



# Coatings & Civil Engineering Applications

Epotec® Epoxy Systems





Transcending the conventional barriers of business to send out a message that “We Care”

## The Aditya Birla Group

A US\$ 29 billion corporation, the Aditya Birla Group is in the League of Fortune 500. It is anchored by an extraordinary force of 130,600 employees, belonging to 40 nationalities. In the year 2009, the Group was ranked among the top six great places for leaders in the Asia-Pacific region, in a study conducted by Hewitt Associates, RBL Group and Fortune magazine. In India, the Group has been adjudged the best employer in India. Over 60 percent of the Group's revenues flow from its overseas operations. The Group operates in 26 countries across 6 continents.

### A Global Perspective

A metals powerhouse, among the world's most cost-efficient aluminium and copper producers. Hindalco-Novelis is the largest aluminium rolling company. It is one of the three biggest producers of primary aluminium in Asia, with the largest single location copper smelter.

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No.1 in viscose staple fiber

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The fourth-largest producer of insulators

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The fourth-largest producer of carbon black

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The fifth-largest producer of acrylic fiber

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The ninth-largest cement producer

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Among the best energy-efficient fertilizer plants

### In India

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Largest premium, branded apparel company.

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The second-largest producer of viscose filament yarn.

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The second-largest in the chlor-alkali sector.

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Among the top four mobile telephony companies.

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Among top 10 Indian BPO companies by revenue size.

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A leading player in life insurance and asset management.

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Among the top three supermarket chains in the retail business.

### Beyond Business

The Aditya Birla Group is working in 2,500 villages, reaching out to 7 million people annually through the Aditya Birla Centre for Community Initiatives and Rural Development, spearheaded by Mrs. Rajashree Birla. The Group's functions span 42 schools and 18 hospitals, furthering its focus on health care, education, sustainable livelihood, infrastructure and social causes.

For more information visit [www.adityabirla.com](http://www.adityabirla.com)



Our Company acts as a solution provider, formulating specialized Epoxy systems for your specific performance needs.

## Aditya Birla Chemicals, Epoxy Division

Aditya Birla Chemicals (Thailand) forms a part of the Aditya Birla Group's chemicals business, which spans over nine units – five in Thailand and four in India. Being the pioneer manufacturer of epoxy resins in the ASEAN region, the Company constitutes its success on its Specialized Epoxy Systems and its complete in-house Research and Application Development Center. Sustainability has also been achieved through its group-wide unique World Class Manufacturing (WCM) strategy for enterprise excellence.

Located within the prestigious *Map Tha Phut Industrial Estate* at Rayong Province in Thailand, the Company started commercial production in 1992 with technology from Tohto Kasei Company Limited, Japan's largest producer of epoxy resins. The Company is currently accredited and certified with ISO 9001:2008 and ISO 14001 in recognition of its quality and environment management systems.

The Company offers a wide range of epoxies, modifiers and curing agents that vary in chemical structure, molecular weight, viscosity and functionality. All products are marketed under the trade name of Epotec®, including liquid, solid, solutions, blends and other multifunctional epoxy resins. Epoxy Resin, a performance polymer, is a versatile resin which finds application in adhesives, civil engineering, composites, casting and encapsulation of electrical components, and coatings including protective, marine, floor, powder, can and coil.

The Company stretches its business arms in all six continents of the globe.





## Protective Coatings

Coatings for Protective - civil and marine applications are known for their resistance to various industrial chemicals, corrosive gases, saline water and humidity. This is achievable only if the coating retains its adhesion to the various substrates such as steel, aluminum, other ferrous / non-ferrous metals and alloys. Our Company offers a wide array of Epotec® Epoxy Resins suitable for individualized application needs.

We offer 100% solvent-free low molecular weight liquid resins, solution grades in standard solvents and customized solution grades, poly-functional epoxies for increased chemical and thermal resistance, reactive diluents and reactive diluent modified resins for improved flexibility.

The main applications of these Epotec® Epoxy Resins are in electro-deposition paints for automotive bodies, industrial maintenance paints, coatings for chemical / fertilizer plants, coatings for offshore oil drilling rigs, heavy duty industrial machinery, shipping yards, boat building facilities, container coatings, refineries and steel plants, and road marking paints.

When it comes to civil engineering, epoxy is the preferred material because of its overall superior performance. Moreover, epoxy systems are also used in floor toppings, grouts, heavy duty mortars, crack injection, wider crack filling systems, expansion joint filling systems and adhesives.

The advantages of using Epotec® Epoxy Resins in civil engineering are:

- Seamless covering.
- Ease of application and maintenance.
- Dust proof nature.
- Good impact and abrasion resistance.
- Hygienic coating.
- Excellent bonding with various substrates.
- High chemical resistance.



## Epotec® Epoxy Resins - Bisphenol-A Type

### Unmodified Liquid Resins

Unmodified Bisphenol-A based Epotec® Epoxy Resins are mainly used for protective coatings, industrial maintenance paints, underwater coatings, structural adhesives and civil engineering applications.

TABLE 1.01 Unmodified Bisphenol-A Epoxy Resins

EPOTEC® GRADE	EEW <sup>1</sup>	VISCOSITY <sup>2</sup>	COLOR <sup>3</sup>	FEATURES
YD126	178 - 186	7,500 - 10,000	0.5	Unmodified low viscosity grade.
YD 127	180 - 188	8,000 - 11,000	0.5	Standard grade, low viscosity.
YD 127LC	180 - 190	9,500 - 12,500	0.5	Less crystallization tendency.
YD 128	185 - 194	11,000 - 14,000	0.5	General purpose resin.
YD 128ED	185 - 194	11,000 - 13,500	0.5	Extremely low ionic impurities for electro-deposition paints.
YD 134	240 - 260	R - U <sup>4</sup>	0.5	Semi-solid resin for electrical casting, coatings and adhesives.
YD 136	290 - 335	A - C <sup>5</sup>	0.5	Semi-solid resin for improved toughness, flexibility and tack for adhesives.

<sup>1</sup> Epoxy Equivalent Weight (gm/eq), <sup>2</sup> Brookfield Viscosity @ 25°C (cP), <sup>3</sup> Gardner Color Scale (Maximum),

<sup>4</sup> Gardner-Holdt Viscosity (70% solids in Butyl Carbitol @ 25°C), <sup>5</sup> Gardner-Holdt Viscosity (40% solids in Butyl Carbitol @ 25°C)

### Reactive Diluent Modified Resins

Reactive Diluent Modified Bisphenol-A based Epotec® Epoxy Resins are available in various viscosities and are mainly used for applications in civil engineering, adhesives and low VOC coatings.

