Strain Gage Applications with M-Bond GA-61 Adhesive

GENERAL DESCRIPTION

Micro-Measurements M-Bond GA-61 is a partially filled, 100%-solids, elevated-temperature-curing epoxy system for use with strain gages and special-purpose sensors. The useful temperature range is from -100° to +500°F [-75° to +260°C]; or short-term exposure to +600°F [+315°C]. Elongation capability is 2% (20 000 microstrain) at +75°F [+24°C], and 1% (10 000 microstrain) at +500°F [+260°C] and -100°F [-75°C]. M-Bond GA-61 can also be used to fill irregular surfaces, as a protective coating over completed gage installations where a high degree of chemical and mechanical protection is required, and to anchor leadwires. Exposed electrical connections should be isolated from direct contact with the M-Bond GA-61 when testing temperature exceeds +400°F [+205°C].

For proper results, the procedures and techniques presented here should be used with installation accessory products qualified by Micro-Measurements (refer to Catalog A-110). Accessories used in this procedure are:

- CSM Degreaser or GC-6 Isopropyl Alcohol
- Silicon-Carbide Paper
- M-Prep Conditioner A
- M-Prep Neutralizer 5A
- GSP-1 Gauze Sponges
- CSP-1 Cotton Applicators
- MJG-2 Mylar® Tape
- GT-14 Pads and Backup Plates
- TFE-1 Teflon® Film
- HSC-X Spring Clamps

MIXING INSTRUCTIONS

M-Bond GA-61 is a two-component system which requires mixing before use. Each kit consists of six jars containing preweighed quantities of resin and hardener to provide three mixes of adhesive. An adhesive mix consists of one jar each of resin and hardener. The recommended mixing procedure is as follows:

1. Resin must be at room temperature before opening.

2. The resin and hardener can be combined at +75°F [+24°C]; however, mixing is greatly simplified if the liquid resin is warmed to +120°F [+50°C] before adding hardener. Loosen the jar cover before warming and stir resin occasionally to prevent excessive localized heating.

3. Add the powdered hardener, a small amount (approximately 10%) at a time, to the resin while stirring the mixture. The entire amount of hardener must be added to the resin and mixed thoroughly until no unmixed components of resin or hardener remain.

Note: Because this adhesive is quite viscous, mixing and application are best accomplished with a metal spatula.

SHELF AND POT LIFE

At +75°F [+24°C] unmixed M-Bond GA-61 has a useful storage life of 6 months minimum. Humidity absorption by the powered hardener is detrimental to adhesive performance. Refrigeration at +40°F [+5°C] is recommended. Once opened and mixed, M-Bond GA-61 has a pot life of 10 hours at +75°F [+24°C], but this can be increased to approximately two weeks by refrigeration at +40°F [+5°C] and extended indefinitely by freezing. Do not open refrigerated adhesive until it has reached room temperature.

Handling Precautions

While GA-61 Adhesive is considered relatively safe to handle, contact with skin and inhalation of vapors should be avoided. Immediate washing with ordinary soap and water is effective in cleansing skin. In case of eye contact, rinse immediately with copious amounts of water and consult a physician. For additional health and safety information, consult the Material Safety Data Sheet, which is available upon request.

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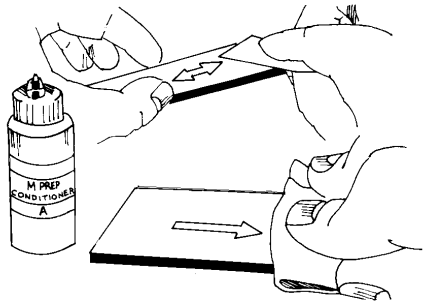
GAGE INSTALLATION PROCEDURE

Step 1

Thoroughly degrease the gaging area with solvent, such as CSM Degreaser or GC-6 Isopropyl Alcohol. The former is preferred, but there are some materials (e.g., titanium and many plastics) that react with CSM. In these cases, GC-6 Isopropyl Alcohol should be considered. All degreasing should be done with uncontaminated solvents-thus the use of "one-way" containers, such as aerosol cans, is highly advisable.

