



LOCTITE EF 9899 AERO

Expanding Syntactic Film

(KNOWN AS SynSpand® 9899)

INTRODUCTION

LOCTITE EF 9899 AERO is a 250°F/121°C or 350°F/177°C curing expanding syntactic film. LOCTITE EF 9899 AERO expands using a unique closed cell process, providing for a completely homogenous cell structure. LOCTITE EF 9899 AERO applications include honeycomb core stabilization, edge close out, RTM core and many others.

FEATURES

- Unique Closed Cell Expanding Film Technology
- Capable of Expanding Over 650%
- Homogeneous Cell Structure
- Co-curable
- 250°F/121°C or 350°F/177°C Cure
- Density/Strength May Be Tailored by Limiting Volume Available for Expansion Supplied as a 1 ft x 2 ft (.30 m x .61 m) Sheet of Controlled Areal Weight and Thickness

Applications

- Core Stabilization
- Edge Close Out
- RTM Core Applications
- Filling Core in Closed Mold Operations
- Stiffening of Composite Structure

Handling

This product is supplied in 1' x 2' (.30m x .61m) sheets in a weight of 0.130 psf/635 g/m², approximately 25 mils/0.63 mm thick, and is ready to use as received. Material should be removed from cold storage and allowed to warm to room temperature before removing the protective packaging. This material has protective liners on it, which must be removed prior to part assembly. The liners will always be a contrasting color from the material to allow the user easy confirmation of removal.

Expanding Syntactic Film physical performance properties are dependent upon cured density. The following charts indicate performance values that can be expected for LOCTITE EF 9899 AERO at a given cured density. Use the chart data to determine the density required to obtain suitable performance for your application.

LOCTITE EF 9899 AERO may be plied up to any desirable mass before curing. If expanding onto a closed mold, the number of plies will determine the cured density. The following equation is a guide for determining the density for a given number of plies, P, expanded to a given height (inches) in a closed, parallel plate mold.

$$(P \times 1.4) / H = \text{Density lbs/ft}^3$$





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If using autoclave pressure to control expansion, the number of plies will have little effect on final density. The dominant variables determining density will be the applied autoclave pressure and the maximum autoclave cure temperature.

Suggested Acceptance Tests for Certification

<u>Test</u>	<u>Typical Values</u>	<u>Test Method</u>
Areal Weight	.13 psf/635 g/m ²	10 in x 10 in Square
DSC	Match Standard	
Cured Density per ASTM D2320	Minimum 6 pcf / Maximum 10 pcf	0.4 in x 0.2 in cured block*

* Press cured at 100 psi @ 285°F/141°C for 1 hour. Two plies in mold 0.4 inches in height by 10 in x 10 in.

Application

Storage - LOCTITE EF 9899 AERO requires refrigerated storage. Store @ 0°F/-18°C or below for maximum storage life. Shelf life @ 0°F/-18°C or below is 12 months. Store in sealed bag. Allow adequate time for the container to warm to room temperature before opening for use. Ambient temperature shipment of samples will be sufficient for durations of less than 7 days.

Applying - LOCTITE EF 9899 AERO is a pliable film with tack and drape. It can be cut to any desired shape using ordinary razor knives or scissors. Razor knives using templates as guides work best. After cutting the material, the user can remove the product liners by peeling them back from a corner.

Open Assembly Time - 15 day working life @ 77°F/25°C.

Curing - LOCTITE EF 9899 AERO may be cured for one hour @ 250°F/121°C and, if desired, post cured for one hour @ 350°F/177°C. See Processing Guidelines for detailed instructions on lay-up and cure.

Expansion - LOCTITE EF 9899 AERO is capable of expanding in excess of 650%. The magnitude of expansion is controlled by applied cure pressure or the volume of a closed mold. The recommended method of expansion uses a closed mold.

Cleanup - Little cleanup should be required. However, uncured material may be removed effectively with ketone solvents in well ventilated areas. Saturate cloth or industrial wipes with solvent and apply just enough to do the job. Avoid contaminating uncured parts with spray or spillage. Wear respirators equipped with organic vapor cartridges, impervious rubber gloves, and mono goggles when handling solvents. Consult solvent container labels for skin and flame warnings.

Typical Physical Performance Properties

Typical Uncured Properties

Density (ASTM D792):	55 lbs/ft ³ (0.88 g/cc)
Pliable and drapable @ 77°F/25°C	
15 day working life @ 77°F/25°C	
Areal weight @ 25 mils:	0.130 psf/635 g/m ²



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Typical Cured Properties

Density range (ASTM D792): 7.5 to 25 lbs/ft³ (0.12 to 0.40 g/cc)

Outgassing

	<u>Total Weight Loss</u>	<u>Volatile Condensable Materials</u>
Cured 2 hours @ 250°F/121°C	1.32%	0.35%
Postcured 1 hour @ 350°F/177°C	0.65%	0.18%

Processing Guidelines

LOCTITE EF 9899 AERO may be cured into any closed cavity or mold. A typical example is curing into honeycomb core. The following details lay-up and cure parameters, which will optimize the successful use of LOCTITE EF 9899 AERO.

