

# Starting Formulation

## SF 8017

### Epoxy Resin System for Pultrusion or Filament Winding EPON™ Resin 826 or EPON™ Resin 862 / LS-81K Anhydride Curing Agent (MTHPA)

**Introduction** EPON Resin 826 or EPON Resin 862/LS-81K Curing Agent system is based on an epoxy resin cured with an anhydride. LS-81K Curing Agent is a formulated methyltetrahydrophthalic anhydride (MTHPA) containing an internal mold release additive and a cure accelerator, LS-81K is manufactured by Lindau Chemicals Inc.

This resin system’s combination of low viscosity, good pot life and fast gelation characteristics during cure make it favorable for wet processing fabrication of composite parts.

- In Pultrusion processes, it processes at high line speeds with low pull loads, and it yields good surface quality. No internal release agents are needed because they are already incorporated in the curing agent.

- In Filament Winding processes, good fiber wet-out is achieved because of the resin system’s low viscosity. It also has a relatively long pot life.

Neat resin casting data indicate this resin system has a unique balance of T<sub>g</sub>, tensile and flexural strength, while providing high toughness properties.

- Suggested Uses**
- Composite structures
  - Civil engineering
  - Sporting goods
  - Transportation
  - Electrical
  - Marine

- Features**
- Non-MDA
  - Non-styrene
  - Low viscosity
  - Long pot life
  - Good surface quality
  - Retention of properties up to 105 °C (221 °F)
  - Good elongation
  - High toughness
  - Good electrical properties

- Chemical Description**
- EPON Resin 826 is a bisphenol A epoxy resin
  - EPIKOTE Resin 862 is a bisphenol F epoxy resin
  - LS-81K is a specially formulated methyltetrahydrophthalic anhydride with an internal mold release agent

Typical Properties Table 1 / Typical Properties

	<u>Method</u>	<u>Units</u>	EPON Resin 826	EPON Resin 862
			Epoxide equivalent weight	D-1652
Viscosity @ 25 °C (77 °F)	D-445	cP	6,500-9,500	2,500-4,500
Color	D-1544	Gardner	1 max.	2 max.
Density @ 25 °C		lbs/gal	9.7	9.9
Specific gravity @ 25 °C, (g/cc)		g/cc	1.16	1.18
	<u>Method</u>	<u>Units</u>	<u>LS-81K Anhydride Curing Agent</u>	
Anhydride equivalent weight		eq/g	185-195	

Generated: October 19, 2021  
Issue Date:  
Revision:

© and ™ Licensed trademarks of Hexion Inc.

#### DISCLAIMER

The information provided herein was believed by Hexion Inc. ("Hexion") to be accurate at the time of preparation or prepared from sources believed to be reliable, but it is the responsibility of the user to investigate and understand other pertinent sources of information, to comply with all laws and procedures applicable to the safe handling and use of the product and to determine the suitability of the product for its intended use. All products supplied by Hexion are subject to Hexion's terms and conditions of sale. HEXION MAKES NO WARRANTY, EXPRESS OR IMPLIED, CONCERNING THE PRODUCT OR THE MERCHANTABILITY OR FITNESS THEREOF FOR ANY PURPOSE OR CONCERNING THE ACCURACY OF ANY INFORMATION PROVIDED BY HEXION, except that the product shall conform to Hexion's specifications. Nothing contained herein constitutes an offer for the sale of any product.

Viscosity @ 25 °C (77 °F)	D-2196	cP	200-300
Density @ 25 °C		lbs/gal	9.8-10.0
Specific gravity @ 25 °C		g/cc	1.18-1.20
		<u>Units</u>	<u>826/LS-81K</u> <u>862/LS-81K</u>
Mix ratio	pbw	100/100	100/100
Viscosity @ 25 °C (77 °F)		cP	1230      897
Density @ 25 °C		lbs/gal	9.8      9.9
Specific gravity @ 25 °C		g/cc	1.18      1.17

