

Instructions for Mixing Type PL-3 Liquid Plastic

Introduction

PL-3 is a room-temperature-curing two-component resin/hardener system for making contourable PhotoStress[®] plastic sheets. It has a K-factor (strain optical constant) of approximately 0.002, and is primarily used to coat rubber products and other low-modulus materials.

Application

1. **Surface Preparation of the Test Part for Contouring**

- See the detailed instructions given in Application Note B-221.

2. **Preparation of the Casting Plate** - See the detailed instructions given in Application Note B-221, Section 2.0.

3. **Preparation of the Plastic** - If the resin and/or hardener were kept refrigerated, bring them to room temperature prior to opening the container. If the hardener was not refrigerated* and/or stored for an extended period, it is important to check its appearance. If the hardener is cloudy or contains foreign particles, discard in favor of a new container free of such impurities.

After removal from cold storage, the hardener (and resin) may be brought to room temperature with a heat lamp, or by placing on the surface of the heated casting plate. The lid should be loosened, but not removed. Keeping the lid on during warm-up is necessary to avoid humidity condensation.

The amount of plastic required must be calculated in advance according to the size and thickness of the sheet to be cast. The total amount of plastic (resin plus hardener) is determined by:

$$W = 18.5 \times A \times t \text{ (English Units in inches)}$$

$$[W = 1.13 (10^{-3}) \times A \times t \text{ (Metric Units in mm)}]$$

where : W = the total amount needed in grams,

A = the area of the sheet to be cast (width x length),

t = the desired thickness.

Note: Plastic density = 18.5 gm/in³ [1.13 x 10⁻³ gm/mm³].

Example: To cast a sheet 7 in x 8 in x 0.10 in thick, the total amount of plastic required is:

$$W = 18.5 \times [8 \times 7] \times 0.10 = 104 \text{ grams}$$

Resin/Hardener Proportion - The amount of hardener required is calculated in parts per hundred, or "pph". In other words, 10 pph of hardener means 10 grams of hardener for 100 grams of resin. For type PL-3 plastic, the hardener amount is 150 pph.

Continuing with the above example, if 104 grams of mixed plastic is required, the resin/hardener amounts are calculated as follows:

$$\text{PL-3 Resin: } 104 \times 100 / 250 = 41.6 \text{ grams}$$

$$\text{PLH-3 Hardener: } 104 \times 150 / 250 = 62.4 \text{ grams}$$

Weigh out the proper amounts of resin and hardener, in separate mixing cups, using an accurate scale (± 0.01 gram). Six-ounce plastic-coated are recommended for mixing. Do not use wax-coated containers. Remember to account for the weight of the mixing cup when weighing. Prior to mixing, both the resin and hardener should be warmed to at least +130°F [+54°C], but never higher than +135°F [+57°C]. Warming will lower the viscosity of the resin and facilitate a more uniform mix with the hardener. As noted in Application Note B-221, the mold (casting plate) must be warmed to 150° [+66°C] for about 1 hour before pouring the plastic. This will allow the mixed plastic to flow properly after pouring.

Note: It is not necessary to weigh the material when using the PL-3 80-gram kit, since the exact proportions of both resin and hardener have been pre-weighed. To use the pre-weighed kit, the contents of the hardener are simply emptied into the resin container after warming.

*Hardener should be stored at 40° [5°C].

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Add the hardener to the resin and stir with a stem thermometer. It is very important to achieve a uniform mixture prior to pouring the resin on the casting plate. Stir slowly using a circular motion. Do not use a whipping action when stirring, which will introduce an excessive amount of air bubbles. Stir slowly, but thoroughly, for about 15 minutes to achieve a clear non-streaking mixture. As stirring progresses, the temperature rise caused by the exothermic reaction must be continually monitored with the stem thermometer. When the temperature reaches 140°F [60°C], the plastic is ready to be poured onto the casting plate. While casting plate temperature is still at 150°F, proceed to pour the mixed resin onto the plate.

When pouring, keep the cup as close as possible to the surface of the casting plate. This technique will minimize the possibility of air bubbles forming. Also, when pouring sheets, move the cup over the casting plate area to improve flow to all edges of the mold.

After the resin has been poured, it will begin to flow out and fill the mold. The stem thermometer may be used to help spread the resin evenly. (The resin will eventually level itself out with time.) After pouring, cover the mold with the plexiglass cover to keep out dirt and to avoid dust settling on the plastic during its polymerization. Allow the casting plate to remain at 150°F for an additional 10 minutes and then shut it off. The approximate time for the cast PL-3 sheet to reach the contourable stage is approximately 1 hour, depending on size, thickness, and cure environment.

Instructions for monitoring the polymerization cycle, removing the semi-polymerized sheet from the casting plate, and contouring the sheet to the test-part surface are presented in Application Note B-221, "Instructions for Casting and Contouring PhotoStress Sheets".

Important Note: These instructions apply for environmental temperature conditions between 70° to 75°F [21° to 24°C] only. Because PL-3 is exothermic, its polymerization time is shortened by higher temperatures and/or casting thicker sheets. Casting of thin sheets at lower environmental temperatures lengthens polymerization time.

PL-3 Optical and Mechanical Properties

K-Factor: 0.002 nominal, calibration required for precise value

Maximum Elongation: >50%

Modulus of Elasticity: 200 psi [0.0014 GPa] after 1 min at constant strain

Strain Optic Sensitivity Constant To: 90°F [32°C]

Transparency: Excellent. Will not appreciably darken with time.

CAUTION

Epoxy resins and hardeners may cause dermatitis or other allergic reactions, particularly in sensitive persons. The user is cautioned to: (1) avoid contact with either the resin or hardener; (2) avoid prolonged or repeated breathing of the vapors; and (3) use these materials only in well-ventilated areas. If skin contamination occurs, thoroughly wash the contaminated area with soap and water immediately. In case of eye contact, flush immediately and secure medical attention. Rubber gloves and aprons are recommended, and care should be taken not to contaminate working surfaces, tools, container handles, etc. Spills should be cleaned up immediately. For additional health and safety information, consult the Safety Data Sheet.

Refer to these publications for detailed information on:

Tech Note TN-704, "How to Select PhotoStress Coatings."

Document 11222, "PhotoStress Coating Materials and Adhesives."

Application Note B-221, "Instructions for Casting and Contouring PhotoStress Sheets."

Application Note B-223, "Instructions for Bonding Flat and Contoured PhotoStress Sheets."

For applications involving special materials or unusual testing conditions, consult Micro-Measurements Applications Engineering Department.

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