Quantity Calculation

Figure 1 indicates the number of plies of LOCTITE EF 9899 AERO 25 mil/0.63 mm film required to fill a mold of specified height to achieve a targeted cured density. For example, a 1 inch high cavity will require 14 plies of 25 mil/0.13 psf LOCTITE EF 9899 AERO to achieve a 1 inch cured foam with a density of 20 pcf. Alternatively, the following calculation yields the same information for any cavity height:

$$\text{Number of plies required} = (\text{Cavity height (inches)} \times \text{Target cured density (pcf)}) / 1.4$$

Lay-up Procedure

Closed Mold Lay-up

Expanding syntactic film is cut to fit the X and Y dimensions of the mold or cavity. Molds may be constructed of metal or any stiff material, which retains its shape under pressure. The plies are stacked together and placed inside the mold. Air paths connecting the interior and exterior of the mold, such as those afforded from glass cloth or strings or porous armalon are recommended to ensure complete expansion of the expanding syntactic film within the cavity. If the expanding syntactic film is not intended to bond to the mold, pre-treat the mold with an appropriate release agent.

Honeycomb Core Filling

Honeycomb sandwich structures reinforced with expanding syntactic film are processed by either one-step (co-cure) or two-step processes described below:

General Co-cure Lay-up Procedure

1. Lay down initial plies of prepreg and adhesive (if applicable).
2. Place lightweight glass cloth as a bleed path for evacuation of air in the core.
3. Place honeycomb core down.
4. Lay down the appropriate plies of expanding syntactic film on top of the core.
5. Place top prepreg plies and adhesive (if applicable) on top of the expanding syntactic film.
6. Place caul plate on top of assembly.
7. Bag the part and pull vacuum, and cure.

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Co-cured structures use the skins of the sandwich structure to confine the expanding syntactic film to the honeycomb cavity during cure. The expanding syntactic film plies are either placed between the honeycomb and adhesive layers of the assembly, or are imbedded into the core using a debulking, or pressing, step. Slight heat (<100°F/38°C) facilitates impregnation. For very thick cores, imbedding is recommended, as this aids the filling operation. For solid skin structures, an air path, such as a lightweight glass cloth, is highly recommended between the honeycomb and adhesive layers to aid air evacuation from the core during cure.

Alternatively, expanding syntactic film may be expanded and cured into a honeycomb core prior to skin bonding or other operations. This process is similar to co-curing, except that the honeycomb face sheets are non-bondable pressure plates which confine the expanding syntactic film expansion to the honeycomb cells. After expansion, the face sheets can be bonded to expanding syntactic film-filled honeycomb standard processes.

Curing - Assemblies containing expanding syntactic film may be cured via autoclave, oven or press techniques. Heat-up rate, cure temperature and pressure are all factors which influence the expansion of expanding syntactic film.

Vacuum bag processing provides the most effective means for curing expanding syntactic film assemblies. Parts containing expanding syntactic film are vacuum bagged and cured via standard techniques. Bleeder plies connect mold interiors to the vacuum source.

Vacuum bagging provides external force to restrain expansion, and is most effective when combined with autoclave curing. Pressure from the autoclave ensures part configuration is retained. Vacuum pressure during autoclave cure is not necessary. Oven processing is a viable alternative when an autoclave is not available. Vacuum pressure must be maintained during an oven cure.

Heat-Up and Cure Temperature

Heat-up rates of between 2°F to 8°F (1°C to 4°C) are recommended for curing expanding syntactic film. Cure may be accomplished between the temperature range of 250°F to 350°F (121°C to 177°C). For vacuum bag and autoclave cures, comparing heat up rates, faster heat up rates will yield lower cured density parts. Hot oven processing is only recommended when processing relatively thin structures. Care should be taken when curing thick structures containing expanding syntactic film to avoid potential exothermic conditions. Generally, slow heat rates and lower cure temperatures will minimize excessive heat build-up in parts.

Pressure Guidelines

Cured expanding syntactic film densities of 15 pcf or lighter can be accomplished with vacuum bag pressure. Cured densities greater than 15 pcf are best fabricated by autoclave or press processes. The robust character of expanding syntactic film expansion requires significant restraint (up to 100 psi) when high cured densities (e.g. >25 pcf) are desired. Tailoring both the heat rise and cure pressure is often successful in producing cured expanding syntactic film parts with the desired features.



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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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