Technical Data Bulletin

HEXION™
Specialty Chemicals

# EPON™ Resin 828

**RP: 3075** **Re-issued: September 2005**

## Introduction

EPON™ Resin 828 is an undiluted clear difunctional bisphenol A/epichlorohydrin derived liquid epoxy resin. When cross-linked or hardened with appropriate curing agents, very good mechanical, adhesive, dielectric and chemical resistance properties are obtained. Because of this versatility, EPON Resin 828 has become a standard epoxy resin used in formulation, fabrication and fusion technology.

## Features

- Fiber reinforced pipes, tanks and composites
- Tooling, casting and molding compounds
- Construction, electrical and aerospace adhesives
- High solids/low VOC maintenance and marine coatings
- Electrical encapsulations and laminates
- Chemical resistant tank linings, flooring and grouts
- Base resin for epoxy fusion technology

## Typical Properties

| Property | Test Method | Unit | Value |
|---|---|---|---|
| Epoxide Equivalent Weight [1] | ASTM D1652 | g/eq | 185-192 |
| Viscosity @ 25°C [2] | ASTM D445 | P | 110-150 |
| Color | ASTM D1544 | Gardner | 1 max. |
| Pounds per Gallon @ 25°C (77°F) | | lbs/gal | 9.7 |
| Density @ 25°C (77°F) | | g/ml | 1.16 |
| Physical form | | | Clear liquid |
| Vapor pressure @ 77°C (170°F) | | mm Hg | 0.03 |
| Refractive index @ 25°C (77°F) | | | 1.573 |
| Specific heat | | BTU/lb/°F | 0.5 |

[1] ASTM D1652 (Epoxy Content of Epoxy Resins – Perchloric Acid Method)

[2] ASTM D445 (Kinematic Viscosity - Determinatin of the Viscosity of Liauids by Ubbelohde Viscometer).

## General Information

The low viscosity and cure properties of EPON Resin 828 allow its use under various application and fabrication techniques including:

- Spraying and brushing
- Filament winding
- Pressure laminating
- Vacuum bag laminating
- Pultrusion
- Casting
- Molding
- Toweling

## Curing Agents

EPON Resin 828 can be cured or cross-linked with a variety of curing agents depending on properties desired in the finished product and the processing conditions employed. Some commonly used curing agents, recommended concentrations, typical cure schedules employed in major end-use applications, plus sources for these curing agents are displayed in Table 1.

## Perfomance Characteristics of Cured EPON Resin 828

### Mechanical Properties

High performance, high strength materials are obtained when this resin is cured with a variety of curing agents. Unfilled systems in common use have tensile values greater than 10,000 psi (69 MPa) with modulus values greater than 400,000 psi (2750 MPa). Such systems are normally very rigid. If greater flexibility is needed systems can be formulated to provide up to 300% elongation.

### Adhesive Properties

One of the most widely recognized properties of cured EPON Resin 828 is strong adhesion to a broad range of substrates. Such systems exhibit shear strength of up to 6,000 psi (41 Mpa). One factor which contributes to this property is the low shrinkage shown by these systems during cure. Compared to other polymers, epoxy resins have low internal stresses resulting in strong and durable finished products.

### Electrical Properties

EPON Resin 828 cured systems have very good electrical insulating characteristics and dielectric properties. For example, systems can be obtained with anhydride and amine curing agents having volume resistivities up to 1 x 1016 ohm-cm, dielectric constants of 3-5 and dissipation factors of 0.002 to 0.020 at ambient conditions. Electrical encapsulations, laminates and molding compounds are frequently based on EPON Resin 828.

### Chemical Resistance

Cured EPON Resin 828 is highly resistant to a broad range of chemicals, including caustic, acids, fuels and solvents. Chemically resistant reinforced structures and linings or coatings over metal can be formulated with EPON Resin 828.

