HexPly® M56

180ºC (350ºF) out-of-autoclave curing matrix

HEXCEL®

Product Data Sheet

Description

HexPly® M56 is a high performance epoxy matrix developed for out-of-autoclave curing of composite aircraft structures.

Benefits and Features

- Matrix specifically formulated for vacuum pressure only cure
- Product formats designed to optimize fiber volume
- Available as carbon UD tape, woven carbon, woven glass and metallic meshes for lightning strike protection
- Excellent drape, tack and out time performance
- 30 days room temperature tack life
- Excellent processability for Automated Tape Laying (ATL) and Advanced Fiber Placement (AFP)

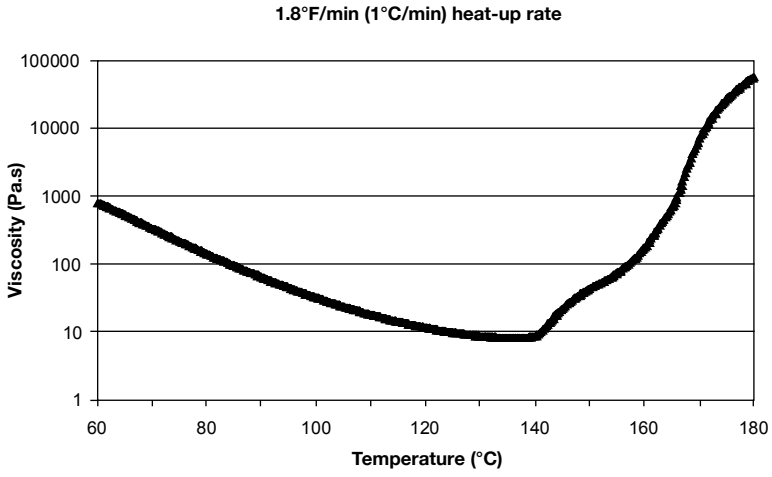
Product Forms

Woven carbon:	M56/40%/280H5/AS4-3K	M56/40%/193PW/AS4-3K
	M56/40%/285T2/AS4C-6K	
UD carbon tape:	M56/35%/UD134/AS7-12K	M56/35%/UD268/IM7-12K
Woven glass:	M56/37%/7781	

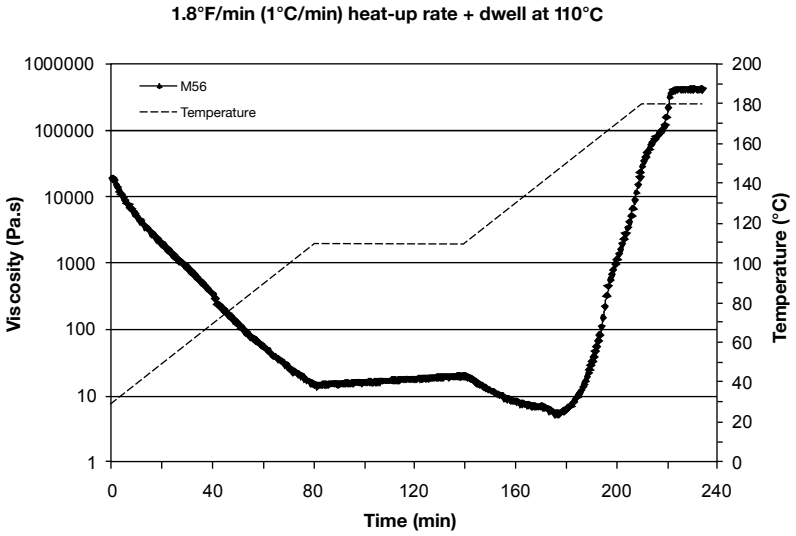
Alternate fibers, reinforcement weights, resin contents, weave styles and metallic meshes for lightning strike protection can all be considered.

Resin Matrix Properties

Rheology



Cure Cycle Viscosity Profiles



Prepreg Lay-up

To achieve the best monolithic laminate quality, the first ply should be vacuum debulked compacted to the mould cure tool at room temperature. The frequency of compaction depends on part size and complexity, but a good rule of thumb is to vacuum compact every subsequent 3 plies to ensure removal of air trapped during the lay-up process. Compact for 5 to 10 minutes.

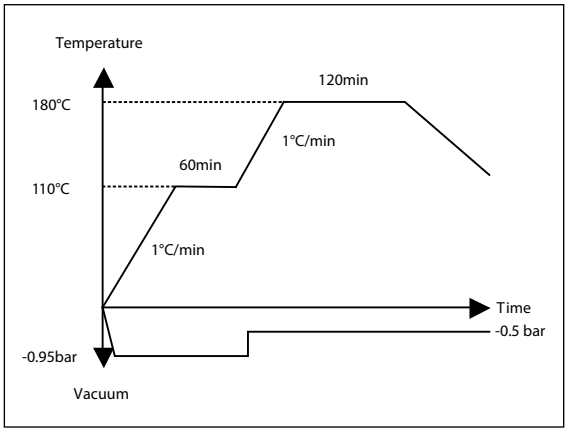
During vacuum compaction of lay-up and for final laminate during cure, use a rigid edge breathing support (such as cork, high tack-high temperature sealant tape, cured silicone rubber or metal) to protect the plies at the edge of the part from pinching off and preventing air evacuation. The edge breathing support should be at least as high as but no more than 1/8 inch higher than the edge of the laminate panel or edge band of sandwich panel. For sandwich panels, vacuum compact after each ply (5 to 10 minutes), including adhesive plies and core placement.

