



## BF 180D

### Experimental Epoxy Resin System

#### Description

BF 180D Experimental Epoxy Resin System is a bromine-free, two component system consisting of XZ 92740.00 Experimental Epoxy Resin Solution and XZ 92741.00 Experimental Epoxy Hardener in a blend of solvents that enables best treater processing. It is designed for the production of FR-4 type rigid and multilayer electrical laminates for printed wire boards. This system features high Tg/Td, low Dk/Df and is bromine-free. The system can pass the UL94 V-0 requirement without additional fillers. The material has outstanding thermal resistance which makes it suitable for lead-free soldering. It offers improved signal integrity and higher signal transmission rates due to lower dielectric constant and loss. Testing shows, that this new epoxy resin system reduces the laminate's density, which should allow for lighter boards with greater resistance to the thermal stresses during lead-free soldering. The very good adhesion properties obtained from the dicyandiamide (DiCy) cure formulations allows formulators to add inorganic fillers to further reduce the coefficient of thermal expansion (CTE) at high temperatures, which results in improved reliability of the finished board.

#### Typical Applications

This product is suitable for use in applications such as:

- Electrical Laminates
- Flame Retardant Coatings
- Composites

#### Typical Properties

Property <sup>(1)</sup>	Value	Method
<b>XZ 92740.00 Experimental Epoxy Resin Solution</b>		
Solid Content (wt%)	84 – 86	ASTM D-1295
Viscosity @ 25°C (mPa·s)	2500 – 5000	ASTM D-445
<b>XZ 92741.00 Experimental Epoxy Hardener</b>		
Solid Content (wt%)	53 – 59	ASTM D-1295
Viscosity @ 25°C (mPa·s)	500 – 2500	ASTM D-445

(1) Typical properties, not to be construed as specifications.

**Typical Mix Ratio** The mix ratio of XZ 92740.00 Experimental Epoxy Resin Solution and XZ 92741.00 Experimental Epoxy Hardener can vary as follows:

- 73 : 64 For best flammability performance.
- 75.3 : 61 Recommended by Dow for the best balance of properties.
- 77.6 : 57.6 Best humidity performance. In this case, V-0 is achieved with the addition of 20% of inorganic fillers such as SiO<sub>2</sub> or aluminium trihydrate (ATH).

The solution ratio should be adjusted according to the corresponding solid content of different components.

For varnish preparation, proceed as follows:

1. Use DMF to make a 20% solids DiCy solution.
2. Use DOWANOL™ PM to make a 20% solids solution of 2-phenylimidazole (2-PI).
3. Add the DiCy and catalyst solution (2-PI) to XZ 92741.00 Hardener and stir until a homogeneous solution is obtained.
4. Add XZ 92740.00 Epoxy Resin Solution.
5. Optionally, add filler and disperse until a homogeneous dispersion is obtained. If necessary, cool the varnish to room temperature in order to avoid an unwanted polymerization. If fillers are used, additional DOWANOL PM can be used in order to retain the target solid content of ~ 65%.
6. Optionally, add additives such as amino- or epoxysilane to improve the interlaminar adhesion in case of higher filler levels.

**Typical Formulations**

**Example of a Typical Starting Formulation**

Material	Solid	Solution
XZ92740.00 Solution (85% solid)	64 – 62	75.3 – 72.9
XZ92741.00 Hardener (59% solid)	36 – 38	61 – 64.4
DiCy (20% DMF)	2.4	12
2-phenylimidazole (20% DOWANOL PM) [2-methylimidazole]	1.6 [0.95]	8 [4.75]
<b>Total</b>	<b>104</b>	<b>156 – 157</b>
Stroke Cure Reactivity (sec)		~230 – 260 [-200 – 220]
Solids	66.5	

The viscosity of the varnish can be adjusted with DOWANOL PM or methyl ethyl ketone (MEK). No additional DMF should be used. In addition to 2-phenylimidazole, any other accelerator can be used; however, the amount needs to be adjusted to obtain the same varnish reactivity.

## Typical Application

### Prepreg Production

The starting formulation as described in above table was used to impregnate 7628 type glass cloth and then passed through a laboratory treater (oven temperature = 175 – 180°C) to yield prepreg with the following target properties:

Typical FR-4 Formulation <sup>(1)</sup>	IPC-TM-650 No.	Value
Resin Content (wt%)	2.3.16.2	40 – 45
Minimum Melt Viscosity (mPa•s) @ 140°C	ICI C&P	130 – 30
Gel Time (sec)	2.3.18	100 – 170
Flow (%)	2.3.17	15 – 25

(1) Typical Values, not to be construed as specification.

The treating conditions must be chosen so that all solvent is evaporated and prepregs have <0.2 wt% of residual solvents.

