HiFlow® 1078-1

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

HEXCEL®

Product Data Sheet

Description

HiFlow® 1078-1 is an aerospace bi-component resin system with liquid Part A & Part B specially developed for Liquid Composite Molding technologies, such as LRI and RTM. Delivered as two component system, HiFlow® 1078-1 provides several benefits over a mono-component resin: air shipment is allowed, storage at 23± 5°C for 12 months and larger packages are possible. HiFlow® 1078-1 Part A:B mixing ratio by weight is 100 : 63.

HiFlow® 1078-1 presents services temperatures from -60°C up to 120°C with greater toughness, Tg stability and cycle processing flexibility making it ideal for primary and secondary aerospace structures. Long injection windows due to HiFlow® 1078-1 low viscosity are also easily reached, facilitating large parts manufacturing.

HiFlow® 1078-1 resin can be used in combination with HexForce®, HiTape® & HiMax® reinforcements. HiFlow® 1078-1 is fully compatible with Hexcel binders and veils. They provide easy preforming properties and reinforcement dimensional stability.

Advantages

- High glass transition temperatures: dry[1]: Tg> 200°C; wet[2]: Tg> 170°C
- Low moisture absorption: 1,0 – 2,0%
- < 100mPa.s at process temperatures
- Toughened system
- Liquid Part A & Part B at room temperature
- Longer shelf life (12 months at RT), as bicomponent system

