

ANCAMINE[®] 2143**Curing Agent****DESCRIPTION**

Ancamine 2143 curing agent is a low-color, low-viscosity cycloaliphatic amine adduct intended for use with liquid epoxy resins. It exhibits very good resistance to amine blush and waterspotting at ambient and low-temperature, high-humidity conditions.

Ancamine 2143 gives high-gloss, abrasion resistant coatings that are resistant to a variety of solvents, acids and bases. These properties make Ancamine 2143 curing agent ideal for formulating maintenance coatings, flooring, tank linings and grouts.

TYPICAL PROPERTIES

Property	Value	Unit	Method
Appearance	Almost Colorless Liquid		
Color	1	Gardner	ASTM D 1544-80
Viscosity @ 77°F	600	cP	ASTM D-445-83, Brookfield, RVTD, Spindle 4
Amine Value	255	mg KOH/g	Perchloric Acid Titration
Specific Gravity @ 77°F	1.03		ASTM D 1475-85
Flash Point (closed cup)	234	°F	Seta Flash Closed Cup
Equivalent Wt/{H}	115		
Recommended use Level	60	phr	EEW=190

ADVANTAGES

- Excellent color and color retention
- Resistance to amine blush
- Good chemical resistance
- Very good resistance to waterspotting at ambient and low temperatures
- High gloss
- Good abrasion resistance

APPLICATIONS

- High-solids coatings
- Self-leveling flooring
- Chemically resistant tank linings, mortars, and grouts
- Decorative tile grouts

SHELF LIFE

At least 24 months from the date of manufacture in the original sealed container at ambient temperature. Store away from excessive heat and humidity.

STORAGE AND HANDLING

Refer to the Safety Data Sheet for Ancamine 2143 curing agent.

TYPICAL CURE SCHEDULE

2 – 7 days at ambient temperature

TYPICAL HANDLING PROPERTIES

Property	A*	B*	Unit	Method
Mixed Viscosity @ 77°F	1,560	1,808	Cp	ASTM D-445-83, Brookfield, RVTD, Spindle 4
Gel Time (150g mix @ 77°F)	42	82	Min	Techne GT-4 Gelation Timer
Thin Film Set Time				BK Drying Recorder
77°F	7.0	9.3	h	
50°F	-	22	h	
40°F	21	-	h	
Peak Exotherm (100g mix @ 77°F)	216	-	°F	ASTM D 2471-71
Peak Exotherm Time	58	-	Min	ASTM D 2471-71

A* Ancamine 2143 formulated with standard Bisphenol-A (DGEBA, EEW = 190) epoxy resin.

B* Ancamine 2143 with 90% DGEBA resin (EEW = 190) and 10% Epodil® 748 diluent (C₁₂-C₁₄ alkyl glycidyl ether).



TYPICAL PERFORMANCE (7 DAY CURE @ 77°F)

Property	A*	B*	Unit	Method
Glass Transition Temperature	123	-	°F	ASTM D 3418-82
Compressive Strength @ Yield	-	10,370	psi	ASTM D 695-85
Compressive Modulus	,	326	thousand psi	
Tensile Strength	7,540	6,860	psi	ASTM D 638-86
Tensile Modulus	432	189	thousand psi	ASTM D 638-86
Tensile Elongation	2.8	8.0	%	ASTM D 638-86
Flexural Strength	11,200	10,610	psi	ASTM D 790-86
Flexural Modulus	376	383	thousand psi	ASTM D 790-86
Hardness	81	181	Shore D	ASTM D 2240-86
60° Film Gloss	103	-		ASTM D 523-85
Abrasion Resistance Weight Loss @ 1,000 cycles with wheel no. 10	-	0.034	gm	ASTM D 4060-90
Mar Resistance	-	0.85	kg	ASTM D 5178-91
Heat Deflection Temperature	120	-	°F	
Bond Strength (mild steel to mild steel)	1,620	-	psi	

SUPPLEMENTAL DATA

EXCELLENT WATERSPOTTING RESISTANCE

For testing purposes, Ancamine 2143 curing agent was combined at the recommended mix ratio with standard Bisphenol-A (DGEBA) epoxy resin (EEW = 190). Under ambient cure conditions (77°F and 90% relative humidity), 100% waterspot defect resistance is developed within one day.

Severe low temperature, high humidity conditions were tested by applying 4-mil films to metal panels, then curing the panels at 45°F and 90% relative humidity. After 24 hours, a water-saturated cotton ball was placed on the coating surface and allowed to stand in the refrigerator for another 24 hours. The film was evaluated after this period for evidence of waterspotting. The procedure was repeated every 24 hours until the surface appeared free of defects.