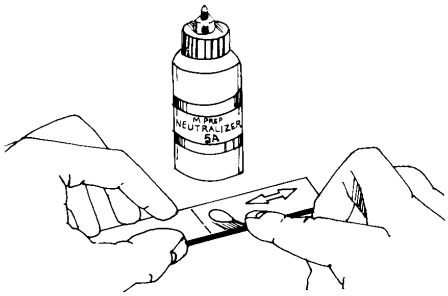
Step 2



Preliminary dry abrading with 220- or 320-grit silicon-carbide paper is generally required if there is any surface scale or oxide. Final abrading is done by using 320- or 400-grit silicon-carbide paper on surfaces thoroughly wetted with Conditioner A; this is followed by wiping dry with a gauze sponge.

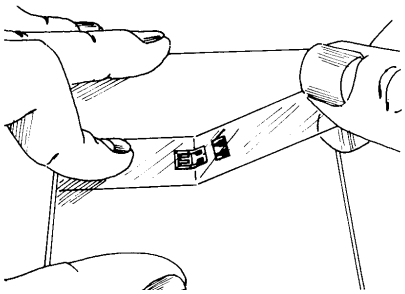
With a 4H pencil (on aluminum) or a ballpoint pen (on steel), burnish (do not scribe) whatever alignment marks are needed on the specimen. Repeatedly apply Conditioner A and scrub with cotton-tipped applicators until a clean tip is no longer discolored. Remove all residue and Conditioner A by again slowly wiping through with a gauze sponge. Never allow any solution to dry on the surface because this invariably leaves a contaminating film and reduces chances of a good bond.

Step 3



Now apply a liberal amount of Neutralizer 5A and scrub with a cotton-tipped applicator. With a single, slow wiping motion of a gauze sponge, carefully dry this surface. Do not wipe back and forth because this may allow contaminants to be redeposited on the cleaned surface.

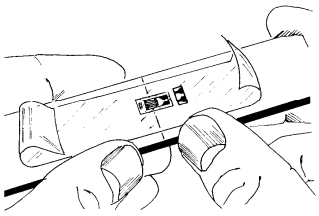
Step 4



Remove the gage from the Mylar envelope by grasping the edge of the gage backing with tweezers, and place it on a chemically clean glass plate or empty gage box, with the bonding side of the gage down. If a solder terminal is to be incorporated, position it on the plate adjacent to the gage as shown. A space of approximately 1/16 in [1.6 mm] should be left between the gage backing and terminal. Using 4 to 6 in [100 to 150 mm] of MJG-2 Mylar Tape, tack one end to the glass plate behind the gage and terminal, and wipe forward onto the terminal and gage. Carefully lift the tape at a shallow angle (about 45 degrees to work surface), bringing the gage up with it.

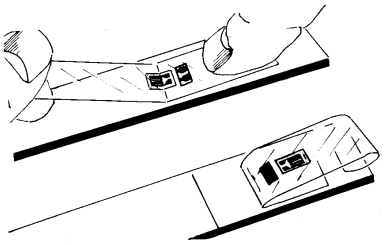
Note: To avoid excessive stretching of the Mylar tape, which could result in resistance offsets in an unbonded gage (Steps 4 and 6), use only enough force to lift the tape from the specimen surface.

Step 5



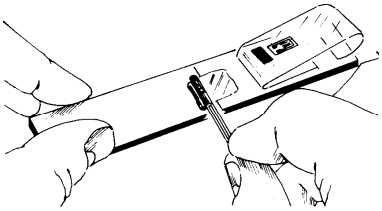
Remove the gage/tape/terminal assembly by peeling tape at a shallow angle (about 45º) and transferring it onto the specimen. Make sure gage alignment marks coincide with specimen layout lines. If misalignment does occur, lift end of tape at a shallow angle until assembly is free. Realign and replace. Use of a pair of tweezers often facilitates this handling.

