POTTING & ENCAPSULATING

Potting and Encapsulating Compounds are used to provide mechanical reinforcement to housed assemblies, to fill large voids, and to protect components from the effects of exposure to chemicals, moisture, mechanical shock, and vibration. Sealing components with potting and encapsulating compounds prevents corrosion and ensures long-term integrity of the device. Variables to consider when selecting a potting or encapsulating material include:

- Viscosity of uncured compound
- Dispensing requirements
- Device operating temperature
- Desired chemical resistance
- Desired thermal conductivity
- Desired flame retardance
- Hardness of cured product
- Overall cost

There are a variety of potting and encapsulating compounds to choose from – epoxy, hot melt, silicone, and urethane. The thermal properties of epoxy and silicone systems make them ideally suited for applications exposed to temperatures above 125°C. If a soft, flexible material is needed, particularly at low temperatures, then a urethane, a silicone or a hot melt material may be used.

What is the Best Product for My Application?

The following chart will work best when selecting a potting or encapsulating compound. This chart is intended to serve as a general guideline to help you determine which categories are best suited for your application. The data presented represents typical properties for each product category; however, individual product properties may differ. It is suggested that, based on the information provided, you consider at least the two best product categories that meet your application criteria. Individual product information can then be found on the pages that follow to help you narrow your search.

This chart should not be used to specify products without specific testing. It is recommended that you conduct on-part testing to ensure product performance before specifying any adhesive.

Henkel Adhesives and Sealants Specialists are available to assist you with new product designs, or to help you re-engineer an existing application using Loctite® brand products for improved performance and cost savings. They can also set up testing of your parts at the Henkel Customer Engineering Center. For application assistance, call 1-800-LOCTITE (562-8483) or visit www.loctite.com and select "Contact Loctite."

PERFORMANCE CONSIDERATIONS	POTTING & ENCAPSULATING COMPOUNDS			
	Hot Melts	Urethanes	Epoxies	Silicones
Benefits	Fast, large gap filling	Excellent toughness/ flexibility	Wide range of formulations	Excellent temperature resistance
Limitations	Low heat resistance	Liquid adhesive sensitive to moisture	Mixing required	Low strength
Temperature Resistance	-65°C to +125°C	-65°C to +125°C	-65°C to +180°C	-65°C to +200°C
Environmental Resistance **Polar Solvents**[1] **Non-Polar Solvents**[2]	 Good (Polyolefins, Polyamides) Good (Polyamides)	 Good Good	 Very Good Excellent	 Good Poor
Hardness	Semi-Soft	Soft	Rigid	Soft
Flexibility	High	High	Low	Very High
Tg	Low	Low	High	Very Low
PROCESS CONSIDERATIONS				
Number of Components	1	2	2	1
Cure Temperature	Room Temperature (applied at elevated temperature)	Room Temperature	Room Temperature	UV/Room Temperature
Gel Time **Average** **Fastest**	 60 seconds 10 - 20 seconds	 1 - 3 hours 15 minutes	 1 - 3 hours 15 minutes	 30 seconds 5 seconds
Full Cure Time	1 hour (or when cooled)	24 hours	24 hours	24 hours
Depth of Cure	Unlimited	Unlimited	Unlimited	Shallow (<0.375")
Dispensing/Curing Equipment Required?	Yes	Yes	Yes	Yes
Light Cure Versions Available?	No	No	Yes	Yes
For more information on each Category, refer to the following pages...	44	40, 41, 44	40, 42-44	45

[1] Examples of Polar Solvents: Water, Ethylene Glycol, IPA, Acetone.
[2] Examples of Non-Polar Solvents: Motor Oil, Gasoline, Toluene, n-Heptane, ATF.

There are a variety of Loctite® brand potting and encapsulating compounds to choose from – epoxy, hot melt, polyurethane, and silicone.

Loctite® brand potting and encapsulating compounds are designed to protect electrical components from the effects of exposure to chemicals, moisture, thermal shock, mechanical shock, and vibration. Sealing components with Loctite® brand potting and encapsulating compounds prevents corrosion and ensures long-term integrity of electrical devices.

