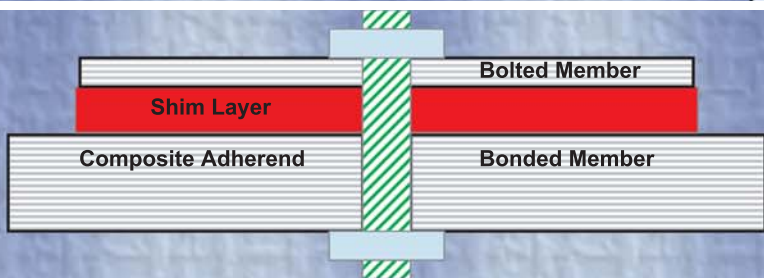


Liquid Shims



for Aerospace Composites



Hysol® Liquid Shims

Description – Liquid shims are epoxy-based materials that possess extremely high compressive strengths. The function of a shim material is to eliminate gaps and differences between two composite parts. Since composites do not lend themselves to grinding and fitting methods commonly used in metal fabrication, shims both in solid and liquid form are used to eliminate gaps. For gaps wider than 3 millimeters, solid shims made out of thermoset plastic or prepreg are used. For gaps less than 3 millimeters, or for wide area fit up, liquid shims are employed. Liquid shims from Hysol represent custom filled epoxies that provide not only high compressive strength, but also a balance between open assembly time and green strength.

Aerospace Applications – Common usage of a liquid shim is found in a composite rib-to-skin assembly. Liquid shims are spread on one side of the rib, squeezed together and bolted. This forces any excess shim material to be squeezed out leaving just the necessary amount of shim to bridge any gaps occurring in the manufacturing process. If the assembly is going to be inspected, users place a film layer that is resistant to bonding. This allows the shim to cure after squeeze-out and the ability remove either the skin or rib side to see if any gaps exist.

Key Features – The key features when selecting a liquid shim material involve outtime, compressive strength, resistance to cyclic fatigue, and optimal viscosity for applying to vertical surfaces. Longer outtimes allow the assembly of larger components and also aid in clean up of unused material. Too long an outtime, however, interferes with production flow, as the shim needs time to reach green strength. Green strength is the when the shim develops approximately 1000 psi strength, which is a measure of when a part is safe to move without disrupting the adhesive.

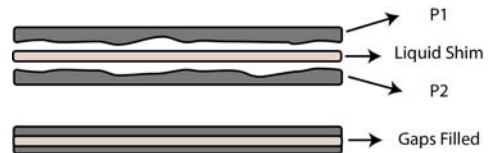
PRIMARY SHIM MATERIALS

Property	Hysol EA 934NA	Hysol EA 9394	Hysol EA 9377
	1 st Generation	2 nd Generation	3 rd Generation
Relative Compressive Strength at 77°F/25°C	9,500 psi / 65.5 MPa	10,000 psi / 68.9 MPa	16,000 psi / 110.2 MPa
Outtime – 450 gram mass	40 minutes	90 minutes	15 minutes
Thin Film Outtime ⁽¹⁾	TBD	TBD	TBD
Drill Time ⁽²⁾	N/A	7.5 hours	6.5 hours
Maximum Temp for 8000 psi @ 2% offset ⁽³⁾	TBD	>150°F / 66°C estimated	220°F / 104°C
Packaging Options	6 oz. Semkits	4:1 volumetric or 6 oz. Semkits	6 oz. Semkits

- (1) Thin film outtime is a function of pot life and is determined either by viscosity measurement or actual squeeze out under a defined load. Thin film outtime is typically longer than a mass outtime due to the heat sink of the substrate and the spreading of the epoxy mass.
 (2) Drill time is typically where the adhesive develops between 750-900 psi tensile lap shear strength. Drill time is also an indication of when a part can be removed from a fixture without disrupting the bondline adversely to perform secondary operations.
 (3) Maximum temperature is a mechanical determination of a shim's potential service temperature.

Hysol EA 9394 – 2nd Generation

- Operates as both an adhesive and shim
- Features resistance to microcracking after slightly less than 1000 thermocycles
- Long out time to facilitate larger parts
- Good compressive strength across wide temperature range
- Qualified at most commercial aircraft OEMs



Hysol EA 9377 – 3rd Generation

- Features resistance to microcracking after 2000 thermocycles
- Optimized to match CTE difference on composite substrates, CTE 60x10⁻⁶
- Highest compressive strength
- Qualified to Boeing BMS 8-338

ALTERNATIVE SHIM MATERIALS

Property	Hysol EA 9394.2	Hysol EA 9360	Hysol EA 9395
Primary Feature	Short pot life for small parts, fast part flow, lower service temperature	Toughened material, with good balance of moderate temperature performance and work life	Similar to Hysol EA 9394, with non-metallic fillers
Compressive Strength 2% offset 77°F/25°C	7,745 psi / 53 MPa	N/A	14,000 psi / 97 MPa
Outtime – 450 gram mass	15-20 minutes for 100 gram mass	50 minutes for 200 gram mass	90 minutes
Drill Time	<4 hours	<5 hours	7.5 hours
Packaging Options	Bulk quarts (pudding cups as alternative)	2:1 volumetric kits and Semkits	6 oz. Semkits

New Developments – A new shim material has been developed that combines the open assembly time of Hysol EA 9394 with the micro-cracking resistance of Hysol EA 9377. The product also provides green strength within 8 hours, improving production flow in a standard production shift. This product is available for sampling and is now called LP 30206.2. Upon scale up, it will be given a production name, such as Hysol EA 9377.1.

