

Starting Formulation

EPIKURE Curing Agent P-101, P-103, P-104 and P-108 Formulation Information

See Table 1. EPIKURE Curing Agents P-101 and P-103 are normally used at a concentration of about 2-4 parts per hundred parts of solid epoxy resin, such as EPON™ Resins 2002-2005. Because powder coatings using EPIKURE Curing Agents P-101 and P-103 are very reactive, they should be melt compounded under low temperature and high shear conditions to limit pre-reaction ("B-staging"), achieve maximum dispersion and minimize the formation of gel particles. The potential for gel formation increases if the curative is not well mixed prior to the start of the melt compounding step. Therefore, EPIKURE Curing Agent P-103 is not recommended for thin film decorative applications, unless it is powdered just prior to usage.

EPIKURE Curing Agents P-104 and P-108 are normally used at a concentration of 4-6 parts per hundred parts of solid epoxy resin. Although EPIKURE Curing Agents P-104 and P-108 are less sensitive to pre-reaction and gelation than EPIKURE Curing Agents P-101 and P-103, good pre-dispersion and moderate extrusion temperatures generally lead to improved appearance and performance.

Figures 1 and 2 show the minimum cure time and temperature which may be used to achieve good powder coating properties with EPIKURE Curing Agents P-101 and P-108, respectively. In this case, good powder coating properties are defined for two mil thick white pigmented powders achieving >100 MEK double rubs and 40-100 inch-pounds reverse impact.

Table 1 / Suggested coating powder formulations

| | Units | P-101 | P-104 | P-108 |
|-------------------------------------|-------|-----------|-----------|-----------|
| EPON™ Resin 2002 | pbw | 91 | --- | 91 |
| EPON Resin 2004 | pbw | --- | 91 | --- |
| EPON Resin 2002-FC-10 | pbw | 10 | 10 | 10 |
| EPIKURE Curing Agent P-101 or P-103 | pbw | 3 | --- | --- |
| EPIKURE Curing Agent P-104 | pbw | --- | 4 | --- |
| EPIKURE Curing Agent P-108 | pbw | --- | --- | 5 |
| Pyrogenic Silica ¹ | pbw | 1 | 1 | 1 |
| Titanium Dioxide, R-900, = 35% | pbw | <u>56</u> | <u>57</u> | <u>58</u> |
| Total | | 161 | 163 | 165 |

| | | | | |
|---|-------------|--------|--------|--------|
| Cured State Coating Properties ² | | | | |
| Cure cycle | minutes/°F | 10/300 | 5/400 | 10/400 |
| Gel time | seconds/°C | 56/150 | 56/175 | 61/200 |
| Gloss 60/20 | % | --- | 97/59 | 100/87 |
| Reverse impact | inch-pounds | P160 | P160 | P160 |
| MEK resistance | double rubs | P100 | P100 | P100 |
| Inclined plate flow | mm | --- | 43 | 76 |
| PCI smoothness | | --- | 1-2 | 7-8 |
| | | | | |

¹ Dry flow aid.Cabot CAB-O-SIL M-5, Degussa AEROSIL 200 or equivalent have been found to give acceptable results.

² Applied at 2 ± 0.2 mils on Bonderite™ 1000 “Q-Panels” and cured at the time and temperature listed.

Figure 1 / Powder coating with 3 phr EPIKURE Curing Agent P-101 minimum time / temperature for cure with a solid epoxy resin like EPON™ Resin 2002 or 2003



Figure 2 / Powder Powder coating with 5 phr EPIKURE Curing Agent P-108 minimum time / temperature for cure with a solid epoxy resin like EPON™ Resin 2002 or 2003



Coating powders cured in the time/temperature region located above the curve give generally good powder coating properties.

EPIKURE Curing Agent P-101, P-103, P-104 and P-108 FDA Acceptability

Please note that some of the EPIKURE Curing Agents P-Series (P-101, P-103, P-104 and P-108) contain a component not specifically listed in 21 CFR. We have conducted extraction tests using several representative epoxy resins and conditions appropriate for these products' intended application. Based on the results of those tests, we have determined to our satisfaction that when used in conjunction with FDA-acceptable epoxy resins, these curing agents meet FDA requirements. Specifically, when properly formulated, applied and cured, we believe that the referenced curing agents are acceptable for food contact applications under the provisions of 21 CFR 175.300 for condition of use E (room temperature filled and stored) for aqueous, acidic, low and high alcohol foods.

