



SynSpand® 9899.1CF

Expanding Syntactic Film

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Description

SynSpand 9899.1CF is a low exotherm closed-cell expanding syntactic film suitable for honeycomb core filling applications. The typical cured density range for SynSpand 9899.1CF is 23 to 37 pcf (0.37 to 0.59 g/cc). The low exotherm chemistry makes this product ideal for deep core fill. High compressive strength provides potential for some structural applications.

This data sheet provides typical values, users developing material specifications should request the SynSpand 9899.1CF Model Specification. For application guidelines and processing instructions, users should refer to the SynSpand 9899.1CF Product Guide. In addition, Henkel has developed a PC-based computer model that allows users to optimize cure parameters before shop floor implementation.

Features

- Patented Closed Cell Expanding Film Technology
- Capable of Expanding Over 200%
- Homogeneous Expansion
- 250°F to 350°F (121°C to 177°C) Cure
- Density/Strength Easily Tailored by Ply Addition
- Provided in Controlled Areal Weight and Thickness
- Wide Processing Window

Applications

- Core Splicing
- Core Stabilization
- Honeycomb Edge Close Out
- Syntactic Paste Replacement
- Localized Stiffening of Composite Structure
- Deep Core Fill - Four inches+
- May Serve as Core in Composite Structure

Handling

This product is supplied in 1 ft x 2 ft (0.30 m x 0.61 m) sheets in a thickness of approximately 100 mils/2.5 mm and 50 mils/1.25 mm or in roll stock 18 inches wide by 25 lineal feet (45.7 centimeters wide by 7.6 lineal meters), 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.

Application

Storage - SynSpand 9899.1CF 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 duration of less than 7 days.

Applying - SynSpand 9899.1CF 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 - SynSpand 9899.1CF may be cured for one hour @ 250°F/121°C and, if desired, post cured for one hour @ 350°F/177°C. It can also be cured @ 350°F/177°C with a 2°F to 5°F (1.1°C to 2.8°C) temperature ramp from ambient. See Processing Guidelines for detailed instructions on lay-up and cure.

Expansion - SynSpand 9899.1CF is capable of expanding in excess of 200%. The magnitude of expansion is controlled by applied cure pressure, heat up rate, or the cavity 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.

Henkel QC Acceptance Testing

This data sheet provides users with typical properties obtained from this adhesive. These values are not meant to be used to develop aerospace QC acceptance testing. Users interested in establishing values and tests for routine QC acceptance should request our internal specification (DAS) which provides detail test methods and values used to certify this adhesive.

Typical Physical Performance Properties

Typical Uncured Properties

Density (ASTM D792),	45.5 lbs/ft ³	0.73 g/cc
Pliable and drapable at 77°F/25°C		
15 day working life at 77°F/25°C		

Typical Areal weight @ 50 mils/1.25 mm	0.19 psf	931 g/m ²
Typical Areal weight @ 100 mils/2.5 mm	0.38 psf	1,862 g/m ²

Typical Cured Properties

Density range (ASTM D792)	23 - 37 lbs/ft ³	0.37 to 0.59 g/cc
Volatiles	1.5%	
Exotherm temperature with 350°F/177°C cure	351°F	177°C

Typical Expansion Ratio

1°F/.5°C heat rise per minute to 250°F/121°C	1.8:1
5°F/3°C heat rise per minute to 350°F/177°C	5.0:1

Free Expansion (3D)

Typical Mechanical Properties

Block Compressive Strength

Block compressive strength was determined via ASTM D695 procedures using ultimate compression strength or strength at 2% load, whichever came first, on cured SynSpand 9899.1CF. Cured SynSpand panels were fabricated using process techniques described in the Processing Guidelines section of this data sheet. Cure was accomplished in a hydraulic press under 65 psi/0.45 MPa cure pressure for 60 minutes @ 350°F/177°C.

Compressive Block Dimensions - tested in expansion direction

Compressive Block Dimensions SynSpand 9899.1CF

0.5 in x 0.5 in x 0.5 in (12.7 mm x 12.7 mm x 12.7 mm)

<u>Test Condition</u>	<u>23 pcf/0.37 g/cc</u>		<u>Nominal Density</u>		<u>37 pcf/0.59 g/cc</u>	
	psi	MPa	psi	MPa	psi	MPa
77°F/25°C	1,000	6.9	1,900	13.1	6,200	42.8
180°/82°C	800	5.5	1,400	9.7	4,500	31.1

Beam Shear - Core used - 0.5 in, 8 pcf, 3/16 in cell HRP, face sheets - 0.125 in 7075-T6 bare aluminum, PAA etched, primed with BR127 adhesive-Hysol EA 9689 0.10 psf (490 g/m²).

<u>Test Condition</u>	<u>Nominal Density</u>	<u>SynSpand X9899CF</u>		<u>SynSpand 9899.1CF</u>	
		psi	MPa	Psi	MPa
77°F/25°C	26 pcf/0.42 g/cc	2,100	14.5	2,050	14.1

Notched Compressive Shear - Specimens were 0.5 inch/12.7 mm inch thick neat castings without face sheets, cured one hour @ 350°F/177°C. Specimens were notched, and then tested in compression.

Notched Compressive Shear

0.5 in x 0.5 in x 3.15 in (12.7 mm x 12.7 mm x 80 mm)

<u>Test Condition</u>	<u>23 pcf/0.37 g/cc</u>		<u>Nominal Density</u>		<u>37 pcf/0.59 g/cc</u>	
	psi	MPa	psi	MPa	psi	MPa
77°F/25°C	600	4.3	1,200	8.3	2,900	20.0
180°/82°C	450	3.1	1000	6.8	2200	15.4

Tube Shear Strength - Specimens were 5052 drawn aluminum, PAA per ASTM D3933 and cured at one hour @ 350°F/177°C.

