HexFlow® RTM6/RTM6-2

180°C Epoxy System for Resin Transfer Molding and Infusion Technologies

HEXCEL®

Product Data Sheet

Description

HexFlow® RTM6 is a mono-component aerospace qualified resin system specially developed for Liquid Composite Molding technologies, such as LRI and RTM.

HexFlow® RTM6-2 is the bi-component version of HexFlow® RTM6. It is delivered as two different components providing several benefits over HexFlow® RTM6: air shipment is allowed, storage at 23± 5°C for 12 months and bigger packages are possible (up to 378 kg).

HexFlow® RTM6-2 is chemically the same as HexFlow® RTM6 and has the same high performances after mixing of Part A and Part B. Their mixing ratio by weight is Part A : Part B (100:68,1).

After mixing of Part A and Part B, service temperatures from -60°C up to 120°C and cycle processing flexibility make HexFlow® RTM6 ideal for primary & secondary aerospace structures. Long injection windows due to HexFlow® RTM6 low viscosities are easily reached facilitating large parts manufacturing.

HexFlow® RTM6 resin can be used with a wide range of HexForce®, HiTape® and HiMax® reinforcements. If needed, binders and veils are also available and fully compatible with HexFlow® RTM6. They provide easy preforming properties, reinforcement dimensional stability and toughening properties.

HexFlow® RTM6 when combined with HiTape® & HiMax® has comparable mechanical properties to latest generation prepregs.

Advantages

Before Mixing

- Longer out life storage of Part A & Part B: 12 months at room temperature (23 ± 5°C)
- Easier transportation regulations: aircraft shipment is allowed

After Mixing

- Qualified and well-known for vacuum infusion and RTM process
- High glass transition temperatures: dry[1]: Tg>200°C; wet[2]: Tg>160°C
- Low moisture absorption: 2,0 – 3,0%
- < 100mPa.s at process temperatures
- Mechanical properties similar to latest generation prepregs when combined with HiTape® & HiMax® reinforcements
- Flexible processing and cure cycles

(1) *Dry: 24h at 105°C*

(2) *Wet: 14 days in water at 70°C*

HexFlow® RTM6 Uncured Resin Properties (HexFlow® RTM6-2 After Mix)