POTTING & ENCAPSULATING

EPOXIES, POLYURETHANES, HOT MELTS & SILICONES

EPOXY & POLYURETHANE COMPOUNDS

Loctite® brand Hysol® Potting and Encapsulating Compounds are two-part epoxy and polyurethane systems formulated to offer a wide range of performance characteristics matched to specific application requirements. Any resin can be combined with any hardener within the same color region to create a mixed system.

Epoxy Resin	Key Features	Epoxy Hardener	Key Features
3140™	General Purpose	**3160™**	Glossy Surface Finish
3141™	High Temperature	**3162™**	Fast Cure
3142™	Thermally Conductive	**3163™**	Excellent Adhesion
3144™	Flame Retardant	**3164™**	General Purpose
		3165™	Low Shrinkage

Polyurethane Resin	Key Features	Polyurethane Hardener	Key Features
3172™	Low Tg Flame Retardant	**3181™**	Low Temperature Flame Retardant
3173™	General Purpose	**3182™**	Fast Cure
		3183™	General Purpose
		3184™	Flame Retardant
3174™	Doming Grade	**3185™**	Crystal Clear, Fast Cure

System Characteristics	Polyurethane Systems				
	3172™/3181™	3173™/3182™	3173™/3183™	3173™/3184™	3174™/3185™
Typical Uncured Properties					
Viscosity, cP					
Resin	200	75	75	75	350
Hardener	12,500	30,000	800	14,000	1,500
Mixed	2,500	5,500	450	2,250	1,120
Working Time					
73°F (23°C)	45-60 min. at 140 g	<7 min. at 300 g	20-40 min. at 105 g	45 min. at 300 g	6 min. at 100 g
Gel Time					
73°F (23°C)	90-120 min. at 140g	14 min. at 300 g	40-70 min. at 105 g	150 min. at 300 g	11 min. at 100 g
Cure Cycle					
Normal 73°F (23°C)	12-30 hrs.	90 min.	24 hrs.	24 hrs.	24 hrs.
Alternate185°F (85°C)	1.5-3 hrs.	30 min.	1-3 hrs.	1-3 hrs.	2 hrs.
Mix Ratio					
By Weight, Resin to Hardener	21.7:100	13:87	30:70	15:85	50:50
By Volume, Resin to Hardener	1:4	1: 5.2	1:3	1:4.8	1:1
Color					
Resin	clear dk. brown	dk. brown	clear brown	clear brown	clear white
Hardener	black	black	opaque black	opaque white	clear white
Mixed	black	black	opaque black	opaque white	clear-water white
Specific Gravity					
Resin	1.28	1.23	1.23	1.23	1.07
Hardener	1.48	1.60	0.96	1.45	1.06
Mixed	1.46	1.55	1.06	1.40	1.06
Typical Cured Properties					
Hardness, Shore A	65	75	70	80	65
Hardness, Shore OO	–	–	–	–	–
Tg, °C	-65	-10	-16	-15	–
CTE above Tg, m/mm°C	159x10e-6	128x10e-6	190x10e-6	151x10e-6	–
Typical Electrical Properties					
Dielectric Constant					
0.1 kHz	5.44	4.68	5.92	4.51	–
1.0 kHz	5.31	4.02	4.36	4.29	–
10.0 kHz	5.15	3.76	3.65	3.94	–
100.0 kHz	4.95	3.63	3.31	3.56	–
Dissipation Factor					
0.1 kHz	0.03	0.13	0.22	0.02	–
1.0 kHz	0.02	0.07	0.17	0.04	–
10.0 kHz	0.02	0.04	0.10	0.06	–
100.0 kHz	0.03	0.02	0.05	0.07	–
Insulation Resistance, ohms	1.3x10e+10	2.5x10e+13	1.1x10e+11	1.1x10e+12	–
Volume Resistivity, ohms/cm	7.03x10e+11	1.5x10e+15	6.83x10e+12	6.61x10e+13	–
Dielectric Strength, Volts/mil	325	370	375	370	–
Flammability Rating	94V-Øat1/4"	–	–	94V-Øat3/8"	–
UL File No. E106917				94V-2at1/4"	

Refer to page 44 for Hysol® package sizes and ordering information.

