Product Data

AMODEL®
polyphthalamide

FR-4133

AMODEL FR-4133 is a 33% glass-reinforced polyphthalamide (PPA) resin designed for electrical and electronic applications. This UL94-V0 resin offers the highest mechanical and electrical properties, plus superior thermal performance to resist blistering during lead-free SMT processes.

Color stability is enhanced compared to previous flame-retarded grades. Quick crystallization in water-cooled molds allows for fast cycle times using mold temperatures as low as 150°F (65°C).

Table 1 Typical Properties of AMODEL FR-4133 Resin - ASTM Test Methods (See Table 2 for Properties by ISO Methods)

	ASTM	Typical Values [1]					
	Test	U.S. Customary Units			SI Units		
Property	Method	DAM[2]	50% RH[3]	Units	DAM[2]	50% RH[3]	Units
Mechanical							
Tensile Strength	D 638	28.9	25.8	kpsi	199	178	MPa
Tensile Elongation	D 638	1.8	1.7	%	1.8	1.7	%
Tensile Modulus	D 638	2.27	2.06	Mpsi	15.7	14.2	GPa
Flexural Strength	D 790	38.7	37.3	kpsi	267	257	MPa
Flexural Modulus	D 790	1.86	2.05	Mpsi	12.8	14.1	GPa
Shear Strength	D 732	12.0	10.2	kpsi	83	70	MPa
Compressive Strength	D 695	22.6		kpsi	156		MPa
Poisson's Ratio		0.37			0.37		
Izod Impact, Notched	D 256	1.6	1.6	ft-lb/in	85	85	J/m
Izod Impact, Unnotched	D 4812	12		ft-lb/in	635		J/m
Rockwell Hardness	D 785	124		R	125		R
Thermal							
Heat Deflection Temperature	D 648						
at 264 psi (1.8 MPa)		574		°F	301		°C
Melting Point	D 570	618		°F	326		°C
Flammability[4], 0.031" (0.8 mm) bar	UL 94	V-0			V-0		
Electrical							
Dielectric Strength at 1/16" (1.2 mm)	D 149	737		V/mil	29		kV/mm
Dielectric Strength at 1/8" (3.2 mm)	D 149	508		V/mil	20		kV/mm
Volume Resistivity	D 257	1×10^{16}		ohm-cm	1×10^{16}		ohm-cm
Surface Resistivity	D 257	$>2 \times 10^{16}$		ohm	$>2 \times 10^{16}$		ohm
HWI	UL 746A	0		PLC	0		PLC
CTI	UL 746A	0		PLC	0		PLC
HAI	UL 746A	0		PLC	0		PLC
General							
Specific Gravity	D 792	1.68			1.68		
Moisture Absorption, 24 hours	D 570	0.1		%	0.1		%
Mold Shrinkage	D 955						
Flow Direction		0.4		%	0.4		%
Transverse Direction		0.6		%	0.6		%

[1] Actual properties of individual batches will vary within specification limits. Values are typical of uncolored resin, addition of colorants or other additives may alter properties.
[2] "dry, as molded".
[3] Conditioned to 50% RH in accordance with ISO-1110 Accelerated Method
[4] This flammability rating is not intended to reflect hazards presented by this or any other material under actual fire conditions.

Solvay
Advanced Polymers

SOLVAY

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Table 2 Typical Properties of AMODEL A-1133 HS Resin - ISO Test Methods

Property	Temp., °C	ISO Test Method	Typical Values (1) U.S. Customary Units Value	Units	SI Units Value	Units
Mechanical						
Tensile Strength	23	527	27.7	kpsi	191	MPa
	100	527	17.3	kpsi	119	MPa
	150	527	12.9	kpsi	89	MPa
	175	527	10.4	kpsi	72	MPa
Tensile Elongation	23	527	1.8	%	1.8	%
	100	527	2.2	%	2.2	%
	150	527	3.1	%	3.1	%
	175	527	4.6	%	4.6	%
Tensile Modulus	23	527	2.13	Mpsi	14.7	GPa
	100	527	1.51	Mpsi	10.4	GPa
	150	527	1.02	Mpsi	7.0	GPa
	175	527	0.84	Mpsi	5.8	GPa
Flexural Strength	23	178	38.6	kpsi	266	MPa
	100	178	25.1	kpsi	173	MPa
	150	178	18.5	kpsi	127	MPa
	175	178	14.6	kpsi	101	MPa
Flexural Modulus	23	178	1.78	Mpsi	12.3	GPa
	100	178	1.36	Mpsi	9.4	GPa
	150	178	0.94	Mpsi	6.5	GPa
	175	178	0.72	Mpsi	5.0	GPa
Izod Impact, Notched	23	180/1A	5.2	ft-lb/in^2	11.0	kJ/m^2
Izod Impact, Unnotched	23	180/1U	24	ft-lb/in^2	50	kJ/m^2
Charpy Impact, Notched	23	179/1eA	6.8	ft-lb/in^2	14.0	kJ/m^2
Charpy Impact, Unnotched	23	179/1eU	46	ft-lb/in^2	97	kJ/m^2
Thermal						
Melting Point		11357-3	618	°F	326	°C
Heat Deflection Temperature at 1.8 MPa		75Af	584	°F	307	°C
General						
Specific Gravity		1183A	1.68		1.68	