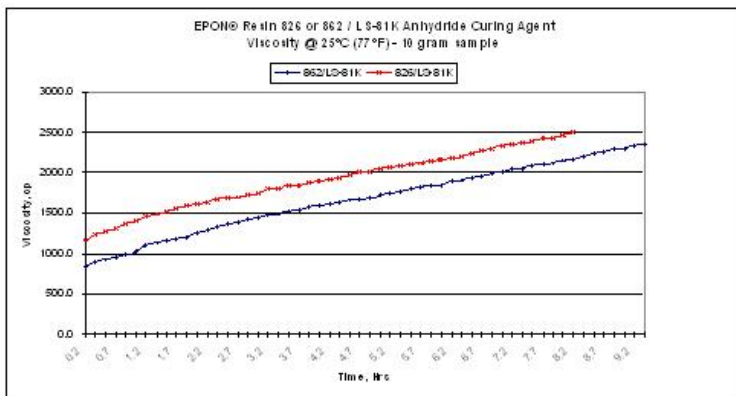
Typical Handling Table 2 / Typical neat resin properties of EPON Resin 826 or EPON 862/LS-81K Anhydride Curing Agent

	<u>Units</u>	<u>826/LS-81K</u>	<u>862/LS-81K</u>
EPON Resin 826	pbw	100	—
EPON Resin 862	pbw	—	100
LS-81K Anhydride Curing Agent	pbw	100	100
Viscosity @ 25 °C <sup>1</sup>	cP	1230	897
Time to double initial viscosity @ 25 °C <sup>1</sup>	hrs	8	5.5
Working life @ 25 °C, time to reach:			
1,000 cP	hrs	N/A	1.0
2,000 cP	hrs	4.6	7.0
3,000 cP	hrs	>8.0	>9.0
Gel time <sup>2</sup>			
@ 150 °C (302 °F)	sec.	80	82
@ 180 °C (356 °F)	sec.	32	28
@ 200 °C (392 °F)	sec.	18	18

<sup>1</sup> ASTM D2196 (Brookfield Viscometer – Small Sample Adapter, about 10 grams).

<sup>2</sup> Hot plate gel time.

Graph 1 / EPON Resin 826 or 862/LS-81K Anhydride Curing Agent viscosity @ 25 °C (77 °F) – 10 gram sample



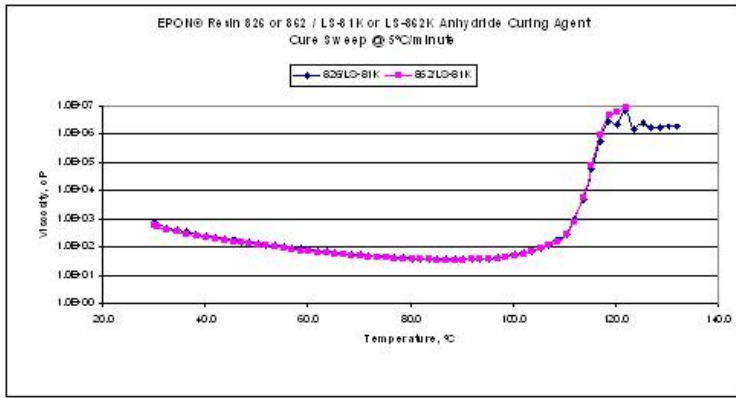
Graph 2 / EPON Resin 826 or 862/LS-81K Anhydride Curing Agent cure sweep @ 5 °C per minute

Generated: October 19, 2021  
Issue Date:  
Revision:

© and ™ Licensed trademarks of Hexion Inc.

DISCLAIMER

The information provided herein was believed by Hexion Inc. ("Hexion") to be accurate at the time of preparation or prepared from sources believed to be reliable, but it is the responsibility of the user to investigate and understand other pertinent sources of information, to comply with all laws and procedures applicable to the safe handling and use of the product and to determine the suitability of the product for its intended use. All products supplied by Hexion are subject to Hexion's terms and conditions of sale. HEXION MAKES NO WARRANTY, EXPRESS OR IMPLIED, CONCERNING THE PRODUCT OR THE MERCHANTABILITY OR FITNESS THEREOF FOR ANY PURPOSE OR CONCERNING THE ACCURACY OF ANY INFORMATION PROVIDED BY HEXION, except that the product shall conform to Hexion's specifications. Nothing contained herein constitutes an offer for the sale of any product.