System Characteristics	Epoxy System 3140™					Epoxy System 3141™				
	3140™/3160™	3140™/3162™	3140™/3163™	3140™/3164™	3140™/3165™	3141™/3160™	3141™/3162™	3141™/3163™	3141™/3164™	3141™/3165™
Typical Uncured Properties										
Viscosity,cP										
Resin	11,000	11,000	11,000	11,000	11,000	80,000	80,000	80,000	80,000	80,000
Hardener	180	120	450	105	55	180	120	450	105	55
Mixed	1,700	2,000	1,500	1,500	2,000	7,000	5,000	4,000	6,000	13,000
Working Time										
77°F(25°C)	80-100 min. at 200 g	5-10 min. at 100 g	80-100 min. at 200 g	10-15 min. at 400 g	60-90 min. at 400 g	90-120 min. at 400 g	5 min. at 200 g	30-45 min. at 200 g	10 min. at 400 g	35-40 min. at 200 g
Gel Time										
77°F(25°C)	2.5-3 hrs. at 200 g	10-15 min. at 100 g	2.5-3 hrs. at 200 g	25-35 min. at 400 g	2-3 hrs. at 400 g	2.5-3.5 hrs. at 400 g	10-15 min. at 200 g	60-80 min. at 200 g	20-25 min. at 200 g	65-75 min. at 200 g
Cure Cycle										
Normal 77°F(25°C)	24 hrs.	16 hrs.	24 hrs.	16 hrs.	24 hrs./77°F +4 hrs./200°F	24 hrs.	24 hrs.	24 hrs.	24 hrs.	24 hrs./77°F +4 hrs./200°F
Alternate 150°F(66°C)	2 hrs.	1 hrs.	2 hrs.	2 hrs.	NA	4 hrs.	2 hrs.	2 hrs.	2 hrs.	NA
Mix Ratio										
By Weight	100:20	100:18.1	100:29	100:29.5	100:9	4:1	100:19.8	100:30	100:31.5	100:9
By Volume	3.1:1	3.6:1	2:1	2:1	6.5:1	2.5 :1	3:1	2:1	2:1	6.5:1
Color										
Resin	black	black	black	black	black	black	black	black	black	black
Hardener	clear	clear	clear	clear	clear	clear	clear	amber	amber	clear
Mixed	black	black	black	black	black	black	black	black	black	black
Specific Gravity										
Resin	1.64	1.64	1.64	1.64	1.64	1.61	1.61	1.61	1.61	1.61
Hardener	1.00	0.99	0.96	0.97	0.96	1.00	0.99	0.96	0.97	0.96
Mixed	1.48	1.48	1.41	1.42	1.55	1.44	1.46	1.40	1.40	1.40
Typical Cured Properties										
Hardness, Shore D	80	80	80	70	85	85	90	80	85	85
Tg, °C	27	35	20	27	67	43	75	38	31	104
CTE above Tg, mm/mm°C	130x10e-6	125x10e-6	133x10e-6	150x10e-6	119x10e-6	160x10e-6	135x10e-6	138x10e-6	111x10e-6	115x10e-5
CTE below Tg, mm/mm°C	44x10e-6	37.5x10e-6	44.9x10e-6	82.6x10e-6	36.0x10e-6	60.7x10e-6	39.7x10e-6	52.6x10e-6	49.2x10e-6	35x10e-6
Typical Electrical Properties										
Dielectric Constant										
0.1 kHz	4.43	4.25	4.61	4.2	4.87	4.30	3.91	3.58	4.11	4.28
1.0 kHz	4.37	4.20	4.37	4	4.83	4.22	3.88	3.52	3.97	4.18
10.0 kHz	4.31	4.16	4.20	3.8	4.75	4.14	3.84	3.46	3.87	4.06
100.0 kHz	4.24	4.10	4.05	3.7	4.64	4.03	3.79	3.39	3.77	3.92
Dissipation Factor										
0.1 kHz	0.008	0.010	0.040	0.08	0.003	0.01	0.01	0.01	0.02	0.01
1.0 kHz	0.008	0.011	0.027	0.04	0.007	0.01	0.01	0.01	0.02	0.02
10.0 kHz	0.010	0.012	0.026	0.03	0.011	0.02	0.01	0.01	0.02	0.02
100.0 kHz	0.014	0.013	0.023	0.03	0.014	0.02	0.01	0.02	0.02	0.02
Insulation Resistance, ohms	1.14x10e+13	2.67x10e+13	1.61x10e+12	7.5x10e+11	5.19x10e+13	5.72x10e+13	4.09x10e+13	1.23x10e+14	4.57x10e+13	2.15x10e+13
Volume Resistivity, ohms/cm	6.03x10e+14	2.53x10e+15	1.02x10e+14	1.5x10e14	2.69x10e+15	4.03x10e+15	2.61x10e+15	7.41x10e+15	2.98x10e+15	1.37x10e+15
Dielectric Strength, Volts/mil	365	385	365	410	350	375	355	385	395	365
Flammability Rating UL File No. E106917	–	–	–	UL 94HB at 1/16"	–	–	–	–	–	–
Insulation System UL File No. E106917	–	–	–	UL 1446	–	–	–	–	–	–