Viscosity

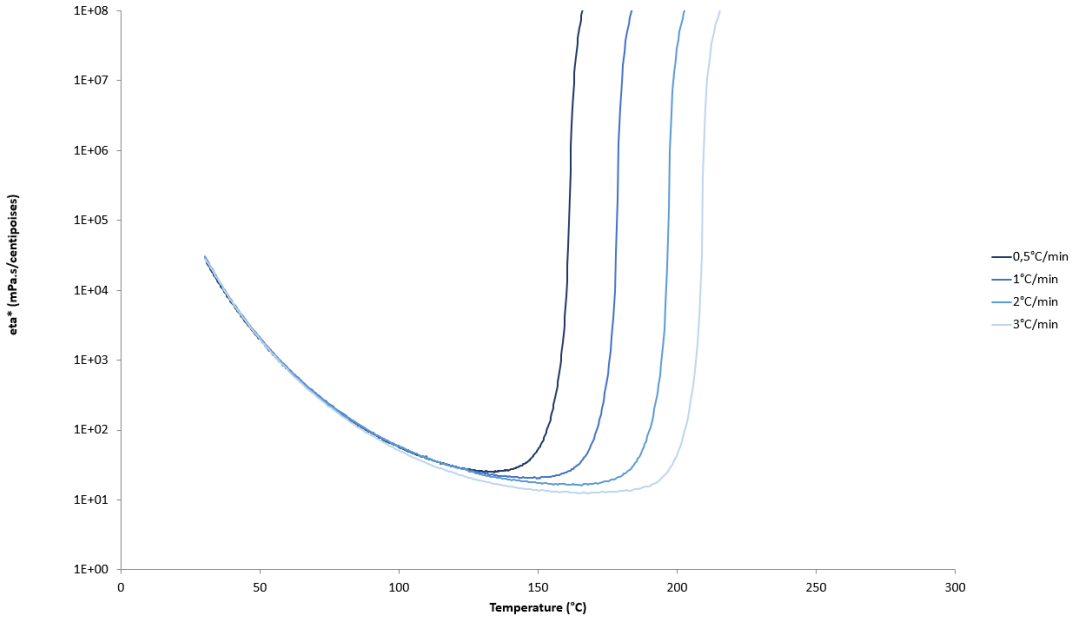

Figure 1: Rheology Profile of HexFlow® RTM6

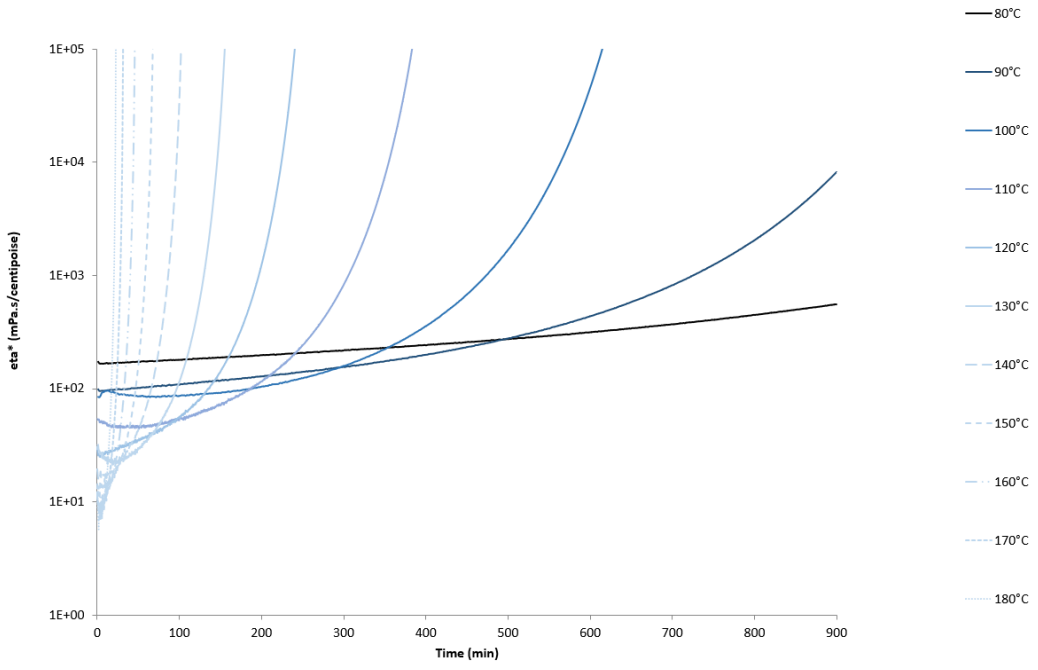

Figure 2: Isothermal Viscosities of HexFlow® RTM6

Gel Point

Temperature (°C)	Gel Time: G' & G" Crossover (h:min)	Time to Reach 1000 mPa·s (h:min)	Time to Reach 200 mPa·s (h:min)
80	> 15:00	> 15:00	Viscosity > 200 mPa·s
90	> 15:00	12:00	
100	11:30	8:00	5:30
110	7:30	5:00	4:00
120	4:00	3:00	2:30
130	2:40	2:00	1:40
140	1:40	1:20	1:10
150	1:00	0:55	0:50
160	0:45	0:40	0:35
170	0:30	0:25	0:25
180	0:20	0:20	0:15

Thermokinetics

Standard DSC Parameters			
Tg Midpoint (°C)	Enthalpy (J/g)	T Peak (°C)	T Onset (°C)
-15	450	240	215