TABLE 1.02 Reactive Diluent Modified Epoxy Resins

EPOTEC® GRADE	EEW <sup>1</sup>	VISCOSITY <sup>2</sup>	COLOR <sup>3</sup>	FEATURES
YD 508	178 - 185	800 - 1,100	0.5	Aromatic reactive diluent modified, very low crystallization tendency.
YD 510	185 - 200	1,500 - 2,000	0.5	Aliphatic reactive diluent modified, good mechanical and impact properties.
YD 515	195 - 210	600 - 900	0.5	Aliphatic reactive diluent modified, low viscosity, better flexibility and impact strength.
YD 519	182 - 196	7,500 - 9,500	0.5	Aromatic reactive diluent modified, low crystallization tendency, retention of chemical and mechanical properties.
YD 522	180 - 190	500 - 700	0.5	Aromatic reactive diluent modified.
YD 120	190 - 210	4,000 - 6,000	0.5	Aromatic reactive diluent modified, excellent crystallization resistance.

<sup>1</sup> Epoxy Equivalent Weight (gm/eq), <sup>2</sup> Brookfield Viscosity @ 25°C (cP), <sup>3</sup> Gardner Color Scale (Maximum)



## Epotec® Epoxy Resins - Bisphenol-A Type

### Solvent-Cut Resins

Solvent-Cut Bisphenol-A based Epotec® Epoxy Resins have medium molecular weight and are supplied in solution form for the ease of processing. They find usage in protective coatings, marine paints and varnishes.

TABLE 1.03 Solvent-Cut Epoxy Resins

EPOTEC® GRADE	EEW <sup>1</sup>	VISCOSITY <sup>2</sup>	COLOR <sup>3</sup>	% NV	FEATURES
YD 011X75	450 - 500	8,000 - 13,000	0.5	74 - 76	General purpose resin.
YD 134X80	240 - 260	500 - 1,500	0.5	79 - 81	Low VOC coatings, high chemical resistance.
YD 134X90	240 - 260	10,000 - 20,000	0.5	89 - 91	Low VOC coatings, high chemical resistance.
YD 012X75	660 - 720	40,000 - 90,000	0.5	74 - 76	Protective coatings with higher flexibility.
YD 901X75	440 - 550	6,000 - 14,000	1	74 - 76	General purpose resin for coatings.
YD 901EK80	460 - 500	4,000 - 8,000	1	79 - 81	Type 1 solid resin solution in MEK for faster drying coatings.

NOTE: X - Xylene

<sup>1</sup> Epoxy Equivalent Weight (gm/eq) on Solids, <sup>2</sup> Brookfield Viscosity @ 25°C (cP), <sup>3</sup> Gardner Color Scale (Maximum) on Solids

## Epotec® Epoxy Resin - Bisphenol-F Type

### Unmodified Resins

Unmodified Bisphenol-F based Epotec® Epoxy Resins have very good chemical resistance, good mechanical properties and are lower in viscosity as compared to Bisphenol-A based resins. When properly formulated with Bisphenol-A resins they help reduce crystallization tendency and find applications in adhesives, laminates, coatings and civil engineering.

TABLE 1.04 Unmodified Bisphenol-F Epoxy Resin

EPOTEC® GRADE	EEW <sup>1</sup>	VISCOSITY <sup>2</sup>	COLOR <sup>3</sup>	FEATURES
YDF 170	160 - 180	2,000 - 5,000	1	Standard resin.
YDF 171	170 - 180	5,000 - 7,000	1	Bisphenol-F resin for high solid coatings, adhesives and laminates.
YDF 170LV	160 - 170	2,000 - 3,000	1	Lower viscosity standard resin.
YDF 173	167 - 175	7,000 - 11,000	1	Slightly higher functionality than standard Bisphenol-F resin, improved chemical resistance.
YDF 170LC	165 - 175	3,000 - 5,000	1	Better crystallization resistance.
YDF 172	165 - 175	3,000 - 5,000	1	Non-crystallizing type.

<sup>1</sup> Epoxy Equivalent Weight (gm/eq), <sup>2</sup> Brookfield Viscosity @ 25°C (cP), <sup>3</sup> Gardner Color Scale (Maximum)

## Epotec® Epoxy Resins - Bisphenol-A / F Type

### Modified Resins

Modified Bisphenol-A / F based Epotec® Epoxy Resins are a blend of various epoxy resins and/or reactive diluents. They are available in various viscosities and are suitable for applications in laminates, civil engineering and coatings.

TABLE 1.05 Modified Bisphenol-A/F Epoxy Resin

EPOTEC® GRADE	EEW <sup>1</sup>	VISCOSITY <sup>2</sup>	COLOR <sup>3</sup>	FEATURES
YDFM 251	185 - 200	500 - 800	0.5	A/F with monofunctional diluent.
YDFM 270	164 - 176	500 - 900	0.5	A/F with difunctional diluent.
YDFM 253	190 - 200	700 - 1,100	0.5	A/F with monofunctional diluent.
YDFM 261LV	170 - 180	3,500 - 5,500	0.5	A/F blend.
YDFM 261	172 - 179	4,500 - 6,000	0.5	A/F blend.
YDFM 269	175 - 185	7,000 - 9,000	0.5	A/F blend.
YDFM 262	175 - 185	6,000 - 8,000	0.5	A/F blend.
YDFM 250	180 - 190	8,000 - 10,000	0.5	A/F blend.
YDFM 256	180 - 190	2,000 - 4,000	0.5	A/F with monofunctional diluent.

<sup>1</sup> Epoxy Equivalent Weight (gm/eq), <sup>2</sup> Brookfield Viscosity @ 25°C (cP), <sup>3</sup> Gardner Color Scale (Maximum)

## Epotec® Epoxy Resins - Poly-Functional

Poly-Functional Epotec® Epoxy Resins are multifunctional epoxy resins with more than two epoxy groups per molecule. The most widely used poly-functional epoxy resins are based on Phenol Novolacs. Features like high functionality makes them suitable for applications like composites, high temperature resistant adhesives, corrosion resistant coatings, industrial maintenance paints, chemical resistant coatings and linings.

