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VIPEL® K022 SERIES VINYL ESTER RESIN



Product Information

FIRE RETARDANT BISPHENOL-A, EPOXY VINYL ESTER RESIN

TYPICAL CAST MECHANICAL PROPERTIES OF VIPEL K022 AC, CC SERIES¹

Test	Unit of Measure	K022-AC Series	K022-CC Series
Tensile Strength	psi/Mpa	12,500/86	12,000/83
Tensile Modulus	psi/Gpa	520,000/3.6	520,000/3.6
Tensile Elongation	%	4.7	5.4
Flexural Strength	psi/Mpa	21,300/147	20,700/143
Flexural Modulus	psi/Gpa	530,000/3.7	530,000/3.7
Heat Distortion Temp.	°F/°C @ 264 psi	241/116	234/112
Barcol Hardness		39	40

TYPICAL CAST MECHANICAL PROPERTIES OF VIPEL K022 CN, E SERIES¹

Test	Unit of Measure	K022-CN Series	K022-E Series
Tensile Strength	psi/Mpa	11,000/76	12,500/86
Tensile Modulus	psi/Gpa	530,000/3.7	510,000/3.5
Tensile Elongation	%	3	4.5
Flexural Strength	psi/Mpa	20,100/138	21,500/149
Flexural Modulus	psi/Gpa	560,000/3.9	540,000/3.7
Heat Distortion Temp.	°F/°C @ 264 psi	237/114	237/114
Barcol Hardness		34	39

TYPICAL LIQUID PROPERTIES²

Versions	Viscosity, cps	Thix Index	Gel Time, min	Gel to Peak, min	Peak Exotherm °F/°C	Specific Gravity	Styrene Content, %
The following versions, as supplied, meet ASTM E 84 Class 1 flame spread							
K022-ACA-00	450 ¹	NA	21 ²	13	340/171	1.15	39
K022-ACB-00	650 ¹	NA	21.5 ⁸		343/173	1.15	37
K022-ACP-20	450 ¹	NA	20 ⁵	11	365/185	1.16	39
K022-ACT-30	525 ¹	2.0 ⁶	30 ⁵	14	350/177	1.15	41
K022-ACT-45	525 ¹	2.0	45 ⁵	17	338/170	1.14	41
K022-CNC-00	450 ¹	NA	35 ²	13	350/177	1.16	39
K022-CND-00	350 ¹	NA	22 ²	12	335/168	1.13	41
K022-CNP-25	450 ¹	NA	25 ⁵	14	350/177	1.16	39
K022-EAA-40	250 ³	NA	40 ⁵	22	266/130	1.12	41
K022-EBB-00	250 ³	NA	25 ²	12	350/177	1.12	41
The following versions, as supplied, meet ASTM E 84 Class 2 flame spread							
K022-CCC-00	450 ¹	NA	22 ²	12	330/166	1.15	39
K022-CCK-18	525 ³	2.0 ⁴	18 ⁵	14	350/177	1.11	41
K022-CCL-00	525 ³	2.0 ⁴	25 ⁷	15	365/185	1.11	41

¹Some specifications modified based on product production history.

- NA-Not applicable
- 1. 77 °F/25 °C Brookfield RV viscosity spindle 2 at 20 rpm
- 2. 77 °F/25 °C Gel time with 0.3% cobalt 6%, 0.05% DMA and 1.25% MEKP 925H
- 3. 77 °F/25 °C Brookfield LV viscosity spindle 3 at 60 rpm
- 4. 6/60 rpm Thix Index
- 5. 77 °F/25 °C Gel time with 1.25% MEKP 925H
- 6. 2/20 rpm Thix Index
- 7. 77 °F/25 °C Gel time with 0.4% Cobalt 6%,
- 8. 100g, @25°C, 0.30% Cobalt 6%, 0.05 DMA+1.25% Butanox M50

*Typical properties are not to be construed as specifications.

DESCRIPTION

AOC's Vipel K022 series are brominated bisphenol-A epoxy vinyl ester resins dissolved in styrene.

APPLICATION

Vipel K022 series is ideally suited for use in hand lay-up, spray-up, filament winding and pultrusion processes where outstanding mechanical properties and excellent resistance to chemicals and heat are required.

All versions of the K022 Series do not meet ASTM E84 Class 1 smoke requirements.