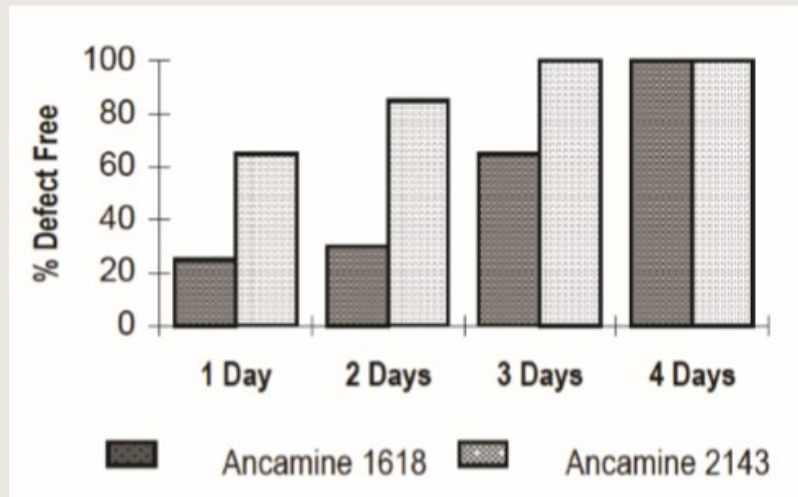
As shown in Figure 1, Ancamine 2143 curing agent develops 100% waterspot resistance within 3 days at low temperature and high humidity, and has over 85% defect-free surfaces within 2 days. This compares favorably with standard cycloaliphatic adduct curing agents such as Ancamine 1618 and Ancamine 1693.

A* Ancamine 2143 formulated with standard Bisphenol-A (DGEBA, EEW = 190) epoxy resin.

B* Ancamine 2143 with 90% DGEBA resin (EEW = 190) and 10% Epodil® 748 diluent (C₁₂-C₁₄ alkyl glycidyl ether).



FIGURE 1: SURFACE DEFECT RESISTANCE AT 45°F / 90% RELATIVE HUMIDITY



GOOD CHEMICAL RESISTANCE

Chemical immersion studies following ASTM D543 were performed using various resin formulations cured with Ancamine 2143 for 7 days at 77°F. Ancamine 2143 curing agent was mixed in the recommended use levels with the following resins for the studies:

- 100% DGEBA resin, EEW = 190
- 100% DGEBF resin, EEW = 172
- 60% DGEBF difunctional, EEW = 176/40% epoxy Novolac multifunctional resin blend
- 10% cresyl glycidyl ether (Epodil 742) diluted DGEBA resin, EEW = 188

Three 1" X 3" samples of 1/8" thick castings were fully immersed in each reagent. Table 4 shows the average percent weight gain or loss after 3 days and 28 days for each of the formulations immersed in various chemicals at 77°F.

TABLE 4: CHEMICAL RESISTANCE FOR ANCAMINE 2143 FORMULATIONS % WEIGHT CHANGE AS A FUNCTION OF TIME — CONTINUOUS IMMERSION

Reagent	DGEBA, EEW = 190		DGEBF, EEW = 172		60% DGEBF/ 40% Novolac Blend		90% DGEBA/10% CGE	
	3 days	28 days	3 days	28 days	3 days	28 days	3 days	28 days
Deionized Water	0.41	1.39	0.35	1.39	0.48	1.36	0.43	1.32
Methanol	10.20	8.07	9.00	6.44	9.05	10.50	10.85	2.50
Ethanol	2.95	7.96	2.16	6.91	2.09	6.10	3.14	8.94
Toluene	0.53	2.79	0.05	1.82	5.07	5.63	0.44	3.81
Xylene	0.01	0.17	-0.01	0.32	0.01	0.24	0.04	0.27
Butyl Cellosolve	0.79	3.15	0.33	1.46	0.32	1.24	1.07	4.30
MEK	21.48	D@5	15.34	9.70	12.75	9.00	21.38	14.97
10% Lactic Acid	3.08	9.52	2.92	7.03	3.31	9.56	2.43	7.40
10% Acetic Acid	5.29	14.85	5.05	14.13	5.88	16.57	4.31	12.46
70% Sulfuric Acid	0.20	0.37	2.83	0.17	0.08	0.30	0.05	0.09
98% Sulfuric Acid	D@1	D@1	1.57		0.67	-3.32	D@1	D@1
50% Sodium Hydroxide	0.04	0.00	-0.09	-0.15	-0.01	-0.01	0.04	-0.05
10% Sodium Hypochlorite	0.42	1.08	0.29	0.94	0.44	1.17	0.40	1.19
Trichloroethane	0.02	0.20	0.02	0.36	0.04	0.22	0.03	0.27

Note: Cured for 7 days at 77°F.