### Phenol Novolac Resins

TABLE 1.06 Phenol Novolac Epoxy Resins

EPOTEC® GRADE	EEW <sup>1</sup>	VISCOSITY <sup>2</sup>	COLOR <sup>3</sup>	FN <sup>4</sup>	FEATURES
YDPN 631	172 - 180	1,100 - 1,700	3	2.8	Improves chemical resistance, good retention of property at elevated temperature. Widely used for coating applications.
YDPN 638	175 - 182	30,000 - 50,000	1	3.6	High mechanical, chemical and elevated temperature resistance properties.
YDPN 638LV	175 - 182	20,000 - 30,000	1	3.6	High mechanical, chemical and elevated temperature resistance properties.
YDPN 661	170 - 178	20,000 - 40,000 <sup>5</sup>	3	2.5	Low viscosity. Good chemical and mechanical properties.
YDPN 638X80	175 - 182*	1,200 - 2,000	2	-	Solution of EPN in Xylene.
YDPN 638EK85	175 - 182*	600 - 1,600	2	-	Solution of EPN in MEK Solvent. Easy to use and apply. Fast drying characteristics.

NOTE: \* on solids

<sup>1</sup> Epoxy Equivalent Weight (gm/eq), <sup>2</sup> Brookfield Viscosity @ 52°C (cP), <sup>3</sup> Gardner Color Scale (Maximum), <sup>4</sup> Functionality,

<sup>5</sup> Brookfield Viscosity @ 25°C (cP)

Above grades are also available in solvent-cut form.

## Epotec® Epoxy Resins - Cycloaliphatic

Cycloaliphatic Epotec® Epoxy Resins are mainly used in weather resistant solvent-based coatings for outdoor applications.

TABLE 1.07 Cycloaliphatic Epoxy Resins

EPOTEC® GRADE	EEW <sup>1</sup>	VISCOSITY <sup>2</sup>	COLOR <sup>3</sup>	HyCl <sup>4</sup>	FEATURES
YDH 3000	220 - 240	2,000 - 4,000	1	0.1	Low viscosity, good weather resistance.
YDH 184	165 - 177	450 - 900	1	-	Good weather resistance properties.

<sup>1</sup> Epoxy Equivalent Weight (gm/eq), <sup>2</sup> Brookfield Viscosity @ 25°C (cP), <sup>3</sup> Gardner Color Scale (Maximum), <sup>4</sup> Hydrolyzable chlorine % w/w max.

## Epotec® Epoxy Systems - Civil Engineering Applications

Epotec® Epoxy Systems are mainly used for floor toppings, grouts, heavy duty mortars, crack injection, wider crack filling systems, expansion joint filling systems and adhesives.

TABLE 1.08 Epoxy Systems for Civil Engineering Applications

EPOTEC® SYSTEM	MIX RATIO <sup>1</sup>	MIX VISCOSITY <sup>2</sup>	GEL TIME <sup>3</sup>	TFST <sup>4</sup>	FEATURES
YD 515: TH 7301	100 : 60	500	35	5	Good gloss, hardness combined with good chemical resistance.
BYD 7201: TH 7201	100 : 33	10,000	20	3	Excellent chemical resistance to most of the strong acids, alkalis and solvents. Very minimal impact of alkalis, acids can cause discoloration when exposed. Can resist conc. H <sub>2</sub> SO <sub>4</sub>
YD 522: TH 7212	100 : 25	400	35	2.5	Ultra low viscosity. Easier to penetrate deep in small, narrow cracks. Excellent bonding to concrete. Faster setting.
YD 522: TH 7903	100 : 25	8,000	15	2	Fast setting. Very good hardness, high compressive strength.
YD 128: THW 4501	100 : 115	-	30	3	Water dilutable. Good hardness and abrasion resistance. Water vapor permeability. Can cure in thick sections. Can be laid on 1 day cure concrete.
YD 128: THW 4502	100 : 140	-	180	6	Water dilutable. Glossy to semi-glossy finish. Excellent hardness. Suitable for low film thickness (< 0.5 mm).
YD 522: THW 4503	100 : 80	2,000	60	6	Water dilutable. Good bonding to varied substrates. High compressive strength.
YD 522: TH 7209	100 : 25	400	20	10	Good gloss, color and hardness.
YD 520: TH 7227	100 : 11	500	10	9	Good adhesion, good penetration in smaller cracks.
YD 522: TH 7302	100 : 50	500	30	6	Fast strength build-up.

<sup>1</sup> Part by weight, <sup>2</sup> Mix Viscosity @ 25°C (cP), <sup>3</sup> Gel time in minutes, <sup>4</sup> Thin Film Set Time in hours



## Epotec® Reactive Diluents

Epotec® Reactive Diluents are epoxy group-containing functional products that can react with the curing agents to become a part of the cross-linked epoxy system. Reactive diluents are mainly used to reduce the viscosity of the base resin to improve handling and ease of processing in various applications. These reactive diluents can be also used to optimize performance properties such as impact strength, adhesion, flexibility, filler-loading, and solvent resistance of the epoxy system.

Epotec® Reactive Diluents are divided mainly in three groups - Aliphatic, Aromatic and Cycloaliphatic. They are further classified based on their functionality as Mono-Functional, Di-Functional and Tri-Functional.

TABLE 1.09 Reactive Diluents

EPOTEC® GRADE	EEW <sup>1</sup>	VISCOSITY <sup>2</sup>	COLOR <sup>3</sup>	FEATURES
<b>Mono-Functional Aliphatic</b>				
RD 108	275 - 300	5 - 10	0.2	C <sub>12</sub> - C <sub>14</sub> glycidyl ether - good diluent and morphology, improved impact strength.
RD 109	270 - 300	5 - 10	0.2	C <sub>12</sub> - C <sub>13</sub> glycidyl ether.
RD 110	215 - 230	2 - 15	0.2	2-Ethyl hexyl glycidyl ether.
RD 118	225 - 245	4 - 9	0.2	C <sub>8</sub> -C <sub>10</sub> glycidyl ether.
<b>Di-Functional Aliphatic</b>				
RD 103	130 - 145	12 - 22	0.2	1,4-Butanediol diglycidyl ether - good property retention, moderate diluent.
RD 107	147 - 161	15 - 25	0.2	1,6-Hexanediol diglycidyl ether - good property retention, moderate diluent.
RD 114LE	130 - 145	12 - 18	0.5	Neopentyl glycol diglycidyl ether - good property retention, moderate diluent.
RD 119LE	315 - 335	50 - 70	0.3	Polypropylene glycol diglycidyl ether - imparts flexibility, improves water dispersibility.
RD 121	165 - 190	20 - 50	0.3	Dipropylene glycol diglycidyl ether - improves impact strength and elongation.
<b>Tri-Functional Aliphatic</b>				
RD 113	135 - 150	100 - 200	0.2	Trimethylol propane triglycidyl ether.
<b>Mono-Functional Aromatic</b>				
RD 104	155 - 170	6 - 12	0.5	Phenyl glycidyl ether - better dilution, retention of chemical resistance.
RD 105	175 - 190	5 - 10	0.5	Cresyl glycidyl ether - overall excellent properties.
RD 106	215 - 240	10 - 30	0.5	p-tertiary Butyl phenyl glycidyl ether - low vapor pressure, low dilution efficiency.
<b>Cycloaliphatic Di-functional</b>				
RD 111	165 - 185	60 - 90	0.5	Cyclohexane dimethanol diglycidyl ether Excellent properties retention, improves UV resistance.