(1) *Dry: 24h at 105°C*

(2) *Wet: 14 days in water at 70°C*

Part A and B Properties

Viscosity

Part A

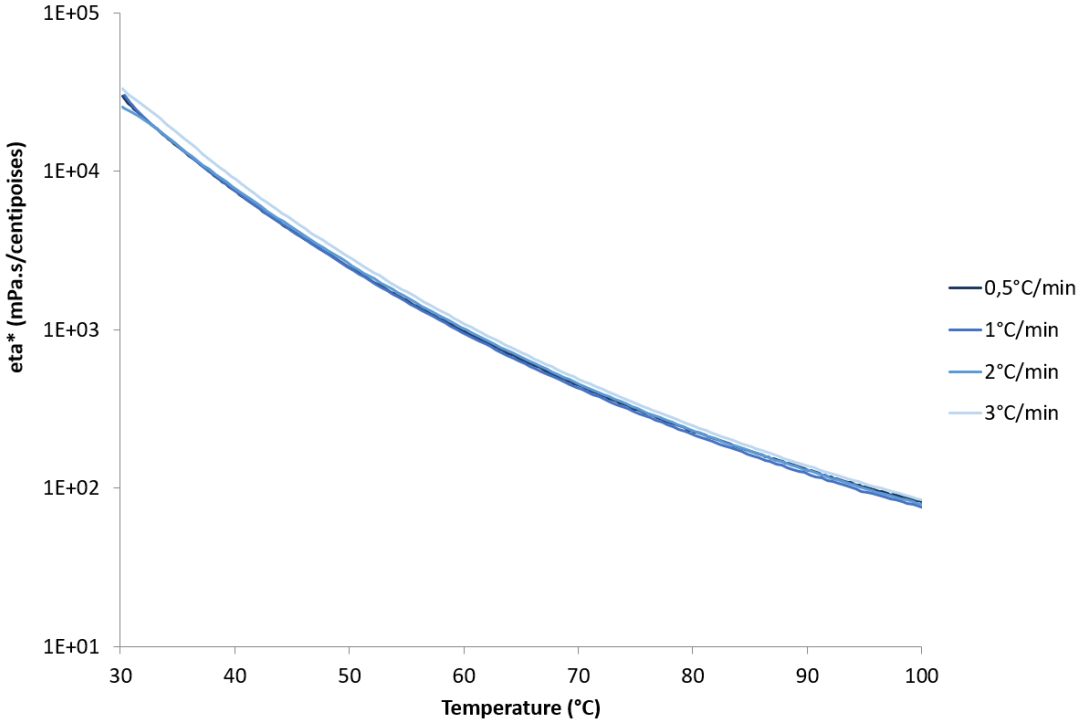

Figure 1 : Rheology Profile of HiFlow® 1078-1 Part A

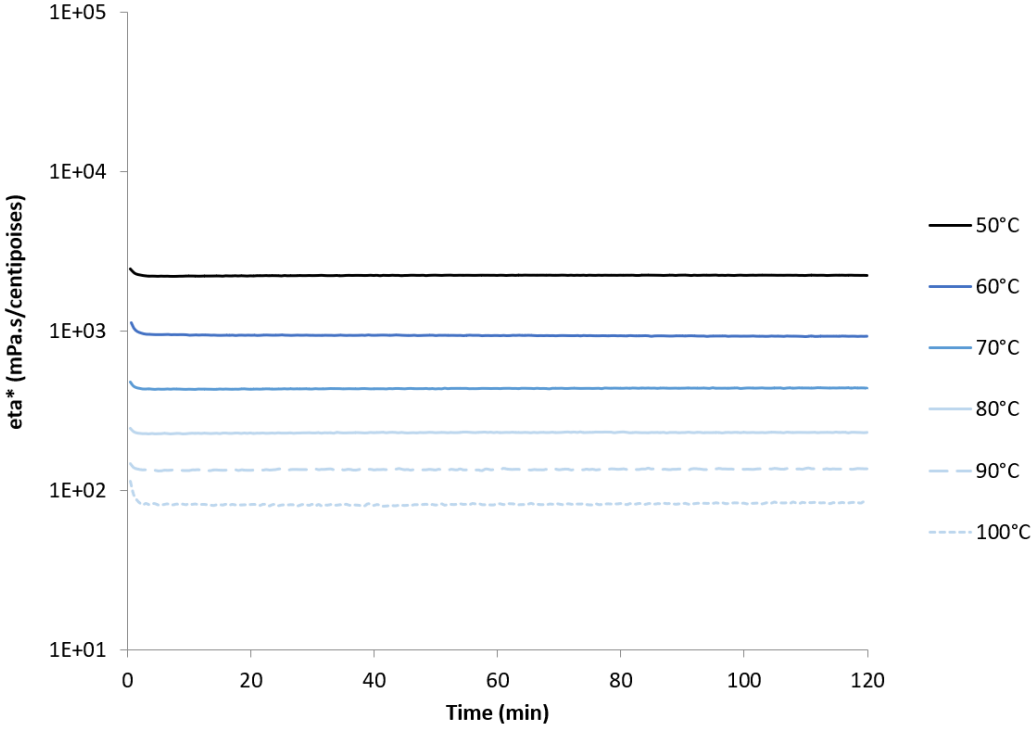

Figure 2: Isothermal Viscosities of HiFlow® 1078-1 Part A

Part B

