

LOCTITE EA 9696 AERO

Epoxy Film Adhesive

(KNOWN AS Hysol EA 9696)

INTRODUCTION

LOCTITE EA 9696 AERO is a modified epoxy film adhesive designed for applications requiring both high toughness and service temperatures to 250°F/121°C. Advances in technology allow this adhesive to excel in both metal to metal and honeycomb bonding applications. Ability to cure at low temperatures; balanced flow; excellent environmental resistance; exceeds creep and fatigue requirements; and long shop out-time make it suitable for a variety of bonding applications.

FEATURES & BENEFITS

Features

- Excellent Environmental Resistance
- High Toughness Maintaining Service Temperature
- Balanced Flow
- Allows from 225°F to 265°F/107°C to 129°C Cure without Change of Properties
- Long Out-time Facilitates Shop Floor Usage and Repair Applications
- Reticulatable

Benefits

- Greater durability over the life of the production article lowers repair costs
- Widens design abilities
- Enables use of one adhesive for applications requiring toughness and 250°F performance
- Lowers clean-up costs
- Enables use of one adhesive for both honeycomb and metal to metal application
- Broadens shop processing conditions
- Lowers handling and storage costs
- Ability to be used on sound suppression assemblies

Application

Storage Life - This product requires refrigerated storage. Store @ 0°F/-18°C or below for maximum storage life. Warranty life @ 0°F/-18°C is 12 months from date of shipment. Store only in sealed containers to prevent moisture contamination. Allow all moisture to evaporate before opening for use.

Applying - Bonding surfaces should be clean, dry and properly prepared. For optimum surface preparation consult the LOCTITE Surface Preparation Guide. The adhesive film, with one liner left on it, may be tacked to the detail part for cutting to shape and size. The liner should remain with the adhesive until just before assembly of the detail to the other faying surface. This will minimize contamination of the adhesive bond. The bonded parts should be held in contact until the adhesive has cured, usually 25 to 50 psi (172 to 345 kPa) is sufficient to assure proper part mating.

Open Assembly Time - This adhesive may be used within the following schedule after removing from cold storage:

- @ 77°F/25°C at least 60 days
- @ 90°F/32°C at least 30 days

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Curing - This product may be cured for 60 to 90 minutes between 225°F to 265°F/107°C to 129°C. Heat-up rate to the cure temperature is not critical, but should be between 1° and 10°F (0.6° and 5.6°C) per minute. Pressure should be applied before heating the parts to be bonded and maintained until cool down of the assembly.

Cleanup - It is important to remove excess adhesive from the part and bonding tools before it hardens. Once the adhesive is cured, it is difficult to remove except by mechanical abrasion. Uncured adhesive may be removed with denatured alcohol or many common industrial solvents. Be careful to prevent any solvent from entering the uncured bondline as solvent will degrade the final performance. Consult with your supplier's information pertaining to the safe and proper use of solvents.

Bond Strength Performance

Metal-to-Metal Wide Area Blister Detection Strength

Wide area overlap shear strength tested per ASTM D3165-73. Adherends are 2024-T3 Bare 0.063"/1.6mm thick aluminum treated with phosphoric acid anodizing per ASTM D3933, then coated with a state of the art corrosion inhibiting primer. Adhesive cure is referenced.

Adhesive Cure Schedule		Test Temperature °F (°C)	EA 9696 .030NW	EA 9696 .060NW
			psi (MPa)	psi (MPa)
Cure ramp rate:	3°F (2°C) per min.	-67 (-55)	4608 (31.8)	4280 (29.5)
Cure Temperature:	250°F (121°C)	77 (25)	4626 (31.9)	4581 (31.6)
Dwell:	90 min. at 250°F (121°C)	176 (80)	3622 (24.5)	3472 (23.9)
Cure Pressure:	45 psi (310 kPa)	250 (121)	1902 (13.1)	1977 (13.6)
Cure ramp rate:	0.5°F (0.3°C) per min.	77 (25)	4445 (30.7)	-
Cure Temperature:	225°F (107°C)	250 (121)	2219 (15.3)	-
Dwell:	90 min. at 225°F (107°C)			
Cure Pressure:	25 psi (172 kPa)			
Cure ramp rate:	10°F (5.6°C) per min.	77 (25)	4567 (31.5)	-
Cure Temperature:	260°F (127°C)	250 (121)	2189 (15.1)	-
Dwell:	90 min. at 260°F (127°C)			
Cure Pressure:	100 psi (689 kPa)			

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Tensile Lap Shear Strength

Tensile lap shear strength tested per ASTM D1002 or EN 2243-1 after curing as shown below. Adherends are 2024-T3 AlClad 0.063"/1.6mm thick aluminum treated with phosphoric acid anodizing per ASTM D3933, then coated with a state of the art corrosion inhibiting primer.