If after the final compaction, rounded edges are evident in the component these will need to be cut away to re-open air paths.

Prepreg Curing Conditions

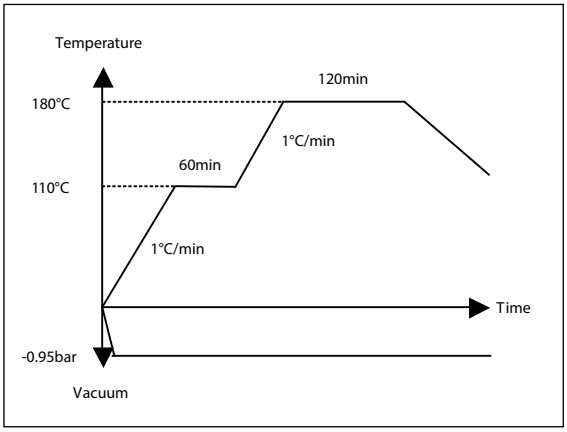
Typical Oven Cure Monolithic Part

1. Apply full vacuum (-28 inches Hg, -0.95bar)
2. Ramp at 2 - 5°F/min (1 - 3°C/min) to 230± 10°F (110 ± 5°C)
3. Hold at 230± 10°F (110 ± 5°C) for 60 ± 5min
4. Reduce vacuum to -15 inches Hg (-0.5bar)
5. Ramp at 2 - 5°F/min (1 - 3°C/min) to 355 ± 10°F (180 ± 5°C)
6. Hold at 355 ± 10°F (180 ± 5°C) for 120 + 30, - 0 min
7. Cool at ≤ 5°F/min under vacuum
8. Release vacuum when laminate temperature is below 140°F



Typical Oven Cure Sandwich Structure – Honeycomb or Foam

1. Apply full vacuum (-28 inches Hg, -0.95bar)
2. Ramp at 2 - 5°F/min (1 - 3°C/min) to 230± 10°F (110 ± 5°C)
3. Hold at 230± 10°F (110 ± 5°C) for 60 ± 5min
4. Ramp at 2 - 5°F/min (1 - 3°C/min) to 355 ± 10°F (180 ± 5°C)
5. Hold at 355 ± 10°F (180 ± 5°C) for 120 + 30, - 0 min
6. Cool at ≤ 5°F/min under vacuum
7. Release vacuum when laminate temperature is below 140°F



Defined heat-up rates will vary depending on the oven, autoclave dimensions, the mass of tooling used and the size and thickness of the component to be manufactured.

Cured Prepreg Properties

Property	Units	M56/40% /280H5/ AS4-3K	M56/40% /285T2/ AS4C-6K	M56/40% /193PW/ AS4-3K
Fiber		AS4	AS4C	AS4
Weave		5HS	2 x 2T	PW
Fiber Mass	g/m^2	280	285	193
	(oz/yd^2)	(8.25)	(8.40)	(5.67)
Nominal Prepreg Mass	g/m^2	467	475	322
	(oz/yd^2)	(13.76)	(14.00)	(9.48)
Measured Cured Ply Thickness	mm	0.292	0.316	0.214
	(inch)	(0.0115)	(0.0124)	(0.0084)
Measured Calculated Fiber Volume	%	50.5	50.3	50.1
Cured Resin Density	g/cm^3	1.21		
	(lbs/ft^3)	(75.54)		
Fiber Density	g/cm^3	1.79	1.79	1.79
	(lbs/ft^3)	(112)	(112)	(112)
Measured Calculated Laminate Density	g/cm^3	1.50	1.50	1.50
	(lbs/ft^3)	(93.6)	(93.6)	(93.6)

Test	Units	M56/40%/280H5/ AS4-3K	M56/40%/285T2/ AS4C-6K	M56/40%/193PW/ AS4-3K
Glass Transition Temp. (Ext. onset E')	°C	193	194	219
	(°F)	(379)	(381)	(426)
Method		EN6032		ASTM D1640
Tensile Strength	MPa	897	787	924
	(ksi)	(130)	(114)	(134)
Tensile Modulus	GPa	68.2	67.0	65.9
	(msi)	(9.89)	(9.72)	(9.56)
Method		EN2597B		ASTM D3039
Compression Strength	MPa	852	807	848
	(ksi)	(124)	(117)	(123)
Compression Modulus	GPa	58.6	58.0	61.5
	(msi)	(8.50)	(8.41)	(8.92)
Method		EN2850 B		SACMA-1R
ILSS	MPa	69.2	65.0	74.1
	(ksi)	(10.0)	(9.4)	(10.8)
Method		EN 2563		
Interlaminar Shear Strength	MPa	121	99.0	128
	(ksi)	(17.5)	(14.4)	(18.6)
In-plane Shear Modulus	GPa	4.10	3.70	3.50
	(msi)	(0.59)	(0.54)	(0.51)
Method		EN6031		ASTM D3518

