Instructions for Mixing Type PL-1 Liquid Plastic

Introduction

PL-1 is a room-temperature-curing resin/hardener system for making contourable PhotoStress plastic sheets. It has the highest K-factor (strain optical constant) of any PhotoStress contourable plastic (approximately 0.10) and is, therefore, the most widely used for coating complex-shaped parts. PL-1 is primarily used to coat metals and many other high-modulus materials exhibiting elongations of less than 5%. PL-1 will darken with time, and is therefore not recommended for long-term tests.

Shelf Life

Shelf life is 12 months for unopened containers stored at +75°F [+24°C]. PLH-1 hardener is light and moisture-sensitive. Light will cause the hardener to darken and moisture will retard the rate of polymerization with the resin. Once containers are opened, the materials should be used as soon as possible. Shelf life of opened materials, even after tightly resealing containers, may be significantly reduced. Refrigeration of PhotoStress resins and hardeners is not recommended, as condensation may shorten shelf life. Refrigerated containers must be allowed to reach room temperature before opening.

Important: These instructions apply for environmental temperature conditions between 70° to 75°F [21° to 24°C] only. Because PL-1 undergoes an exothermic reaction while curing, its polymerization time is shortened by higher temperatures and/or casting thicker sheets. Casting of thin sheets at lower environmental temperatures lengthens polymerization time.

Application

1. ***Surface Preparation of the Test Part for Contouring*** - Detailed instructions, given in Application Note IB-221, must be followed without exception in order to achieve high-quality contoured sheets.

2. ***Preparation of the Casting Plate*** - Detailed instructions, given in Application Note IB-221, must be followed without exception in order to achieve high-quality contoured sheets.

3. ***Preparation of the Plastic*** - 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:

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

$[W = 1.13 (10^{-3}) \times A \times t$ (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/in^3 [1.13 x 10^{-3} gm/mm^3].

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

$W = 18.5 \times [8 \times 7] \times 0.10 = 104$ 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-1 plastic, the hardener amount is 18 to 20 pph.

Continuing with the above example, if 104 grams of mixed plastic is required, the resin/hardener amounts are calculated as follows (using 20 pph of hardener):

PL-1 Resin: 104 x 100 / 120 = 86.67 grams

PLH-1 Hardener: 104 x 20 / 120 = 17.33 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 cups, like Part No. 012-8, 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 90°F [32°C], but never higher than 110°F [43°C]. Warming will lower the viscosity of the resin and facilitate a more uniform mix with the hardener. As noted in Application Note IB-221, the mold (casting plate) must be warmed to 100° to 110°F [38° to 43°C] for at least 30 minutes 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-1 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.

Add the hardener to the resin and stir with a stem thermometer (Part No. 012-6). It is very important to

achieve a uniform mixture prior to pouring the resin onto the casting plate. Stir slowly using a circular motion. Do not use a whipping action when stirring, as this will introduce an excessive amount of air bubbles. Stir slowly, but thoroughly, 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 125° to 130°F [52° to 55°C], the plastic is ready to be poured onto the casting plate. Immediately prior to pouring the mixed plastic, set the temperature control switch on the casting plate heat controller to the OFF position.

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 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. The time for the cast PL-1 sheet to reach the contourable stage is approximately 1-1/2 hours, depending on size, thickness, and cure environment.

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

PL-1 Optical and Mechanical Properties

K-Factor: 0.094 nominal, calibration required for precise value

Maximum Elongation: 3 to 5%

Modulus of Elasticity: 420 000 psi [2.9 GPa]

Poisson's Ratio: 0.36

Maximum Usable Temperature: 450°F [232°C]

Strain-Optic Sensitivity Constant To: 180°F [82°C]

Transparency: Excellent. Will generally darken after 2 to 3 months.

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 Material 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 IB-221, "*Instructions for Casting and Contouring PhotoStress Sheets*."

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

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