Adhesive Cure:

- Vacuum Cure: 5.0°F/2.8°C per minute ramp rate to 250°F/121°C and held 75 minutes with 22 in-Hg/75 KPa vacuum.
- Pressure Cure: 3.6°F/2.0°C per minute ramp rate to 250°F/121°C and held for 90 minutes with 45 psi/310 kPa pressure. Vented to the atmosphere at 20 psi/138kPa pressure during pressurization at 90°F/32°C.

Sample Conditioning	Test Temperature °F (°C)	EA 9696 .030NW psi (MPa)		EA 9696 .060NW psi (MPa)
		Vacuum Cure	Pressure Cure	Pressure Cure
None	-67 (-55)	5538 (38.2)	6508 (44.9)	6778 (46.7)
	77 (25)	5048 (34.8)	5564 (38.4)	6219 (42.9)
	176 (80)	3937 (27.2)	4507 (31.1)	4754 (32.8)
	250 (121)	2507 (17.3)	2255 (15.5)	1930 (13.3)
Dry Heat 176°F (80°C) for 2000 hours	-67 (-55)	5554 (38.3)	6491 (44.8)	6702 (46.2)
	77 (25)	5020 (34.6)	5765 (39.8)	6145 (42.4)
	176 (80)	4055 (28.0)	4294 (29.6)	4741 (32.7)
Hot/Wet at 158°F (70°C) & 95% RH for 2000 hours	77 (25)	4715 (32.5)	5342 (36.8)	5633 (38.8)
	176 (80)	3059 (21.1)	3206 (22.1)	2893 (19.9)
Hydraulic Fluid Tri-n-Butyl Phosphate at 158°F (70°C) for 2000 hours	77 (25)	4695 (32.4)	4777 (32.9)	4541 (31.3)
	176 (80)	3796 (26.2)	3681 (25.4)	3530 (24.3)
De-icing Fluid at 104°F (40°C) for 2000 hours	77 (25)	4987 (34.4)	5377 (37.1)	5765 (39.8)
	176 (80)	3859 (26.6)	4018 (27.7)	4120 (28.4)
JP-8 Fuel at 77°F (25°C) for 2000 hours	77 (25)	4988 (34.4)	5645 (38.9)	6158 (42.5)
	176 (80)	4034 (27.8)	4340 (29.9)	4638 (32.0)

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Metal-to-Metal Peel Strength

Adhesive Cure: 5°F/2.8°C per minute ramp rate to 250°F/121°C and held for 60 minutes under 45 psi/310 kPa pressure. Vented to the atmosphere at 20 psi/138kPa pressure during pressurization at 90°F/32°C.

Test Property & Test Details	Test Temperature °F (°C)	EA 9696 .030NW	EA 9696 .060NW
T-Peel, lb/in (N/25mm) <ul style="list-style-type: none"> ▪ Method: ASTM D1876 ▪ Metal: 2024T-3 Bare, 0.020"/0.51mm ▪ Metal Etch: ASTM D3933 ▪ Primer: Corrosion inhibiting 	77 (25)	-	42 (187)
Climbing Drum Peel, in-lb/in (m·N/m) <ul style="list-style-type: none"> ▪ Method: ASTM D1781 ▪ Metal: 2024T-3 AlClad, 0.020"/0.51mm & 0.040"/1.02mm thick ▪ Metal Etch: ASTM D3933 ▪ Primer: Corrosion inhibiting 	77 (25)	116 (516)	142 (632)
Floating Roller Peel, lb/in (N/25mm) <ul style="list-style-type: none"> ▪ Method: ASTM D3167 (1"/25.4mm wide) ▪ Metal: 2024T-3 AlClad, 0.020"/0.51mm & 0.063"/1.6mm thick ▪ Metal Etch: ASTM D3933 ▪ Primer: Corrosion inhibiting 	77 (25)	75 (334)	71 (316)
	176 (80)	72 (320)	87 (387)

