The Institute for Interconnecting and Packaging Electronic Circuits
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IPC-TM-650
TEST METHODS MANUAL

Number	
2.3.31	
Subject	
Relative Degree of Cure in U.V. Curable Materials	
Date	Revision
2/88	**Reaffirmed**
Originating Task Group	
N/A	

1.0 Scope This test method is designed to determine relative degree of cure in liquid U.V. curable materials such as etch resists, plating resists and solder masks. It is not applicable to dry film products nor to solvent-based thermal cure products.

2.0 Applicable Documents None

3.0 Test Specimens Test specimens are formed in the apparatus described below.

4.0 Apparatus

4.1 Degree of Fineness Gauge, Model PB-20

4.2 U.V. curing unit

4.3 Mold release

5.0 Procedure

5.1 Test Conditions The cure unit shall be operated at 3 meters [10 feet] per minute conveyor speed with two focused lamps rated at 200 W/inch operating at full power.

5.2 Test Specimen Preparation Clean the surface of the Degree of Fineness Gauge and apply a thin coat of mold release. Remove excess release. One release application should last through several tests.

Place a quantity of the material to be tested sufficient to fill the trough in the deep end of the trough. Level with the straight edge supplied. Repeat in the second trough.

5.3 Cure Place the gauge on the conveyor belt. Allow it to pass through the machine. Orient the long axis of the gauge parallel to the long axis of the cure unit. See notes for precautions.

5.4 Results and Evaluation Remove the gauge from the cure unit's conveyor. Carefully remove the cured films from the troughs beginning at the deep end. Use a small, thin blade (microspatula) to aid removal.

Examine the bottom surface of the film and the trough surface. Record the following points using the gauge markings starting from 0 (zero) mils:

a. The last point at which the film's bottom surface is dry and tack free and last point at which the trough shows no residue;

b. The last point at which the film's bottom surface is tacky and/or soft but not wet and at which the trough has a soft or tacky but not wet residue.

The regions of dry, tacky and wet are not always delineated by a straight line. At times, a finger of tacky or wet material will exist in the trough center with dry or tacky material, respectively, at the trough sides. Other materials will exhibit the opposite phenomena—tacky or wet residue on the trough sides surrounding a finger of a dry area or tacky residue, respectively, in the center. Therefore, for evacuation purposes, the point in (a) is taken as the point at which there is no residue across the width of the trough or the width of the film's bottom surface. The point in (b) is the last point at which there is a dry or tacky but not wet residue across the film's bottom surface or across the width of the trough.

The point in (a) represents the maximum depth of cure that can be expected with materials tested. This depth should be the minimum as specified or as agreed by the vendor and user.

6.0 *Notes*

6.1 Precautions Some cure units have openings beneath the conveyor belt in the lamp section for air-flow or other considerations. If these openings are wide enough, the back of the gauge may cause the belt to deflect into this opening. This will raise the front end of the gauge—possibly jamming it against the housing. A few strategic metal strips to prevent large belt deflections or a large, thin piece of material under the gauge to distribute its weight will eliminate this problem.

6.2 Background This test method is based on the chemistry of U.V. curing. As light enters the U.V. coating, it is absorbed by various molecular species. The most important are the photoinitiator molecules. Curing will not take place unless a sufficient number of these molecules absorb light to eventually yield free radicals. At some point below the surface of the coating, there is insufficient light intensity to convert photoinitiator molecules to free radicals or there are too few radicals for effective polymerization.

By holding the light intensity and the exposure time (i.e., conveyor speed) constant, while varying the applied thickness in the trough, the coating's ability to make efficient use of light intensity and time can be evaluated. Thus, the dry tacky and wet regions on the cured film's bottom surface represent the regions of good, poor and no cure.

6.3 References

IPC-TP-324 ''Determining Relative Degree of Cure in U. V.-Curable Process Resists'', by W. R. Collins.

6.4 Suppliers

1. Model PB-20, Fineness of Grind Gauge available from Precision Gage &Tool Co., 28 Volkenand Avenue, Dayton, Ohio 45410, (513) 254-8404.
2. Gordon's Permuasil® Carnauba Wax Mold Release, M. J. Gordon Co., McKees Rock, PA 15136.