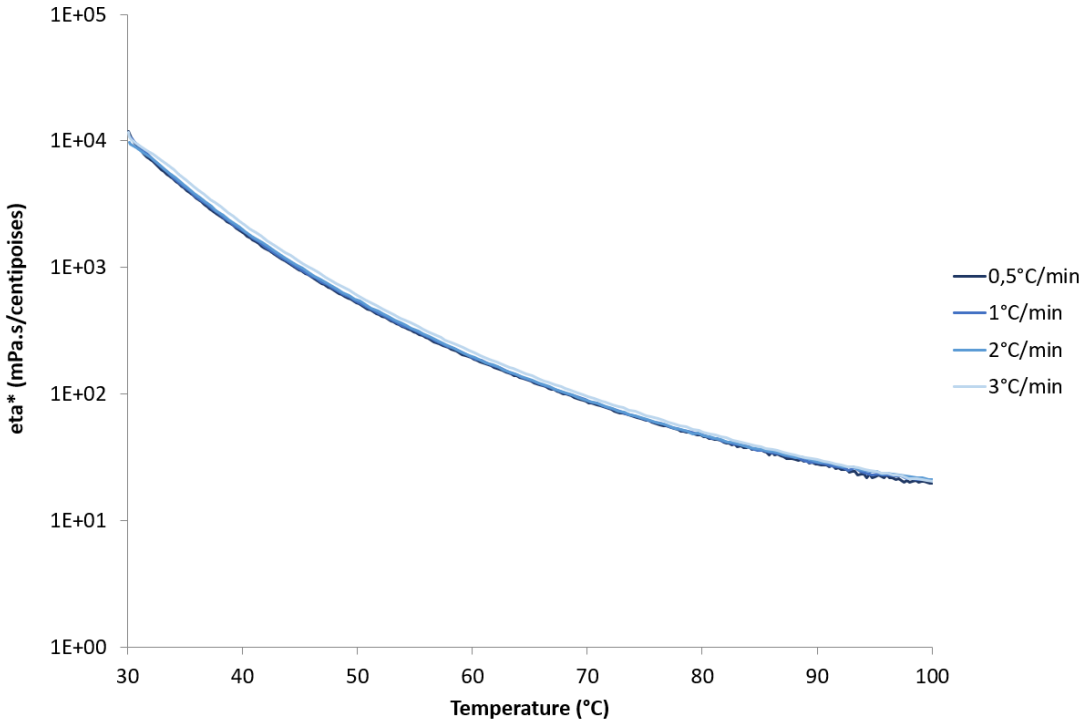

Figure 3: Rheology Profile of HiFlow® 1078-1 Part B

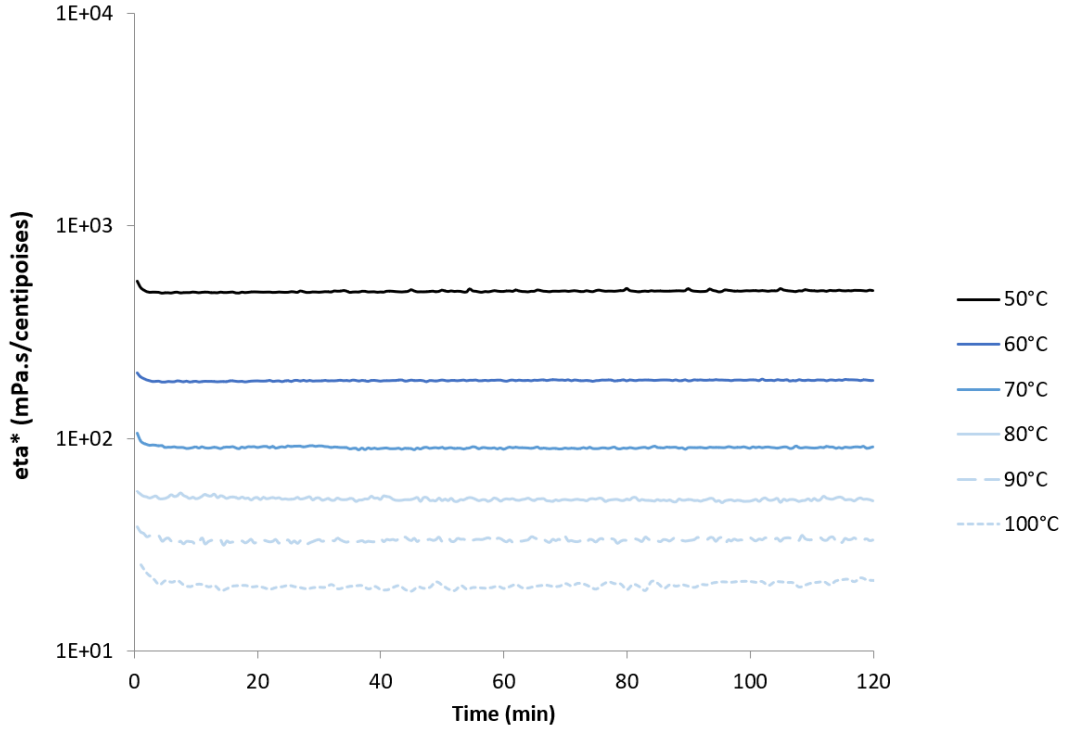

Figure 4: Isothermal Viscosities of HiFlow® 1078-1 Part B

Thermokinetics
Part A

	Standard DSC Parameters			
	Tg midpoint (°C)	Enthalpy (J/g)	T peak (°C)	T onset (°C)
Part A	-18	830	335	315

