Aldila Composite Materials
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ALDILA COMPOSITE MATERIALS

AR4550 Bismaleimide (BMI) Data Sheet

Updated: 8/19/2014

AR4550 is a Toughened Bismaleimide (BMI) Resin system, ideal for "Out Of Autoclave" (OOA) Curing.

Features:

- Low Temperature cure, as low as 375F, with Free standing post cure will provide Tg of **530F.**
- Intrinsically Toughened.
- Medium Tack
- Good Drape
- Good Work Time (Unitape Tack Retention) one weeks at Room Temperature.
- Good Out time (No Change in Gel Time) 4 weeks at Room Temperature.
- Available in most commercial fibers, and woven fabrics.
- Storage Time: 6 months at 40°F, 12 months at 0° F.
- It has medium high flow.
- Neat Resin Gel Curve
- Neat Resin (Complex) Rheology, Viscosity vs. Temperature
- Neat Resin (Complex) Rheology, Viscosity vs. Time.
- Isothermal Viscosity Curves.
- DSC Scan
- Lay-up and Fabrication.
- It can be processed in autoclave, press or oven.
- The following **Autoclave Cure Cycle** was used to develop mechanical properties:

1. Applied Full Vacuum. 1B. 3F°/min 290F/60 mins, applied 85 Psi 1C.Started heating @3F°/min
2. Vented @ 22 Psi, applied 85 Psi Pressure. 3. At **310F°** it was held for **1hour** .
4. Increased temperature @3F°/min to **375°F** Held for **2hours**
5. Cool under pressure, Removed part at or below 140°F
6. **Free standing Post Cure:** In Oven at 3-5F°/min to **410F°/4hrs**.Cooled to room Temp slowly. Removed the part at RT

- **Cured Neat resin Density 1.25 g/cc (by Pycnometer).**

R&D

Material:	**34-700 (24k)-AR4550-200/35-24"**

34-700 (24k) is a PAN based 7 micron filament carbon from Grafil, with 700 Ksi Tensile Strength, 34 Msi Modulus, 2% elongation, and 1.8 g/cc density.

Prepreg Properties:		**34-700 (24k)-AR4550-200/35-24"**
Lot#/Roll#:		**Lot#10-1753, Roll#1**
RC% (Wash Out):		**34.7%**
FAW:		**198.9 GSM**
PAW:		**304.8 GSM**
Prepreg Gel (Fisher Johns): Temperature:	At 325F	**8 minutes, 35 Seconds**
Flow: (4 x4"x4") **Time: 20mins/Temp: 325F/Pressure: 25 psi**	(0,90,90,0)(ASTMD 3531)	**12.7%**
Volatiles:	(10 mins @325F)	**Nil**
Tack:		**Medium**
Drape:		**Good**

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Lay-up: 8-Plies (0-deg), 0-degree face up; ILSS 4(+/-45) 1x10in
Tool/Teflon/Prepreg Stack/Airweave/Teflon/Caul Plate/Bag; Rubber Frame around prepreg stack

Cure: Autoclave: Rate of rise: A. 3-5F/min, 290F/1hr, B.3F/min, 310F/1hr, C.3F/min, 375F/1hr. Full Vic, Vent @ 22psi, 85 psi. Cool at 3-5F/min to 140F under pressure before removal.

Post Cure: Free Standing Post cure: 3-5F/min to 410F/4h cool slowly to RT.