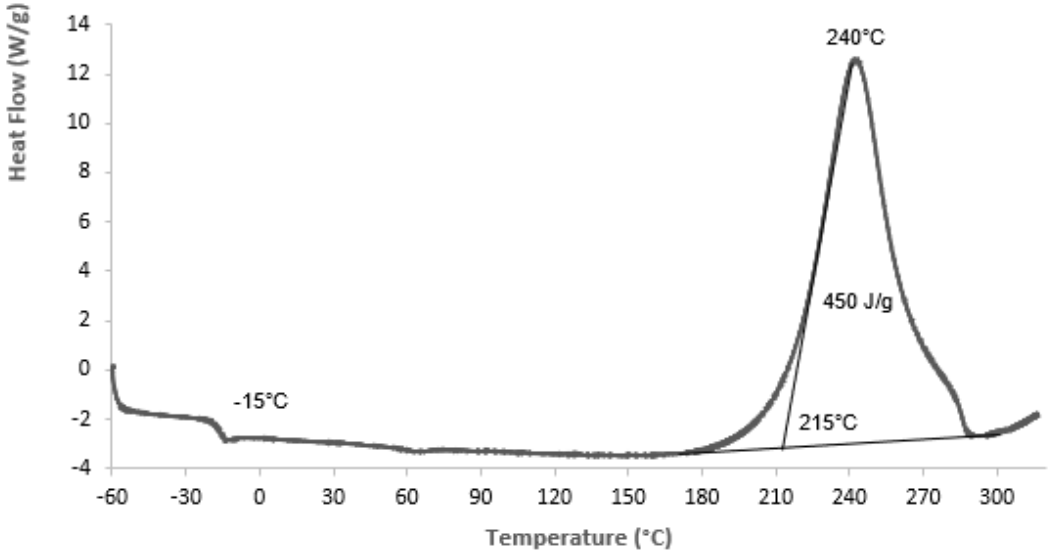

Figure 3: Standard DSC of HexFlow® RTM6

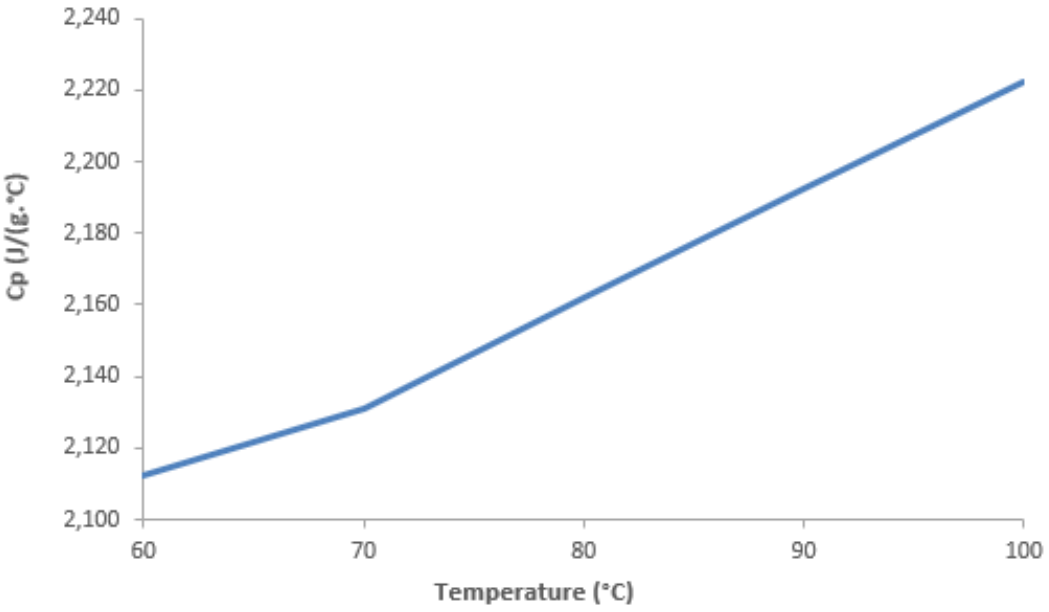

Figure 4: Specific Heat of HexFlow® RTM6

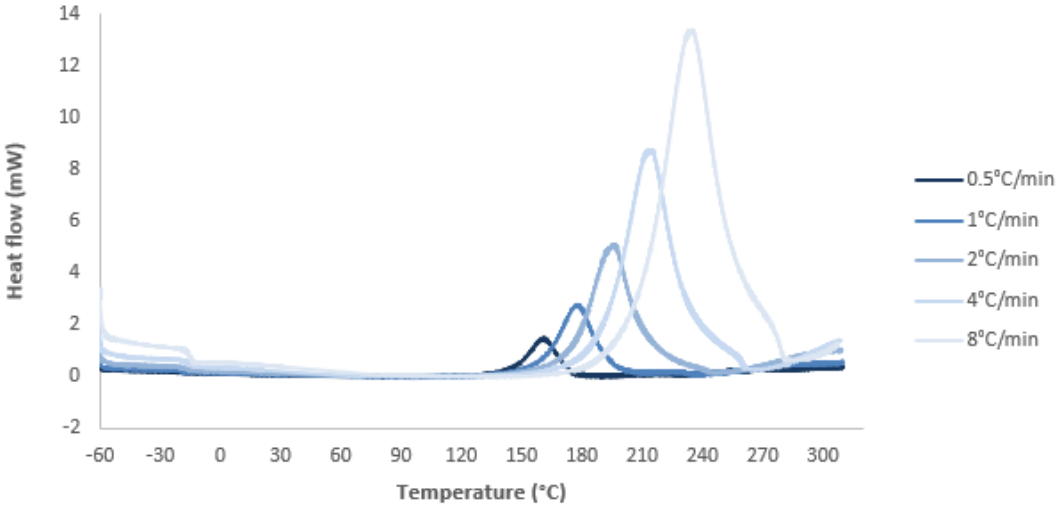

Figure 5: Standard DSC at Various Heating Rates of HexFlow® RTM6

Processing Recommendations
For uncured resin handling, please refer to "Hexcel HexFlow® RTM6/RTM6-2 Safety Processing Guidelines" document.