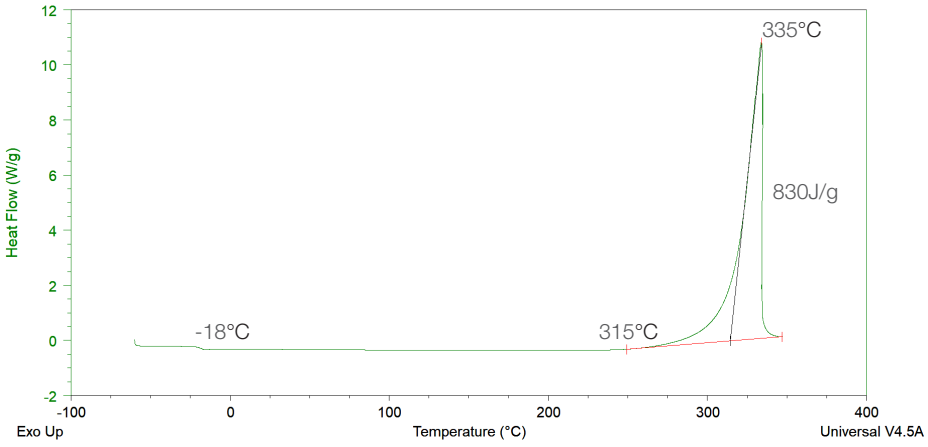

Figure 5: Standard DSC of HiFlow® 1078-1 Part A

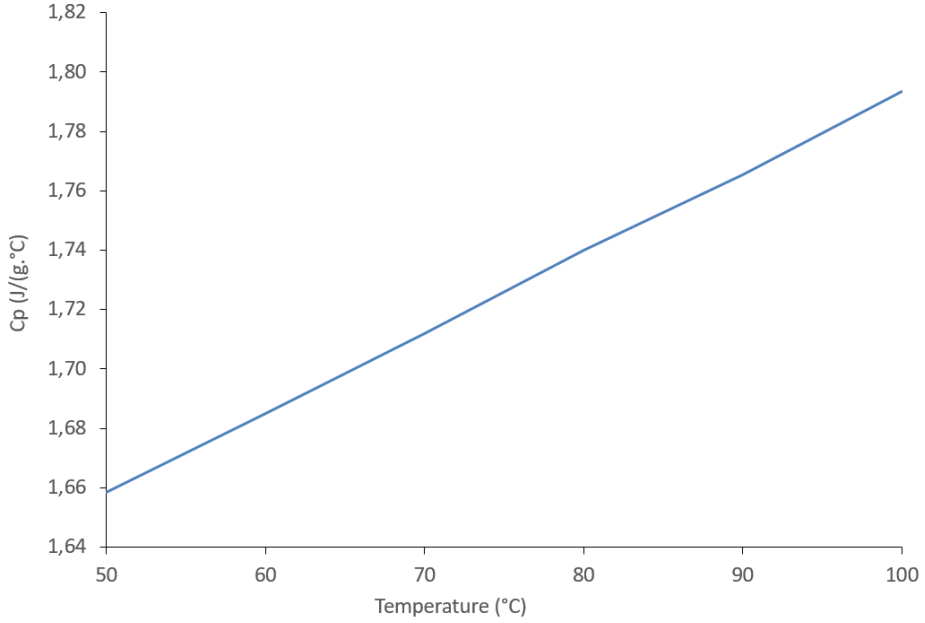

Figure 6: Specific Heat of HiFlow® 1078-1 Part A

Thermokinetics
Part B

	Standard DSC Parameters			
	Tg midpoint (°C)	Enthalpy (J/g)	T peak (°C)	T onset (°C)
Part B	-18	Not applicable	Not applicable	Not applicable