<sup>1</sup> Epoxy Equivalent Weight (gm/eq), <sup>2</sup> Brookfield Viscosity @ 25°C (cP), <sup>3</sup> Gardner Color Scale (Maximum)

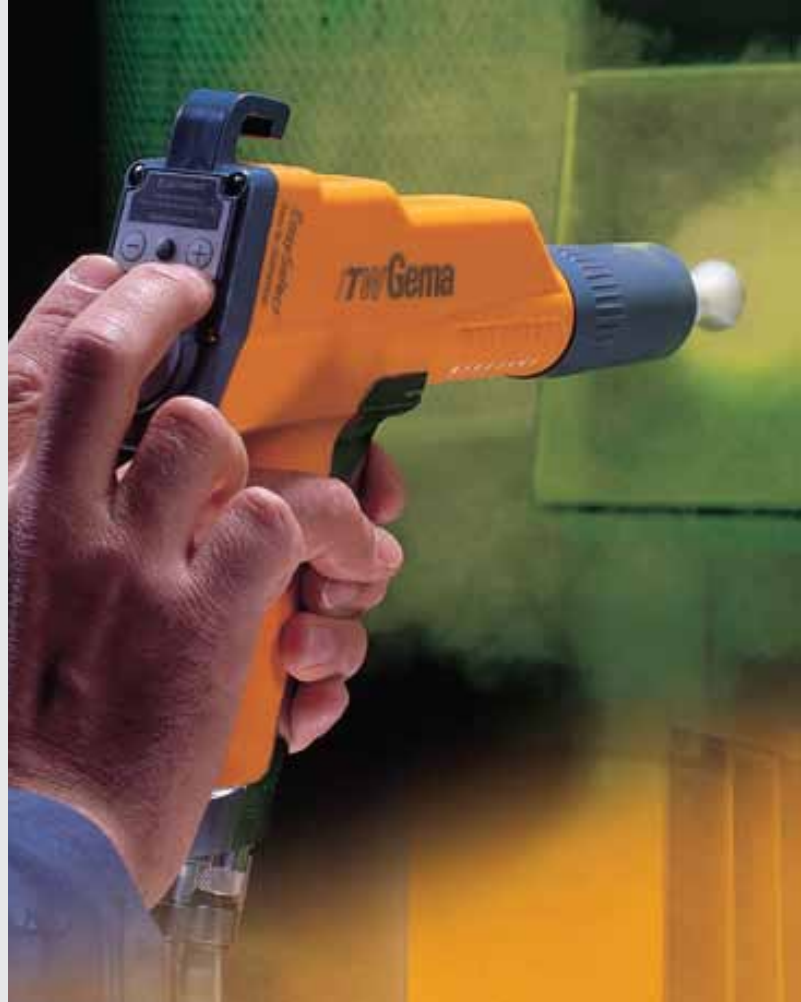


## Powder Coatings

Application of powder coatings has grown impressively for past many years, primarily because of its economical, efficient and yet environment friendly nature. Furthermore, the spread is enhanced by extensive developments in the field of powder coating. Aditya Birla Chemicals (Epoxy Division) offers an array of solid Epotec® Epoxy Resins with varying molecular weight and viscosities. These products have low color combined with good clarity and mechanical strength. Other advantage with Epotec® Epoxy Resins is their excellent compatibility with each other. This gives the formulating chemist a free hand to optimize the formulation in terms of flow, reactivity and mechanical properties.

Medium Molecular Weight (Standard Viscosity) Epotec® Epoxy Resins are used for general purpose powder coatings whereas Medium Molecular Weight (Low Viscosity) Epotec® Epoxy Resins are preferred for high gloss finishes as well as low film thickness coatings. These Epotec® grades are also recommended for clear, transparent coatings on ferrous as well as non-ferrous substrates.

Poly-Functional Epotec® Epoxy Resins in combination with Phenolic Epotec® Curing Agents are used for high chemical resistant coatings and linings. These Epotec® grades are widely used for making FBE coatings for re-bar and pipelines. Poly-Functional Epotec® Epoxy Resins with higher functionality are recommended for high Tg applications requiring high thermal stability coatings for higher service temperatures.



# Epotec® Epoxy Resins

## Medium Molecular Weight (Standard Viscosity)

Conventional solid Medium Molecular Weight (Standard Viscosity) Epotec® Epoxy Resins based on Bisphenol-A with different molecular weights and viscosities are suitable for general purpose powder coatings for electric panel boards, automobile spares, bathroom fittings, decorative articles and fixtures.

TABLE 2.01 Medium Molecular Weight (Standard Viscosity) Epoxy Resins

EPOTEC® GRADE	EEW <sup>1</sup>	MELT VISCOSITY <sup>2</sup>	COLOR <sup>3</sup>	S.P. <sup>4</sup>	FEATURES
YD 901	450 - 525	200 - 700	0.5	65 - 75	Standard type 1 resin. Sinter upon storage.
YD 901H	525 - 600	1,000 - 2,500	0.5	67 - 77	Higher Tg than Epotec® Epoxy Resin YD 901. Can sinter when stored in warm condition.
YD 902	660 - 725	2,200 - 3,500	0.5	81 - 91	Suitable for hybrid/pure epoxy powder coating, good Tg.
YD 903	725 - 800	3,800 - 6,000	0.5	90 - 96	Suitable for hybrid/pure epoxy powder coating.
YD 903H	800 - 880	4,000 - 7,000	0.5	92 - 102	Suitable for hybrid/pure epoxy powder coating.
YD 903HE	860 - 930	7,000 - 10,200	0.5	104 - 110	Suitable for hybrid/pure epoxy powder coating.
YD 904	900 - 975	800 - 1,600 <sup>5</sup>	0.5	96 - 107	Suitable for epoxy ester formulation.
YD 905	1,250 - 1,400	3,000 - 6,000 <sup>5</sup>	1	105 - 120	Suitable for re-bar/pipe coatings.

<sup>1</sup> Epoxy Equivalent Weight (gm/eq), <sup>2</sup> ICI Melt Viscosity @ 150°C (cP), <sup>3</sup> Gardner Color Scale (Maximum), <sup>4</sup> Softening Point (°C) - Mettler Ball & Cup, <sup>5</sup> ICI Melt Viscosity @ 200°C (cP)

## Medium Molecular Weight (Low Viscosity)

Specially formulated Medium Molecular Weight (Low Viscosity) Epotec® Epoxy Resins give the maximum flow, clarity and chemical storage stability to the powder. They are recommended for use in the applications where aesthetics with protection is equally important. These Epotec® grades are extensively used for coating white / grey goods.