The resulting prepreg has a very good surface appearance. It should be stored in a cool, dry place to reduce moisture absorption.

### Laminate Production

Laminates were produced using 8 plies of the above prepregs (<0.2 wt% residual solvent) between 2 sheets of 35µm copper foil. The constructions were pressed at 15 kg/cm for a minimum of 90 minutes (effective) at 200°C. Cure schedules can be optimized by Dow to customer needs upon request.

The laminates produced should be compliant with IPC 4101A/94. However, as these materials are experimental in their nature, variability may be encountered that shift the performance out of the specification. It is the customer's responsibility to make sure that the product performs according to the applicable specification. The following table may act as a typical reference profile:

Typical Properties <sup>(1)</sup> (2): FR-4 Formulation	IPC-TM-650	Value Range <sup>(2)</sup>
Peel Strength, minimum B. Standard profile copper (N/mm)	2.4.8.2	>1.6
Glass Transition (DSC) (°C)	2.4.25	>175
Moisture Absorption (%)	2.6.16	0.2-0.3
Time to Delamination (288°C) min.	2.4.24.1	>30
Permittivity at 1 MHz, max	2.5.5.2 & 3&9	<4.3
Loss Tan. at 1 MHz, max	2.5.5.2 & 3&9	<0.015
Flammability Rating	UL 94	V-0

(1) Typical properties, not to be construed as specifications.

(2) The results of small scale tests are not intended to reflect hazards associated with this or any other material under actual fire conditions.

## Safety and Handling

BF 180D Experimental Epoxy Resin System is a bromine-free, two components solution of epoxy resin in non-reactive solvents. Because of the possible hazards of the solvents used, solutions may be more hazardous to handle than the pure resins alone. Solutions may be much more irritating to the skin and eyes. These solutions are hazardous from inhalation with the potential to cause central nervous system depression (including signs such as dizziness and drowsiness followed by unconsciousness or even death) and other systemic effects. The solvents have exposure guidelines from the American Conference of Governmental Industrial Hygienists (ACGIH). The Threshold Limit Value (TLV) varies according to the specific solvent employed. The resin solutions containing solvent are more flammable than solid resins alone, with fire and explosion hazard again related to the solvent used. Hazard from ingestion is generally low but several of the solvents may cause chemical pneumonia if aspirated into the lung. Additional references related to hazards and storage include the *DOW Epoxy Resins Product Stewardship Manual, Safe Handling and Storage*, Form No. 296-00312, and the Material Safety Data Sheet (MSDS) or Safety Data Sheet (SDS) for this product.

## Product Stewardship

The Dow Chemical Company has a fundamental concern for all who make, distribute, and use its products, and for the environment in which we live. This concern is the basis of our Product Stewardship philosophy by which we assess the health and environmental information on our products and then take the appropriate steps to protect employee and public health and the environment. The Dow Chemical Company has enduring commitments to Responsible Care® in the management of chemicals worldwide. Our Product Stewardship program rests with every individual involved with Dow products from the initial concept and research to the manufacture, sale, distribution, and disposal of each product.

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Dow encourages its customers and potential users of Dow products to review their applications for such products from the standpoint of human health and environmental quality. To help ensure that Dow products are not used in ways for which they were not intended or tested, Dow personnel are available to assist customers in dealing with ecological and product safety considerations. Your Dow sales representative can arrange for the proper contacts. Dow literature, including MSDS or SDS, should be consulted prior to the use of Dow products.

## Medical Application Policy

Dow will not knowingly sell or sample any product or service ("Product") into any commercial or developmental application that is intended for:

- (a) permanent (long term) contact with internal body fluids or internal body tissues. Long term is a use which exceeds 72 continuous hours;
- (b) use in cardiac prosthetic devices regardless of the length of time involved (cardiac prosthetic devices include, but are not limited to, pacemaker leads and devices, artificial hearts, heart valves, intra-aortic balloons and control systems and ventricular bypass assisted devices);
- (c) use as a critical component in medical devices that support or sustain human life; or
- (d) use specifically by pregnant women or in applications designed specifically to promote or interfere with human reproduction.

Additionally, all Products intended for use in pharmaceutical applications must pass the then current Pharmaceutical Liability Guidelines. For additional information please contact your regular Dow representative.

## Food Contact Applications

This epoxy resin system does not comply with U.S. Food, Drugs and Cosmetics Act as amended under Food Additive Regulation 21 CFR 175.300.

If your applications include food contact requirements, please contact your Dow representative for further information and forthcoming EC regulations. Also consult the Dow data sheet, *Food Additive Status for Epoxy Resins, Curing Agents and Epoxy Novolac Resins*, Form No. 296-01425.

## Regulatory Status

For more information on the regulatory status of this product, please refer to the MSDS or SDS for this product.

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