Laminate Physical Properties:		34-700 (24k)-AR4550-200/35-24"			
Test Direction		0-Direction		90-Direction	
Thickness/ply		6.77 mil/ply		7.48 mil/ply	
Properties:	**Test Method**	**DRT**	**450F**	**DRT**	**450F**
Tensile, Strength, kpsi; (0.5x10.0)in	ASTMD 3039 Type I	369.6		7.0	
Tensile, Mod, Mpsi; (0.5x10.0)in	ASTMD 3039 Type I	20.6		1.6	
Tensile Elongation at Ultimate, %	ASTMD 3039 Type I	0.0		0.0	
Tensile, Poisson Ratio	ASTMD 3039 Type I	0.3			
Compression Strength, kpsi; (0.5x3.18)in	ASTMD 695 Mod.	252.4		65.4	
Compression Modulus, Mpsi; (0.5x3.18)in	ASTMD 695 Mod.	20.3	20.2	1.7	1.3
Compression Elongation At Ultimate, %	ASTMD 695 Mod.	0.0	0.0	0.0	0.0
Compression Elongation At Break, %	ASTMD 695 Mod.	0.0	0.0	0.0	0.0
Flexural Strength (3-pt, S/D 40/1), kpsi;(0.5xlength(40:1))in	ASTMD 790	342.9	113.0	19.1	2.8
Flexural Modulus (3-pt, S/D 40/1), Mpsi; (0.5xlength(40:1))in	ASTMD 790	19.8	19.1	1.4	0.3
ILSS (Short Beam Shear) 5:1, kpsi; (0.25x1.0)in	ASTMD 2344	18.5	6.1	2.0	0.6
ILSS (Short Beam Shear) 4:1, kpsi; (0.25x1.0)in	ASTMD 2344	20.3	4.9	2.9	0.8
In-Plane Shear Strength, (+/-45)2S; 8-Plies; (1.0x10.0)in	ASTMD 3518	23.3			
In-Plane Shear Modulus, (+/-45)2S; 8-Plies; (1.0x10.0)in	ASTMD 3518	3.6			

Material:

TR30S (3k) is a PAN based 7 micron filament carbon from Grafil, with 640 Ksi Tensile Strength, 34 Msi Modulus, 1.9% elongation, and 1.79g/cc density.

Prepreg Properties:		3KPW (TR30S)-AR4550-199/38-25"
Lot#/Roll#:		Lot#10-1751, Roll#1
RC% (Wash Out):		38.5%
FAW:		200.61 GSM
PAW:		326.25 GSM
Prepreg Gel (Fisher Johns): Temperature:	At 325F	12 minutes 47seconds
Flow: (4 x4"x4") Time: 20mins/Temp: 325F/Pressure: 25 psi	(0,90,90,0)(ASTMD 3531)	19.3%
Volatiles:	(10 mins @325F)	Nil
Tack:		Medium
Drape:		Good

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Lay-up: 8-Plies (0-deg), 0-degree face up; ILSS 4(+/-45) 1x10in

Tool/Teflon/Prepreg Stack/Airweave/Teflon/Caul Plate/Bag; Rubber Frame around prepreg stack

Cure: Autoclave: Rate of rise: A. 3-5F/min, 290F/1hr, B.3F/min, 310F/1hr, C.3F/min, 375F/1hr. Full Vac., Vent @ 22psi, 85 psi. Cool at 3-5F/min to 140F under pressure before removal.

Post Cure: Free Standing Post cure: 3-5F/min to 410F/4h cool slowly to RT.

Laminate Physical Properties:		3KPW (TR30S)-AR4550-199/38-25"			
Test Direction		Warp-Direction		Fill-Direction	
Thickness/ply		7.90 mil/ply		7.72 mil/ply	
Properties:	**Test Method**	**DRT**	**450F**	**DRT**	**450F**
Tensile, Strength, kpsi; (0.75x6.5)in	ASTMD 638 Type I	117.8	105.5	86.2	91.2
Tensile, Mod, Mpsi; (0.75x6.5)in	ASTMD 638 Type I	10.3	10.8	9.2	10.4
Tensile Elongation at Ultimate, %	ASTMD 638 Type I	0.0	0.0	0.0	0.0
Compression Strength, kpsi; (0.75x3.13)in	ASTMD 695	93.6	64.6	70.9	46.5
Compression Modulus, Mpsi; (0.75x3.13)in	ASTMD 695	10.0	10.0	9.8	10.2
Compression Elongation At Ultimate, %	ASTMD 695	0.0	0.0	0.0	0.0
Flexural Strength (3-pt, S/D 40/1), kpsi;(0.5xlength(40:1))in	ASTMD 790	145.5	71.3	132.4	45.1
Flexural Modulus (3-pt, S/D 40/1), Mpsi; (0.5xlength(40:1))in	ASTMD 790	7.9	10.3	7.6	8.7
ILSS (Short Beam Shear) 5:1, kpsi; (0.25x1.0)in	ASTMD 2344	10.0	3.6	9.6	3.2
In-Plane Shear Strength, (+/-45)2S; 8-Plies; (1.0x10.0)in	ASTMD 3518	31.3			
In-Plane Shear Modulus, (+/-45)2S; 8-Plies; (1.0x10.0)in	ASTMD 3518	3.0			

