soldered.
7. Inspect connections. Incomplete or “peaked” solder joints should be resoldered with additional flux on gage tab and limited amounts of solder reapplied to iron tip.

Gage Removal And Cleaning

1. After soldering has been completed, thoroughly flood the gage and tape area with several brush applications of RSK Rosin Solvent.
2. Work the solvent brush around solder areas and under tape. Do not try to lift gage/leadwire assembly until rosin solvent has loosened tape from gage face.
3. Lift gage assembly by the leadwires and dip into a container of clean rosin solvent. Scrub the solder connections and gage face with brush provided with the rosin solvent.
4. Remove assembly from rosin solvent and *blot* dry between layers of gauze sponges. Use caution not to snag gauze on gage backing or solder connections.
5. Place gage on a clean work surface with the bonding surface exposed. Wipe with a cotton applicator slightly moistened with Neutralizer 5A. Rolling the cotton applicator as you wipe will improve cleansing. Allow to air dry 5 minutes.
6. Slip cleaned gage into acetate folder and tape shut. This will minimize contamination and provide lead support until ready for installation.

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Additional Suggestions

1. Before bonding, make a resistance and continuity check of the gage/leadwire assembly. Test instruments should not apply more than 1 to 2 volts during measurement.
2. Follow instructions for gage bonding according to the adhesive selected. When positioning gage for adhesive application and alignment on specimen, handle gage by the leadwires to minimize force applied to the solder connections. Tape leadwires to surface after gages are in position.