

LIQUID THERMOPLASTIC RESIN FOR GLASS-REINFORCED COMPOSITE

The **ELIUM® 150** is a low viscosity liquid, thermoplastic resin for **infusion** and **RTM** processes.

Through the use of the same low pressure processes and equipments used today to produce thermoset composite parts, these formulations lead to the production of thermoplastic composites reinforced by continuous glass, carbon or natural fibers. The resulting thermoplastic composite parts show mechanical properties similar to those of parts made of epoxy resins while presenting the major advantages of being post-thermoformable and recyclable and of offering new possibilities for composite/composite or composite/metal assemblies.

<p>APPLICATIONS AND USE</p>	<p>ELIUM® 150 resin can be used to produce aesthetic or structural composites reinforced by glass, carbon, or other continuous fibers. This resin can be used for RTM (Resin Transfer Molding), VARI (Vacuum Assisted Resin Infusion) and other closed mold processes.</p>																
<p>TYPICAL LIQUID RESIN PROPERTIES</p>	<table border="1"> <thead> <tr> <th colspan="2">Property⁽¹⁾ at 25 °C</th> </tr> </thead> <tbody> <tr> <td>Colorless Limpid Liquid</td> <td></td> </tr> <tr> <td>Liquid Specific Gravity</td> <td>1.01 g/cm³</td> </tr> <tr> <td>Viscosity Brookfield LVF #2, 60 rpm</td> <td>100 mPa.s</td> </tr> </tbody> </table> <p>(1) Properties are typical values based on material tested in our laboratories. Typical values should not be construed as a guaranteed analysis of any specific lot or as specification items.</p>	Property ⁽¹⁾ at 25 °C		Colorless Limpid Liquid		Liquid Specific Gravity	1.01 g/cm ³	Viscosity Brookfield LVF #2, 60 rpm	100 mPa.s								
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<p>TYPICAL CURING CHARACTERISTICS</p>	<p>The ELIUM® resins are 2K based formulations that undergo radical polymerization to produce thermoplastic composite matrices. The polymerization is initiated by Peroxide compounds (Luperox®). Typical open time and peak time with 3% Luperox® EZ-FLO are:</p> <table border="1"> <thead> <tr> <th>Reactivity⁽²⁾ (200 grams)</th> <th>Infusion open time</th> <th>Injection open time</th> <th>Peak time</th> </tr> </thead> <tbody> <tr> <td>15 °C</td> <td>30 min.</td> <td>35 min.</td> <td>50 min.</td> </tr> <tr> <td>20 °C</td> <td>25 min.</td> <td>30 min.</td> <td>40 min.</td> </tr> <tr> <td>25 °C</td> <td>20 min.</td> <td>25 min.</td> <td>33 min.</td> </tr> </tbody> </table> <p>(2) If a lower reactivity infusion resin is needed, we recommend to use the Elium® 180. Please contact your Arkema representative for more information.</p> <p>The demolding can take place 5-10 minutes after reaching the peak exotherm. Open time is the amount of time during which the viscosity of the resin is low enough to inject the resin. Temperature and peroxide ratio will affect the open and peak times. The recommended peroxide ratio is from 1,5% (slow reactivity) to 3% (higher reactivity). Out of this range the resin will not polymerize properly. Room temperature polymerization leads to high conversion rate, so post-curing is generally not needed. If maximum mechanical properties are desired, post-curing at 80 °C for 4 hours is beneficial. Vinyl ester or epoxy molds with a glass transition of 100-120 °C are recommended.</p>	Reactivity ⁽²⁾ (200 grams)	Infusion open time	Injection open time	Peak time	15 °C	30 min.	35 min.	50 min.	20 °C	25 min.	30 min.	40 min.	25 °C	20 min.	25 min.	33 min.
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25 °C	20 min.	25 min.	33 min.														

INFUSION PROCESSING

Processing by infusion can be carried out at a vacuum ranging from 100 mbar to 500 mbar, due to the good fiber impregnation behavior of the resin. Before introducing the peroxide into the resin, firmly close the container and shake vigorously. If using BPO pastes, skip the shaking step. Resin and peroxide must be mixed carefully for two minutes, to reach a homogeneous color and no particles, especially at the bottom and on the sides of the mixing pot. It is recommended to position a perforated plastic film or a cap on top of the pot during infusion, to reduce the smell in the workshop and prevent curing inhibition caused by air. The low viscosity of Elium® 150 allows a quick and complete fiber wetting with infusion distance up to 500 mm. Processing by infusion can be carried out at a vacuum pressure ranging from 100 mbar to 500 mbar, due to the good fiber impregnation behavior of the resin. The flow mesh length and break length between the resin inlet(s) and vacuum tube(s) have to be dimensioned to allow a full impregnation of the laminate in 10-15 minutes at 25 °C, with an additional 5-10 cm of break material before the vacuum tube, to avoid resin entering into the vacuum tubes. Following impregnation speeds can be used to dimension flow mesh and brake lengths:

- resin impregnation speed into a laminate with flow mesh: 10 cm/min on average (15 cm for the first minute)
- resin impregnation speed into a laminate without flow mesh: 1 cm/min in average

The remaining resin in the pot will generally foaming and change color during the peak exotherm.

