



ClaveCore™ Film HT

ClaveCore Film HT technology allows for specialized composite geometries to be formed Out Of Autoclave (OOA) or outside of a lamination press. ClaveCore film technology is based on ClaveCore bulk mandrel technology. When heated, ClaveCore materials self-pressurize when confined inside a tool. The ClaveCore Film HT film pressure can be used to produce an aerospace grade laminate (<1% voids). After the composite cure cycle, it can be easily removed. Its high temperature capability can assist the processing of **high temperature thermosets and thermoplastics**.

ClaveCore Film HT key properties:

- Expands and self-pressurizes when heated
- Temperature-Pressure-Volume Expansion Models Exist
- Pressures up to 700psi are possible depending on grade / process requirements
- Produces precision OML dimensions
- Produces high surface quality
- Bendable/Conformable when applied to tooled surface
- Bendable/Collapsible to aid removal allowing zero/negative draft
- Allows for complex, seamless (unbounded) structures
- Designed for >250°C (480°F) applications (thermoset or thermoplastic)





Figure 1, ClaveCore film in sheet form (4x12”).



Figure 2. ClaveCore Film HT application demonstration. Film easily conforms around 90° corner.



Figure 3. Carbon-PPS composite brackets produced via ClaveCore Film HT.



ClaveCore Material Selection & Process Design

In selecting the right grade of ClaveCore, one must consider:

1. Process Cure temperature
2. Target Pressure
3. Final Composite thickness
4. Typical mandrel cross section width

Using this information, one can select the grade that has the best combination of:

Pressure - Temperature - % Volume Expansion Behavior

Pressure and Temperature requirements are typically specified by the composite supplier. Volume requirements are driven by the mandrel sizing requirements and the composite thickness (before cure and after cure). Increasing volumetric expansion decreases the pressure achieved. Figure 4 shows the Pressure-Temperature-Volume behavior for ClaveCore Film HT-A . A list of existing grades and typical properties are shown in Table 1 and Table 2.



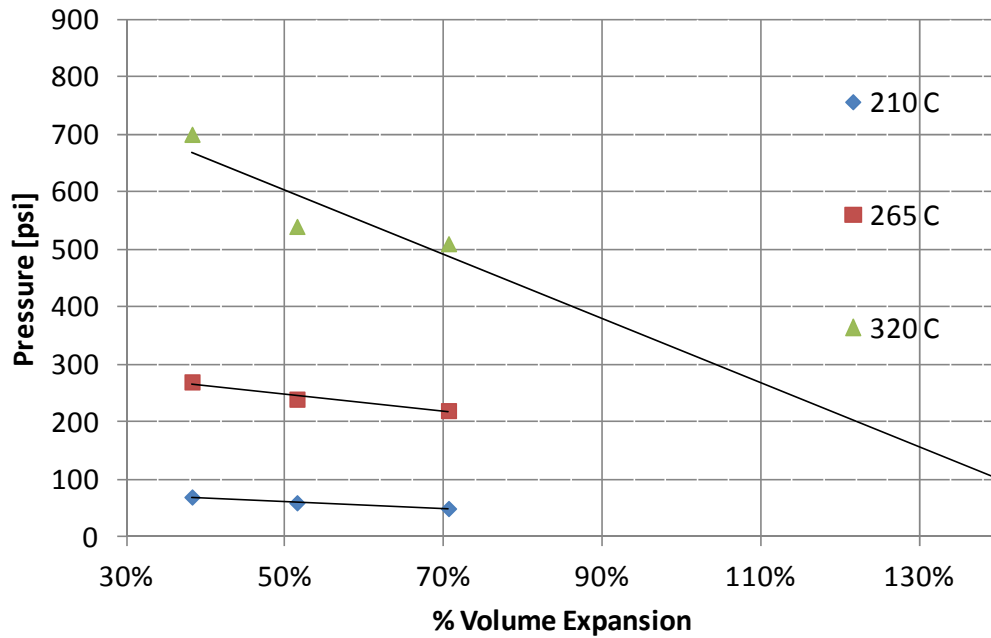


Figure 4. Pressurization of ClaveCore Film HT-A as a function of temperature and expansion.



Table 1. Typical properties and attributes of ClaveCore Film tooling systems.

Tooling System	Complexity	Tolerances [in]	**Peak Pressure [psi]	Composite Processing Window [°F]	Density [g/cm ³]	Compressive Strength [psi]	CTE [ppm/°C]
ClaveCore Film HT-A	High	Female tool limited	700	>480	1.0-1.2	NA	NA

*Under development

**Variable depending on grade, geometry, and process conditions

Table 2. ClaveCore Film HT grades and expansion behavior.

		Peak Pressure Examples [psi]							
		[40% Expansion]		[50% Expansion]		[70% Expansion]			
Commercial Grade	Min T [°C]	Min T [°F]	210°C	320°C	210°C	320°C	210°C	320°C	*Pressurization Model
ClaveCore Film HT-A	~250	480	70	700	60	540	50	510	$P(T,V\%) = (-4.5059 * T + 937.74) * V\% + 7.1651 * T - 1466.3$

*Pressurization Model Notes: T=°C, V%=Volume Expansion (Enter 50% expansion as “0.50”)

*Greater expansion ratios than those listed are also possible.