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Honeycomb Strength

Adherends are 2024-T3 AlClad 0.020"/0.51mm thick aluminum for Honeycomb Climbing Drum Peel per ASTM D1781 and 0.063"/1.6mm thick aluminum for Flatwise Tension per ASTM C297. The aluminum was treated with phosphoric acid anodizing per ASTM D3933, then coated with a state of the art corrosion inhibiting primer.

Honeycomb Core: 5052 aluminum alloy, 7.9 pcf/127 kg/m², 0.25"/6.35mm cell, 0.625"/15.88mm thick.

Adhesive Cure: 3.6°F/2.0°C per minute ramp rate to 250°F/121°C and held for 90 minutes with 45 psi/310 kPa pressure. Vented to the atmosphere at 20 psi/138kPa pressure during pressurization at 90°F/32°C.

Test Property & Method	Sample Conditioning	Test Temperature °F (°C)	EA 9696 .060NW
Honeycomb Climbing Drum Peel, in·lbs/3" (m·N/m)	None	-67 (-55)	72 (107)
		77 (25)	78 (116)
		176 (80)	68 (101)
Flatwise Tension, psi (MPa)	None	-67 (-55)	1624 (11.2)
		77 (25)	1298 (9.0)
		176 (80)	886 (6.1)
	Dry Heat 176°F (80°C) for 2000 hours	-67 (-55)	1616 (11.1)
		77 (25)	1316 (9.1)
		176 (80)	830 (5.7)

Service Temperature

Service temperature is defined as that temperature at which this adhesive still retains 1000 psi/6.9 MPa using test method ASTM D1002 and is 250°F/121°C.

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Bulk Resin Properties

Volatile Content 60 min. at 250°F (121°C)	Cured Density	Adhesive Circle Flow			Glass Transition Temperature (T _g) via DMTA (E' curve) °F (°C)		
		0.030NW	0.060NW	0.085NW	Dry	Wet ¹	Moisture Uptake
<1%	1.14 g/ml	400%	700%	950%	253 (123)	200 (93)	<3%

1. Wet conditioning at 160°F (71°C) & 98% R.H. to moisture equilibrium.

Tensile Properties - tested using 0.125 inch/3.18 mm castings per ASTM D638.

Test Temperature °F/°C	Ultimate Tensile Strength psi (MPa)	Tensile Modulus ksi (MPa)	% Elongation at Break %	Poisson's Ratio Report
-65/-55	11,070 (76.3)	324.0 (2234)	7	.460
77/25	6,839 (47.2)	277.3 (1912)	16	.361
180/82	3,841 (26.5)	148.3 (1022)	51	.394
220/104	2,528 (17.4)	55.10 (380)	61	.416
250/121	982 (6.8)	2.4 (16.5)	55	.250

Thermal Conductivity Specimens Fabricated per ASTM D 2214-70
Coefficient of Thermal Expansion Specimens Fabricated per ASTM E 831-86

	Temp. Range °C	C.T.E. μm/m°C
Coefficient of Thermal Expansion	50-90	98.4
	170-210	152.6
Thermal Conductivity	5.10 x 10 ⁻⁴ cal/cm sec°C	

Handling Precautions

Do not handle or use until the Material Safety Data Sheet has been read and understood. For industrial use only.

DISPOSAL INFORMATION

Dispose of spent remover and paint residue per local, state and regional regulations. Refer to HENKEL TECHNOLOGIES MATERIAL SAFETY DATA SHEET for additional disposal information.



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PRECAUTIONARY INFORMATION

General:

As with most epoxy based systems, use this product with adequate ventilation. Do not get in eyes or on skin. Avoid breathing the vapors. Wash thoroughly with soap and water after handling.

Before using this product refer to container label and HENKEL TECHNOLOGIES MATERIAL SAFETY DATA SHEET for additional precautionary, handling and first aid information.

Note

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