Defrosting
- 24h at 23°C ± 5°C (10kg)

Process Parameters (Infusion or RTM)
- Preheat resin at 80°C (please refer to "Hexcel HexFlow® RTM6/RTM6-2 Safety Processing Guidelines" document for maximum preheating time)
- Mold temperature: between 120°C and 180°C, at constant temperature
- Injection / infusion lines: 90-110°C
- Mold / bagging leakage: below 15 mbar in 5 min
- Vacuum Infusion: below 5 mbar
- RTM Piston Pressure: atm to 5 bars

Cure Cycle
- 90 min minimum at 180°C - no post cure required (degree of cure: $\alpha > 90\%$)

*For additional technical information on processing & curing, please contact **Hexcel Technical Support**.*

Cured Resin Mechanical Properties

Neat resin cure cycle (convention oven accurate to +/- 3°C)

(1) *Dry: 24h at 105°C*
(2) *Wet: 14 days in water at 70°C*

Parameter (Unit)	Value		
K1c (MPa.m½)	0,6		
Density (g/cm³)	1,14		
Coefficient of thermal expansion (10^{-6} K^{-1})	-50°C to 20°C	20°C to 100°C	100°C to 180°C
	55	65	80
Moisture uptake (%)	2,0 – 3,0		

Compression (ASTM D695)

Conditioning	Dry[1]		Wet[2]	
Test Temperature	23°C	120°C	23°C	120°C
Yield strength (MPa)	140	85	130	65
Yield strength (ksi)	20,3	12,3	18,8	9,4
Ultimate strength (MPa)	325	190	320	175
Ultimate strength (ksi)	47,2	27,3	46,8	25,3
Modulus (GPa)	3,4	2,8	3,4	2,4
Modulus (msi)	0,50	0,40	0,49	0,36

Tensile (ASTM D638)

Conditioning	Dry[1]		Wet[2]	
Test Temperature	23°C	120°C	23°C	120°C
Ultimate strength (MPa)	95	70	80	40
Ultimate strength (ksi)	13,9	9,8	11,9	5,3
Modulus (GPa)	3,1	2,5	3,0	1,9
Modulus (msi)	0,45	0,36	0,44	0,27

DMA (EN6032)

Tg (°C)	Dry[1]	Wet[2]
Onset	210	175
Loss Modulus	215	190
Tanδ	230	225

Laminate Mechanical Properties

Reinforcement: HexForce® G0926 HS-6K, 375g/m² 5H Satin (WITHOUT BINDER).

(3) *Dry: 23 ± 5°C / 50 ± 7% RH*
(4) *Wet: 70 ± 5°C / 85 ± 7% RH until saturation*

Compression (EN2850A1)

Test	Lay up	Property	Dry[3]		Wet[4]	
			23 ± 5°C	120 ± 5°C	23 ± 5°C	120 ± 5°C
Compression 0°	$[0]_6$	Ultimate strength (MPa)	730	570	555	440
		Ultimate strength (ksi)	105,9	82,7	80,5	63,1
		Modulus (GPa)	60,9	63,9	64,1	64,9
		Modulus (msi)	8,83	9,27	9,30	9,41
Compression 90°		Ultimate strength (MPa)	660	545	545	415
		Ultimate strength (ksi)	95,7	79,0	79,0	60,2
		Modulus (GPa)	62,6	62,2	62,8	71,7
		Modulus (msi)	9,08	9,02	9,11	10,36

In plane shear IPS (EN6031)

Lay up	Property	Dry[3]		Wet[4]			
		23 ± 5°C	120 ± 5°C	23 ± 5°C	70 ± 5°C	90 ± 5°C	120 ± 5°C
$[+45/-45]_{2S}$ (8 plies)	Ultimate strength (MPa)	115	85	95	95	85	70
	Ultimate strength (ksi)	16,7	12,3	13,8	13,8	12,3	10,1
	Modulus (GPa)	3,8	3,4	4,1	4,0	3,5	2,9
	Modulus (msi)	0,55	0,49	0,59	0,58	0,51	0,42

Compression after impact CAI (ASTM D7136/ D7137)

Testing	Lay up	23 ± 5°C, Dry[3]					
		Delaminated area		Indent depth		Gross strength	
		(mm²)	(in²)	(mm)	(in)	(MPa)	(ksi)
15J impact	$[+45/0]_{3S}$ (12 plies)	505	0,78	0,15	0,006	245	35,5
30J impact	$[+45/0]_{3S}$ (12 plies)	970	1,50	0,5	0,020	215	31,2