Step 6



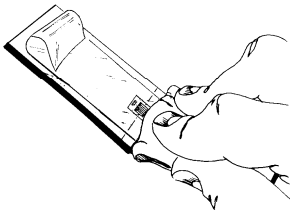
Lift one end of the tape at a shallow angle to surface (about 45 degrees) until the gage and terminal are free of the specimen surface. Tuck loose end of the tape under and press to surface so the gage lies flat with the bonding side exposed. Leave enough slack in the tape to allow a finger to be slipped behind the gage to support it while applying the adhesive (Step 7).

Step 7



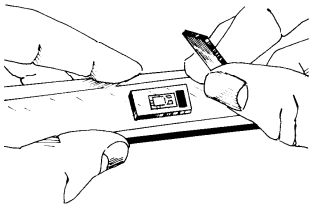
Apply a thin layer of adhesive to the gage bonding side and to the specimen. The adhesive film should be just thick enough to cover the gaging area without bubbles or voids. Approximately 0.002 in [0.08 mm] is typical on metal surfaces. Any lumps of unmixed adhesive should be removed before proceeding.

Step 8



Replace the gage/tape assembly over the alignment marks on the specimen and, using a piece of gauze, slowly make a single wiping stroke over the assembly.

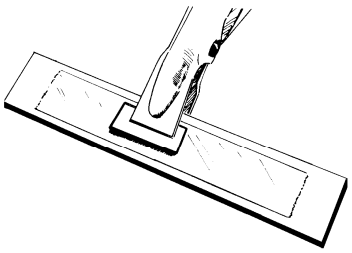
Step 9



Overlay the gage/terminal area with a piece of thin Teflon sheet (TFE-1). If necessary, anchor the Teflon in position with a piece of Mylar tape across one end.

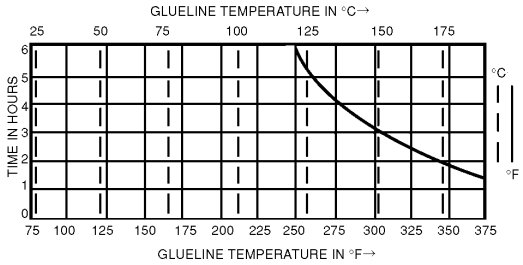
Cut a 3/32-in [2.5-mm] thick silicone-gum pad and a metal backup plate (GT-14) to a size slightly larger than the gage/terminal area, and carefully center these as shown in Step 9. Larger pads may restrict proper spreading of adhesive.

Step 10



Either HSC-X spring clamps, as in, or deadweight can be used to apply pressure during the curing cycle. A clamping pressure of 10 to 30 psi [70 to 200 kN/m2] is recommended. Place clamped gage/specimen into a cool oven and raise temperature to the desired curing level at a rate of 5° to 20°F [3° to 11°C] per minute.

RECOMMENDED CURE SCHEDULE



Upon completion of the curing cycle, allow oven temperature to drop to at least 100ºF [55ºC] before removing the specimen. Remove clamping pieces and Mylar tape. It is advisable to wash off the entire gage area with either RSK Rosin Solvent or toluene; this should remove all residual mastic and other contamination. Blot dry with a gauze sponge.

FINAL INSTALLATION PROCEDURE

1. Refer to Catalog A-110 to select an appropriate solder, and attach leadwires. Be sure to remove solder flux with rosin solvent. Gage tabs and terminals can be cleaned prior to soldering by light abrading with pumice to remove the adhesive film. This pumicing is not required with gages having integral leads (Options L and LE) or pre-attached solder dots. See Application Note TT-606, "*Soldering Techniques for Lead Attachment to Strain Gages with Solder Dots*." General soldering instructions are discussed in Application Note TT-609, "*Strain Gage Soldering Techniques*."

2. Select and apply protective coatings according to recommendations given in Catalog A-110.