BENEFITS

Versatile

Vipel K022 is available in a wide range of formulations, which allows the product to be used in many processes and also optimizes cost/performance.

Vipel K022-CN versions already contain an antimony product to meet a Class 1 flame spread.

Fire Retardant

Because of the versatility of Vipel K022, versions are available to meet ASTM E 84 Class 1 or 2 flame spread.

Mechanical Properties

Vipel K022 is suitable for moldings that are subjected to particularly high static or dynamic loads.

Corrosion Resistance

Vipel K022 is highly resistant to a number of chemical environments. Refer to AOC's "Corrosion Resistant Resin Guide" for corrosion resistance information or for questions regarding suitability of a resin to any particular chemical environment contact AOC.

Vipel K022-CN versions are not recommended for use in the corrosion liner.



Flammability Properties ASTM E-84 Tunnel Test**

ASTM E 84			
Versions	Antimony Trioxide	Flame Spread	Classification (*)
K022-ACA, ACB, ACP & ACT		25	Class 1
K022-CNC and CNP	Yes	10	Class 1
K022-CND-00	Yes	15	Class 1
K022-EAA & EEB		25	Class 1
K022-CCC, CCK & CCL		40	Class 2

* None of the K022 products meet ASTM E 84 Class 1 smoke requirements, which is defined as less than 450. Consult an AOC representative for specific smoke development value.

** 2 plies of 2.0 ounce per square foot (600 grams per square meter) fiber glass chopped strand mat Fiberglass content - 30% laminates were post cured at 212°F/100°C for 3 hours.

Note: The degree of fire resistance of a cured resin is characterized by the ASTM E 84 test. This test is performed under strictly controlled conditions where a flame spread rating is assigned according to comparisons with test set-point materials. The behavior of the end-users composite cured under controlled conditions can vary significantly in an actual fire situation due to the large number of unpredictable variables associated with actual fire situations.

Vipel® K022 Tensile Property Testing At Various Temperatures

Temperature, °F/°C	Physical Property	Casting	Chopped Mat ***	RTP-1 Laminate ****
Ambient	Tensile strength, psi/MPa	12,000/83	15,000/103	21,500/148
	Tensile modulus, psi/GPa	520,000/3.6	1,400,000/9.6	1,770,000/12
		4.6	1.6	1.7
150/66	Tensile strength, psi/MPa	9,900/68	16,500/114	21,500/148
	Tensile modulus, psi/GPa	436,000/3.0	1,200,000/8.3	1,650,000/11
	Elongation,%	5.1	2	1.8
200/93	Tensile strength, psi/MPa	7,200/50	13,000/90	21,000/145
	Tensile modulus, psi/GPa	415,000/2.8	1,000,000/6.9	1,480,000/10
	Elongation,%	6.1	2.1	1.7
250/121	Tensile strength, psi/MPa	1,200/8	7,900/54	13,000/90
	Tensile modulus, psi/GPa	128,000/0.9	490,000/3.4	800,000/5.5
	Elongation,%	>10	2.2	2
275/135	Tensile strength, psi/MPa	210/1.5	6,000/42	9,500/66
	Tensile modulus, psi/GPa	1,900/0.01	420,000/2.9	850,000/5.9
	Elongation,%	11.5	4.4	1.3
300/149	Tensile strength, psi/MPa		4,200/29	7,100/49
	Tensile modulus, psi/GPa		420,000/2.9	630,000/4.3
	Elongation,%		2.3	1.2
	Glass Content,%		29	37