(1) Actual properties of individual batches will vary within specification limits. Properties are typical of uncolored resin. Colorants or other additives will alter values.

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Drying

Resin should be dried before molding because excessive moisture will result in nozzle drool, reduced mechanical properties, poor surface appearance, and sprue sticking. Extremely wet resin will result in a foamy extrudate. The target moisture level is 0.03 to 0.06% (300 to 600 ppm) and the maximum recommended drying temperature is 135°C (275°F).

Although AMODEL resins are shipped with less than 0.15% moisture and packaged in moisture-proof foil-lined bags or boxes, the resin should be dried for optimum molding results. The preferred drying condition is 4 hours at 120°C (248°F). Alternatively, the resins can be dried for 8 hours at 90°C (194°F). In either case, a desiccant bed dryer with a dew point below -30°C (-22°F) should be used.

Drying Tips:

- Do not open containers until ready to process.
- Drying at temperatures higher than 125°C (257°F) may result in the darkening of natural colored pellets.
- If a thermogravimetric moisture analyzer is used, it should be set to 170°C (338°F)
- AMODEL resin in an open container needs to be dried as shown in the following table. The recommended drying time depends on how long the container has been open and the estimated relative humidity.

Drying Time at 120°C (248°F), hours

	Elapsed Time From Container Opening, hours				
Relative Humidity, %	**0.25**	**0.5**	**1**	**2**	**3**
30	4.5	5.0	5.5	6.0	6.5
50	5.0	5.5	6.0	7.0	7.5
75	5.0	5.5	6.5	7.5	8.0
100	5.5	6.5	7.5	8.5	9.0

Injection Molding

AMODEL FR-4133 resin can be readily injection molded in most screw injection molding machines. A general purpose screw is recommended, with minimum back pressure.

The melt temperature should be between 625°F and 645°F (329°C and 340°C). Generally this can be achieved with barrel temperatures from 600° to 615°F (315° to 324°C) in the rear zone gradually increasing to 620° to 630°F (327° to 332°C) in the front zone.

Set injection pressure to give rapid injection, 3 to 4 in./sec (7.6 to 10 cm/sec). Adjust holding pressure to one-half injection pressure. Set hold time to maximize part weight. Transfer from injection to hold pressure at the screw position just before the part is completely filled. A mold temperature between 150°F and 200°F (65°C and 93°C) is generally high enough to achieve full crystallinity in the typical molded part with this resin.

Standard Packaging/ Labeling

AMODEL FR-4133 resin is packaged in foil lined multiwall paper bags containing 25 kg (55.115 pounds) of material. Special packaging can be supplied upon request.

Individual packages will be plainly marked with the product number, the color, the lot number, and the net weight.

Precautionary Labeling

On the basis of toxicological, physical, and chemical properties of AMODEL FR-4133 resin, labeling used on containers is as follows:

Caution: Handling and/or processing this material may generate a dust which can cause mechanical irritation of the eyes, skin, nose, and throat.

Product Safety and Emergency Service

For product safety information or a Material Safety Data Sheet on a product of Solvay Advanced Polymers

1 (800) 621-4557
1 (770) 772-8880 outside of U.S.

For information or help in an emergency such as a spill, leak, fire or explosion, call day or night:

Emergency Health Information

1 (800) 621-4590
1 (770) 772-5177 outside of U.S.

Emergency Spill Information

CHEMTREC 1 (800) 424-9300
1 (703) 527-3887 outside of U.S.
collect calls accepted

For Additional Information

Technical Service
1 (800) 621-4557

Customer Service
1 (800) 848-9744