

LOCTITE EA 7000 AERO

Epoxy Film Adhesive

(KNOWN AS Hysol PL7000)

INTRODUCTION

LOCTITE EA 7000 AERO is an epoxy film adhesive for composite bonding applications. LOCTITE EA 7000 AERO is formulated to provide excellent performance properties in composite bonding, and has excellent results on composite surfaces that have been exposed to bond shop environments and may have absorbed moisture. LOCTITE EA 7000 AERO may be cured at 250°F/121°C or 350°F/177°C with service temperatures up to 300°F/150°C.

LOCTITE EA 7000 AERO also exhibits excellent fracture toughness (G1c) over composite surfaces exhibiting cohesive failure patterns indicating superior adhesion characteristics.

FEATURES

- Dual temperature cure capabilities 250°F/121°C or 350°F/177°C
- Excellent peel and -67°F/-55°C properties
- Ideal for composite co-curing and secondary bonding applications
- Excellent hot-wet resistance
- Superior out-time characteristics - maintained after 30 days @ 90°F/32°C & 50% RH

Uses

- Composite repair
- Composite surfacing
- Bonding pre-cured composite
- Co-curing with composite prepregs

Typical Technical Data	LOCTITE EA 7000 AERO
Type:	Modified epoxy film
Scrim:	Non-woven polyester
Weight:	0.030 to 0.080 psf (146 to 391 g/m ²)
Thickness:	0.005 - 0.015" (0.0127 - 0.038 cm)
Color:	Green
Width:	Standard width 36"/91 cm (Optional width 48"/122 cm)
Volatiles:	<1%
Out Time:	>30 days @ 90°F/32°C & 50% RH
Shelf Life:	>1 year at 0°F/-18°C
Gel Time (RDS):	~45 minutes when heated from 50°C at 2°C/minute, 2% strain, 10 rad/sec

LOCTITE EA 7000 AERO

Epoxy Film Adhesive

(KNOWN AS Hysol PL7000)

Performance Properties

Typical technical data and performance properties given for reference only and not for specification purposes.

TABLE 1
Composite Double Overlap Shear¹
LOCTITE EA 7000 AERO 0.050 psf (250 g/m²) with Matt Scrim

Test Temperature		Specimen Aging Prior to Test	psi	MPa
°F	°C			
-65	-55	Tested Dry	3800	26.2
75	24	Tested Dry	4500	31.0
75	24	1000 hours at 160°F/71°C & 95% RH	5300	36.6
160	71	Tested Dry	4800	33.1
160	71	14 days at 160°F/71°C & 95% RH	4800	33.1
270 ²	132	Tested Dry	1300	9.0

1. Substrate consisted of W3T282-42-F263-8 pre-cured for 2 hours at 350°F/177°C, 85 psi (586 kPa) following a heat up from room temperature of 5°F/minute (2.8°C/minute). Precision Fabrics 60,001 peel ply was used. Adhesive was cured as indicated except that the bonding pressure was 45 psi (300 kPa).
2. Substrates for 270°F/132°C double lap shear were pre-bond conditioned 168±12 hours at 75±5°F (23±2.8°C) & 55±5% RH.

LOCTITE EA 7000 AERO

Epoxy Film Adhesive

(KNOWN AS Hysol PL7000)

TABLE 2
Honeycomb Flatwise Tensile³
LOCTITE EA 7000 AERO 0.050 psf (250 g/m²) with Matt Scrim

Test Temperature		Hexcel Prepreg ⁴		Cytec Prepreg ⁵	
°F	°C	PSI	MPa	PSI	MPa
-65	-54	1050	7.2	1020	7.0
75	23	1070	7.4	940	6.5
160	71	1010	7.0	1000	6.9

TABLE 3
Double Cantilever Beam⁶
LOCTITE EA 7000 AERO 0.050 psf (250 g/m²) with Matt Scrim

Adhesive Pre-Bond Conditioning	in·lbs/in ²	J/m ²	Failure Pattern
None	4.3	758	Cohesive
30 Days at 90°F/32°C & 50% RH	4.5	793	Cohesive

- Adhesive and prepreg was co-cured for 2 hours at 350°F/177°C, 45 psi (300 kPa) following a heat up from room temperature of 5°F/minute (2.8°C/minute). Three plies of prepreg were bonded to HRP core 8.0 pcf/128 kg/m³, 0.188"/4.76 mm cell, 0.500"/12.7 mm thick.
- Hexcel W3T282(T)-42-F263-8HT/56
- Cycom 970/PWC T300 3KUT(TY) 42
- Toray P2352-19 pre-cured 2 hours at 350°F/177°C, 85 psi (586 kPa) following a heat up from room temperature of 5°F/minute (2.8°C/minute). Precision Fabrics 60,001 peel ply was used. Adhesive was cured as indicated except that the bonding pressure was 45 psi (300 kPa).