HexFlow® RTM6-2 Part A & B Properties

Viscosity

Part A

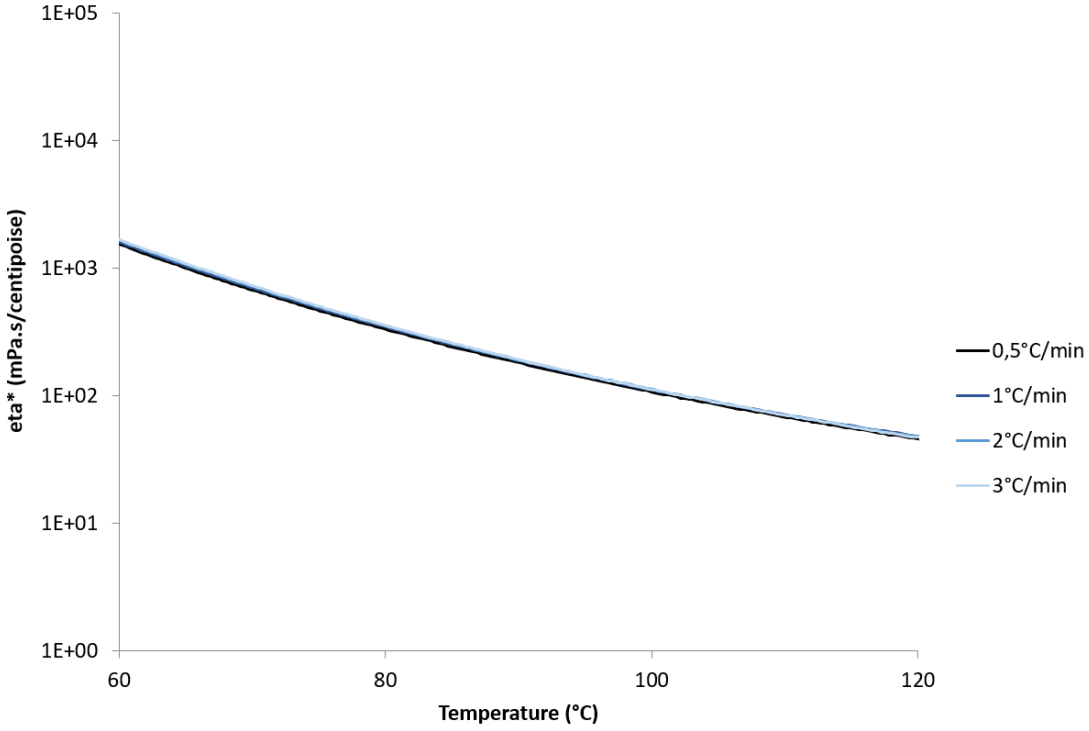

Figure 6: Rheology Profile of HexFlow® RTM6-2 Part A

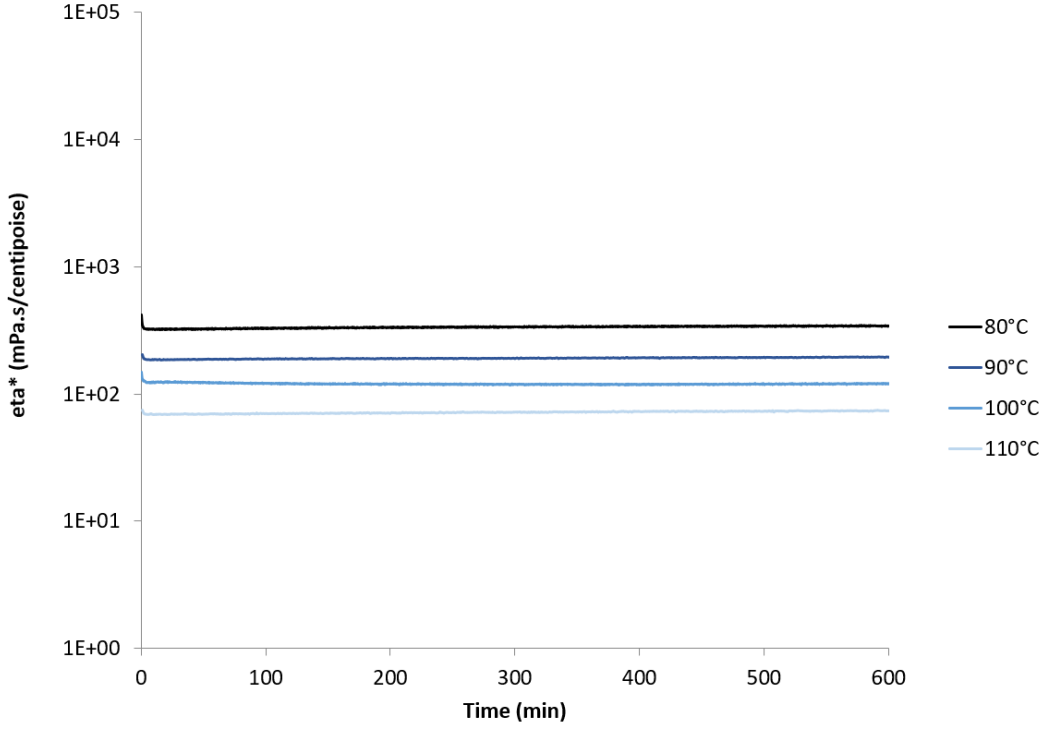

Figure 7: Isothermal Viscosities of HexFlow® RTM6-2 Part A

HexFlow® RTM6-2 Part A & B Properties

Viscosity

Part B

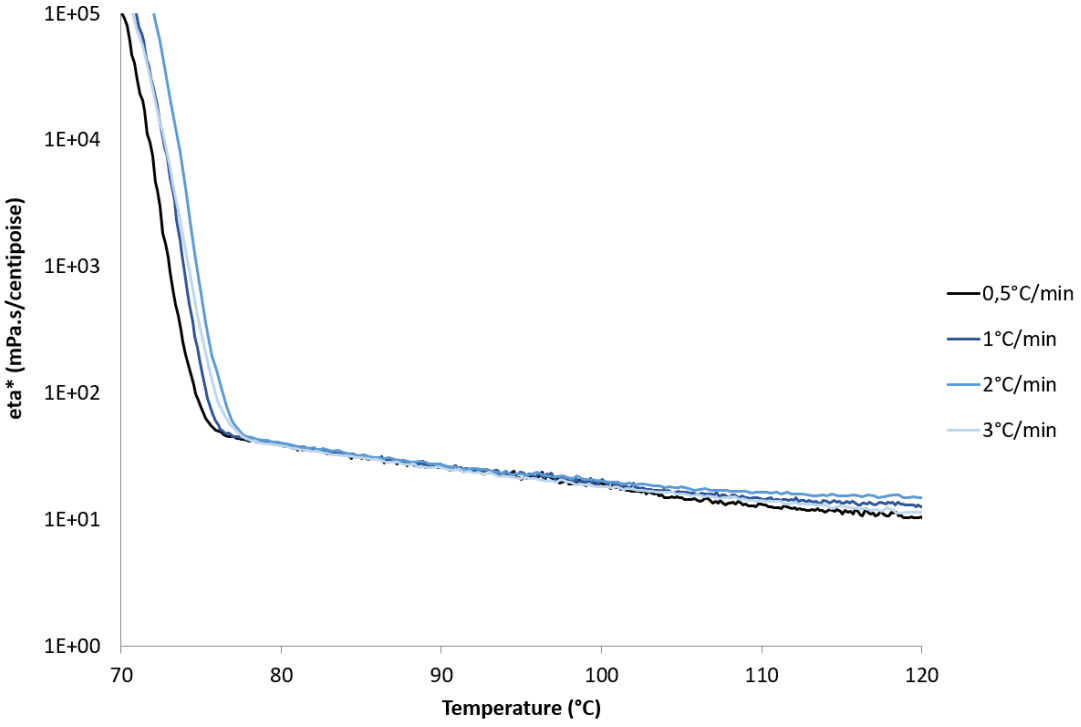

