



POLYMER-TO-CERAMIC™ TECHNOLOGY

Engineering Appendix: Cure and Pyrolysis Processing of Starfire Systems Polymers

Table 1: Press Mold Conditions to Cure SPR-684, SPR-688, SPR-212, and SPR-036 based Laminates

Temperature	Condition	Pressure
RT – 85 °C +/- 5 °C	Heat platens at maximum rate	None
Load Part	---	Apply Pressure to ‘Touch’
85 °C – 140 °C	Ramp Heat at 3.0 – 5.0 °C/min	Apply Pressure to ‘Touch’
140 °C – 300 °C		Maximum Pressure
300 °C +25/-0 °C	Hold for 60 minutes +60/-0 minutes	Maximum Pressure
300 °C – 40 °C (maximum)	Cool at maximum rate	Maximum Pressure

Table 2: Press Mold Conditions to Cure SBMC-601, SBMC-843 molding compound

Temperature	Condition	Pressure
RT – 65 °C +/- 5 °C	Heat tool at maximum rate	None
Tool Temp – 250 °C	Ramp Heat at 2.5 – 3.0 °C/min	Maximum pressure to reach target thickness
250 °C +/- 5 °C	Hold for 30 +/- 5 minutes	
250 °C – RT	Cool at maximum rate	Maximum pressure

These conditions are to be treated as processing guidelines, and may not be optimized for unique applications.



POLYMER-TO-CERAMIC™ TECHNOLOGY

Table 3: Furnace Conditions to Pyrolyze SMP-10, SMP-730, SMP-877, SBMC-601, SBMC-843, SPR-684, SPR-688, SPR-212, and SPR-036 based Laminates/Composites

Temperature	Condition	Hold	Atmosphere
RT – 100 °C	1.0 °C/min	30 min	Inert; nitrogen or argon Positive flow, atmospheric pressure
100 °C – 200 °C	1.0 °C/min	60 min	
200 °C – 300 °C	1.0 °C/min	30 min	
300 °C – 500 °C	1.0 °C/min	60 min	
500 °C – 600 °C	1.0 °C/min	60 min	
600 °C – 700 °C	1.0 °C/min	60 min	
700 °C – *800/850 °C	1.0 °C/min	60 min	
*800/850 °C – 1,000 °C	1.0 °C/min	60 min	
*1,000 °C – 1,100 °C	1.0 °C/min	60 min	
*1,100 °C – 1,200 °C	1.0 °C/min	60 min	
*1,200 °C – 300 °C	1.0 °C/min	None	

*complete pyrolysis processing through the desired maximum temperature

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POLYMER-TO-CERAMIC™ TECHNOLOGY

Table 4: Furnace Conditions to Pyrolyze SMP-10, SMP-730, SMP-877, SBMC-601, SBMC-843, SPR-684, SPR-688, SPR-212, SPR-212 based Laminates/Composites; <2mm

Temperature	Condition	Atmosphere
RT – 650 °C +/- 10 °C	Ramp Heat at 1.0 +/- 0.25 °C/min	Inert; nitrogen or argon Positive flow, atmospheric pressure
650 °C – *850 °C +/- 10 °C	Ramp Heat at 2.0 +/- 0.25 °C/min	
*850 °C +/- 10 °C	Hold for 120 +/- 10 minutes	
*850 °C – 300 °C	1.0 °C/min	

*Maximum pyrolysis temperature up to 1,200°C

Table 5: Press Mold Conditions to Cure SMP-10 based Composites; Gel Cure

NOTE: Gel Cure allows handling

Temperature	Condition	Pressure
RT – 150 °C +/- 5 °C	Heat platens at maximum rate	None
Load Part	---	Apply Pressure to ‘Touch’
150 °C +/- 5 °C	Hold for 5 min +/- 1 min	Apply Pressure to ‘Touch’
150 °C +/- 5 °C	Hold for 30 min +/- 5 min	Maximum Pressure
150 °C – RT	Maximum Rate	Maximum Pressure (optional)

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POLYMER-TO-CERAMIC™ TECHNOLOGY

