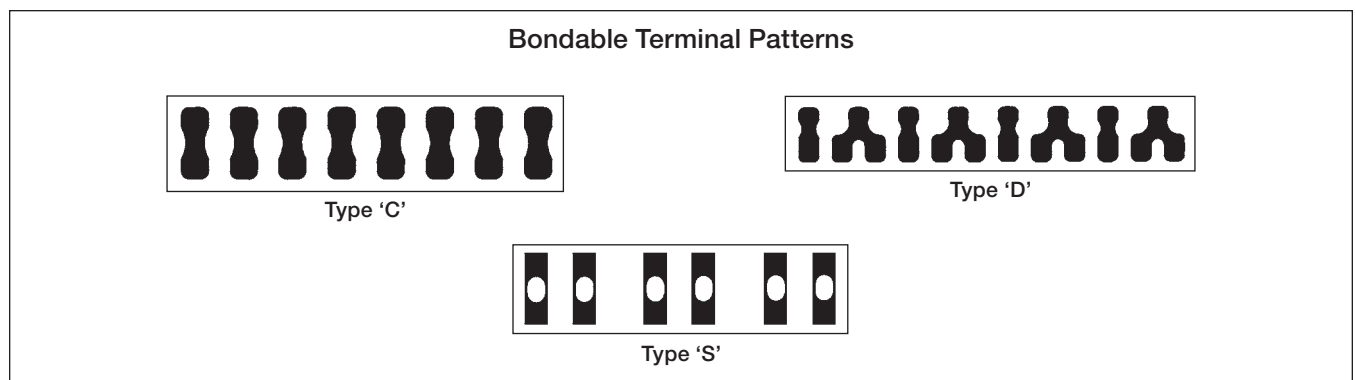


The Proper Use of Bondable Terminals in Strain Gage Applications

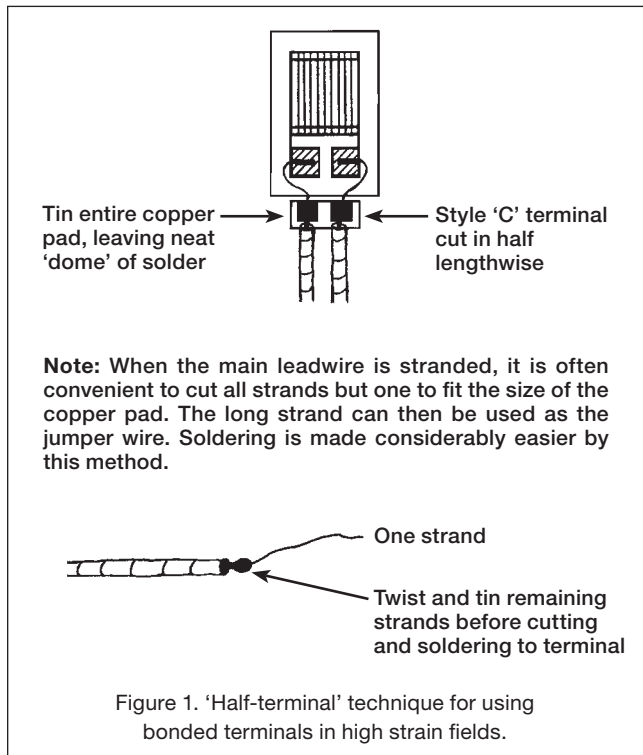
It is common practice to employ bondable printed-circuit terminals between the main leadwire and the relatively small and delicate jumper wires to the strain gage. The primary purpose is to provide an anchor for both sets of leads, and to prevent forces transmitted along the main leadwire system from damaging the strain gage or degrading its performance. In order to obtain maximum benefit from the use of these terminals, they must be installed with care and knowledge of their limitations. Otherwise, the terminal can be a source of performance degradation for the entire installation.

Micro-Measurements printed-circuit terminals are produced from 0.0014 in (0.03 mm) electrolytic copper foil bonded to a carrier of either polyimide film or fiberglass-reinforced epoxy. Micro-Measurements manufactures both types in a wide variety of configurations as described in Micro-Measurements Strain Gage Accessories Data Book. The following instructions will assist greatly in obtaining proper performance from bondable terminals.