TABLE 2.02 Medium Molecular Weight (Low Viscosity) Epoxy Resins

EPOTEC® GRADE	EEW <sup>1</sup>	MELT VISCOSITY <sup>2</sup>	COLOR <sup>3</sup>	S.P. <sup>4</sup>	FEATURES
YD 012	660 - 720	1,200 - 2,100	0.5	78 - 90	High flow standard resin.
YD 012HE	750 - 800	2,200 - 3,500	0.5	85 - 98	Excellent flow, good stability and reactivity.
YD 903TP	720 - 760	1,800 - 2,800	0.5	80 - 95	Good flow and leveling.
YD 013	820 - 880	3,600 - 5,000	0.5	85 - 98	Good flow and storage stability.
YD 014	900 - 975	5,300 - 7,000	0.5	91 - 102	Medium molecular weight, better flexibility. Can be used for epoxy esters.

<sup>1</sup> Epoxy Equivalent Weight (grams/equivalent), <sup>2</sup> ICI Melt Viscosity @ 150°C (cP), <sup>3</sup> Gardner Color Scale (Maximum), <sup>4</sup> Softening Point (°C) - Mettler Ball & Cup

## Epotec® Epoxy Resins

### Modified Resins

Flow Modified Epotec® Epoxy Resins are designed to improve flow and leveling characteristics of a resin. They are primarily used in special formulations to meet the end use requirements of critical applications.

TABLE 2.03 Modified Epoxy Resins

EPOTEC® GRADE	EEW <sup>1</sup>	MELT VISCOSITY <sup>2</sup>	COLOR <sup>3</sup>	S.P. <sup>4</sup>	FEATURES
YD 902F10	720 - 770	2,500 - 3,500	Milky Flakes	80 - 95	Flow modified resin master batch.
YD 903F	750 - 800	3,000 - 5,000	Milky Flakes	88 - 98	Flow modified with acrylic flow modifier.
YD 903F10	800 - 850	3,000 - 6,000	Milky Flakes	87 - 97	Flow modified master batch.
YD 928	705 - 775	1,500 - 3,500	Milky Flakes	75 - 90	Modified to improve contamination tolerance.
YD 942	500 - 560	1,500 - 4,000	0.5	80 - 90	Modified resin for better chemical resistance re-bar/pipe coatings.
YD 972	750 - 850	2,500 - 5,000 <sup>5</sup>	0.5	95 - 110	Modified resin for better chemical resistance re-bar/pipe coatings.

<sup>1</sup> Epoxy Equivalent Weight (gm/eq), <sup>2</sup> ICI Melt Viscosity @ 150°C (cP), <sup>3</sup> Gardner Color Scale (Maximum),

<sup>4</sup> Softening Point (°C) - Mettler Ball & Cup, <sup>5</sup> ICI Melt Viscosity @ 200°C (cP)

## Epotec® Curing Agents

### Phenolic

Phenolic Epotec® Curing Agents are used with Poly-Functional Epotec® Epoxy Resins. They give excellent chemical resistance and adhesion to the surface and retain properties to give good service life at elevated temperatures when formulated properly. They are also widely used in functional coatings like FBE coatings for re-bar and pipeline coatings.

TABLE 2.04 Phenolic Curing Agents

EPOTEC® GRADE	HYDROXYL EW <sup>1</sup>	MELT VISCOSITY <sup>2</sup>	COLOR <sup>3</sup>	S.P. <sup>4</sup>	FEATURES
TH 981	250 - 280	290 - 750	1	75 - 90	Phenolic curing agent to adjust the reactivity when using Epotec® Curing Agent TH 982 / TH 983.
TH 982	250 - 290	290 - 750	1	75 - 90	Accelerated phenolic curing agent for chemical resistant coatings for re-bar and pipes.
TH 983	250 - 290	290 - 750	Milky Flakes	75 - 90	Accelerated and flow modified phenolic curing agent for chemical resistant coatings for re-bar and pipes.
TH 984	370 - 400	1,000 - 2,000	1	90 - 102	Phenolic curing agent with better flexibility for chemical resistant coatings for re-bar and pipes.

<sup>1</sup> Hydroxyl Equivalent Weight (gm/eq), <sup>2</sup> ICI Melt Viscosity @ 150°C (cP), <sup>3</sup> Gardner Color Scale (Maximum),

<sup>4</sup> Softening Point (°C) - Mettler Ball & Cup



## Can and Coil Coatings

Apart from the chemical corrosion resistance, an exceedingly important property that can and coil coating manufacturers desire in the coating is the highest possible flexibility. Considering this important requirement of the industry, our Company has developed a wide range of Epotec® Epoxy Resins with varying rigidity and flexibility combined with excellent resistance to various chemicals including household chemicals, food chemicals and boiling water. These grades also have excellent compatibility and thus give the formulator a free hand to choose and combine different grades to optimize performance.

The main applications of these resins are in coatings for beverage cans, seafood cans, fruit juice cans, enclosures for glass bottles, crown caps, coatings for aerosol / perfume spray bottles, general lining for dry food packs such as containers for cookies, cold creams, in marker pens, roofing sheets, sheets for appliance bodies, sheet metal furniture and modulated office cabins.





## Epotec® Epoxy Resins

### High Molecular Weight Solids

High Molecular Weight Epotec® Epoxy Resins are used extensively in coatings for beverage cans, seafood cans, fruit juice cans, enclosures for glass bottles, crown caps, coatings for aerosol / perfume spray bottles, general lining for dry food packs such as containers for cookies, cold creams, in marker pens, roofing sheets, sheets for appliance bodies, sheet metal furniture and modulated office cabins.

TABLE 3.01 High Molecular Weight Epoxy Resins

EPOTEC® GRADE	EEW <sup>1</sup>	VISCOSITY <sup>2</sup>	COLOR <sup>3</sup>	S.P. <sup>4</sup>	FEATURES
YD 017	1,750 - 2,100	2,000 - 4,000	0.5	117 - 127	Standard type 7 resin for can coatings.
YD 017S	1,750 - 2,100	1,290 - 2,270	0.5	113 - 123	Type 7 resin with improved flow and adhesion.
YD 019	2,500 - 2,900	4,630 - 9,850	0.5	130 - 145	Standard type 9 resin for can and coil coatings.
YD 019S	2,500 - 2,900	1,760 - 4,630	0.5	124 - 133	Type 9 resin with better flow.
YD 010S	4,500 - 5,500	4,600 - 9,000	0.5	135 - 150	Type 10 resin with excellent flexibility, adhesion and flow.
YD 907	1,750 - 2,100	1,600 - 2,200	0.5	117 - 127	Type 7 resin for can and coil coating and printing inks with better flow.
YD 909	2,500 - 2,800	5,000 - 8,000	0.5	130 - 145	Type 9 resin for can and coil coatings with better flexibility.