### Formulating Techniques

The primary components of a thermosetting resin formula are the epoxy resin and the hardener or curing agent. However, in practice other materials are normally incorporated to achieve special properties. For example, inert fillers such as silicas, talcs, calcium silicates, micas, clays and calcium carbonate can be added to further reduce shrinkage and improve dimensional stability. Also, reactive diluents can be added to EPON Resin 828 to reduce viscosity. The effect on viscosity by adding such materials is shown in Figure 1.

Table 1 / **Curing Agents for EPON™ 828**

| Curing Agent [1] | Physical State | Recommended Concentration range, phr [2] | Typical Cure Schedule Time °C (°F) | Deflection Temperature [3] °C (°F) | Applications [4] | Suppliers [5] |
|---|---|---|---|---|---|---|
| Aliphatic Amines | | | | | | |
| EPIKURE™ 3223 (DETA) | Liquid | 12 | 7d, 25(77) | 120(250) | ABCDEFHI | 5 |
| EPIKURE 3234 (TETA) | Liquid | 13 | 7d, 25(77) | 120(250) | ABCDEFHI | 5 |
| EPIKURE 3200 (AEP) | Liquid | 22 | 24h, 25(77) & 1h, 150(300) | 120(250) | BCEFGH | 5 |
| EPIKURE 3270 | Liquid | 75 | 14d, 25(77) | 56(133) | ABCDEFHI | 5 |
| EPIKURE 3271 | Liquid | 18 | 14d, 25(77) | 66(151) | ABCDEFHI | 5 |
| EPIKURE 3274 | Liquid | 40 | 14d, 25(77) | --- | ABCDEFHI | 5 |
| EPIKURE 3230 | Liquid | 35 | 7d, 25(77) | 68(155) | ABCDEFHI | 1 |
| D-400 Type PEA | Liquid | 55 | 30 min, 115(240) | 31(88) | ABCEFH | 1 |
| Cycloaliphatic Amines | | | | | | |
| EPIKURE 3370 | Liquid | 38 | 7d, 25(77) | 56(133) | ABCDEFHI | 5 |
| EPIKURE 3382 | Liquid | 63 | 7d, 25(77) | 63(145) | ABCDEFHI | 5 |
| EPIKURE 3383 | Liquid | 60 | 24h, 25(77) & 2h, 100(212) | 54(129) | ABCDEFHI | 5 |
| Polyamides | | | | | | |
| EPIKURE 3115 | Liquid | 120 | 1h, 100(212) | 85(185) | AB | 5 |
| EPIKURE 3125 | Liquid | 90 | 7d, 25(77) | 90(195) | ABCEFH | 5 |
| EPIKURE 3140 | Liquid | 75 | 7d, 25(77) | 115(240) | ABCEFH | 5 |
| Amindoamines | | | | | | |
| EPIKURE 3015 | Liquid | 50 | 16h, 25(77) & 2h, 93(200) | --- | ABCDEFHI | 5 |
| EPIKURE 3055 | Liquid | 50 | 16h, 25(77) & 2h, 93(200) | 67(153) | ABCDEFHI | 5 |
| EPIKURE 3072 | Liquid | 35 | 14d, 25(77) | 59(138) | ABCDEFHI | 5 |
| Aromatic Amines | | | | | | |
| EPIKURE W | Liquid | | | | | 5 |
| Metaphenylenediamine (MPDA) | Solid | 14 | 2h, 80(175) & 2h, 150(300) | 150(300) | BCDGHI | 3 |
| Methylene dianiline (MDA) | Solid | 27 | 2h, 80(175) & 2h, 150(300) | 160(320) | BCDEGHI | 13 |
| Diaminodiphenyl Sulfone (DADS) | Solid | 25 | 5h, 125(257) & 1h, 200(392) | 170(350) | BCDGHI | 2, 13 |