Typical Cured State Table 2 / Typical cured neat resin system casting properties of EPON Resin 826 or 862/LS-81K Anhydride Curing Agent

			826/LS-81K	862/LS-81K
	Method	Units	Value	Value
<b>Cure Schedule</b>				
Step 1		hrs/°C (°F)	1.5/66 (151)	
Step 2		hrs/°C (°F)	1/85 (185)	
Step 3		hrs/°C (°F)	3/150 (302)	
Tg by rheometrics (max. tan delta)	D-4065	°C (°F)	136 (277)	126 (259)
Tensile Strength, at Break	D-638	psi	10,700	10,700
Tensile Elongation, at Break		%	5	5
Tensile Modulus		ksi	396	413
Flexural Strength	D-790	psi	17,800	17,800
Flexural Modulus		ksi	439	457
Fracture toughness, K <sub>IC</sub>	E-399	psi-in <sup>1/2</sup>	1187	1234
Moisture absorption <sup>1</sup>		% wt.	3.01	2.97
Specific gravity	D-792	g/cc	1.20	1.23
<b>Electrical Properties</b>				
Dielectric constant @ 1 Meg Hz & 23 °C	D-150		3.17	3.24
Dissipation factor @ 1 Meg Hz & 23 °C	D-150		0.018	0.016
Dielectric strength	D-149	Volts/mil	432.3	418.8

<sup>1</sup> Samples immersed in 65 °C (140 °F) water for 30 days (equilibrium), sample size 0.039 in. x 0.5

in. x 2.5 in.

Suggested Formulations

Filament Winding

Generated: October 19, 2021  
Issue Date:  
Revision:

© and ™ Licensed trademarks of Hexion Inc.

DISCLAIMER

The information provided herein was believed by Hexion Inc. ("Hexion") to be accurate at the time of preparation or prepared from sources believed to be reliable, but it is the responsibility of the user to investigate and understand other pertinent sources of information, to comply with all laws and procedures applicable to the safe handling and use of the product and to determine the suitability of the product for its intended use. All products supplied by Hexion are subject to Hexion's terms and conditions of sale. HEXION MAKES NO WARRANTY, EXPRESS OR IMPLIED, CONCERNING THE PRODUCT OR THE MERCHANTABILITY OR FITNESS THEREOF FOR ANY PURPOSE OR CONCERNING THE ACCURACY OF ANY INFORMATION PROVIDED BY HEXION, except that the product shall conform to Hexion's specifications. Nothing contained herein constitutes an offer for the sale of any product.

	<u>Units</u>	<u>Pultrusion</u>	
EPON Resin 826 or EPON Resin 862	pbw	100	100
LS-81K Anhydride Curing Agent	pbw	100	100
ASP-400P <sup>1</sup>	pbw	10-20	N/A

<sup>1</sup> ASP is a registered trademark of Engelhard Corporation.

Composite Fabrication / Pultrusion The properties of this low viscosity and quick cure system at elevated temperatures provide the pultruder with a processable epoxy resin system. The unique resin system characteristics translate into high line speeds, low pull forces and good surface quality. All features are advantages of fabricators who desire the higher performance properties of epoxy resins.

Mixing – A high shear mixer is recommended to insure complete dispersion of the filler. Mixing time should be kept to a minimum to avoid excess heat build-up of the resin system, as this can reduce the working life of the system.

Resin bath – The resin impregnation bath temperature should be as close to 25 °C (77 °F) as possible to maximize working life.

Process– The EPON Resin 826 or EPIKOTE Resin 862 /LS-81K Curing Agent will cure at die temperatures ranging from 170-180 °C (338-356 °F). The optimum temperatures will depend on parameters such as part thickness, line speed, and preheat temperature. The epoxy part will react to a high degree of cure during the pultrusion process. A post cure, however, may enhance the properties.