Note:
These are average values showing typical data and not guaranteed minimum values.
Comments:
Data generated following oven cure at 180°C (356°F) for 120min with 60min dwell at 110°C (230°F)
Measured cured ply thickness figures are based on zero bleed
Fabric samples were tested in the warp direction
Tension and Compression data normalised to Vf = 60% for UD carbon, 56% for woven carbon & 48% for woven glass Cured Prepreg Properties

Cured Prepreg Properties (continued)

Property	Units	M56/35%/UD268/ IM7-12K	M56/35%/UD134/ AS7-12K	M56/37%/7781
Fiber		IM7	AS7	E-glass
Weave		UD	UD	8HS
Fiber Mass	g/m^2	268	134	300
	(oz/yd^2)	(7.90)	(3.95)	(8.84)
Nominal Prepreg Mass	g/m^2	394	206	476
	(oz/yd^2)	(11.60)	(6.07)	(14.03)
Measured Cured Ply Thickness	mm	0.2530	0.134	0.263
	(inch)	(0.0100)	(0.0053)	(0.0104)
Theoretical Calculated Fiber Volume	%	58.8	56.2	44.6
Cured Resin Density	g/cm^3	1.21		
	(lbs/ft^3)	(75.54)		
Fiber Density	g/cm^3	1.78	1.79	2.54
	(lbs/ft^3)	(111)	(112)	(159)
Measured Calculated	g/cm^3	1.53	1.53	1.81
Theoretical Calculated Laminate Density	(lbs/ft^3)	(95.5)	(95.5)	(112)

Test	Units	M56/35%/UD268/ IM7-12K	M56/35%/UD134/ AS7-12K	M56/37%/7781
Glass Transition Temp. (Ext. onset E')	°C	204	197	211
	(°F)	(399)	(387)	(412)
Method		EN6032		
Tensile Strength	MPa	2730	2330	470
	(ksi)	(396)	(338)	(68.2)
Tensile Modulus	GPa	182	141	25.0
	(msi)	(26.4)	(20.4)	(3.63)
Method		EN2597 B		
Compression Strength	MPa	1550	1308	-
	(ksi)	(225)	(190)	-
Compression Modulus	GPa	156	129	-
	(msi)	(22.6)	(18.7)	-
Method		EN2850 B		
ILSS	MPa	98.6	94.4	67.0
	(ksi)	(14.3)	(13.7)	(9.72)
Method		EN2563		
Interlaminar Shear Strength	MPa	81	115	-
	(ksi)	(11.8)	(16.7)	-
In-plane Shear Modulus	GPa	4.50	4.10	-
	(msi)	(0.65)	(0.59)	-
Method		EN6031		

Note:
These are average values showing typical data and not guaranteed minimum values.
Comments:
Data generated following oven cure at 180°C (356°F) for 120min with 60min dwell at 110°C (230°F)
Measured cured ply thickness figures are based on zero bleed
Fabric samples were tested in the warp direction
Tension and Compression data normalised to Vf = 60% for UD carbon, 56% for woven carbon & 48% for woven glass

Prepreg Storage Life

Tack Life: 30 days at 23°C (73°F)

Out Life: 35 days at 23°C (73°F)

Shelf Life: 18 months at –18°C (0°F) (from date of manufacture)

Definitions

Shelf Life: The maximum storage life for HexPly® prepreg, from date of manufacture, when stored continuously, in a sealed moisture-proof bag, at -18°C (0°F). To accurately establish the exact expiry date, consult the box label.

Tack Life: The time, at room temperature, during which prepreg retains enough tack for easy component lay-up.

Out Life: The maximum accumulated time allowed at room temperature between removal from the freezer and cure.

For maximum storage life, HexPly® M56 prepregs should be stored continuously at -18°C (0°F). After removal from cold storage, prepreg should be allowed to reach room temperature before opening the polythene bag to prevent condensation (a full roll in its packaging can take up to 48 hours).

Precautions For Use

A Safety Data Sheet is available for this product. The usual precautions when handling uncured synthetic resins and fibrous materials should be observed. The use of clean, disposable, inert gloves provides protection for the operator and avoids contamination of material and components.

For more information

Hexcel is a leading worldwide supplier of composite materials to aerospace and industrial markets.
Our comprehensive range includes:

- HexTow® carbon fibers
- HexForce® reinforcements
- HiMax® multiaxial reinforcements
- HexPly® prepregs
- HexMC®-i molding compounds
- HexFlow® RTM resins
- HexBond™ adhesives
- HexTool® tooling materials
- HexWeb® honeycombs
- Acousti-Cap® sound attenuating honeycomb
- Engineered core
- Engineered products
- Polyspeed® laminates & pultruded profiles
- HexAM® additive manufacturing

For U.S. quotes, orders and product information call toll-free 1-800-688-7734. For other worldwide sales office telephone numbers and a full address list, please go to:

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