

Starting Formulation

SF 4009 Adhesive Formulations EPON and Epikure Adhesive Formulations for Thermoplastic Substrates

EPON™ Resins 8132, 828, 58005, 862, 58003 / EPIKURE™ Curing Agent 30055, 3125, 3163, and 3164

Introduction These adhesive systems are designed for use in ambient or elevated temperature bonding of thermoplastic substrates such as Nylon 11, polyethylene terephthalate, polyvinyl chloride, and polyurethane.

- Features**
- Good adhesion to thermoplastic substrates
 - Solvent-free, no volatile by-products

Mixing Instructions Processing data are presented in Table 1. All of the starting point formulations discussed in this bulletin utilize Cab-O-Sil M-5 as the thixotropic agent (see Table 1). The Cab-O-Sil M-5 should be dispersed into a portion of the base resin (EPON Resin 8132, EPON Resin 828, EPON Resin 862) using a high shear dispersing technique. Add the remaining base resin and any other resins in the formulation to the resulting dispersion and mix, using conventional mixing equipment, until a uniform consistency is attained.

This formulation is a basic starting point and can be modified with other filler types, such as aluminum powder, talc, alumina, silica, wollastonite, or calcium carbonate. Addition of a sufficient quantity of filler can adjust the combining ratio to a convenient level. Modification with silane coupling agents improves bonds to concrete and glass. Pigment may be incorporated into either or both portions for the purpose of color-coding.

Processing Properties Table 1 / Processing Properties

Formulation number	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
Resin, parts by weight (by volume)							
EPON Resin 8132	75 (82)	–	–	–	100 (109)	100 (109)	100 (109)
EPON Resin 828	25 (26)	75 (77)	–	–	–	–	–
EPON Resin 58005	–	25 (28)	–	–	–	–	–
EPON Resin 862	–	–	75 (76)	–	–	–	–
EPON Resin 58003	–	–	25 (28)	–	–	–	–
PON Resin 58135	–	–	–	100 (105)	–	–	–

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Cab-O-Sil M-5	2(1)	2(1)	2(1)	2(1)	2(1)	2(1)	2(1)
Resin viscosity @ 25 °C ¹ , P							
@ 0.3 rpm	-	1360	-	-	-	-	-
@ 0.6 rpm	-	1320	-	873	-	-	-
@ 1.5 rpm	-	1300	436	828	-	-	-
@ 3 rpm	-	1290	421	805	-	-	-
@ 6 rpm	-	-	407	787	-	-	-
@ 12 rpm	37.2	-	396	-	-	-	-
@ 30 rpm	32.9	-	-	-	19.9	19.9	19.9
@ 60 rpm	30.6	-	-	-	18.7	18.7	18.7
Curing agent, parts by weight (by volume)							
EPI-CURE Curing Agent 3055	42 (53)	42 (53)	46 (58)	42 (53)	-	-	-
EPI-CURE Curing Agent 3125	-	-	-	-	50 (62)	-	-
EPI-CURE Curing Agent 3163	-	-	-	-	-	138 (169)	-
EPI-CURE Curing Agent 3164	-	-	-	-	-	-	86 (106)
Curing Agent Viscosity @ 25 °C ¹ , P	2	2	2	2	330	1490	82
Gel Time @ 25 °C ²							
Gel Time @ 25 °C ² 100 gram mass, min.	345	165	178	142	193	113	109
Dry Time, thin film Gel Time @ 25 °C ³ , hr.	16	11	13	13	10	20.5	34.5

¹ Brookfield DV-II

² Shyodu Gel Timer

³ Gardco Circular Drying Time Recorder, 0.2 mm film

Application Instructions Surfaces to be bonded should be clean and free of dust, dirt, grease, or other extraneous material. Mix the adhesive components and apply immediately by spreading a thin film over the surface to be bonded. Maintain light pressure during cure to achieve the best bond. For the data presented, the surfaces were wiped with acetone or methyl ethyl ketone in order to remove dust, dirt, oils, etc.

The initial cure step may be carried out at room temperature or at elevated temperature. If initially cured at room temperature, an elevated temperature post cure should be evaluated depending on the requirements of the desired application. An elevated temperature cure will decrease the cure time significantly and will reduce the need for an additional post cure. Data are presented in Table 2 for both room and elevated temperature cure schedules. The cure schedule used was 30 minutes at 140 °C (280 °F).

Performance Properties Table 2 / Typical Properties

Formulation number	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>
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Room Temperature Cure

Cure Schedule 7 days @ 25 °C (77 °F)

Lap shear strength ¹, psi

CARILON® P-1000 ²

Average	1012	884	950	832	691	621	499
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Standard Deviation	193	216	189	166	43	81	33
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Polyvinylchloride (PVC) ³

Average	691*	677*	754*	776	308	549	529
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Standard Deviation	199	77	37	136	31	55	61
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Polyurethane ⁴

Average	479	435	759	573	718	906	730
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Standard Deviation	252	83	103	168	70	122	150
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Polyethylene terephthalate (PET) ⁵

Average	255	254	487	506	525	800	632
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Standard Deviation	68	29	139	324	81	75	52
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Elevated Temperature Cure

Cure Schedule 30 minutes @ 140 °C (284 °F)

Lap shear strength ¹, psi

CARILON® P-1000 ²

Average	1396*	1401*	1359*	688	784	886	388
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Standard Deviation	119	187	169	230	128	27	54
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Polyvinylchloride (PVC) ³

Average	1216*	1281*	939*	951*	661*	969*	674*
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Standard Deviation	346	193	434	220	111	123	98
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Polyurethane ⁴

Average	319	550	385	407	307	583	429
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Standard Deviation	75	38	124	112	49	103	77
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Polyethylene terephthalate (PET) ⁵

Average	768	653	890	796	964	1244	848
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Standard Deviation	125	160	117	113	79	106	44
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Nylon ⁶

Average	434	–	414	444	650	725	466
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Standard Deviation	105	–	168	67	188	27	57
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Glass Transition Temperature ⁷ , °C	60	86	75	70	50	45	40
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¹ ASTM D 3163 96 AT 25 °C, Average of 5 Specimens, Solvent Wiped

² CARILON® P-1000 was supplied by Shell Chemical Company

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³ Polyvinylchloride (PVC), Type 1, was supplied by McMaster-Carr Supply Company

⁴ Polyurethane was supplied by McMaster-Carr Supply Company and had a Shore Durometer reading of 75 and a tensile strength of 7500 psi

⁵ Polyethylene terephthalate (PET) was supplied by McMaster-Carr Supply Company

⁶ Nylon was supplied by ElfAtochem as Rilsan® Polyamide 11 Resin

⁷ Dynamic Mechanical Analysis, Rectangular Torsional Geometry, 1 °C/min

* All samples failed in tensile mode within the bond line.

Storage Recommendations regarding storage conditions can be obtained by visiting our web site at www.hexion.com

General Information

These are starting formulations and are not proven in the user's particular application but are simply meant to demonstrate the efficacy of the products and to assist in the development of the user's own formulation. It is the user's responsibility to fully-test and qualify the formulation, along with the ingredients, methods, applications or equipment identified herein ("Information"), by the user's knowledgeable formulator or scientist, and to determine the appropriate use conditions and legal restrictions, prior to use of any Information.

Safety, Storage & Handling

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

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