

## Strain Gage Installations with M-Bond 450 Adhesive

### INTRODUCTION

M-Bond 450 is a high-performance, two-component, solvent-thinned epoxy system specially formulated for strain gage use. It is capable of forming very strong, thin (down to 0.001 in [0.025 mm]), repeatable bonds. M-Bond 450 is formulated especially for high accuracy, elevated-temperature installations.

While M-Bond 450 is compatible with all Micro-Measurements strain gage series, it is especially compatible with J5K-Series gages. With this combination, it is possible to make high-performance-transducer installations capable of withstanding temperatures above +400°F [205°C] for extended periods.

M-Bond 450 is a multi-stage epoxy system. Once the adhesive is brought to its B-stage (the stage of the polymerization cycle where the adhesive is dry and tack-free at room temperature, but is still fusible under heat and pressure), the adhesive may stand for extended periods until the final cure is initiated.

### OPERATING TEMPERATURE

#### Short Term

-450° to +750°F [-269° to +400°C]

#### Long Term

-452° to +500°F [-269° to +260°C]

### HANDLING PRECAUTIONS

M-Bond 450 is flammable in the uncured state. Do not use near sparks or flames. Epoxy resins may cause dermatitis or other allergic reactions, particularly in sensitive persons. The user is cautioned to: Avoid contact with skin or mucous membranes; avoid prolonged or repeated breathing of vapors; and use the adhesive only in well-ventilated areas. If skin contact occurs, immediately wash the affected area with soap and warm water. In case of eye contact, flush immediately with water and secure medical attention. As with all epoxy resin systems, rubber gloves, safety goggles, and aprons are recommended, and care should be taken to prevent contamination of working surfaces, tools, etc. Spills should be cleaned up immediately. For additional health and safety information, consult the Material Safety Data Sheet, which is available upon request.

### ELONGATION CAPABILITY

Greater than 5% at +75° [+24°C].

### SHELF LIFE

Minimum: Six months at +75° [+24°C].

### POT LIFE

Six weeks at +75° [+24°C].

### MIXING M-BOND 450

M-Bond 450 is a two-component system supplied in premeasured quantities.

1. Parts A and B must be at room temperature before opening. Shake Part B vigorously for 10 seconds.
2. Using the disposable plastic funnel, empty contents of the bottle labeled "Part B" into the bottle of resin labeled "Part A". Discard funnel.
3. After tightening the brush cap provided, thoroughly mix the adhesive by vigorously shaking the bottle for 10 seconds.
4. Mark the date mixed in the space provided on the bottle.
5. Allow the adhesive to stand for 24 hours at room temperature before using.

### SURFACE PREPARATION

The extensive subject of surface preparation is covered in Application Note B-129, "*Surface Preparation for Strain Gage Bonding*". Transducer manufacturers using production line methods of surface preparation for adhesives such as M-Bond 600 or 610 may use the same methods for M-Bond 450.

### GAGE INSTALLATION

#### Step 1

Prepare the surface of the specimen in accordance with "Surface Preparation" above.

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### Step 2

Apply a layer of adhesive on the component to be gaged, making certain to wet the entire area to be covered by the gage and/or terminal. Allow the installation to air-dry for 10 to 30 minutes at +75 °F [+24 °C] and 50% relative humidity. Longer air-dry times may be necessary for lower temperature and/or higher humidities.

### Step 3

Bring the adhesive layer to its B-stage by placing the test part in a cool oven and increasing the temperature to +225 °F [+105 °C] for 30 minutes. The oven temperature rise rate should be 5° to 20 °F [3° to 11 °C] per minute.

**Note:** Ideally, ovens used for gage bonding and postcuring should not be used for any other purpose. Forced-air ovens tend to circulate contaminants such as oils, carbonized particles, and dust. Since M-Bond 450 is exposed to the environment during its B-stage cycle, contaminants are likely to settle into the adhesive and cause bonding problems.

Once the adhesive has reached its B-stage, it is possible to store the component in a clean, dry place for up to one week without sacrificing the final bond strength or repeatability. If there is a possibility that the B-staged adhesive layer has been exposed to a humid environment during storage, heat the component to +225° [+105 °C] for 10 minutes to expel any moisture that may have been absorbed.

### Step 4

Clean a glass plate (or an empty gage box) and a pair of blunt-nosed tweezers with a gauze sponge and M-Prep Neutralizer 5. Remove a gage from its envelope by gently grasping the corner of the gage backing with the cleaned tweezers. Position the gage, bonding side down, on the cleaned work surface. The gage envelope may be used to temporarily hold the gage in position. Place a short length of MJG-2 Mylar tape over approximately half the gage tabs and the bondable terminal, if used.

### Step 5

Remove the tape/gage assembly from the work surface by peeling the tape at a shallow angle (45° or less), and transfer it to the component surface. Do not apply additional adhesive. If misalignment occurs, lift the tape at a shallow angle and reposition the assembly. Make certain the entire area under the gage has been previously covered with the now B-staged adhesive.

### Step 6

Overlay the gage area with a piece of Teflon film. If necessary, anchor the film in place with a piece of MJG-2 tape. Apply a 3/32 in [2 mm] thick silicone rubber pad and a metal backup plate that is slightly larger than the area covered by the gage.

### Step 7

Clamp the installation by using deadweights, spring clamps, or other methods described in Application Note TT-610, "*Strain Gage Clamping Techniques*". Recommended clamping pressure is 40 to 100 psi [275 to 690 kN/m<sup>2</sup>]. Place the component in an oven and increase the temperature to +350 °F [+175 °C]. Cure for 1 hour. Temperature rise time is not critical.

### Step 8

Upon completion of the curing cycle, allow the component to cool sufficiently and remove it from the oven. Unclamp the gages and remove the Mylar tape.

### Step 9

For best performance, a postcure is recommended. It is desirable to postcure the installation after wiring; however, careful consideration must be given to the temperature limits of the leadwires and solder. Postcure the installation for at least 1 hour at a temperature at least 50 °F [28 °C] above the maximum operating temperature. The maximum postcure temperature should not exceed +550 °F [+290 °C], and should be reached by going up in 50 °F [25 °C] steps from the +350 °F [+175 °C] cure temperature, dwelling 60 minutes at each step.

## REFERENCES

Application Note B-129, "*Surface Preparation for Strain Gage Bonding*".

Instruction Bulletin B-130, "*Strain Gage Installations with M-Bond 600 and 610 Adhesive Systems*".

Application Note TT-610, "*Strain Gage Clamping Techniques*"

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