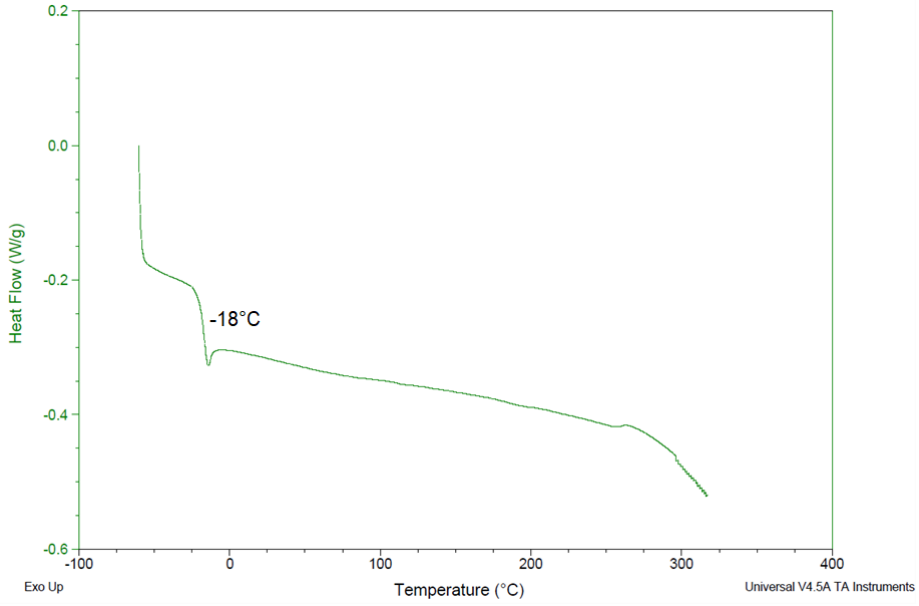

Figure 7: Standard DSC of HiFlow® 1078-1 Part B

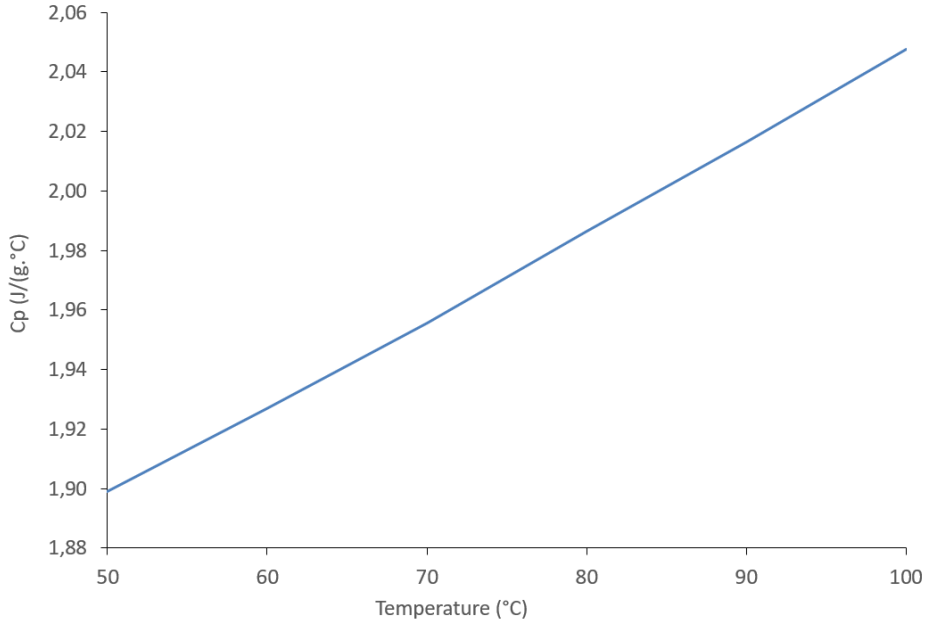

Figure 8: Specific Heat of HiFlow® 1078-1 Part B

1078-1 (After Mix) Uncured Resin Properties

Viscosity

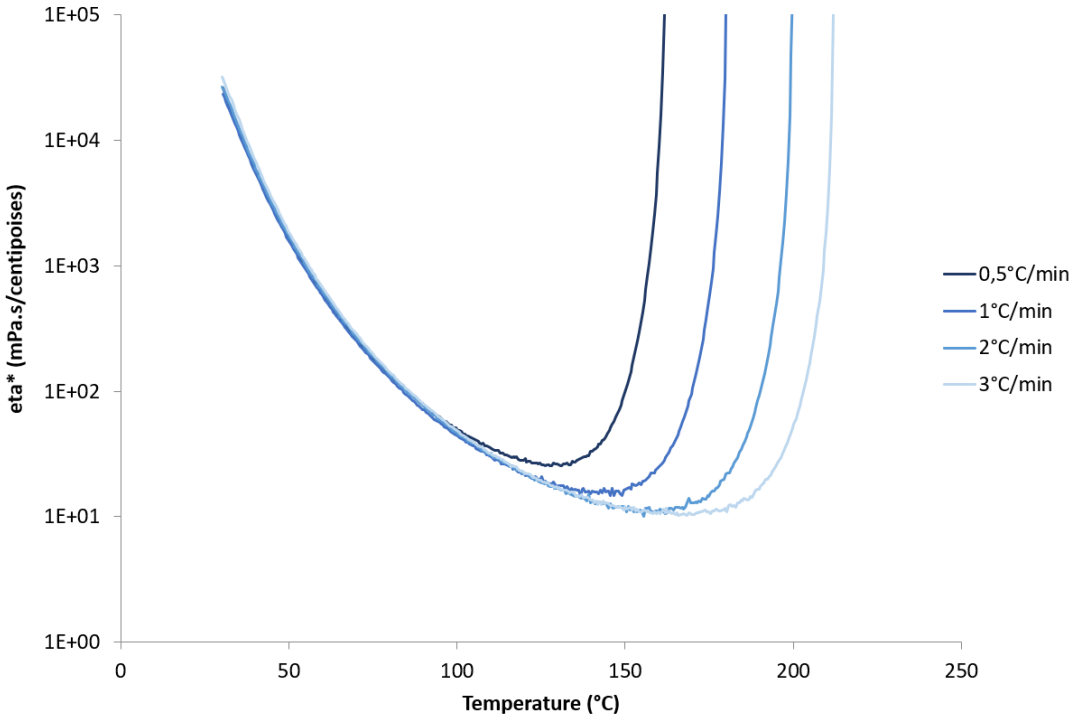

Figure 9: Rheology Profile of HiFlow® 1078-1 (After Mix)