<sup>1</sup> Epoxy Equivalent Weight (gm/eq), <sup>2</sup> Brookfield Viscosity @ 25°C (in 40% Butyl Carbitol Solution), <sup>3</sup> Gardner Color Scale (Maximum), <sup>4</sup> Softening Point (°C) - Mettler Ball & Cup



## Waterborne Epoxy Resins and Curing Agents

With the increasing need to lower VOC (volatile organic compound) level in coatings, waterborne epoxy resins and curing agents are gaining much attention as replacements over the traditional solvent-based coatings.

Fiber sizing, adhesives, flexographic / lithographic printing, sealing compounds, civil engineering, marine and structural coatings are some of the major applications of waterborne systems.

Epotec® Waterborne Resins offer high gloss, good adhesion and excellent chemical resistance.

Epotec® Waterborne Curing Agents can be used for damp surfaces including green concrete, self-leveling floors, trowelable floors, floor toppings and grouts with higher water vapor permeability compared to conventional solvent-based or solvent-free systems.

Epotec® Waterborne Resins and Curing Agents are easily dilutable with water without the need for additional emulsifiers, thus allowing the formulation of high build, high-solids epoxy systems. Other technical features include fast drying rates, rapid development of hardness, high green strength and good slip and scratch resistance.



# Epotec® Waterborne Epoxy Resins and Curing Agents

## Waterborne Epoxy Resins

A wide range of Epotec® Waterborne Epoxy Resins exhibiting high stability and excellent dilution efficiency, are available, offering different functionalities for a variety of applications. These aqueous epoxy dispersions incorporate non-ionic epoxy-functional emulsifiers which allow the emulsifier to become

part of the cured product with minimal impact on the mechanical properties. They find wide applications in fiber sizing, coatings, anti-corrosion primers, heat stoving paints, marine coatings to name a few.

TABLE 4.01 Waterborne Epoxy Resins

EPOTEC® GRADE	EWV <sup>1</sup>	VISCOSITY <sup>2</sup>	COLOR	% NV <sup>3</sup>	% CO-SOLVENT	FEATURES
TW 5001 (Aq. emulsion of LER)	195 - 220	300 - 3,500	Off-white / milky emulsion	60	0	High reactivity, good chemical resistance.
TW 5002 (Aq. dispersion of Type 1)	485 - 555	7,000 - 17,000	Off-white / milky emulsion	55	10 <sup>4</sup>	High gloss, fast dry time.
TW 5003H (Aq. dispersion of Type 7)	1,800 - 2,100	7,000 - 17,000	Off-white / milky emulsion	53	13 <sup>5</sup>	Good adhesion to substrate, flexibility, fast dry time.
TW 5004 (Aq. emulsion of Bis-F epoxy)	180 - 190	1,000 - 2,500	Off-white/ milky emulsion	50	0	Low viscosity, good chemical resistance, high reactivity.

<sup>1</sup> Epoxy Equivalent Weight (gm/eq), <sup>2</sup> Brookfield Viscosity @ 25°C (cP), <sup>3</sup> % Non-Volatile (+/- 2%), <sup>4</sup> Methoxy Propanol, <sup>5</sup> Propoxy Ethanol

## Waterborne Curing Agents

EpoteC® Waterborne Curing Agents are based on modified polyamines. In addition to cross-linking liquid epoxy resins in the final film they also act as emulsifiers allowing the formulation of zero VOC systems and avoiding the

need for additional emulsifiers. They find wide applications in self-leveling, trowelable flooring, coatings, water wipeable tile grouts etc.

TABLE 4.02 Waterborne Curing Agents

EPOTEC® GRADE	COLOR	% NV <sup>1</sup>	VISCOSITY <sup>2</sup>	phr <sup>3</sup>	POT LIFE <sup>4</sup>	TFST <sup>5</sup>	FEATURES
THW 4501	Off-white / white emulsion	60	15,000 - 25,000	115	25 - 35	2 - 3	Rapid hardness development, high ultimate strength.
THW 4502	Translucent emulsion	55	20,000 - 55,000	130 - 150	180 - 200	6 - 8	Long pot life, high gloss.
THW 4503	Amber liquid	70	2,500 - 6,000	80	50 - 75	6 - 7	High strength, low color.
THW 4504	Pale yellow liquid	60	3,500 - 8,500	100	60 - 75	5 - 7	Long pot life, low color high strength.

NOTE: All values are tested with Epotec Epoxy Resin YD 128.

<sup>1</sup> % Non-Volatile (+/- 2%), <sup>2</sup> Brookfield Viscosity @ 25°C (cP), <sup>3</sup> Parts per hundred of Resin, <sup>4</sup> Pot Life in minutes, @ 25°C, <sup>5</sup> Thin Film Set Time in hours @ 25°C

## Epotec® Curing Agents

Curing agents are a vital part of the Epotec® Epoxy Resin and Curing Agent System. The selection of the right curing agent is important as it influences the viscosity, reactivity and working time in general and mechanical, chemical and optical properties in specific.

### Modified Aliphatic Amines

These curing agents derived from aliphatic amines, react at room temperature. The basic aliphatic amines are modified to reduce their vapor

pressure and thereby reduce their corrosiveness. The modification is also done to optimize the hardness, reactivity, handling time of system and also to improve the carbonation resistance.

Modified Aliphatic amines are used in a wide variety of applications like high chemical resistance flooring, grouts, adhesives, laminates, industrial, marine coatings, offshore primers/top coats, chemical resistant mortars, concrete impregnation, patch repair compounds, crack injection system etc.