Composite Fabrication / Filament Winding The low viscosity and long working life of the resin system make it desirable for Filament Winding thin wall parts.

Mixing – A high shear mixer is recommended to insure complete mixing. Mixing time should be kept to a minimum to avoid excess heat build-up of the resin system, as this can reduce the working life of the system.

Resin bath – The resin impregnation bath temperature should be as close to 25 °C (77 °F) as possible to maximize working life. However, elevated temperatures may be required to obtain the appropriate viscosity for fiber wet-out.

Process– The 826 or 862/LS-81K system will cure at mandrel/oven temperatures of 80-150 °C within 1-3 hours. The optimum temperatures will depend on parameters such as part thickness.

Storage Recommendations regarding storage conditions can be obtained by visiting our web site at [www.hexion.com](http://www.hexion.com)

#### General Information

These are starting formulations and are not proven in the user's particular application but are simply meant to demonstrate the efficacy of the products and to assist in the development of the user's own formulation. It is the user's responsibility to fully-test and qualify the formulation, along with the ingredients, methods, applications or equipment identified herein ("Information"), by the user's knowledgeable formulator or scientist, and to determine the appropriate use conditions and legal restrictions, prior to use of any Information.

#### Safety, Storage & Handling

Please refer to the MSDS for the most current Safety and Handling information.

Exposure to these materials should be minimized and avoided, if feasible, through the observance of proper precautions, use of appropriate engineering controls and proper personal protective clothing and equipment, and adherence to proper handling procedures. None of these materials should be used, stored, or transported until the handling precautions and recommendations as stated in the Material Safety Data Sheet (MSDS) for these and all other products being used are understood by all persons who will work with them. Questions and requests for information on Hexion Inc. ("Hexion") products should be directed to your Hexion sales representative, or the nearest Hexion sales office. Information and MSDSs on non-Hexion products should be obtained from the respective manufacturer.

#### Contact Information

Generated: October 19, 2021  
Issue Date:  
Revision:

© and ™ Licensed trademarks of Hexion Inc.

#### DISCLAIMER

The information provided herein was believed by Hexion Inc. ("Hexion") to be accurate at the time of preparation or prepared from sources believed to be reliable, but it is the responsibility of the user to investigate and understand other pertinent sources of information, to comply with all laws and procedures applicable to the safe handling and use of the product and to determine the suitability of the product for its intended use. All products supplied by Hexion are subject to Hexion's terms and conditions of sale. HEXION MAKES NO WARRANTY, EXPRESS OR IMPLIED, CONCERNING THE PRODUCT OR THE MERCHANTABILITY OR FITNESS THEREOF FOR ANY PURPOSE OR CONCERNING THE ACCURACY OF ANY INFORMATION PROVIDED BY HEXION, except that the product shall conform to Hexion's specifications. Nothing contained herein constitutes an offer for the sale of any product.

For product prices, availability, or order placement, please contact customer service:

[www.hexion.com/Contacts/](http://www.hexion.com/Contacts/)

For literature and technical assistance, visit our website at [www.hexion.com](http://www.hexion.com)

---

Generated: October 19, 2021  
Issue Date:  
Revision:

® and ™ Licensed trademarks of Hexion Inc.

DISCLAIMER

The information provided herein was believed by Hexion Inc. ("Hexion") to be accurate at the time of preparation or prepared from sources believed to be reliable, but it is the responsibility of the user to investigate and understand other pertinent sources of information, to comply with all laws and procedures applicable to the safe handling and use of the product and to determine the suitability of the product for its intended use. All products supplied by Hexion are subject to Hexion's terms and conditions of sale. HEXION MAKES NO WARRANTY, EXPRESS OR IMPLIED, CONCERNING THE PRODUCT OR THE MERCHANTABILITY OR FITNESS THEREOF FOR ANY PURPOSE OR CONCERNING THE ACCURACY OF ANY INFORMATION PROVIDED BY HEXION, except that the product shall conform to Hexion's specifications. Nothing contained herein constitutes an offer for the sale of any product.