*** Laminates made with 3 plies of 1.5 oz (450 grams/m²) chopped strand mat

****Laminates made with veil/5plies of 1.5 oz mat(450 grams/m²), 24 oz (814 grams/m²) woven roving. (veil/3M/R/M/R/M)





GEL TIMES FOR VIPEL K022 SERIES										
COBALT NAPHTHENATE (6%) & DMA AND DEA ALTERNATIVE WITH 1.25% MEKP 925H										
Resin Temperature (°F)	DMA					DEA				
	60s	70s	90s	60s	70s	90s	60s	70s	90s	
10 – 20 min.	20	13	17	16	17	13				
MEKP,%	1.25	1.25	1.25	1.25	1.25	1.25				
CoNAP,%	0.2	0.3	0.3	0.3	0.3	0.3				
DMA,%	0.2	0.15	0.05							
DEA,%						0.5	0.3		0.2	
20 – 40 min.	24	32	36	27	31	30	28	35	36	33
MEKP,%	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
CoNAP,%	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
DMA,%	0.1	0.05	0.05	0.05	0.05					
DEA,%						0.1	0.1	0.1	0.1	0.1
2,4-P,%		0.05		0.08			0.5		0.08	
TBC,%			0.0075		0.01			0.004		0.017
40 – 60 min.	44	52	48	50	46	55	44	45	48	56
MEKP,%	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
CoNAP,%	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
DMA,%	0.05	0.05	0.05	0.05	0.05	0.05				
DEA,%							0.1	0.1	0.1	0.1
2,4-P,%	0.04		0.075		0.1		0.04		0.06	0.01
TBC,%		0.007		0.015		0.02		0.005		0.025

GEL TIMES FOR VIPEL K022 SERIES						
BENZOYL PEROXIDE CATALYST (BPO) WITH DMA AND ALTERNATIVE DEA						
[FOR LAMINATES LESS THAN 3/16 INCHES (4.8 MM) THICK]						
Resin Temperature (°F)		60s		70s		90s
10 – 20 min.		17	18	18	18	10
	BPO,%	1.0	1.0	1.0	1.0	1.0
	DMA,%	0.35		0.23		0.2
	DEA,%		0.8		0.5	0.3
20 – 40 min.		23	27	26	28	26
	BPO,%	1.0	1.0	1.0	1.0	1.0
	DMA,%	0.25		0.12		0.09
	DEA,%		0.5		0.3	0.2
40 – 60 min.		49	56	44	55	42
	BPO,%	1.0	1.0	1.0	1.0	1.0
	DMA,%	0.1		0.1		0.05
	DEA,%		0.25		0.15	0.1





PERFORMANCE GUIDELINES

A. Keep full strength catalyst levels between 1.0% - 2.5% of the total resin weight.

B. Maintaining shop temperatures between 65°F/18°C and 90°F/32°C and humidity between 40% and 90% will help the fabricator make a high quality part. Consistent shop conditions contribute to consistent gel times and will help the fabricator make a high quality part.

C. Finished part surfaces that have been cured at room temperature in contact with air should be relatively tack free. They may not, however, be fully cured and are thus not as resistant to chemicals as a fully cured part. If no further laminating is planned, a 10% solution of 5% paraffin wax solution (MP 115-118°F/46-48°C) in styrene may be added to the last resin layer to provide a tack free surface.

D. Optimum cure and performance may be obtained by post curing room temperature cured laminates for two hours at 158-212°F/70-100°C.

E. Room temperature curing by means of cobalt acceleration should be completed with low hydrogen peroxide content MEKP catalyst, such as MEKP 925H, to minimize foaming.

STORAGE STABILITY

Vipel K022-ACP-20, K022-ACT-30, K022-ACT-45, K022-CCK-18, K022-CNP-25 and K022-EAA-40 are stable for 3 months from the date of manufacture when stored in original containers, away from direct sunlight or other UV light sources and at or below 77°F (25°C). All other Vipel K022 products are stable for 6 months from the date of manufacture when stored in original containers, away from direct sunlight or other UV light sources and at or below 77°F (25°C).

Storage stability of two months or less should be anticipated if the storage temperature exceeds 86°F (30°C).

After extended storage, some drift may occur in the product viscosity and gel time.

SAFETY

See the appropriate Safety Data Sheet for guidelines.

ISO 9001:2008 CERTIFIED

The Quality Management Systems at every AOC manufacturing facility have been certified as meeting ISO 9001:2008 standards. This certification recognizes that each AOC facility has an internationally accepted model in place for managing and assuring quality. We follow the practices set forth in this model to add value to the resins we make for our customers.

FOOTNOTES

(1.) Based on tests of Vipel K022 at 77°F/25°C and 50% relative humidity. All tests performed on unreinforced cured resin castings. Thixotropic components, if applicable, are excluded from casting samples. Castings were prepared using 1.0% BPO and post cured 1 hour at 93°C, 1 hour at 116°C and 2 hours at 138°C.

(2.) The gel times shown are typical but may be affected by catalyst, promoter, inhibitor concentration, resin, mold, and shop temperature. Variations in gelling characteristics can be expected between different lots of catalysts and at extremely high humidities. Pigment and fillers can retard or accelerate gelation. It is recommended that the fabricator check the gelling characteristics of a small quantity of resin under actual operating conditions prior to use.



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