Figure 8: Rheology Profile of HexFlow® RTM6-2 Part B

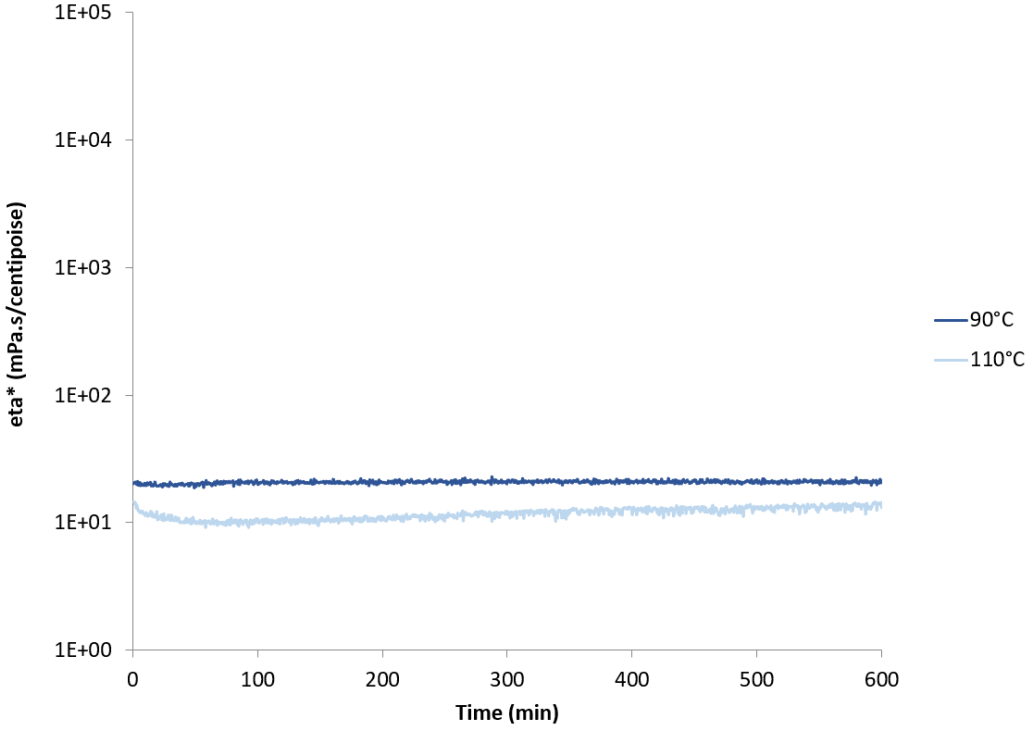

Figure 9: Isothermal Viscosities of HexFlow® RTM6-2 Part B

Thermokinetics
Part A

	Standard DSC Parameters			
	Tg midpoint (°C)	Enthalpy (J/g)	T peak (°C)	T onset (°C)
Part A	-20	1120	330	310

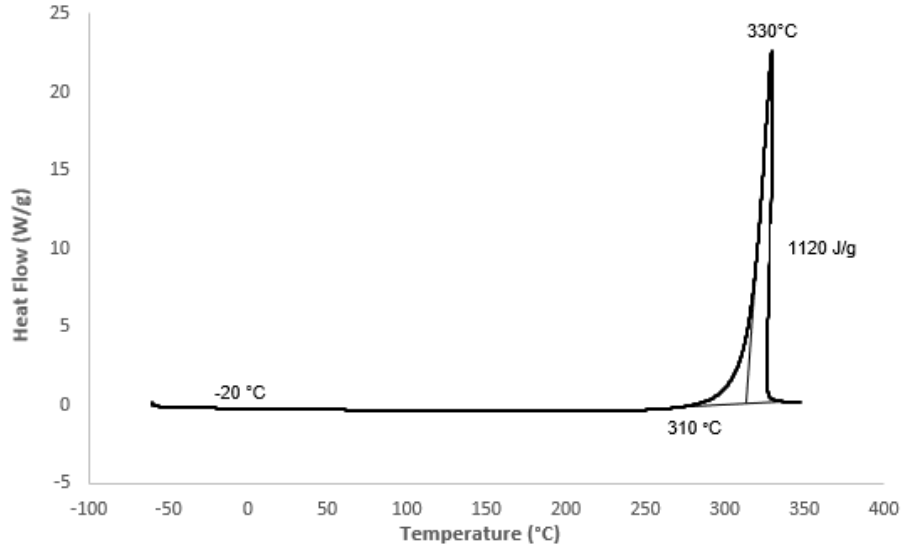