However, any use of these products in FDA-regulated applications must be at your discretion and based on your judgment of their suitability for the intended use. Since the application and use of these products are not under our control, the ultimate determination of FDA acceptability of the final food contact product is the responsibility of the end user.

EPIKURE Curing Agent P-101, P-103, P-104 and P-108 Product Description

EPIKURE™ Curing Agents P-101 and P-103 are the reaction products of an epoxy resin and an imidazole. They act primarily as a catalytic type curing agent and may be used as a sole curative or in combination with other materials, such as dicyandiamide. Because of its finely divided powder form, EPIKURE Curing Agent P-101 may be used to prepare both fast curing functional powders and low temperature cure decorative powders (see Table 1). The pastille form of EPIKURE Curing Agent P-103 makes it less suitable for decorative applications (see "Formulation information").

EPIKURE Curing Agents P-104 and P-108 are accelerated dicyandiamide types. They interact with epoxy resins through both catalytic and addition type reaction of the dicyandiamide portion. EPIKURE Curing Agent P-104 is normally used in thick film decorative or functional powder coatings. EPIKURE Curing Agent P-108 is normally used to prepare thin film decorative powders. Typical properties are provided on page 2. These curing agents can be used individually or in combination to formulate a wide variety of powder coatings tailored for specific applications.

- P-101 - Imidazole adduct
- P-103 - Pastille form of P-101
- P-104 - Accelerated dicyandiamide
- P-108 - Accelerated dicyandiamide

EPIKURE Curing Agent P-101, P-103, P-104 and P-108 Sales Specification

| | | P-101 | P-103 | P-104 | P-108 | |
|------------|-------|-----------|-----------|-----------|-----------|------------------------|
| Property | Units | Value | Value | Value | Value | Test Method / Standard |
| Alkalinity | | 3.5 - 3.8 | 3.5 - 3.8 | 1.7 - 2.1 | 0.6 - 0.8 | ASTM D2896 |

EPIKURE Curing Agent P-101, P-103, P-104 and P-108 Typical Properties

| | | P-101 | P-103 | P-104 | P-108 | |
|----------------------|---------|-----------------|-------------------|-----------------|-----------------|------------------------|
| Property | Units | Value | Value | Value | Value | Test Method / Standard |
| Viscosity at 150°C | P | 10 - 30 | 10 - 30 | --- | --- | |
| Melt Point | °C | 85 - 105 | 85 - 105 | --- | --- | Mettler |
| Form | | 200 mesh powder | = 3/16" pastilles | 200 mesh powder | 200 mesh powder | |
| Density ¹ | g/cm | 1.16 | 1.16 | 1.26 | 1.38 | |
| Container | lb Drum | 50 | 100 | 100 | 100 | |

EPIKURE Curing Agent P-101, P-103, P-104 and P-108 Safety, Storage & Handling

Please refer to the MSDS for the most current Safety and Handling information.

Please refer to the Hexion web site for Shelf Life and recommended Storage information.

All of these products have acceptable physical stability if properly handled. They remain in a free-flowing powder or pastille form, with careful inventory management, shipping and storage to avoid exposure to high temperature and moisture. Exposure to excessively high temperature, greater than about 95 °F (35 °C), or high humidity conditions, can lead to some sintering/solidification. While this solidification does not chemically modify the curing agents, it is important that they be in their original form, either a finely divided powder or pastille, so they can be uniformly dispersed into the coating powder systems. Non-uniform dispersion could lead to powder coatings with inconsistent performance and/or gel particles. If refrigerated storage is used, the products should be allowed to come to room temperature prior to use in order to prevent excessive moisture pick-up from condensation.

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 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.

EPIKURE Curing Agent P-101, P-103, P-104 and P-108 Packaging

Available in fiber drum quantities.

EPIKURE Curing Agent P-101, P-103, P-104 and P-108 Contact Information

For product prices, availability, or order placement, please contact customer service:
www.hexion.com/Contacts/

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

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