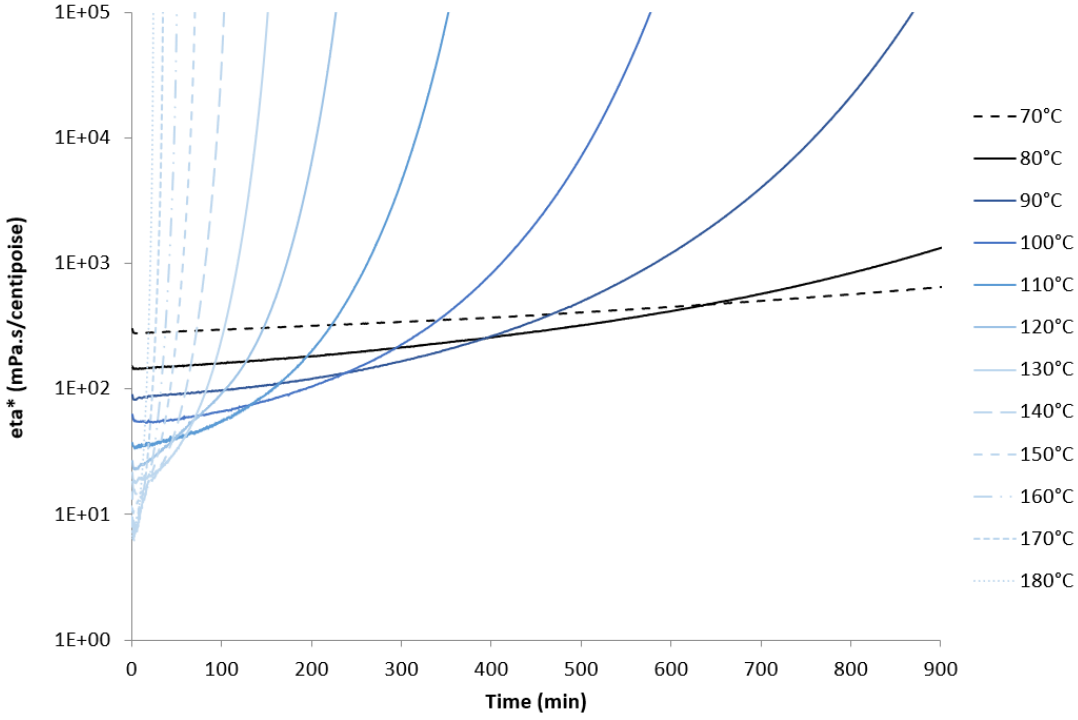

Figure 10: Isothermal Viscosities of HiFlow® 1078-1 (After Mix)

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)
70	> 15:00	> 15:00	Viscosity > 200mPa·s
80	> 15:00	14:00	
90	> 15:00	9:45	5:45
100	11:30	6:50	4:50
110	6:50	4:20	3:20
120	4:20	2:50	2:15
130	2:45	2:00	1:35
140	1:50	1:20	1:10
150	1:15	0:55	0:45
160	0:50	0:40	0:35
170	0:35	0:30	0:25
180	0:25	0:20	0:20

Thermokinetics

Standard DSC parameters			
Tg midpoint (°C)	Enthalpy (J/g)	T peak (°C)	T onset (°C)
-15	425	245	205

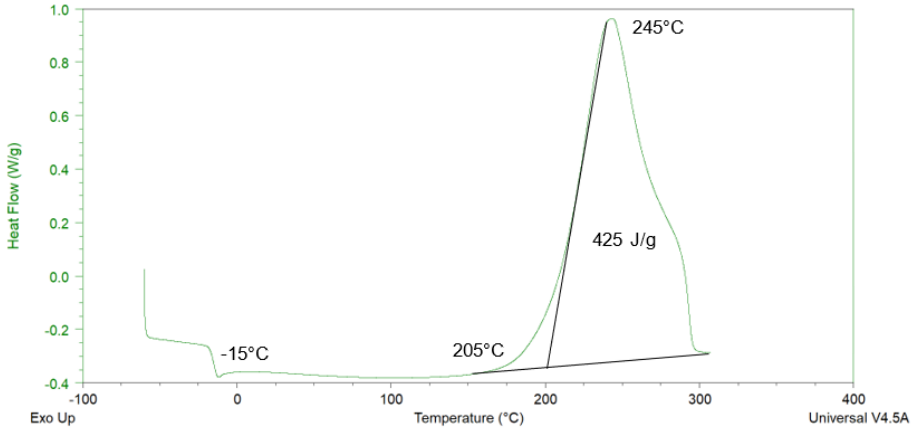

Figure 11: Standard DSC HiFlow® 1078-1 (After Mix)