If this resin is be used in combination with a pump system (for mixing and/or infusing), the machine has to be cleaned daily with acetone for the resin circuit and with water for the peroxide circuit.

INJECTION PROCESSING

Light RTM processing of Elium® 150 can be done under similar conditions than standard polyester resins. Specific injection machines are required to pump the Luperox® EZ FLO, so standard machines designed for MEKP should not be used. Contact your representative to have the details on the machine type. The machine has to be cleaned daily with acetone for the resin circuit and with water for the peroxide circuit.

TYPICAL MECHANICAL PROPERTIES

Properties of a 4 mm unfilled resin casting	Value	ISO method
Rockwell Hardness (M)	100	2039
Shore D Hardness	85-90	868
Tensile Strength	76 MPa	527
Tensile Modulus	3.300 MPa	527
Tensile Deformation	6 %	527
Flexural Strength	130 MPa	178
Flexural Modulus	3.250 MPa	178
Compression Strength	130 MPa	684
Specific Gravity	1,19	1183
Heat Deflection Temperature	109 °C	75/A
Maximum Continuous Temperature Service	85 °C	-
Water Uptake (8 days)	0,5%	62
Coefficient of Linear Expansion	0,065 mm/m/°C	2155-1
Fracture Toughness Stress Intensity, K _{1c}	1,2 MPa.m ^{0.5}	13586

Properties of a composite aesthetic part ⁽³⁾	Value	ISO method
Flexural Strength	270 MPa	14125
Flexural Modulus	9.600 MPa	14125
In-plane Shear Modulus	2.500 MPa	14129

Properties of a composite structural part ⁽⁴⁾	Value	ISO method
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ELIUM® 150

	Tensile Strength	557 MPa	527	
	Tensile Modulus	27 GPa	527	
	Flexural Strength	700 MPa	14125	
	Flexural Modulus	27 GPa	14125	
	Compressive Strength	347 MPa	14126	
	Compressive Modulus	28 GPa	14126	
	In-plane Shear Modulus	5.600 MPa	14129	
	Charpy Impact Strength (un-notched)	206 kJ/m ²	179/2D	
	Properties of a UD composite part⁽⁵⁾		Value	ISO method
	Tensile Strength 0°		1.005 MPa	527
	Tensile Modulus 0°		47 GPa	527
	Tensile Strength 90°		53 MPa	527
	Tensile Modulus 90°		12 GPa	527
	Flexural Strength		1.230 MPa	14125
Flexural Modulus		45 GPa	14125	
Compression Strength		900 MPa	14126	
Lap shear Strength		22 MPa	4587	
Interlaminar Fracture Toughness Energy, G _{IC}		1.370 J/m ²	15024	
(3) Molded by RTM with Rovicore™ 450/B5/450(16) from Chomarat, fiber volume content: 11%				
(4) Molded by RTM with a plain weave fabric from Chomarat, fiber volume content: 53%				
(5) Molded by infusion, with UD from Chomarat, fiber volume content: 58%				
THERMOFORMING	Fiber-reinforced Elium® parts can be thermoformed with heat and pressure. The use of a water-free peroxide for the Elium® polymerization is recommended when composite parts need to be thermoformed. This process requires the heating of the consolidated part at 180-200 °C for a few minutes, and the compression at a pressure between 5 and 20 bars depending on the reinforcement type and the thickness of the part.			
ADHESIVE ASSEMBLY	Fiber-reinforced composites made with ELIUM® resins can be assembled with adhesives. The SAF® 30 adhesive, from AEC Polymers, is recommended for structural bonding. A cohesive rupture is obtained with tensile lap shear strength at 17,5 MPa, according to the EN-1465. This adhesive is also recommended to bond metals, with lap-shear strength ranging from 18 to 21 MPa (aluminum 1050A, 6060 and 6061, stainless steel, steel).			
STANDARD PACKAGES	These resins are supplied in non-returnable drums with net weight of 200 kg.			
STORAGE	The shelf life of the resin in original sealed container is 6 months at a temperature not higher than 25 °C. For further information we advise you to read carefully the current Safety Data Sheet.			

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See MSDS for Health & Safety Considerations

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