Free Standing, 3°F/min to 375°F/1hrs, 3°F/min to 410°F/4hrs, 3°F to 440°F/6hrs. Cool slowly to RT.

Thermally Cycling Data continued on the next page.

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Lay-up: 20 Plies (0°/90° Sequential)

Cure: Autoclave:

Rate of rise: A. 3°F/min, to 250°F/45min, B. 3°F/min to 375°F/6hr

Pressure: Full Vac., 15psi at 250°F/45min, Vent @ 22psi, then applied 100 psi

Cool: At 3°F/min, to 140°F.

Post cure: Free Standing, 3°F/min to 375°F/1hrs, 3°F/min to 410°F/4hrs, 3°F to 440°F/6hrs. Cool slowly to RT.

Thermal Cycling: Machined specimens were placed in an oven and heated from Room Temperature at 1-5°F/min to 365°F +10°F/-0°F and held for 6hrs. They were cooled at 0-5°F/min to under 100°F. This cycle was repeated accordingly.

Material:	6K 2x2-AR4550-370/35.1-50"							
Properties:	Test Method	Base line (TR#900)			250 Thermal Cycles (TR#900)		500 Thermal Cycles (TR#900)	
Tg, DMA On set	ASTMD 7028	542°F			551°F		555°F	
CTE	ASTME 831	55 um/mm-°C						
Mechanical Properties:	Test Method	Base line (TR#900)			250 Thermal Cycles (TR#900)		500 Thermal Cycles (TR#900)	
		DRT	D365°F		DRT	D365°F	DRT	D365°F
Compression Strength, ksi	ASTMD 6641	101.0	87.1					
Compression Modulus, Mpsi	ASTMD 6641	8.5	8.8					
Flexural Strength, ksi	ASTMD 7264	121.0	91.9		92.6	82.9	70.5	60.2
Flexural Modulus, Mpsi	ASTMD 7264	7.9	7.8		8.0	7.9	7.7	7.4
ILSS (Short Beam Shear), ksi	ASTMD 2344	6.9	7.4		5.9	6.0	5.9	5.5
In-Plane Shear Strength, ksi	ASTMD 3518	11.4	9.5					
In-Plane Shear Modulus, Mpsi	ASTMD 3518	0.8	0.6					

Material:	12K 2x2-AR4550-670/35.1-50"							
Properties:	Test Method	Base line (TR#960A)			250 Thermal Cycles (TR#836-1)		500 Thermal Cycles (TR#836-1)	
Tg, DMA On set	ASTMD 7028	528.1°F						
CTE	ASTME 831	52.74 um/mm-°C						
Mechanical Properties:	Test Method	Base line (TR#960A)			250 Thermal Cycles (TR#836-1)		500 Thermal Cycles (TR#836-1)	
		DRT	D365°F		DRT	D365°F	DRT	D365°F
Compression Strength, ksi	ASTMD 6641	25.0	21.5					
Compression Modulus, Mpsi	ASTMD 6641	2.5	2.6					
Flexural Strength, ksi	ASTMD 7264	32.8	27.2		92.2	67.0	63.1	55.9
Flexural Modulus, Mpsi	ASTMD 7264	2.4	1.8		8.0	7.3	7.3	6.7
ILSS (Short Beam Shear), ksi	ASTMD 2344	5.5	4.8		8.1	6.5	6.5	6.5
In-Plane Shear Strength, ksi	ASTMD 3518	8.9	7.7					
In-Plane Shear Modulus, Mpsi	ASTMD 3518	0.7	0.5					