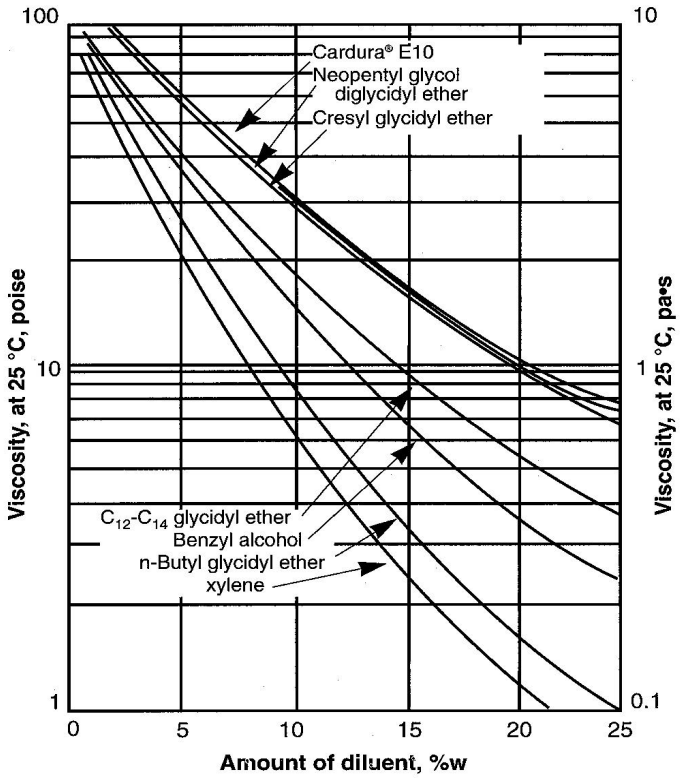
Table 1 / **Curing Agents for EPON™ 828 (cont.)**

| Curing Agent [1] | Physical State | Recommended Concentration range, phr [2] | Typical Cure Schedule Time °C (°F) | Deflection Temperature [3] °C (°F) | Applications [4] | Suppliers [5] |
|---|---|---|---|---|---|---|
| Anhydrides | | | | | | |
| Methyl tetrahydrophthalic Anhydride (MTHPA) | Liquid | 80 | 2h, 120(250) & 2h, 150(300) | 130(266) | BCDGHI | 9, 11, 14 |
| NADIC Methyl Anhydride (NMA) | Liquid | 90 | 1h, 120(250) & 2-24h, 260(500) | 180(356) | BCDGHI | 9, 14 |
| Hexahydrophthalic Anhydride (HHPA) | Solid | 80 | 1h, 80(175) & 2h, 150(300) | 130(265) | BCDGHI | 8, 12, 14 |
| Catalysts and Miscellaneous | | | | | | |
| 2-Ethyl- 4-Methyl Imidazole (EMI-24) | Metastable Liquid | 3 | 4h, 50(122) & 2h, 170(340) | 170(340) | BCDGHI | 15, 16 |
| BF3-Monoethylamine (BF3-MEA) | Liquid | 3 | 1h, 120(250) & 2h, 170(340) | 170(340) | BCDGHI | 17 |
| Diethylaminopropylamine [6] | Solid | 6 | 30 min, 115(240) | 100(212) | ABC | 6 |
| Dicyandiamide | Solid | 4 | 1h, 177(350) | 150(300) | BCDGHI | 18, 19 |

[1] Cures can be effected with these curing agents over a wide range of temperatures. Higher temperatures yield shorter cure times and highest Tg.
[2] Parts of curing agent per 100 parts of resin.
[3] Systems cured at room temperature were post cured at elevated temperature to achieve deflection values.
[4] Application codes: A - Coatings; B - Adhesives; C - Castings; D - Moldings; E - Flooring; F - Paving; G - Electrical Laminates; H - Structural Laminates; I-Filament Winding.
[5] Supplier Code:
1. Huntsman Chemical
2. RSA Corporation
3. E.I. DuPont de Nemours & Co., Chemicals & Pigments Dept.
4. Harshaw Chemical Company
5. Hexion Specialty Chemical
6. BASF Corporation
7. American Cyanamid - Industrial Chemical Div.
8. Milliken & Company
9. Lindau Chemicals, Inc.
10. Anhydrides and Chemicals, Inc.
11. Dixie Chemical Co., Inc.
12. Buffalo Color Corp.
13. Air Products and Chemicals, Inc.
14. Lonza
15. Interchem
16. Polyorganix
17. Atotech
18. SKW Trotsbery
19. Ashland Chemical