TABLE 4.03 Modified Aliphatic Amines

EPOTEC® GRADE	COLOR <sup>1</sup>	VISCOSITY <sup>2</sup>	AMINE VALUE <sup>3</sup>	Sp. Gr. <sup>4</sup>	A.H.E.W. <sup>5</sup>	phr <sup>6</sup>	GEL TIME <sup>7</sup>	TFST <sup>8</sup>	FEATURES
TH 7201	3	20 - 60	475 - 520	1.06	60	33	18 - 30	2 - 3	High reactivity, with excellent chemical resistance.
TH 7202	3	80 - 130	1,050 - 1,080	1.04	31	15	10 - 16	2 - 3	Good chemical and heat resistance.
TH 7203	3	250 - 400	360 - 380	1.10	88	46	25 - 30	2 - 3	Excellent chemical resistance, with low temperature curing.
TH 7207	3	150 - 350	615 - 675	0.97	95	50	5 - 12	1 - 2	Faster cure in presence of high humidity.
TH 7210	4	3,000 - 4,500	770 - 820	1.07	38	20	12 - 22	3 - 4	Provide excellent resistance to solvents and alcohols.
TH 7211	2	35 - 80	300 - 330	0.95	76	40	80 - 120	9 - 12	Good color.
TH 7212	2	15 - 30	690 - 720	1.05	48	25	30 - 50	2 - 4	Low temperature curing, excellent mechanical strength with good adhesion to concrete.
TH 7222N	8	450 - 700	430 - 490	1.05	112	60	20 - 35	3 - 5	Curing at room temperature giving high glossy finish.
TH 7227	2	10 - 50	1,430 - 1,475	0.99	24	13	5 - 15	4 - 6	Good adhesion, good penetration in small cracks.
TH 7903	10	1,200 - 2,100	760 - 800	1.08	50	26	10 - 18	1 - 3	High reactivity at low temperature and curable in highly humid conditions.
TH 7905	5	400 - 600	350 - 390	1.02	75	40	15 - 20	1 - 2	High reactivity at low temperature, curable in highly humid conditions with excellent chemical resistance. Good adhesion to concrete and steel.

NOTE: All values are tested with Epotec® Epoxy Resin YD 128.

<sup>1</sup> Gardner Color Scale (Maximum), <sup>2</sup> Brookfield Viscosity @ 25°C (cP), <sup>3</sup> mg of KOH/g, <sup>4</sup> Specific Gravity @ 25°C, <sup>5</sup> Equivalent Weight per Active-H, <sup>6</sup> Parts per hundred of Resin, <sup>7</sup> Gel Time in minutes, 150 grams @ 25°C, <sup>8</sup> Thin Film Set Time in hours @ 25°C, 75 μ thick film



## Epotec® Curing Agents

### Modified Cycloaliphatic Amines

These are curing agents that work at room temperature. Excellent color and lower corrosiveness makes them the preferred choice for self-leveling floorings, primers, top coats, mortars and water-wipeable tile grouts. These Epotec® Curing Agents possess low yellowing tendency and offer good early water spotting resistance.

They find applications in self-leveling flooring, solvent free high solid coatings, mortars, primers/ top coats, industrial flooring, concrete repair compounds etc.

TABLE 4.04 Modified Cycloaliphatic Amines

EPOTEC® GRADE	COLOR <sup>1</sup>	VISCOSITY <sup>2</sup>	AMINE VALUE <sup>3</sup>	Sp. Gr. <sup>4</sup>	A.H.E.W. <sup>5</sup>	pH <sup>6</sup>	GEL TIME <sup>7</sup>	TFST <sup>8</sup>	FEATURES
TH 7301	1	270 - 380	260 - 285	1.03	115	60	28 - 45	6 - 8	Excellent color stability providing high gloss surface with good chemical resistance.
TH 7302	3	280 - 420	300 - 320	1.03	95	50	25 - 35	6 - 7	High mechanical strength and resistance to amine blush and water spotting.
TH 7310	1	2,000 - 3,500	320 - 325	1.01	110	58	20 - 30	5 - 7	Light color and develops fast hardness and strength.
TH 7320	1	250 - 500	235 - 270	1.04	95	50	30 - 45	5 - 8	Provides clear, glossy hard surface.
TH 7901	4	100 - 300	280 - 325	1.02	102	55	23 - 30	5 - 8	High reactivity at low temperature, curable in highly humid conditions with excellent chemical resistance.
TH 7902	3	120 - 320	345 - 375	1.00	102	55	23 - 27	3 - 5	Phenol-free version of Epotec Curing Agent TH7901.

<sup>1</sup> Gardner Color Scale (Maximum), <sup>2</sup> Brookfield Viscosity @ 25°C (cP), <sup>3</sup> mg of KOH/g, <sup>4</sup> Specific Gravity @ 25°C, <sup>5</sup> Equivalent Weight per Active-H, <sup>6</sup> Parts per hundred of Resin, <sup>7</sup> Gel Time in minutes, 150 grams @ 25°C, <sup>8</sup> Thin Film Set Time in hours @ 25°C, 75 μ thick film



## Epotec® Curing Agents

### Phenalkamines

Epotec® Phenalkamine Curing Agents are unique curing agents in the sense that they possess rapid curing characteristics at relatively longer pot life with very low to no volatility. These curing agents also possess special ability to cure at low temperatures. Phenalkamines are reaction products of cardanol, which is a naturally occurring phenolic compound in cashew nut shell liquid, and thus is renewable.

Epotec® Phenalkamine Curing Agents, because of their characteristic properties, are used widely to produce heavy duty industrial coatings, concrete coatings, marine and offshore coatings.

TABLE 4.05 Phenalkamines

EPOTEC® GRADE	COLOR <sup>1</sup>	VISCOSITY <sup>2</sup>	Sp. Gr. <sup>3</sup>	% SOLIDS	A.H.E.W. <sup>4</sup>	pH <sup>5</sup>	GEL TIME <sup>6</sup>	TFST <sup>7</sup>	FEATURES
TH 7940	17	2,000 - 3,000	0.97 - 1.0	100	80	40	30 - 45	2 - 5	High solids coatings, potable water pipe lines, concrete coatings.
TH 7940NB	17	1,000 - 3,000	0.95 - 0.99	95 +/- 2	84	17 <sup>8</sup>	70 - 90 <sup>8</sup>	2 - 4 <sup>8</sup>	Solvent containing variant of Epotec® Curing Agent TH 7940.
TH 7941	17	20,000 - 50,000	0.98 - 1.01	100	140	70	65 - 90	6 - 9	Medium to high solids marine and industrial maintenance coatings, potable water tank coatings, ballast tank coatings.
TH 7941S10	17	200 - 700	0.93 - 0.98	75 +/- 2	150	80	100 - 150 <sup>9</sup>	6 - 8	Solvent based industrial coatings.
TH 7942	17	10,000 - 20,000	0.96 - 1.02	75 +/- 2	155	25 <sup>8</sup>	60 - 80 <sup>9</sup>	1 - 3 <sup>8</sup>	Fast curing coatings with good gloss.
TH 7966	17	1,000 - 4,000	0.98 - 1.01	100	95	50	18 - 30	2 - 4	Fast-setting high solids coatings.