1. Select terminal *configuration* to match the geometrical arrangement of the gage/leadwire system, and select terminal size appropriate to the AWG size of the main leadwires.
2. Printed-circuit terminal strips are usually bonded to the specimen with the same adhesive used to install the gage. After soldering and flux removal, the terminal strip and jumper wires should be coated with a protective compound suitable for the environment, usually the same compound applied over the gage itself.
3. The polyimide-type terminals (prefix CPF) have the highest conformability and highest temperature capability, and are best for general use. However, the high expansion coefficient of unfilled polyimide may cause loss of bond below -100°F (-75°C), and the fiberglass-epoxy terminals (prefix CEG) are therefore preferred for cryogenic applications.
4. Electrolytic copper foil has an inherently poor fatigue life. Whenever possible, orient the long dimension of the copper terminal along the axis of minimum strain. If the strain level exceeds $\pm 500 \mu\epsilon$, and if the terminal installation must have a long life under cyclic loading, use the 'C' configuration terminals cut in half as shown in Figure 1. This reduces the bonded length of the terminals, and allows the same solder mass to join both sets of wires. Failure of the copper between solder joints is prevented by this technique.
5. Use only rosin-type soldering fluxes (such as M-Flux AR) on printed-circuit terminals, and **remove all flux residue after soldering**. Acid and/or chloride type fluxes, particularly the paste type, may cause the copper to unbond from the backing, and often create serious electrical leakage problems, especially at elevated temperature. If the leadwire system is an alloy that must be soldered with a corrosive flux, pre-tin the wire with an active acid flux such as M-Flux SS, remove flux residue, and then solder the wire to the printed-circuit terminal with rosin flux.
6. Thermal EMF generation and leadwire temperature differences can create significant error signals in strain gage circuits, particularly when high heating or cooling rates are involved. These problems are minimized

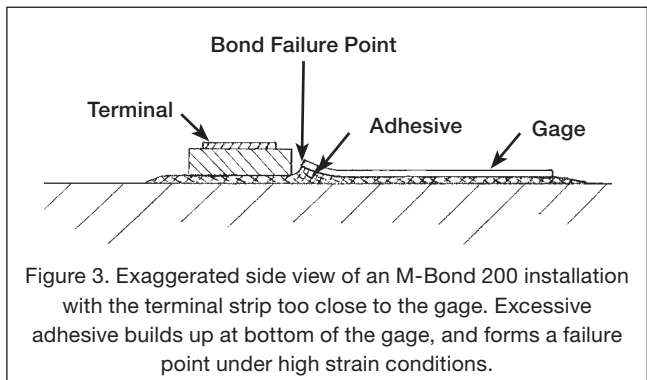


The Proper Use of Bondable Terminals in Strain Gage Applications

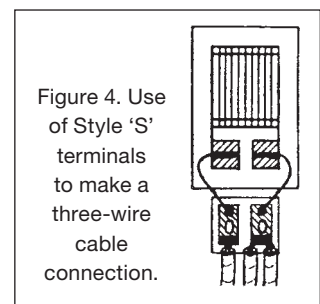


by keeping thermal masses and jumper wires as symmetrical as possible. Use neat solder joints on all terminals with the same amount of solder on each, and keep all jumper wires the same length from terminal strip to gage. Figure 2 shows the use of a narrow piece of tape to mask the center area of a set of terminals. This prevents nonuniform solder spread, and assists in obtaining thermal symmetry.

- When terminal strips are used with high-elongation strain gages (post-yield measurements), it is preferable to locate the terminal strip at least $\frac{1}{16}$ in (1.5 mm) away from the end of the gage backing to avoid unbonding problems due to thick areas of adhesive. If the terminal backing is placed against the gage backing in an M-Bond 200 installation, a "ramp effect" results as shown in Figure 3, and the bond will generally fail at the location shown. The "half-terminal" technique (paragraph 4) is usually employed if the strain level will exceed 2 to 3%.



- The Type 'S' terminal, shown in Figure 4, has a unique construction; the hole in the center provides thermal isolation between the soldering areas. This arrangement is popular where soldering and desoldering of leadwires may be encountered.



- Type 'S' terminals are not recommended where high cyclic endurance is required.
- High g-fields can create large unbonding forces between the copper pads and backing material. When printed-circuit terminals are used in this application, keep the solder and leadwire mass to a minimum. When practicable, locate the terminal strip such that centrifugal forces act either parallel with the plane of the terminal, or compressive on the terminal surface; this assists in keeping the terminal in place. Refer to Tech Tip TT-601 relating to techniques for bonding leadwires to surfaces experiencing high centrifugal forces.
- The figures in this Tech Tip show various methods of terminal use in gage circuits. Note that in every case a "stress relief loop" is used in the jumper wires between terminal strip and gage to minimize forces applied to the gage tabs, and to prevent wire failure at the solder joints.

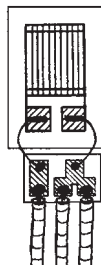
Please note that reduction of electromagnetic noise pickup requires special leadwire considerations, and stress relief loops may be undesirable in these cases. Tech Note TN-501 provides a detailed discussion of noise control in strain gage measurements.

The Proper Use of Bondable Terminals in Strain Gage Applications

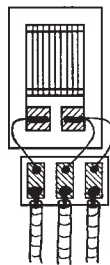
ADDITIONAL WIRE CONFIGURATIONS – Various methods of making three-wire cable connections.



2 Style 'C'
Terminals

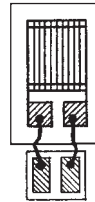


2 Style 'D'
Terminals



3 Style 'C'
Terminals

Note: The above methods using Style 'C' terminals can be combined with the 'half-terminal' technique shown in Figure 1 on previous page.



'Vertical' stress-relief loop.
Often used when gages have
integral jumper leads.

Side View



No terminals are required with a CEA-type gage. Two of the leadwires are twisted together; then all three leads are trimmed and soldered directly to the copper-coated tabs.