<u>Test Condition</u>	<u>22 pcf/0.35 g/cc</u>		<u>Nominal Density</u>		<u>37 pcf/0.59 g/cc</u>	
	psi	MPa	psi	MPa	psi	MPa
-67°/-55°C	550	3.8	850	5.9	3,100	21.7
77°F/25°C	525	3.6	800	5.5	2,800	19.2
275°F/125°C	290	2.0	700	4.8	1,100	7.6
1000 hr/85% RH at	600	4.1	600	4.1	1,800	12.4
160°F/70°C						

Environmental Soaks - compressive blocks

0.5 in x 0.5 in x 0.5 in (12.7 mm x 12.7 mm x 12.7 mm)

<u>23 pcf/0.37 g/cc Density</u>	<u>psi</u>	<u>MPa</u>
Initial, pre-exposure	1,000	7.0
14 days @ 160°F/71°C, 95% RH**	850	5.9
7 days @ 77°F/25°C, Skydrol	1,000	7.0
7 days @ 77°F/25°C, Jet Fuel	1,000	7.0
15 min, degreasing fluid vapors	1,000	7.0

37 pcf/0.59 g/cc Density

Initial, pre-exposure	6,200	42.6
14 days @ 160°F/71°C, 95% RH	5,000	34.5
7 days @ 77°F/25°C, Skydrol	6,200	42.6
7 days @ 77°F/25°C, Jet Fuel	6,200	42.6
15 min, degreasing fluid vapors	6,200	42.6

**SynSpand is a foamed product, and as such, under water immersion or saturating humidity, moisture gains of more than 15% may occur at the lower densities after immersion for 2,500 hours. However, during normal flight thermocycling from -67°F to 160°F (-55°C to 71°C), this moisture effect is reversed and SynSpand maintains typical epoxy weight gains of 1.5%. No significant degradation in typical mechanical properties or microcracking has been observed.

Processing Guidelines

SynSpand 9899.1CF 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 for the successful use of SynSpand 9899.1CF.

Quantity Calculation

The formula described herein provides the number of plies of SynSpand 9899.1CF 100 mil/2.5 mm film required to fill a mold of specified height to achieve a targeted average cured density.

For example, a 1 inch high (25.4 mm) cavity will require 6 plies of 100 mil/2.5 mm SynSpand 9899.1CF to achieve a 1 inch (25.4 mm) cured foam with an average cured density of 27 pcf.

$$((1 \text{ inch core height} * .083) * 27 \text{ pcf}) / .38 \text{ pcf} = 5.9 \text{ plies of 100 mil (round up to nearest whole number)}$$

The following calculation yields the same information for any cavity height:

$$\text{Number of plies required} = \frac{\text{Cavity height (ft)} \times \text{Target cured density (pcf)}}{\text{areal weight}}$$

*Target cured density must be within 23 - 37 pounds per cubic foot for formula to be valid. Round up to nearest whole number.

Lay-up Procedure

Closed Mold Lay-up

SynSpand 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 SynSpand within the cavity. If the SynSpand 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 SynSpand 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 SynSpand on top of the core.
5. Place top prepreg plies and adhesive (if applicable) on top of the SynSpand.

6. Place caul plate on top of assembly.
7. Bag the part and pull vacuum, and cure.

Co-cured structures use the skins of the sandwich structure to confine the SynSpand to the honeycomb cavity during cure. The SynSpand 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, SynSpand 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 SynSpand expansion to the honeycomb cells. After expansion, the face sheets can be bonded to SynSpand-filled honeycomb standard processes.

Curing

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

Vacuum bag processing provides the most effective means for curing SynSpand assemblies. Parts containing SynSpand 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°F to 4°C) on the leading and lagging part thermocouples are recommended for curing SynSpand. It is important that the heat-up rate is controlled by measuring the part temperature and not the oven temperature. Cure may be accomplished between the temperature range of 250 - 350°F/121 - 177°C. For vacuum bag and autoclave cures, comparing heat-up rates, faster heat-up rates will yield lower cured density parts. Care should be taken when curing thick structures containing SynSpand to avoid potential exothermic conditions. Generally, slow heat rates and lower cure temperatures (250°F/121°C) will minimize excessive heat build-up in parts. Low temperature step curing (250°F/121°C) prior to cure at 350°F/177°C is recommended with thick structures >1.5 inch/4 cm and/or when more than eight 100 mil plies of SynSpand are used.

Pressure Guidelines

Cured SynSpand densities of 23 pcf (0.37 g/cc) can be accomplished with vacuum bag pressure. Cured densities, however, are best controlled by autoclave or press processes. Cured SynSpand structures exceeding 25 pcf (0.40 g/cc) usually require cure pressures of 45 psi or greater. Tailoring both the heat rise and cure pressure is often successful in producing cured SynSpand parts with the desired features.

Handling Precautions

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

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. Empty containers retain product residue and vapors, so obey all precautions when handling empty containers.

ONE PART

CAUTION! This material may cause eye and skin irritation or allergic dermatitis. It contains epoxy resins.

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Users should review the Materials Safety Data Sheet (MSDS) and product label for the material to determine possible health hazards, appropriate engineering controls and precautions to be observed in using the material. Copies of the MSDS and label are available upon request.



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