Refer to page 44 for Hysol® package sizes and ordering information.

System Characteristics	Epoxy System 3142™					Epoxy System 3144™				
	3142™/3160™	3142™/3162™	3142™/3163™	3142™/3164™	3142™/3165™	3144™/3160™	3144™/3162™	3144™/3163™	3144™/3164™	3144™/3165™
Typical Uncured Properties										
Viscosity, cP										
Resin	95,000	95,000	95,000	95,000	95,000	18,000	18,000	18,000	18,000	18,000
Hardener	180	120	450	105	55	180	120	450	105	55
Mixed	7,500	6,000	7,000	8,000	18,000	6,000	4,000	2,500	3,000	7,000
Working Time										
77°F(25°C)	90-120 min. at 400 g	10-15 min. at 200 g	2 hrs. at 400 g	25 min. at 400 g	80 min. at 400 g	80-100 min. at 200 g	15-20 min. at 200 g	3 hrs. at 200 g	30-40 min. at 200 g	3 hrs. at 400 g
Gel Time										
77°F(25°C)	3.5-4 hrs. at 400 g	25-35 min. at 200 g	>3 hrs. at 400 g	50 min. at 400 g	2.5 hrs. at 400 g	2.5-3 hrs. at 200 g	30-40 min. at 200 g	>5 hrs. at 200 g	60-90 min. at 200 g	6 hrs. at 400 g
Cure Cycle										
Normal 77°F(25°C)	24 hrs.	24 hrs.	48 hrs.	24 hrs.	24 hrs./77°F +4 hrs./200°F	24 hrs.	16 hrs.	24 hrs.	24 hrs.	24 hrs./77°F +2 hrs./200°F
Alternate 150°F(66°C)	4 hrs.	2 hrs.	4 hrs.	2 hrs.	4 hrs./+200°F	2 hrs.	2 hrs.	4 hrs.	2 hrs.	4 hrs./+200°F
Mix Ratio										
By Weight	100:10.7	100:9	100:10.9	100:14.3	100:4.1	100:17.5	100:13	100:16	100:21	100:6.1
By Volume	3.8:1	4.5:1	3.6:1	2.8:1	9.7:1	3.4:1	4.5:1	3.5:1	2.8:1	9.3:1
Color										
Resin	black	black	black	black	black	black	black	black	black	black
Hardener	clear	clear	amber	amber	clear	clear	clear	clear	clear	clear
Mixed	black	black	black	black	black	black	black	black	black	black
Specific Gravity										
Resin	2.40	2.40	2.40	2.40	2.40	1.68	1.68	1.68	1.68	1.68
Hardener	1.00	0.99	0.96	0.97	0.96	1.00	0.99	0.96	0.97	0.96
Mixed	1.54	1.54	1.53	1.50	1.62	1.54	1.52	1.53	1.50	1.62
Typical Cured Properties										
Hardness, Shore D	90	90	90	85	90	75	80	75	55	85
Tg, °C	26	42	30	29	84	12	25	20	15	28
CTE above Tg, mm/mm°C	104x10e-6	97.2x10e-6	96.1x10e-6	106x10e-6	87.7x10e-6	138x10e-6	138x10e-6	140x10e-6	147x10e-6	109x10e-6
CTE below Tg, mm/mm°C	29.2x10e-6	28.2x10e-6	33.5x10e-6	51.9x10e-6	26.9x10e-6	48.2x10e-6	39x10e-6	67.1x10e-6	93.4x10e-6	42.1x10e-6
Thermal Conductivity										
Watts/Meter°C	1.15	1.40	1.40	1.27	1.14	0.34	0.41	–	–	–
Typical Electrical Properties										
Dielectric Constant										
0.1 kHz	5.77	4.87	5.28	5.51	5.65	4.74	4.24	4.29	5.31	4.26
1.0 kHz	5.69	4.83	5.20	5.35	5.57	4.53	4.12	4.03	4.87	4.17
10.0 kHz	5.62	4.78	5.12	5.21	5.46	4.39	4.03	3.84	4.52	4.10
100.0 kHz	5.52	4.72	5.02	5.06	5.34	4.28	3.96	3.70	4.23	4.05
Dissipation Factor										
0.1 kHz	0.00	0.01	0.01	0.02	0.01	0.03	0.02	0.04	0.06	0.01
1.0 kHz	0.01	0.01	0.01	0.02	0.01	0.03	0.02	0.04	0.06	0.01
10.0 kHz	0.01	0.01	0.01	0.02	0.01	0.02	0.01	0.03	0.05	0.01
100.0 kHz	0.01	0.01	0.01	0.02	0.01	0.02	0.01	0.02	0.04	0.01
Insulation Resistance ohms	4.61x10e+13	5.31x10e+13	3.65x10e+13	2.75x10e+12	4.09x10e+13	5.52x10e+12	1.79x10e+13	1.60x10e+12	4.23x10e+10	3.14x10e+13
Volume Resistivity ohms/cm	3.00x10e+15	3.47x10e+15	2.55x10e+15	1.65x10e+14	2.61x10e+15	3.15x10e+14	7.97x10e+14	1.05x10e+14	2.85x10e+12	1.84x10e+15
Dielectric Strength Volts/mil	360	345	355	345	335	375	375	360	365	340
Flammability Rating UL File No. E106917	–	–	–	–	–	UL 94V-0 at 1/8"	UL 94V-0 at 1/8" -		–	–