LOCTITE EA 7000 AERO

Epoxy Film Adhesive

(KNOWN AS Hysol PL7000)

TABLE 4
Single Lap Shear Strength (Composite / Composite)
LOCTITE EA 7000 AERO 0.050 psf (250 g/m²) with Matt Scrim

Test Details	Specimen Conditioning	Test Temperature		Average Test Results	
		°F	°C	psi	MPa
<u>Test Method</u> AITM 1-0019 S7 Co-bonded <u>Prepreg</u> AS4/8552 FAW 196 g/m ² Lot 064034, 11 plies <u>Peel Ply</u> Precision Fabrics 60,001	None	-67	-55	3625	25
		77	25	4060	28
		176	80	4060	28
		250	121	3335	23
		270	132	3045	21
	1000 hours at 158°F/70°C & 85% RH 2000 hours DI Water at 158°F/70°C	77	25	4495	31
		176	80	3625	25
		77	25	3625	25
		176	80	2175	15

TABLE 5
Flatwise Tensile Strength (CF Skin / HRP Honeycomb Core)
LOCTITE EA 7000 AERO 0.050 psf (250 g/m²) with Matt Scrim

Test Details	Specimen Conditioning	Test Temperature		Average Test Results	
		°F	°C	psi	MPa
<u>Test Method</u> AITM 1-0025 <u>Prepreg</u> WST-282-42" F263-8HT/56, 2 plies <u>Peel Ply</u> Precision Fabrics 60,001 & Sand <u>HRP Honeycomb Core</u> 8.0 pcf/128 kg/m ³ , 0.188"/4.76 mm cell, 0.500"/12.7 mm thick	None	77	25	1015	7
		250	121	580	4

LOCTITE EA 7000 AERO

Epoxy Film Adhesive

(KNOWN AS Hysol PL7000)

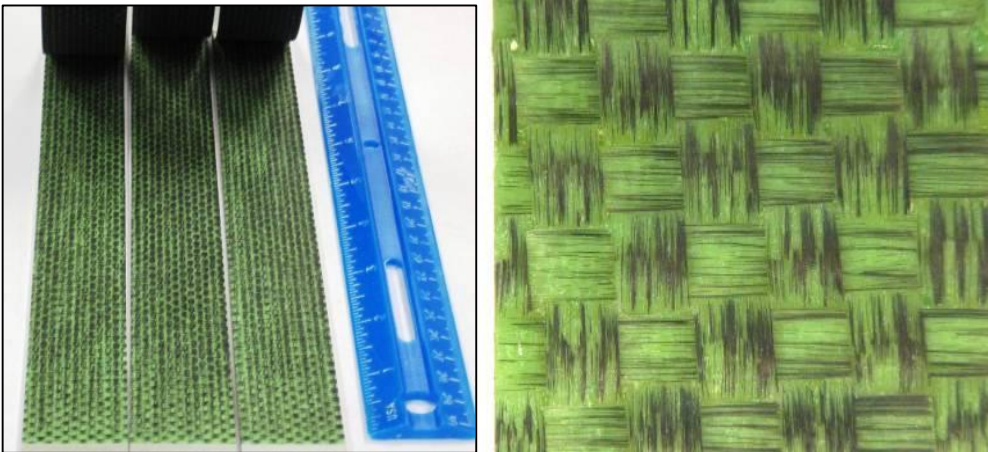
Rapid Adhesion Test

Provides a means to assess adhesion on a qualitative basis with the same reliability as the double cantilever beam (DCB) test. Is a simple modification of the climbing drum peel test where the peeling adherend has the applicable adherend and surface preparation. The RAT test specimen successfully predicts the same adhesion failure as the DCB specimen.

- The backing adherend clamped to while the peeling adherend is removed
- Report qualitative failure mode for bond quality
 - Adhesion (unacceptable)
 - Cohesive or Interlaminar Failure (acceptable)

Test Result:

LOCTITE EA 7000 AERO resulted in an interlaminar failure mode with no peel ply pattern seen at 20X magnification on both dry peel ply Precision Fabrics 60,001 & LOCTITE EA 9895WPP AERO.



LOCTITE EA 7000 AERO

Epoxy Film Adhesive

(KNOWN AS Hysol PL7000)

Compatibility Testing using LOCTITE EA 9895 Wet Peel Ply (WPP) AERO

LOCTITE EA 9895 WPP AERO is a pre-impregnated polyester peel ply product supplied in film form. It is a specially designed resin system capable of curing at 177°C (350°F). It is compatible with state-of-the-art composite prepreg resin systems and provides minimal residual peel ply fibers at the bond surface after curing and removal. No further processing steps are required prior to secondary bond operations, thus eliminating the need for sand and solvent wipe operations.