Figure 10: Standard DSC of HexFlow® RTM6-2 Part A

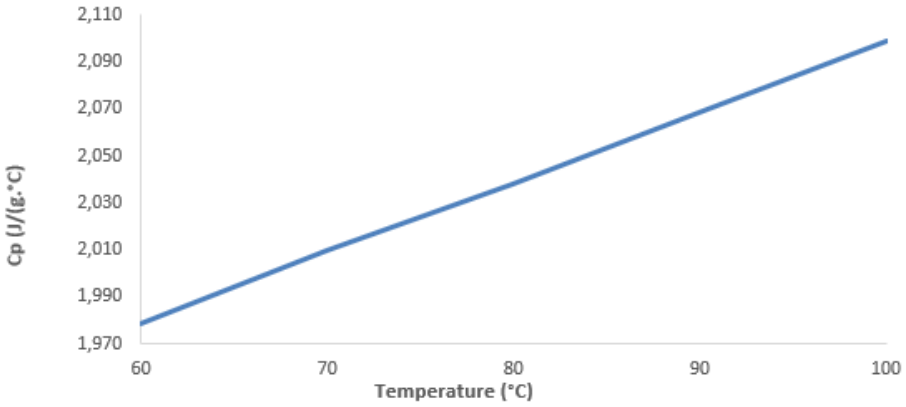

Figure 11: Specific Heat of HexFlow® RTM6-2 Part A

Thermokinetics
Part B

	Standard DSC Parameters					
	Enthalpy (J/g)	T peak 1 (°C)	T peak 2 (°C)	Softening Tg (°C)	Melting start T (°C)	Melting end T (°C)
Part B	70	55	75	40	50	80