Refer to page 44 for Hysol® package sizes and ordering information.

LOCTITE® BRAND HYSOL® PACKAGE SIZES AND ORDERING INFORMATION

Product No.	1 quart	1 gallon	5 gallon[1]	55 gallon[1]
Hysol® Epoxy Resins				
3140™	–	39944	39945	–
3141™	–	39947	39948	–
3142™	–	39950	39951	39952
3144™	–	39953	39954	–
3143™	–	–	39822	39823
Hysol® Epoxy Hardeners				
3160™	39956	–	39958	–
3162™	39960	–	39962	–
3163™	39964	–	39966	–
3164™	–	39969	39970	–
3165™	39395**	–	39974	–

[1] 5 gal. & 55 gal. are made-to-order items.
** 1 pint fill.

Product No.	1 quart	1 gallon	5 gallon[1]	55 gallon[1]
Hysol® Polyurethane Resins				
3172™	39980	–	39982	–
3173™	39984	39985	39986	–
3174™*	33954	33955	–	–
Hysol® Polyurethane Hardeners				
3181™	–	39992	39993	–
3182™	–	39995	39996	39997
3183™	–	39998	39999	–
3184™	–	39398	39397	–
3185™*	33954	33955	–	–

*3174/3185 – kit.

HOT MELT ADHESIVES

In addition to structural bonding, Loctite® brand Hysol® Hot Melt Adhesives are also well suited for fast, deep potting applications requiring large gap fills in a high speed manufacturing environment.

Loctite® 1942™ Hysol® Hot Melt Adhesive

EVA Based

Medium setting, general purpose hot melt adhesive. Excellent adhesion to wood and many plastics.

Loctite® 7901™ Hysol® Hot Melt Adhesive

Polyamide

Low viscosity polyamide used extensively for potting and encapsulating.

