



# IPC-TM-650 TEST METHODS MANUAL

**1.0 Scope** This method is designed for determining the treated weight of a specific area of prepreg. Treated weight is an alternative to Resin Content Percent as a means of determining the usability and functionality of prepreg. This method is applicable to both organic and inorganic reinforcements but effective use of this technique requires knowledge of resin and reinforcement specific gravity, as well as basis weight of the reinforcement.

## 2.0 Applicable Documents

**IPC-EG-140** Specification for Finished Fabric Woven From "E" Glass for Printed Board

**IPC-SG-141** Specification for Finished Fabric Woven From "S" Glass

**IPC-A-142** Specification for Finished Fabric Woven From Aramid for Printed Boards

**IPC-QF-143** Specification for Finished Fabric Woven From Quartz (Pure Fused Silica) for Printed Boards

### IPC-TM-650

Method 2.4.38, Prepreg Scaled Flow Testing

Method 2.3.16, Resin Content of Prepreg by Burn-off

## 3.0 Test Specimens

**3.1 Size** The prepreg specimen shall be two or more die cut plies. Each ply shall be  $140 \pm 0.25$  mm [ $5.5 \pm 0.01$  in] by  $178 \pm 0.25$  mm [ $7.0 \pm 0.01$  in]. Use of the specimen for scaled flow test (IPC-TM-650, Method 2.4.38) is recommended. See 2.4.38 for additional criteria.

Alternate specimen sizes such as 102 mm x 102 mm [4 in x 4 in] or 457 mm x 610 mm [18 in x 24 in] are acceptable by agreement between supplier and user.

**3.2 Quantity and Sampling** Unless otherwise specified, three specimens shall be taken from the lot at randomly selected locations, whether taken from a roll or from precut panels. Specimens shall be taken from the fabric roll (as supplied by the manufacturer) no closer to the selvage (or cut edge) than a distance equal to one-tenth of the width of the roll.

## 4.0 Apparatus or Material

Number <b>2.3.16.2</b>	
Subject <b>Treated Weight of Prepreg</b>	
Date <b>12/94</b>	Revision
Originating Task Group <b>MIL-P-13949 Test Methods Task Group (7-11b)</b>	

**4.1** Analytical balance capable of weighing to the nearest 0.001g.

**4.2** Static shield (a thin piece of metal, e.g., 7 oz copper foil at least 25.4 mm [1.0 in] larger in length and width than the prepreg specimen). This is not required if the balance pan is larger than the specimen.

**4.3** Sample cutting press with die  $140 \pm 0.25$  mm x  $178 \pm 0.25$  mm [ $5.50 \pm 0.01$  in x  $7.00 \pm 0.01$  in].

**4.4** Kraft paper or equivalent back up material for cutting press.

**4.5** Desiccator capable of maintaining an atmosphere less than 30% R.H. at 23°C [73°F].

## 5.0 Procedure

### 5.1 Specimen Preparation

**5.1.1** Cut the specimens to the specified size and configuration, see 3.1.

**5.1.2 Preconditioning** Unless the prepreg is tested within 10 minutes of production, the specimen shall be desiccated for a minimum of 4 hours. For referee testing, the specimens shall be desiccated.

**5.2 Test Conditions** The test shall be performed at standard laboratory conditions. For materials which absorb moisture rapidly, care should be taken to insure that moisture content is not significant by measurement immediately after removal from desiccation.

**5.3 Equipment Setup** Place the static shield on the balance pan and zero the balance.

### 5.4 Measurement

**5.4.1** Place each specimen on the balance, ensuring that it sits entirely on the static shield.

**5.4.2** Determine and record the treated weight of each specimen to the nearest 0.001g.

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## 5.5 Report

**5.5.1** Average the individual specimen weight and report the average per ply treated weight to the nearest 0.001g per 25.4 sq mm [1.0 sq in] .

## 6.0 Notes

**6.1** The volatile content of the prepreg (excluding moisture) is considered part of the treated weight using this method. If it is desired to exclude volatile content, the specimen should be baked for an appropriate time and temperature.

**6.2** The effect of static charges may present a serious problem in weighing material if the specimen size is greater than the sample pan.

**6.3** If it is desired to check variation across or along the web, individual specimens should be taken from the location in question.

**6.4** If it is desirable to check the weight uniformity of the reinforcement, this can be done by burn-off similar to IPC-TM-650, Method 2.3.16, if inorganic.

**6.5 Calculations** Treated weight can be used to specify and/or predict prepreg thickness and resin content. Equations to calculate thickness and resin content for woven fabric "E"-glass reinforced epoxy FR-4 prepreg are given below. The calculations assume a resin specific gravity of 1.37 gr/cc and an "E"-Glass specific gravity of 2.59 gr/cc.

Woven "E"-glass fabric nominal dry weights and tolerances are assumed the values given in IPC-EG-140. **The nominal dry weights and tolerances for other reinforcements, such as "S" glass, woven aramid, and quartz fabric, can be found in IPC-SG-141, IPC-A-142, IPC-QF-143.** Appropriate values for the specific gravities of other resins and reinforcements and the basis weights of other reinforcements are the responsibility of the vendor or can be negotiated between vendor and user. Inorganic reinforcement basis weight can be measured as given in 6.4.

**6.5.1 Resin Content** The resin content can be calculated from the average per ply treated weight and the measured or nominal unit glass fabric weight. Conversely, the treated weight can be calculated from the resin content. Equations to calculate both are shown below:

$$RC = \left(1 - \frac{BW}{TW}\right) \times 100$$

$$TW = \frac{BW}{1 - (RC/100)}$$

Where:

RC = resin content by weight  
 TW = treated weight (weight per area per ply)  
 BW = unit basis weight (weight per area per ply)

**6.5.2 Prepreg Thickness** The average prepreg thickness can be calculated using the average per ply treated weight and the measured or nominal unit glass fabric weight. Equations to calculate prepreg thickness for Scaled Flow test sized specimens (38.5 square inches per ply) are given below: In general:

$$H_o = \frac{1.585TW}{d_r} - \frac{1.585W_f (d_f - d_r)}{d_f d_r}$$

For "E"-glass reinforced FR-4 epoxy prepreg:

$$H_o = 1.157 TW - 0.545 W_f$$

Where:

H<sub>o</sub> = prepreg thickness (mils per ply)  
 TW = treated weight (weight per 38.5 sq in per ply)  
 W<sub>f</sub> = unit glass fabric weight (weight per 38.5 sq in per ply)  
 d<sub>r</sub> = resin density (grams per cubic centimeter)  
 d<sub>f</sub> = fabric fiber density (grams per cubic centimeter)

**6.6 Desiccator Conditions** The Test Methods Task Group determined that a great majority of test laboratories are unable to consistently hold the Relative Humidity in a desiccator to less than 20%. Based on data from participating company lab management, the lowest practically feasible RH for use with the affected IPC Test Methods is 30% maximum.