Table 6: Press Mold Conditions to Cure SMP-10 based Composites; Hard Cure

NOTE: Hard Cure allows handling and machining

Temperature	Condition	Pressure
RT – 150 +/- 5 °C	Heat platens at maximum rate	None
Load Part	---	Apply Pressure to 'Touch'
150 °C +/- 5 °C	Hold for 5 min +/- 1 min	Apply Pressure to 'Touch'
150 °C – 400 °C	Ramp Heat at 2.5 – 3.0 °C/min	Maximum Pressure
400 °C +10/-50 °C	Hold for 30 min +/- 5 min	Maximum Pressure
400 °C – RT	Maximum Rate	Maximum Pressure (optional)

Table 7: Press Conditions to Cure SPR-684/SPR-688 Electronic Laminates

NOTE: Polymer Catalyst Loading –
 2.0 wt% CAT-776 Catalyst
 1.5 wt% Dicumyl-peroxide complex (50:50 Dicumyl peroxide: Toluene)

Temperature	Condition	Pressure
RT – 100 +/- 5 °C	Heat platens at maximum rate	None
Load Part	---	Apply Pressure to 'Touch'
100 °C +/- 5 °C	Hold for 15 min +/- 1 min	Apply Pressure to 'Touch'
100 °C – 180 °C	Ramp Heat at 2.5 – 3.0 °C/min	Pressure = 500 psi
180 °C – 280 °C	Hold for 30 min +/- 5 min	Pressure = 500 psi
280 °C – RT	Maximum Rate	Pressure = 500 psi

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POLYMER-TO-CERAMIC™ TECHNOLOGY

Table 8: Press Conditions to SSMC-670

Temperature	Condition	Pressure
RT – 100 +/- 5 °C	Heat platens at maximum rate	None
Load Part	---	Apply Pressure to 'Touch'
100 °C +/- 5 °C	Hold for 5 min +/- 30 sec	Apply Pressure to 'Touch'
100 °C – 200 °C	Ramp Heat at 2.5 – 3.0 °C/min	Pressure = 200 psi
200 °C	Hold for 30 min +/- 5 min	Pressure = 200 psi
200 °C – RT	Maximum Rate	Pressure = 200 psi

Table 9: Furnace High Temperature Heat Treatment Conditions for SMP-10, SMP-730, SMP-877, SMP-500, SMP-800, SBMC-900, SBMC-998

Temperature	Condition	Atmosphere
RT – 1,200 °C +/- 10 °C	Ramp Heat at 1.0 – 3.0 +/- 0.25 °C/min	Inert; nitrogen or argon Positive flow, atmospheric pressure
1,200 °C – *1,650 °C +/- 25 °C	Ramp Heat at 1.0 +/- 0.25 °C/min	Inert; Argon Positive flow, atmospheric pressure
*1,650 °C +/- 25 °C	Hold for 60 +/- 10 minutes	
*1,650 °C – 300 °C	1.0 °C/min	

*maximum temperature is determined by customer

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POLYMER-TO-CERAMIC™ TECHNOLOGY

Table 10: Curing / Crosslinking Conditions for SMP-730, SMP-500, SMP-800, SBMC-900, and SBMC-998

Temperature	Condition	Atmosphere
Load part into vacuum bag	---	Pull vacuum
RT	Hold for 30 min +/- 5 min	Vacuum
Load into oven, autoclave (optional)	---	---
RT – 50 °C +/- 5 °C	Heat at Maximum Rate, up to 25 °C/min	Vacuum (bag)
50 °C +/- 5 °C	Hold for 15 min +/-5 min	
50 °C – 200 °C +/- 5 °C	Heat at Maximum Rate, up to 25 °C/min	Vacuum (bag) 120 psi (autoclave)**
200 °C +/- 5 °C	Hold for 2 hr +6 hr/-0 hr*	
200 °C – RT	Maximum Rate	

*maximum time is determined by customer
 ** autoclave pressures determined by customer

These conditions are to be treated as processing guidelines, and may not be optimized for unique applications.