[6] Dimethylamino propylamine may be substituted at expense of slightly reduced pot life. Sources are 2 and 16.

Figure 1 / **Viscosity at 25 °C of EPON™ Resin 828 blends with various diluents**




**Fusion Technology**

EPON Resin 828 is the product of choice for a resin chemist using a specific fusion catalyst when processing proprietary solid epoxy resins or epoxy esters. Upon request, Hexion Specialty Chemicals can provide EPON Resin 828 exhibiting extremely low hydrolyzable and total chlorine, two end groups that may be deleterious to resin curing and long term performance in electrical uses.

**FDA Status**

Provisions are made in the FDA regulations for the use of EPON Resin 828, when properly formulated, applied and cured, for food contact applications under Title 21 Code of Federal Regulations 175.300. The regulations should be consulted for complete details. In particular, we direct your attention to subparagraph (b) of 21 CFR 174.5 and the general provisions applicable to indirect food additives listed there.

**Identification and Classification**

**Chemical Abstract Service Registry Number:** 25068-38-6 (EPA/TSCA inventory designation)

**Generic name:** Liquid Bisphenol A Epichlorohydrin based epoxy resin.

**Chemical designation:** Phenol, 4,4O - (1-methylethylidene) bis-polymer with (chloromethyl) oxirane.

Figure 2 / **Viscosity - temperature profile for EPON™ Resin 828**

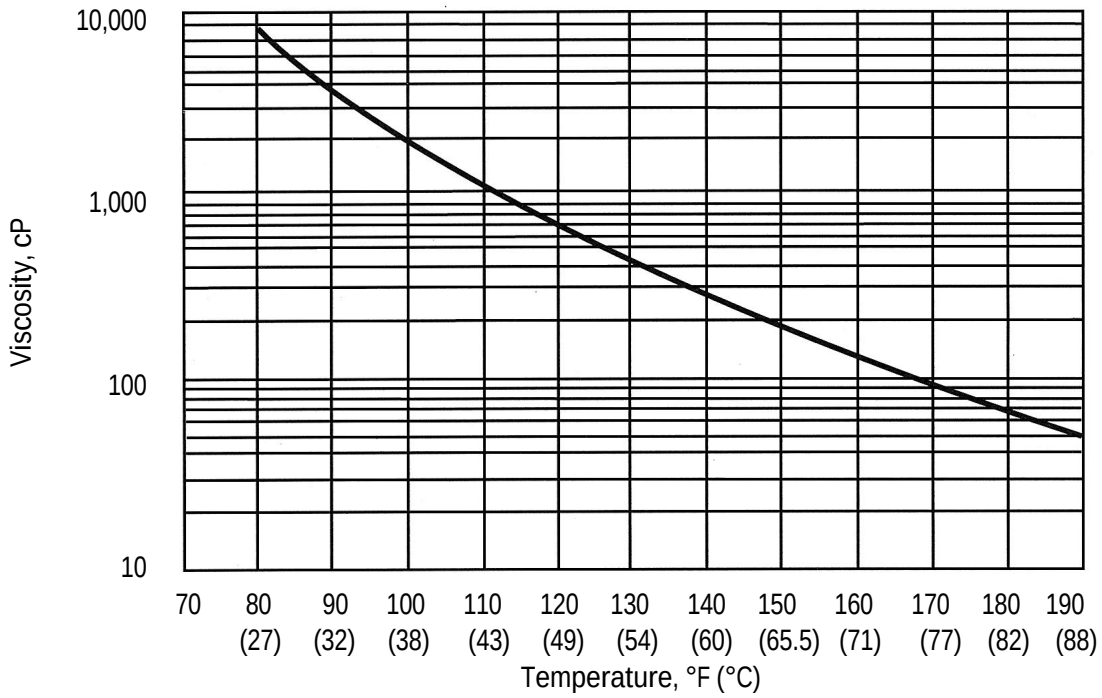
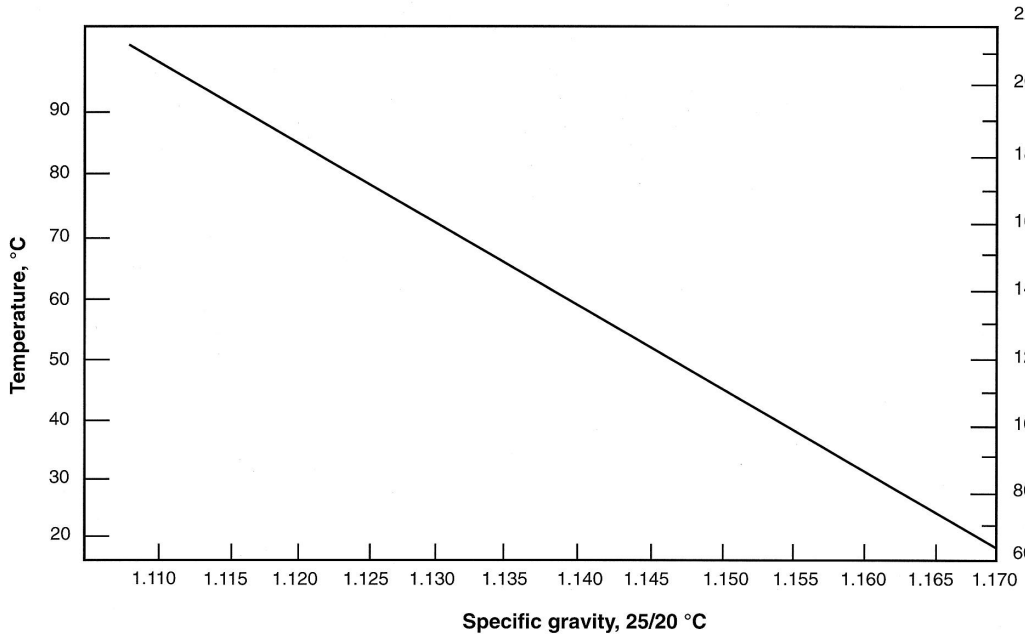


