Leadwire Attachment Techniques for Obtaining Maximum Fatigue Life of Strain Gages

Introduction

Micro-Measurements WA-, WK-, and WD-Series Strain Gages are manufactured with integral beryllium-copper lead ribbons. To maximize the inherently good fatigue life of this gage/lead combination, the gage-to-instrument leadwire connection must also be highly resistant to fatigue damage. The techniques described here are recommended for applications where the cyclic strain endurance requirements approach the fatigue limits of the gage in use.

Wiring procedures for gages with integral solder dots instead of lead ribbons are described in *Micro-Measurements Application Note TT-606*, and general gage soldering techniques are discussed in detail in *Application Note TT-609*.

Bonding

M-Bond 600 and M-Bond 610 are the strain gage adhesives generally recommended for high-performance applications. However, any M-Bond adhesive can be used where temperature conditions and other factors permit. Although Micro-Measurements strain gage adhesives are not particularly fatigue sensitive, some potential problem areas are:

- Adhesive failure due to improper surface preparation or environmental protection.
- Voids or air bubbles in the glueline, causing "hot spots" in the gage and subsequent premature failure.

Bonding instructions for M-Bond 600 and 610 are detailed in *Micro-Measurements Instruction Bulletin B-130*.

Wherever possible, the use of bondable terminals is recommended to provide an anchor for the instrument leadwire, preventing damage to the gage when the leadwire is subjected to any type of force. Micro-Measurements Type CPF-75C terminals are particularly suitable for this application within their operating temperature range. If bonded in a high strain field, terminals should be cut in half and/or bonded 90º to the maximum strain direction. Figure 1 is representative of typical installations.

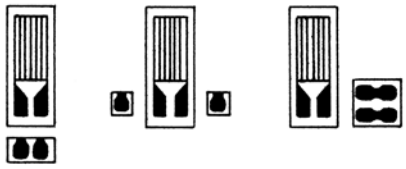

Figure 1

Lead Preparation and Attachment

Step 1

Carefully lift the gage lead ribbons from the specimen surface by laying the wood extension of a cotton-tipped applicator firmly across the gage at the lead exit point, grasping each lead end with tweezers and raising the lead at a shallow angle (Figure 2). Avoid introducing kinks or sharp corners.

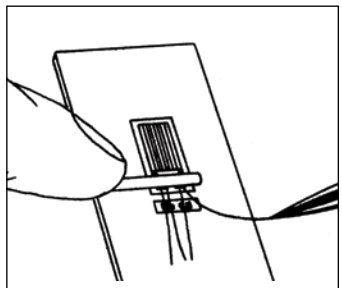

Figure 2

Step 2

With tweezers, guide each lead ribbon upward and around the tip of a dental probe to form a small loop above the surface between the lead exit point and the edge of the gage backing (Figure 3). Do not twist or kink the ribbons. Once kinked, a lead will easily break.

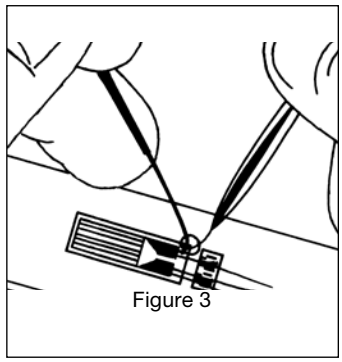

Figure 3

TECH NOTE

Leadwire Attachment Techniques for Obtaining Maximum Fatigue Life of Strain Gages

Step 3

Insulated, three-conductor, stranded tinned-copper leadwire cable is normally selected for static or static/dynamic measurements. Refer to Micro-Measurements Strain Gage Accessories Data Book for the selection of a suitable leadwire. Typically recommended cable types are Micro-Measurements 326-DFV (flat, and most convenient for routine applications) or 326-DSV (twisted, and shielded for use when electrical noise fields are present). Both cables are color-coded red, white, and black. The 326-DFV is used to illustrate the following step-by-step procedures.

Cut the leadwire cable to the appropriate length. At the gage end of the leadwire, separate the three color-coded conductors, and strip 0.5 in (*13 mm*) of insulation from each. A thermal wire stripper is recommended to help prevent nicking the wires.

Step 4

Separate a single wire strand from both the red conductor and the black conductor.

Twist the remaining strands of the red conductor together, leaving the single strand separated. Twist the remaining strands of the black conductor together with all strands of the white conductor, leaving the single strand from the black conductor separated.

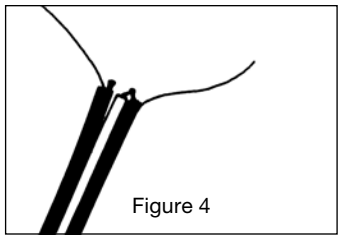
Figure 4

Tin the two twisted bundles of stranded wire with solder. With diagonal cutters, trim each bundle to approximately 0.1 in (2.5 mm) from the insulation, being careful not to trim the two single strands of wire extending from the red conductor and the black/white conductor (Figure 4).

Step 5

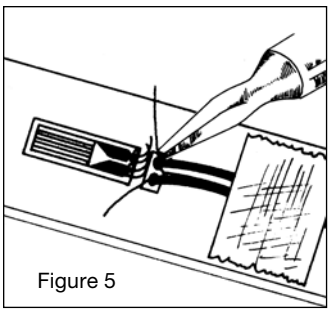
Figure 5

Tin the bonded terminals with solder. Place the tinned, trimmed sections of the leadwires on the terminals, and anchor the cable in this position with drafting tape. Solder the leads in place (Figure 5), avoiding large masses of solder.

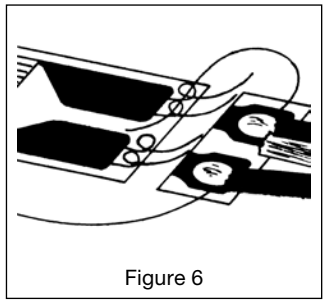
Figure 6

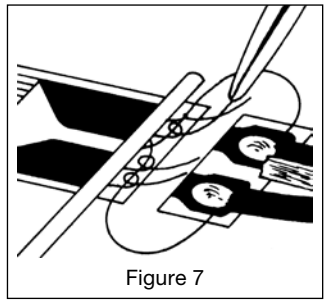
Figure 7

Step 6

With tweezers, form the single wire strands and insert through the gage lead loops as shown in Figure 6. Tighten the gage lead loops by pulling gently with a pair of tweezers (Figure 7). To avoid damage to the gage joint, lightly press the wood extension of a cotton-tipped applicator over the area as indicated in the figure.

Solder the joints and cut off excess lead ribbons and wire strands.

Step 7

Remove solder flux with rosin solvent, gently blotting dry with a gauze sponge. If any wire strands come in contact with the specimen, gently lift with a dental probe.

Protective Coating Application

Refer to Micro-Measurements Strain Gage Accessories Data Book for the selection and application of a suitable protective coating.

Note: WD-Series Strain Gages are supplied with single beryllium-copper leads. The WA- and WK-Series gages, as shown throughout this Application Note, are supplied with dual leads. The WD gages should be handled in the same manner as the dual lead connections.

TECH NOTE