Technical Process Bulletin

# LOCTITE EA 9695 AERO
## Epoxy Film Adhesive
**(KNOWN AS Hysol EA 9695)**

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**INTRODUCTION**
LOCTITE EA 9695 AERO is a composite bonding film adhesive with excellent environmental resistance. It is suited for bonding composite structures, both for co-cure and pre-cured laminates. Its ability to cure at lower temperatures makes it suitable for repair of composite structures. Its low flow characteristics minimize prepreg resin intermingling.

**FEATURES**
- X-ray Opaque
- Excellent Environmental Resistance
- Reticulatable
- Good Pre and Post Bond Moisture Resistance
- Low Flow
- Allows 250°F/121°C or 350°F/177°C Cure
- Co-Cure with Composites
- Long Out time Facilitates Shop Floor Usage and Repair Applications

**Handling**
This product is in film form and is ready to use as received. The adhesive should be removed from cold storage and allowed to warm to room temperature (77°F/25°C). All moisture should be removed from the protective packaging before opening. The adhesive film has a protective liner(s) on it which must be removed prior to parts assembly (see "Applying" below). The liner(s) will always be a contrasting color from the adhesive to allow the user easy confirmation of removal.

**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 greater than 12 months from date of shipment. Store only in sealed containers to prevent moisture contamination. Allow all moisture to evaporate from container 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 /17 to 34 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 90 days
@ 90°F/32°C at least 45 days

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**Curing** - This product may be cured for 1 - 1 ½ hours @ 250°F/121°C or for 1 - 2 hours @ 350°F/177°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 and many common industrial solvents. Be careful to prevent any solvent from entering the uncured bondline as solvent will degrade the final bond performance. Consult with your supplier's information pertaining to the safe and proper use of solvents.

**Bond Strength Performance**
**Tensile Lap Shear Strength**
Tensile lap shear strength tested per ASTM D1002. Adherends are 2024-T3 bare aluminum treated with phosphoric acid anodizing per ASTM D3933. Adhesive cure cycle: 120 minutes @ 350°F/177°C.

**Typical Results for Film Weight**

| | 0.035 psf (171 g/m$^2$) | | 0.050 psf (244 g/m$^2$) | |
|---|---|---|---|---|
| Test Temperature, °F/°C | psi | MPa | psi | MPa |
| 77/25 | 4,600 | 31.7 | 5,000 | 34.5 |
| 250/121 | 4,400 | 30.3 | - | - |
| 300/149 | 2,900 | 20.0 | 3,400 | 23.4 |

**Double Lap Shear Strength**
Properties were measured on double overlap shear specimens of pre-cured epoxy graphite laminate. Adhesive cure cycle: 120 minutes @ 350°F/177°C.

**Typical Results for Film Weight**

| | 0.035 psf (171 g/m$^2$) | | 0.050 psf (244 g/m$^2$) | |
|---|---|---|---|---|
| Test Temperature, °F/°C | psi | MPa | psi | MPa |
| -67/-55 | 4,500 | 31.0 | 4,400 | 30.3 |
| 77/25 | 5,000 | 34.5 | 5,000 | 34.5 |
| 160/71 | 5,000 | 34.5 | 5,400 | 37.2 |
| 270/132 | 2,700 | 18.6 | 2,800 | 19.3 |

**Flatwise Tensile**

Composite to Honeycomb (co-cured). Specimen was 2" x 2" (5.1 cm x 5.1 cm) honeycomb sandwich bonds using two plies of co-cured epoxy graphite prepreg face sheets bonded to honeycomb core HRP 3/16 inch/4.76 mm cell, 0.50 inch/12.7 mm thick - 8 pcf/128 kg/m$^3$).

| | Typical Results for Film Weight | | | |
|---|---|---|---|---|
| | 0.035 psf (171 g/m$^2$) | | 0.050 psf (244 g/m$^2$) | |
| Test Temperature, °F/°C | psi | MPa | psi | MPa |
| -67/-55 | 1,000 | 6.9 | 1,000 | 6.9 |
| 77/25 | 1,000 | 6.9 | 1,200 | 8.3 |
| 160/71 | 1,000 | 6.9 | 1,200 | 8.3 |

**Short Beam Shear Performance**

Composite to Honeycomb (co-cured). Properties were obtained using 3" x 6" (7.1 cm x 15.2 cm) honeycomb sandwich bonds from a three-ply co-cured epoxy graphite prepreg face sheet bonded to honeycomb core HRP 3/16 inch/4.46 mm cell, 0.50 inch/12.7 mm thick - 8 pcf/128 kg/m$^3$. Pull rate used 4" (10.2 cm) per minute. Adhesive cure cycle: 120 minutes @ 350°F/177°C.

| | Typical Results for Film Weight | |
|---|---|---|
| | 0.050 psf (244 g/m$^2$) | |
| Test Temperature, °F/°C | psi | MPa |
| -67/-55 | 750 | 5.2 |
| 77/25 | 650 | 4.5 |
| 160/71 | 650 | 4.5 |

**Peel Performance**

Bell peel strength tested on 2024T-3 bare aluminum adherends treated with phosphoric acid anodizing per ASTM D3933. Cure cycle: 120 minutes @ 350°F/177°C.

| | Typical Results | |
|---|---|---|
| Test Temperature, °F/°C | lb/in | N/25mm |
| 77/25 | 20 | 89.6 |

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**Environmental Conditioning**
Composite specimens for Flatwise Tensile were co-cured using a 120 minute cure @ 350°F/177°C with a heat up rate of 3° to 5°F (1.8° to 3°C) per minute. Autoclave pressure was 45 psi/310 kPa during cure cycle. Pre-cured laminates for double overlap shear used the same cure with the exception of 85 psi/585 kPa pressure.

| Test Property | Environmental Conditioning | Test Temperature, °F/°C | Typical Results 0.050 psf (244 g/m$^2$) psi | MPa |
|---|---|---|---|---|
| Composite Double Lap Shear Strength | Dry | 77/25 | 5,400 | 37.2 |
| | 1000 hour soak @ 160°F/71°C & 100% RH | | 4,400 | 30.3 |
| | Dry | 160/71 | 5,400 | 37.2 |
| | 1000 hour soak @ 160°F/71°C & 100% RH | | 3,900 | 26.9 |
| Composite Flatwise Tensile Strength | Dry | 160/71 | 1,200 | 8.3 |
| | 1000 hour soak @ 160°F/71°C & 100% RH | | 850 | 5.9 |

**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 >300°F/149°C.

**Bulk Resin Properties**
**Glass Transition Temperatute (Tg) -** Tg, measured by dynamic mechanical analysis, is taken at the knee of the G' curve.

| Tg Dry | Result |
|---|---|
| Cured 1 hr. @ 250°F/121°C | 252°F/122°C |
| Cured 1 hr. @ 350°F/177°C | 302°F/150°C |

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### 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.

### 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.

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