Test	Pre-cured Laminate Conditioning	Specimen Conditioning	Test Temp. °F (°C)	LOCTITE EA 9895WPP AERO		
				LOCTITE EA 9695 0.050K AERO	LOCTITE EA 795 0.050S AERO	LOCTITE EA 7000 0.050M AERO
Wide Area Overlap Shear, psi (MPa)	None	Dry	-67 (-55)	3260 (22.5)	2918 (20.1)	3078 (21.2)
			77 (25)	4591 (31.7)	3674 (25.3)	5060 (34.9)
			270 (132)	3631 (25.0)	3434 (23.7)	2468 (17.0)
BMS 8-276 Prepreg Co-bonded	Wet ¹	Dry	270 (132)	3719 (25.6)	3497 (24.1)	2699 (18.6)
	None	2000 hours at 160°F/71°C & 85% RH	270 (132)	1486 (10.2)	1206 (8.3)	938 (6.5)
Double Cantilever Beam, in-lb/in ²	None	Dry	77 (25)	2.7	2.7	3.9
	Wet ¹			2.3	2.6	3.6
BMS 8-276 Prepreg Bonded						
Honeycomb Climbing Drum Peel, in-lb/3in (m·N/m)	None	Dry	77 (25)	24 (36)	24 (36)	27 (40)
BMS 8-212 Prepreg Bonded						

- The pre-cured laminates were exposed with the peel ply attached for 24 hours at 160°F/71°C & 85% RH to achieve a bulk moisture gain of 0.60%.

LOCTITE EA 7000 AERO

Epoxy Film Adhesive

(KNOWN AS Hysol PL7000)

Application Method

Allow adhesive film to reach room temperature before opening poly bag to prevent moisture contamination. Bonding surfaces should be clean, dry and free of contamination. Remove poly liner and apply adhesive to one surface to be bonded. Just prior to bonding, remove remaining liner. The bonded parts should be held in contact until the adhesive is cured.

Curing

- 90-120 minutes at 250°F/121°C and 25-100 psi/170-690 kPa
- 60-120 minutes at 350°F/177°C and 25-100 psi/170-690 kPa
- Other cure conditions are possible.

Clean-up

Uncured adhesive may be removed effectively with ketone solvents in well-ventilated areas. Avoid contaminating uncured parts. Consult solvent container label/MSDS for proper safety and handling procedures.

Storage

LOCTITE EA 7000 AERO has a shelf life of 1 year at 0°F/-18°C and 30 days at 90°F/32°C & 50% RH.

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.

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.



LOCTITE EA 7000 AERO

Epoxy Film Adhesive

(KNOWN AS Hysol PL7000)

Note

The data contained herein are furnished for information only and are believed to be reliable. We cannot assume responsibility for the results obtained by others over whose methods we have no control. It is the user's responsibility to determine suitability for the user's purpose of any production methods mentioned herein and to adopt such precautions as may be advisable for the protection of property and of persons against any hazards that may be involved in the handling and use thereof. In light of the foregoing, **Henkel Corporation specifically disclaims all warranties expressed or implied, including warranties of merchantability or fitness for a particular purpose, arising from sale or use of Henkel Corporation's products. Henkel Corporation specifically disclaims any liability for consequential or incidental damages of any kind, including lost profits.** The discussion herein of various processes or compositions is not to be interpreted as representation that they are free from domination of patents owned by others or as a license under any Henkel Corporation patents that may cover such processes or compositions. We recommend that each prospective user test his proposed application before repetitive use, using this data as a guide. This product may be covered by one or more United States or foreign patents or patent applications.

Rev. 9/2013

Henkel Corporation Aerospace | 2850 Willow Pass Road | Bay Point, CA 94565
PHONE: +1.925.458.8000 | FAX: +1.925.458.8030 | www.henkel.com/aerospace

Trademark usage

Except as otherwise noted, all trademarks in this document are trademarks of Henkel Corporation in the U.S. and elsewhere. ® denotes a trademark registered in the U.S. Patent and Trademark Office.

The data contained herein are furnished for information only and are believed to be reliable. We cannot assume responsibility for the results obtained by others over whose methods we have no control. It is the user's responsibility to determine suitability for the user's purpose of any production methods mentioned herein and to adopt such precautions as may be advisable for the protection of property and of persons against any hazards that may be involved in the handling and use thereof. In light of the foregoing, **Henkel Corporation specifically disclaims all warranties expressed or implied, including warranties of merchantability or fitness for a particular purpose, arising from sale or use of Henkel Corporation's products. Henkel Corporation specifically disclaims any liability for consequential or incidental damages of any kind, including lost profits.** The discussion herein of various processes or compositions is not to be interpreted as representation that they are free from domination of patents owned by others or as a license under any Henkel Corporation patents that may cover such processes or compositions. We recommend that each prospective user test his proposed application before repetitive use, using this data as a guide. This product may be covered by one or more United States or foreign patents or patent applications.