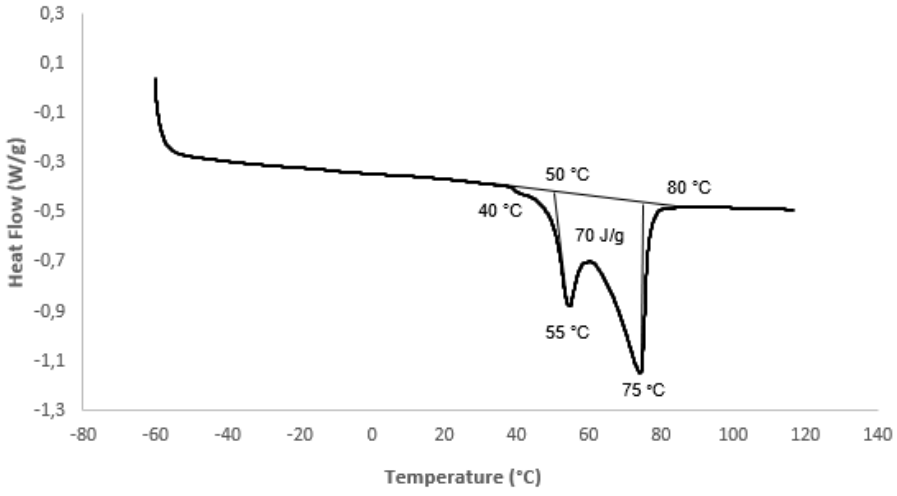

Figure 12: Standard DSC of HexFlow® RTM6-2 Part B

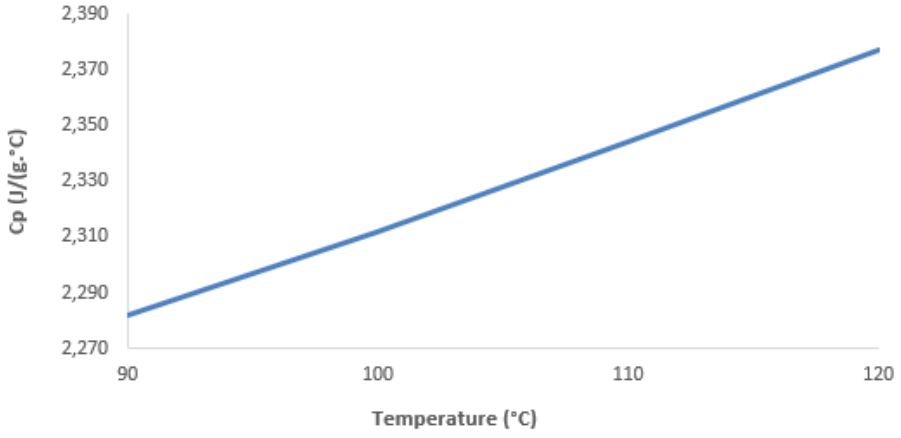

Figure 13: Specific Heat of HexFlow® RTM6-2 Part B

Processing Recommendations
For uncured resin handling, please refer to "Hexcel HexFlow® RTM6/RTM6-2 Safety Processing Guidelines" document.

Defrosting
- Part A & Part B: 24h at 23°C ± 5°C

Mixing
- Pre-heating temperature: Part A ≤ 90°C & Part B 90°C - 110°C
- Mixing ratio by weight: Part A 100: Part B 68,1

*For additional technical information on processing & curing, please contact **Hexcel Technical Support**.*

Testing Conditions

Uncured Resin Data

Isothermal Viscosities: EN6043
Gap: 0,5mm
Shear rate: 10 rad/s
Strain: 4%

Rheology Profile: EN6043
Gap: 0,5mm
Shear rate: 10 rad/s
Strain: 4%
Temperature range: from 30°C to 250°C

Standard DSC: EN6041
Heating rate: 10°C/min
Temperature range: from -60°C to 350°C

Modulated DSC:
from -50°C to 235°C at 2°C/min
Oscillation: +/-1°C
Period: 120s

Cured Resin Data

K1c: ASTM D5045

Density: ISO1183

DMA: EN6032
Mode: fixed frequency, simple cantilever
Amplitude: 15µm
Frequency: 1Hz
Heating rate: 3°C/min
Temperature range: 30°C to 250°C

Compression: ASTM D695
Modulus strain range: 0.1% - 0.5% & 0.3% - 0.5%

Tensile: ASTM D638

Laminate Mechanical Data

Compression: EN2850A1

CAI: ASTM D7136/ D7137

DMA: EN6032
Mode: fixed frequency, simple cantilever
Amplitude: 15µm
Frequency: 1Hz
Heating rate: 3°C/min
Temperature range: from 30°C to 250°C

Tensile: EN2561B

IPS: EN6031

Transport and Storage of Uncured Resin
Product classification & transport conditions: Please refer to "HexFlow® RTM6/RTM6-2 Safety Data Sheet."

Shelf Life

- Before mixing (Part A & Part B)
  - 12 months at 23 ± 5°C

- After mixing
  - 15 days maximum at 23 ± 5°C
  - 9 months at temperatures below -18°C

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
- HexAM® additive manufacturing
- HexMC® molding compounds
- HiFlow® RTM resins
- HexBond® adhesives
- HexTool® tooling materials
- HexWeb® honeycomb
- Acousti-Cap® sound attenuating honeycomb
- Engineered core
- Engineered products
- Polyspeed® laminates
- & pultruded profiles

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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