LOCTITE® BRAND HYSOL® HOT MELT ADHESIVES PROPERTIES CHART

PRODUCT	Item Number	Container	Color	Viscosity (cP) at Dispense Temperature	Tensile Strength (psi)	Open Time	Temperature Resistance	% Elongation	Hardness (Shore A)	Key Specifications
1942™ Hysol®	83266 83267 83268 83269 83271 83272 83273 83274 83275 83276 83277	5 lb. sample bag pellets 40 lb. carton pellets Maxistick™ sample 7 oz. bag Maxistick™ 35 lb. carton PT™ stick 35 lb. carton Ministick™ 35 lb. carton Superstick™ sample 10" 5 oz. bag Superstick™ 10" 25 lb. carton Superstick™ 4" 25 lb. carton Polyshot™ sample 12 oz. bag Polyshot™ 35 lb. carton	Tan	5,000	250	30 seconds	142°F	500	–	FDA CFR175.105
3650™ Hysol®	31302 31297	22 lb. pellets 44 lb. pellets	Light beige	2,900	305	60-80 seconds	176°F	43	87	–
3651™ Hysol®	31303	26.4 lb. squares	Beige	10,000	334	80-100 seconds	266°F	790	55	–
7809FR™ Hysol®	83388 83390 83391	5 lb. bag sample pellets Superstick™ sample 10" 13 oz. bag Polyshot™ 13 oz. bag	Amber	7,000	363	35 seconds	240°F	373	85	UL Listed for U.S.
7811™ Hysol®	83337 83339	5 lb. bag sample pellets Polyshot™ sample 13 oz. bag	Amber	6,400	400	35 seconds	266°F	1,200	–	–
7901™ Hysol®	83341 83342 83343 83344	5 lb. bag sample pellets 40 lb. carton pellets Polyshot™ sample 13 oz. bag Polyshot™ 25 lb. pail	Amber	750	260	35 seconds	300°F	80	84	–

Refer to page 27 for related Hot Melt Stick size/diameter chart.

SILICONE POTTING COMPOUNDS

Loctite® brand silicones are single-component, tough protective potting and encapsulating compounds that seal components against moisture, solvents, and environmental conditions. Loctite® brand Nuva-Sil® products cure in as little as 30 seconds to depths of .150" when exposed to UV light, while Loctite® brand RTV silicones cure in 24 hours at room temperature when exposed to atmospheric moisture.

Loctite® 5088™ Nuva-Sil® Silicone Potting Compound Light Cure Adhesive

A medium viscosity, thixotropic, non-corrosive, UV curing silicone for high speed, shallow potting of sensitive substrates.

Loctite® 5091™ Nuva-Sil® Silicone Potting Compound

High Adhesion

A low viscosity, self-leveling, UV curing silicone for high speed shallow potting, coating, and sealing applications. Provides high adhesion for difficult-to-bond substrates.

Loctite® 5092™ Nuva-Sil® Silicone Potting Compound

Non-Corrosive

A low viscosity, self-leveling, non-corrosive UV curing silicone for high speed shallow potting, coating, and sealing applications. Excellent adhesion to engineering plastics, gold, brass, and tin-plated leads.

Loctite® 5140™ RTV Silicone Potting Compound

A non-corrosive, self-leveling RTV silicone for shallow potting, sealing, and coating of devices, especially for military and industrial applications.

LOCTITE® BRAND SILICONE POTTING COMPOUNDS PROPERTIES CHART

PRODUCT	Item Number	Container	Cure Schedule (Cure/Alt. Cure)	Viscosity (cP) (mixed)	Gel Time	Hardness	Agency Approvals
5088™ Nuva-Sil®	17614 17382	300 ml cartridge 40 lb. pail	UV/moisture 60 sec. @ 40mW/cm^2	65,000	Seconds	30 shore A	–
5091™ Nuva-Sil®	17412 18074	300 ml cartridge 40 lb. pail	UV/moisture 60 sec. @ 40mW/cm^2	5,500	Seconds	34 shore A	UL Listed for U.S.
5092™ Nuva-Sil®	28354 28355	300 ml cartridge 40 lb. pail	UV/moisture 60 sec. @ 70mW/cm^2	5,800	Seconds	42 shore A	–
5140™	18120 18117 17660	85 gm tube 300 ml cartridge 40 lb. pail	Moisture 24 hrs. @ 25°C	35,000	<3 hrs. (skin over)	30 shore A	MIL-A-46146B

Indicates worldwide availability.

For technical information and/or product availability, call 1-800-LOCTITE or on the web

Visit www.loctite.com