<sup>1</sup> Gardner Color Scale (Maximum), <sup>2</sup> Brookfield Viscosity @ 25°C (cP), <sup>3</sup> Specific Gravity @ 25°C, <sup>4</sup> Equivalent Weight per Active-H, <sup>5</sup> Parts per hundred of Resin with EPOTEC YD 128 (EEW = 186 g/eq),

<sup>6</sup> Gel Time in minutes, 100 grams @ 25°C with EPOTEC YD 128 (EEW = 186 g/eq), <sup>7</sup> Thin Film Set Time in hours @ 25°C, 75 μ thick film EPOTEC YD 128 (EEW = 186 g/eq), <sup>8</sup> With standard Bisphenol A epoxy resin EPOTEC YD 011X75 (EEW = 630 g/eq on solution), <sup>9</sup> By Gelnorm @ 35°C



## Technical Information

Using epoxy resin and curing agent in the correct ratio is important to achieve the desired performance out of the system. The following formulas are used for calculating mixing ratios of epoxy resins and curing agents:

### Determination of Epoxy Equivalent Weight (EEW) of Mix

$$\text{EEW of Mix} = \frac{\text{Total Weight}}{\frac{\text{Weight of A}}{\text{EEW of A}} + \frac{\text{Weight of B}}{\text{EEW of B}} + \dots}$$

### Determination of Active Hydrogen Equivalent Weight (AHEW)

$$\text{AHEW of Mix} = \frac{\text{Total Weight}}{\frac{\text{Weight of A}}{\text{AHEW of A}} + \frac{\text{Weight of B}}{\text{AHEW of B}} + \dots}$$

### Determination of Curing Agent quantity per hundred resin (phr)

$$\text{phr of Curing Agent} = \frac{\text{AHEW of Curing Agent}}{\text{EEW of Resin}} \times 100$$

### Risk Phrases

R10	Flammable.
R20	Harmful by inhalation.
R21	Harmful if contact with skin.
R22	Harmful if swallowed.
R34	Causes burn.
R36	Irritating to eyes.
R37	Irritating to respiratory system.
R38	Irritating to skin.
R41	Risk of serious damage to eyes.

### Safety Phrases

S23	Do not breath gas / fumes / vapors.
S24	Avoid skin contact.
S25	Avoid contact with eyes.
S26	In case of contact with eyes, wash immediately with plenty of water, seek medical advice.
S28	In case of contact with skin, wash immediately with solvents as recommended in the MSDS.
S36	Wear suitable protective clothing.
S37	Wear suitable gloves.
S39	Wear suitable eye / face protection.

## Technical Information

TABLE 5.01 Typical Physical Properties of Common Solvents

PRODUCT	SPECIFIC GRAVITY <sup>1</sup>	BOILING POINT <sup>2</sup>	FLASH POINT <sup>3</sup>	RELATIVE EVAPORATION RATE <sup>4</sup>
Hexane	0.675 <sup>5</sup>	~ 67	< 0	6.3
Mineral Spirits	0.771 <sup>5</sup>	~ 160	37	0.1
Toluene	0.872 <sup>5</sup>	~ 110	7	2.0
Xylene	0.871 <sup>5</sup>	~ 138	26	0.7
Acetone	0.792	57	- 20	5.7
MEK	0.802	80	- 8	3.8
MIBK	0.802	116	15	1.6
Cyclohexanone	0.948	156	43	0.3
DAA	0.940	158	52	0.12
Ethyl Acetate 99%	0.901	77	- 4	4.1
n-Propyl Acetate	0.889	101	12	2.3
n-Butyl Acetate	0.883	127	37	1.0
Ethylene Glycol Diacetate	1.107	190	88	0.02
Ethanol 95%	0.812	78	24	1.9
IPA	0.786	82	12	1.7
n-Butanol	0.811	118	36	0.5
Propylene Glycol Monomethyl Ether Acetate	0.970	140	45	0.4

<sup>1</sup> Specific Gravity @ 20°C, <sup>2</sup> Boiling Point (°C), <sup>3</sup> Flash Point (°C), <sup>4</sup> Relative Evaporation Rate (n-BuAc=1), <sup>5</sup> Specific Gravity @ 15°C

## List of Methods for Testing

TABLE 5.02

NO.	PROPERTY	TEST METHOD
1	Appearance	Visual
2	Color (Gardner)	ASTM D 1544-04
3	Epoxy Equivalent Weight	ASTM D 1652-04
4	Viscosity (Gardner)	ASTM D 1545-07
5	Viscosity (Brookfield)	ASTM D 2196-05
6	Melt Viscosity (ICI cone & plate)	ASTM D 4287-00
7	Hydrolysable chlorine	ASTM D 1726-03
8	Water content (Karl Fischer)	ASTM E 203-01
9	% NV for solvent cut products	TEC-AS-P-012
10	Softening point (Mettler cup and ball)	ASTM D 6090-99
11	Density	ASTM D 1475-98
12	Amine value	DIN 16945

## Reference Charts

TABLE 5.03 Mesh to Micron Conversion

ASTM MESH #	ISO MICRON	MM
18	1000	1.000
35	500	0.500
50	300	0.300
70	212	0.212
100	150	0.150
120	125	0.125
140	106	0.106
170	90	0.090
200	75	0.075
230	63	0.063
325	45	0.045
450	32	0.032

TABLE 5.04 Coverage Chart - Theoretical Coverage (m<sup>2</sup>/kg) @ 100% Transfer Efficiency

SPECIFIC GRAVITY	FILM THICKNESS (mil)				
	1	2	3	4	5
1.1	36.3	18.1	12.1	9.0	7.2
1.2	33.3	16.6	11.1	8.3	6.6
1.3	30.8	15.3	10.2	7.6	6.1
1.4	28.5	14.2	9.5	7.1	5.7
1.5	26.6	13.3	8.8	6.6	5.3
1.6	25.0	12.5	8.3	6.2	5.5
1.7	23.5	11.7	7.8	5.8	5.0
1.8	22.2	11.1	7.4	5.5	4.7
1.9	21.0	10.5	7.0	5.2	4.4
2.0	20.0	10.0	6.6	5.0	4.24



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#### **Material Safety, Handling and Storage Conditions**

Due to variety of materials used in epoxy systems, please consult Epotec® Technical Data Sheets (TDS) and Material Safety Data Sheets (MSDS). TDS and MSDS are available for all Epotec® products upon request. Alternatively, visit [www.epotec.info](http://www.epotec.info) for detailed material safety, handling, and storage conditions.



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## Coatings & Civil Engineering Applications

Epotec® Epoxy Systems

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