

Instructions for Brushing PhotoStress® Coatings on Test Part Surfaces

Introduction

For accurate quantitative analysis using PhotoStress®, application of the photoelastic coating material is best accomplished using pre-manufactured sheets if the surface is flat, or the contoured sheet technique for complex-shaped surfaces. However, it is possible to brush the coating on by using liquid material and keeping the following limitations in mind:

- a. The part being coated must be heated.
- b. Achieving a good-quality coating of sufficient and uniform thickness for general stress analysis testing is difficult.

Because of the above limitations, application of brush-on coatings is normally reserved for flat, or nearly flat, parts that will be subjected to strain magnitudes in the post-yield range of deformation. In this instance, the coating thickness, which is directly related to its photoelastic response, is of lesser importance due to the very high strains present.

Surface Preparation of the Test Part

One parts with reflective surfaces (steel, aluminum, titanium, etc.), all that is required is a thorough cleaning so the surface will accept the PhotoStress liquid plastic. Recommended cleaning procedures for different materials are given in Application Note B-223, "Instructions for Bonding Flat and Contoured Photoelastic Sheets to Test Part Surfaces".

On non-reflective surfaces (such as plastics, composite materials, rubber, etc.), the surface of the part should be cleaned, and then sprayed with aluminum paint. After painting, the surface should be allowed to dry thoroughly before proceeding with the brush-on PhotoStress material.

Note: It is important to confirm that adhesion between the reflective paint and the test part material will be adequate for the strain range expected.

For tests on low-modulus materials like rubber, a reflective coating having high-elongation capability is preferred.

Selection of PhotoStress Coating Material

Any of the available liquid plastics normally used to make controllable sheets can be used for brush-on applications.

The material choices are as follows:



Figure 1 – PhotoStress coating being brushed on steel test specimens of different alloy content for the purpose of studying the post-yield strain behavior.

- For coating metal or other high-modulus materials, PL-1 or PL-10 is normally used.
- For coating low-modulus materials or metals that will be subjected to very large deformations (>5% elongation), choose either PL-2 or PL-3.

The specific physical properties (modulus, elongation, etc.) of all PhotoStress coating materials are given in Document 11222, "PhotoStress Coatings and Adhesives".

Plastic Preparation and Application

Before brushing the PhotoStress coating on the test part, the surface must be heated to a nominal temperature of 150°F [65°C] for PL-1 and PL-10, and 180°F [80°C] for PL-2 and PL-3. This temperature must be maintained during the coating application. Depending on the size of the part, heating can be accomplished in an oven or with infrared lamps.

After the test part surface has been heated, calculate the amount of resin and hardener required for the desired coverage. (See Application Note B-221, "Instructions for Casting and Contouring Photoelastic Sheets", for resin-hardener amounts for the different coating materials.) Mix the hardener and resin thoroughly with a glass rod until a non-streaking, clear liquid is obtained. Slow mixing will avoid excessive air bubbles. Mixing time will depend on the amount of material being prepared; for example,

80 grams will take approximately ten minutes. After the material is mixed, it can be poured into a shallow container in order to spread the liquid mass over a larger area and thus extend pot life.

Note: It is important to remember that an exothermic reaction is taking place as the material is mixed; therefore, uninterrupted stirring is necessary to obtain a clear, non-streaking liquid. The material should immediately be applied to the test part after stirring. The pot life of the mixed material will depend on the amount prepared. As an example, 50 grams of PL-10 will have a nominal pot life of approximately 30 minutes after mixing, while larger amounts will have a lesser time.

Use a disposable brush to apply a thin layer of liquid plastic on the part. As the plastic begins to set, smoke may rise from the surface. After a few minutes, the coating will be hard and the second coat can be applied. (Hardness can be checked with a pointed object.) Repeat this procedure until the desired thickness is reached. The practical maximum thickness that can be applied using this procedure is about 0.020 in [0.5 mm]. After achieving the desired thickness, continue to cure under heat for approximately 20 minutes, and then remove from the heat source and allow to cool to room temperature. The part will now be ready for testing.

Using the brush-on method on flat surfaces will usually yield a smooth, fairly even thickness as the successive layers are applied. On irregular surfaces, the cured coating can be smoothed to an even thickness by working the surface with fine (400-grit) silicon carbide paper. After smoothing the surface, it can be coated with mineral oil to restore transparency.

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 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 Bulletins for detailed information on:

- TN-704 *"How to Select Photoelastic Coatings"*.
- Document 11222 *"PhotoStress Coating Materials and Adhesives"*.
- B-221 *"Instructions for Casting and Contouring Photoelastic Sheets"*.
- B-223 *"Instructions for Bonding Flat and Contoured Photoelastic Sheets to Test-Part Surfaces"*.
- B-241 *"Instructions for Mixing Type PL-10 Liquid Plastic"*.

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