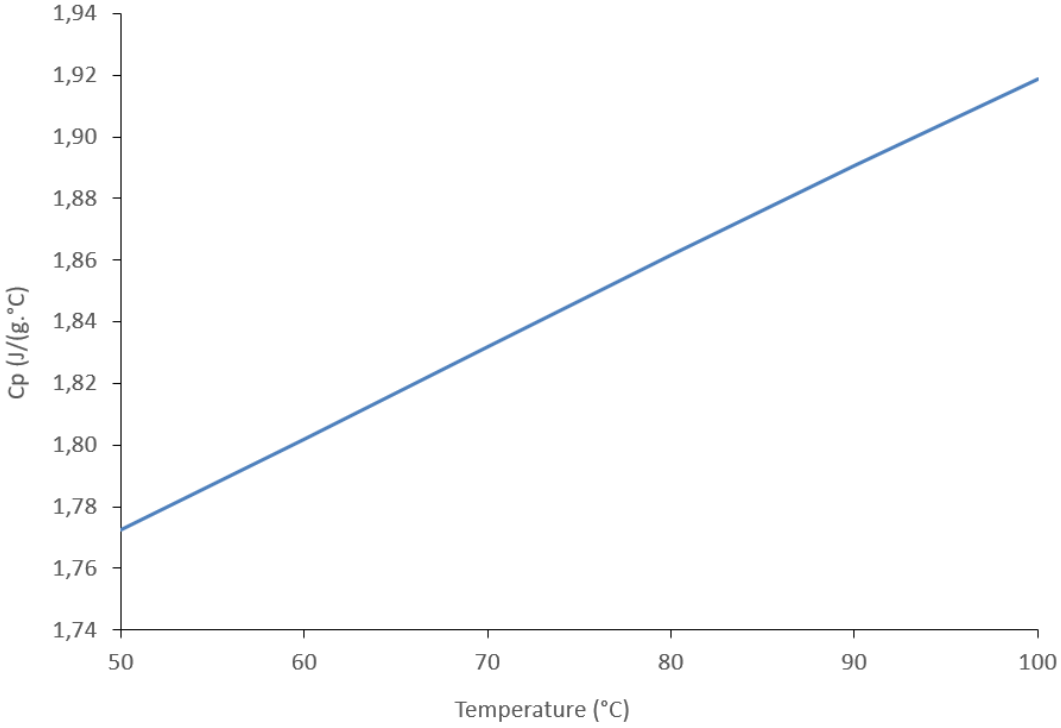

Figure 12: Specific Heat of HiFlow® 1078-1 (After Mix)