Spillage resistance studies were conducted on Ancamine 2143 curing agent formulated with a 90% DGEBA resin (EEW = 190) and 10% Epodil 748 (C₁₂-C₁₄ alkyl glycidyl ether) diluent blend. Samples were cured for 7 days at 77 °F; three samples were tested for each reagent. The immersion/recovery schedule for the testing is shown in Table 5. Percent weight gain or loss and Shore D hardness were measured after each of the immersion periods. The samples were then allowed to recover before reimmersion for the next time period. Results of this study are presented in Table 6.

TABLE 5: SPILLAGE RESISTANCE TEST METHOD SCHEDULE

Samples Immersed	3h	24h	3 days	7 days	28 days	90 days
Recovery Time	24 h	24 h	3 days	7 days	7 days	

Castings of 1/8" thickness are immersed for specified time period.

Sample is then removed, weighed and hardness is tested immediately.

Sample is then allowed to recover for specified time before reimmersion.



TABLE 6: SPILLAGE RESISTANCE FOR ANCAMINE 2143 WITH 90% DGEBA/10% EPODIL 748 % WEIGHT CHANGE AND SHORE D HARDNESS AS A FUNCTION OF TIME

Reagent	Initial		After 3 hr		After 24 hr		After 3 days		After 7 days		After 28 days		After 90 days	
	Hard	% wt.	Hard	% wt.	Hard	% wt.	Hard	% wt.	Hard	% wt.	Hard	% wt.	Hard	% wt.
10% Acetic Acid	81	1.03	80	2.94	73	5.61	65	8.76	60	15.1	51	24.5	42	
10% Lactic Acid	81	0.52	81	1.72	78	3.36	77	5.31	74	9.25	70	16.0	63	
Toluene	81	0.01	79	0.74	74	2.54	67	5.42	57	17.8	45	17.6	47	
Xylene	81	0.01	79	0.04	76	0.30	74	0.86	70	3.93	72	12.4	59	
Trichloroethane	81	0.06	79	0.38	77	1.45	73	3.16	70	10.7	66	24.5	37	
Methanol	81	2.41	70	5.44	43	12.1	25	DESTROYED						
Ethanol	81	0.62	76	1.87	66	3.61	55	5.49	49	8.15	41	2.92	52	
Butyl Cellosolve	81	0.12	80	0.56	74	2.04	70	3.28	65	6.74	62	15.7	47	
MEK	81	3.62	67	13.5	32	17.3	21	14.7	22	13.3	38	14.2	25	
Skydrol	81	0.04	78	0.14	78	0.24	77	0.52	78	0.87	78	1.40	52	
70% Sulfuric Acid	81	0.26	82	0.10	81	0.14	81	0.20	82	0.22	82	0.10	81	
98% Sulfuric Acid	81	-12.7	80	DESTROYED										
Deionized Water	81	0.14	78	0.28	78	0.45	78	0.85	78	1.52	79	1.89	79	
50% Sodium Hydroxide	81	0.03	81	-0.05	81	-0.05	81	-0.04	81	-0.08	81	-0.13	65	
Bleach	81	0.14	81	0.25	79	0.46	80	0.73	79	0.90	79	-0.37	63	

Note: Cured for 7 days at 77°F.

Spillage resistance tests were also conducted on Ancamine 2143 curing agent and an industry standard cycloaliphatic (Ancamine 1618 curing agent) after a longer cure schedule. The curing agents were formulated with 100% Bisphenol-A liquid resin and cured for 28 days at 77°F. Table 7 shows the resistance of the curing agent formulations as determined by the degree of hardness retained over the time period until failure. This test is particularly relevant for flooring applications where the resistance to chemical spillage is demonstrated in the ability of the floor to support traffic after exposure.

These studies show that Ancamine 2143 curing agent provides excellent chemical resistance to a variety of solvents, inorganic acids and bases. Overall, its resistance is superior to standard cycloaliphatic adduct curing agents except for organic acids. The superior chemical resistance of Ancamine 2143 curing agent becomes even greater with longer cure schedules. The superior hardness retention results confirm the suitability of Ancamine 2143-based systems for flooring and coating applications where spillage resistance is required.