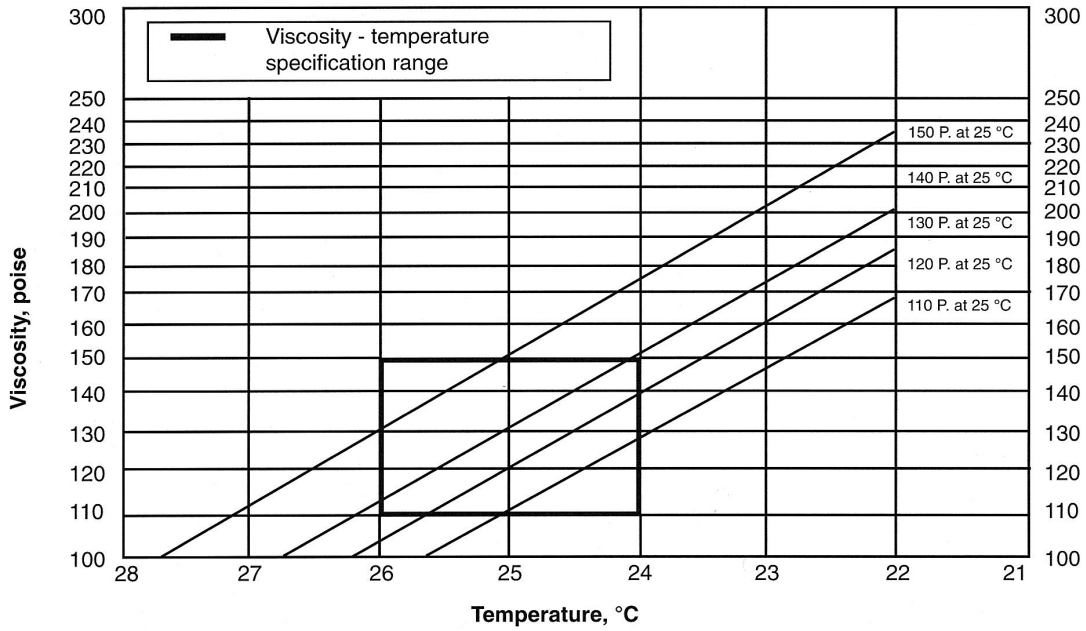

Figure 3 / **Specific gravity - temperature profile for EPON™ Resin 828**



## Formulation and Application Information

For additional performance characteristics information covering adhesives, laminating, casting and molding applications, consult bulletin SC:67, entitled "EPON Resin Structural Reference Manual." For epoxy resin amine-cured coatings, consult bulletin SC:193, entitled "Formulating Amine-Cured Coatings with EPON Resin."

Figure 4 / **Viscosity - temperature profile (for 5 samples of EPON™ Resin 828 ranging in viscosity from 110-150 poise)**




## Packaging and Storage

EPON Resin 828 is an undiluted liquid epoxy resin that is available in tank cars, tank trucks and 500 pound net closed head drums. EPON Resin 828 is normally shipped in bulk from 150 °F (66 °C) to 180 °F (82 °C) and can be stored at 120-140 °F (49-60 °C) for ease of handling. The viscosity/temperature profile and the specific gravity/temperature profile for EPON Resin 828 are displayed in Figures 2 and 3 respectively for your guidance.

EPON Resin 828 is susceptible to crystallization upon prolonged storage at normal ambient temperatures. It may be reconstituted by warming to 120-140 °F for 4-24 hours depending on the mass involved.

**NOTE OF CAUTION:** When checking viscosity of EPON Resin 828 incoming samples, we caution you to make certain that the product is maintained at 25 +/- 0.01 °C before testing. You will note in Figure 4 that EPON Resin 828 can vary in viscosity by 10-15 poise for each degree in temperature the product varies from 25 °C.

According to the Department of Transportation regulations (Code of Federal Regulations, Title 49), EPON Resin 828 is not classified or regulated as a flammable or combustible material. No special labeling is required for transportation.

For more storage information, please visit the “Shelf Life” section of our website at: www.hexion.com

For product prices, availability, or order placement,
call our toll-free customer service number at:
1-877-859-2800

For sales in North and South America outside the United States, call:
1-832-366-2365

For literature and technical assistance, visit our website at:
www.hexion.com

## SAFETY & HANDLING

These products are capable of producing adverse health effects ranging from minor skin irritation to serious systemic effects. Exposure to these materials should be minimized and avoided, if feasible, through the observance of proper precautions, use of appropriate engineering controls, and proper personal protective clothing and equipment, and adherence to proper handling procedures. **None of these materials should be used, stored, or transported until the handling precautions and recommendations as stated in the Material Safety Data Sheet (MSDS) for these and all other products being used are understood by all persons who will work with them.** Questions and requests for information on Hexion Specialty Chemicals, Inc. ("Hexion") products should be directed to your Hexion sales representative, or the nearest Hexion sales office. Information and MSDSs on non-Hexion products should be obtained from the respective manufacturer.

HEXION™

**Hexion Specialty Chemicals, Inc.**
PO Box 4500
Houston, TX 77210-4500

For worldwide locations visit
hexionchem.com