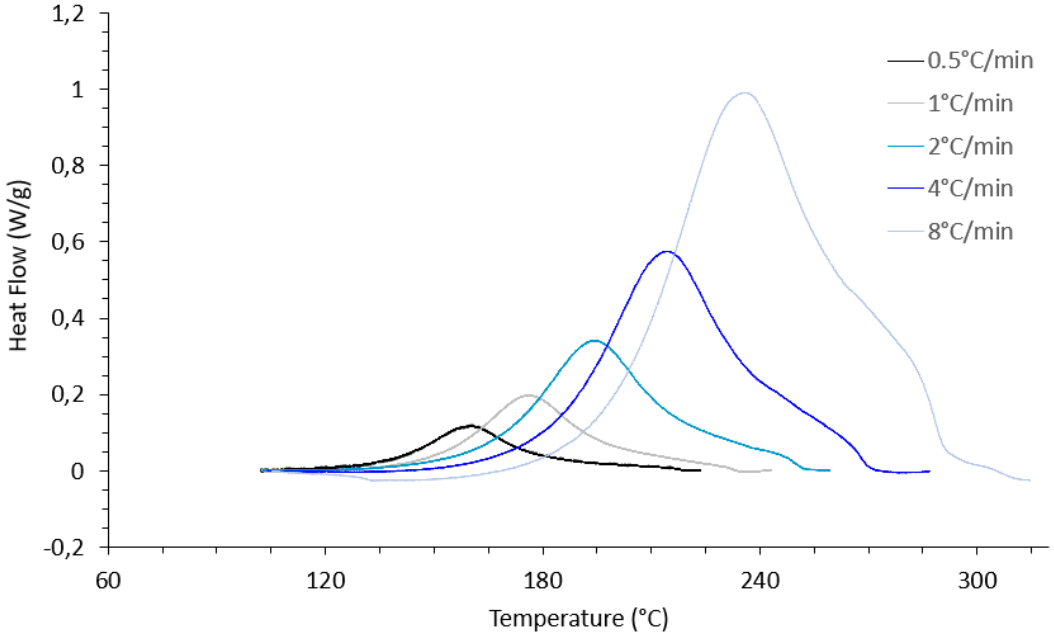

Figure 13: Standard DSC at Various Heating Rates of HiFlow® 1078-1 (After Mix)

Processing Recommendations
For uncured resin handling, please refer to "Hexcel HiFlow® 1078-1 Safety Processing Guidelines" document.

Defrosting

- 24-48h at 23°C ± 5°C (74°F)
- Part A & B pre-heat temperature: 50 – 70°C (122-158°F), at constant temperature
- Mixing ratio by weight (A:B) : 100:63

Process Parameters (Infusion or RTM)

- Preheat resin at 70°C (158°F) (please refer to "Hexcel HiFlow® 1078-1 Safety Processing Guidelines" document for maximum preheating time)
- Mold temperature: between 120°C and 140°C (248 - 284°F), at constant temperature
- Injection / infusion lines: 90-110°C (194 - 230°F)
- Mold / bagging leakage: below 15 mbar (0,22 Psi) in 5min
- Vacuum Infusion: below 5 mbar (0,007 Psi)
- RTM Piston Pressure: atm to 5 bars (73 Psi)

Cure Cycle

- 120 min minimum at 180°C (356°F) - 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 (convection 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.m^{½})	0,7		
Density (g/cm^3)	1,12		
Coefficient of thermal expansion (10^{-6} K^{-1})	-50°C to 20°C	20°C to 100°C	100°C to 180°C
	55	70	85
Moisture uptake (%)	1,0 – 2,0		

Compression (ASTM D695)

Conditioning	Dry[1]		Wet[2]	
Test Temperature	23°C	120°C	23°C	120°C
Yield strength (MPa)	130	80	120	60
Yield strength (ksi)	18,8	11,6	17,4	8,7
Ultimate strength (MPa)	Not available			
Ultimate strength (ksi)				
Modulus (GPa)	3,1	2,4	2,9	2,4
Modulus (msi)	0,45	0,35	0,42	0,35

Tensile (ASTM D638)

Conditioning	Dry[1]		Wet[2]	
Test Temperature	23°C	120°C	23°C	120°C
Ultimate strength (MPa)	90	55	70	30
Ultimate strength (ksi)	13,0	8,0	10,1	4,3
Modulus (GPa)	3,0	2,3	2,8	1,7
Modulus (msi)	0,43	0,33	0,41	0,25

DMA (EN6032)

Tg (°C)	Dry[1]	Wet[2]
Onset	205	170
Loss Modulus	210	180
Tanδ	220	215

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 90°	$[0]_6$	Ultimate strength (MPa)	620	490	625	435
		Ultimate strength (ksi)	90	71	90	63

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)	110	80	105	85	80	65
	Ultimate strength (ksi)	15,9	11,6	15,2	12,3	11,6	9,4
	Modulus (GPa)	4,1	3,4	3,9	3,7	3,6	3,0
	Modulus (msi)	0,59	0,49	0,57	0,54	0,52	0,43

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)	440	0,68	0,10	0,004	250	36,2
30J impact	$[+45/0]_{3S}$ (12 plies)	590	0,91	0,35	0,014	240	34,8

Testing Conditions

Uncured Resin Data

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

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: 3000-5000 usn

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 "HiFlow® 1078-1 Safety Data Sheet."

For ease of transportation and storage, HiFlow® 1078-1 is only available as a bi-component version. For HiFlow® 1078-1 transports longer than 21 days, +5°C or +23°C temperature-controlled shipment is mandatory.

Shelf Life

- Before mixing (Part A & Part B)
  - 21 days at 60 ± 3°C
  - 12 months at 23 ± 3°C

- After mixing
  - 5 days at 23 ± 5°C
  - 12 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:

https://www.hexcel.com/contact

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