Chemical resistance of Ancamine 2143-based formulations can be optimized for specific chemicals (for example, 98% sulfuric acid and MEK) using different resin blends. For information on the chemical resistance of many other Evonik curing agents, please refer to “Chemical Resistance for Ambient Cure Epoxy Formulations” (Pub. No. 125-9326).



TABLE 7: RESISTANCE TO SPILLS HARDNESS CHANGE UPON IMMERSION — 28-DAY CURE WITH DGEBA RESIN

Reagent	Ancamine 2143						Ancamine 1618					
	3 h	24 h	3 days	7 days	28 days	6 mo	3 h	24 h	3 days	7 days	28 days	6 mo
30% Citric Acid	0	0	0	0	0	0	0	2	2	2	2	2
5% Acetic Acid	0	0	0	0	0	0	0	2	2	2	2	2
30% Lactic Acid	0	0	0	0	0	0	0	3	3	3	3	3
30% Nitric Acid	0	1	1	1	1	1	0	1	1	2	2	2
75% Sulfuric Acid	0	0	0	1	1	1	0	0	2	2	2	2
Conc. Hydrochloric Acid	0	0	0	0	0	0	0	2	2	2	2	2
Methylated Spirit	0	0	0	0	0	0	0	3	3	3	3	3
Propanol	0	0	0	0	0	0	0	0	0	2	2	2
Toluene	0	0	0	0	0	0	0	2	2	2	2	2
Diethyl Ether	0	0	0	0	0	0	0	2	2	2	2	2
Ethyl Acetate	0	2	2	3	3	3	3	3	3	4	D	D

Note: Cured for 7 days at 77°F.

Definitions:

- 0 - unaffected: >90% hardness retention
- 1 - surface discoloration
- 2 - slight softening: 75-90% hardness retention
- 3 - moderate softening: 65-75% hardness retention
- 4 - severe softening: <60% hardness retention
- D - sample destroyed

Test Method Schedule:

Samples Immersed 3 hr 24 hr 3 days 7 days 28 days 3 months 3 months
 Recovery Time 24 hr 24 hr 3 days 7 days 7 days 7 days
 Castings of 1/8" thickness are immersed for specified time period.
 Sample is then removed, weighed and hardness tested immediately.
 Sample is then allowed to recover for specified time before reimmersion.

HARDNESS DEVELOPMENT

Gel time and thin film set time define well the development of cure but often do not accurately predict development of hardness. pendulum hardness was measured as a function of 77°F/50% relative humidity cure time for 10-mil coatings formulated with Ancamine 2143 and three resin blends. Results are presented in Table 8.



CURE SPEED

Thin film set time of Ancamine 2143 with DGEBA resin in a 3-mil film is 7 hours at 77°F and 21 hours at 41°F. Using a 90% DGEBA resin/10% Epodil 748 diluent blend, the thin film set time is 9.25 hours at 77°F and 22 hours at 50°F. Low-temperature cure time performance is comparable to the stand cycloaliphatic adduct. To speed up thin film set time and hardness development at ambient temperatures, Ancamine 2143 can be accelerated with aliphatic amine curing agents such as 10% Ancamine 2089M, 10% Ancamine 2432, 10% Ancamine 1856 or 10% Ancamine 2205 curing agent. Ten percent Ancamine 2089M or Ancamine 2432 curing agent is recommended for low temperature (<55°F) acceleration.

TABLE 8: ANCAMINE 2143 FORMULATION KÖNIG PENDULUM HARDNESS

Number of Days Cure	1	2	3
König 100% DGEBA	87	121	131
90% DGEBA/10% CGE	67	117	122
100% DGEBF	43	103	116

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EVONIK OPERATIONS GMBH

Business Line Crosslinkers
Paul-Baumann-Str. 1
45764 Marl
Germany

www.evonik.com/crosslinkers

Product Information: APCSE@evonik.com

Sample Request: APCSE@evonik.com

EVONIK CORPORATION

Business Line Crosslinkers
7001 Hamilton Boulevard
Trexlerstown, PA 18087
USA

CrosslinkersProinfo@evonik.com

Crosslinkers-Samples@evonik.com

EVONIK SPECIALTY CHEMICALS (SHANGHAI) CO., LTD.

Business Line Crosslinkers
55, Chungong Road
Xinzhuang Industry Park
Shanghai, 201108
China

CL-Asiainfo@evonik.com

CL-Asiainfo@evonik.com

