



INDUSTRY COMPOSITE SOLUTIONS

FOR THE AEROSPACE INDUSTRY COMPOSITE SOLUTIONS FOR THE AEROSPACE INDU

COMPOSITES

## CONTENTS

Introduction	3
Value Engineering for Design and Performance	4
Quality Assurance that Exceeds Industry Expectations	6
Manufacturing Processes	8
High Performance Composite Ducting	10
Aircraft Interiors, A Growing Market	11





USED ON AEROSPACE COMPREHENSIVE CAPABILITIES

FOCUSED ON AEROSPACE COMPREHENSIVE CAPABILITIES FOCUSED ON

Senior Aerospace Composites has one of the most comprehensive composite fabrication facilities dedicated solely to the aerospace market. Our extensive experience is unparalleled. In a 50-plus-year history, we have developed a wide range of process capabilities including compression molding, resin-transfer molding, vacuum-form molding as well as high- and low-pressure curing. Our impressive breadth of product offerings is targeted to the business jet, commercial transport, general aviation and military market segments including both fixed and rotary-wing aircraft.

We work as a seamless extension of our customers' internal departments whether they require build-to-print or design integration. As part of the Senior plc organization, we offer the stability, responsiveness and financial strength that only a worldwide aerospace manufacturing organization can provide. Senior Aerospace supports our business initiatives by building on our current strengths and making investments in technology, manufacturing processes and people. In higher level, system and sub-system opportunities where composites represent the core competency, Senior Aerospace Composites can offer interdivisional solutions in combination with other Senior Aerospace companies, acting as a single-source provider to customers.

Positioned for growth, Senior Aerospace Composites has a 65,000-square-foot manufacturing facility located on 10 acres, targeted for expansion.

With over 200 employees, we are able to dedicate ourselves to our customers' engineering and fabrication issues.

COMPETITIVE MARKET REQUIRES HIGH-LEVEL SOLUTIONS

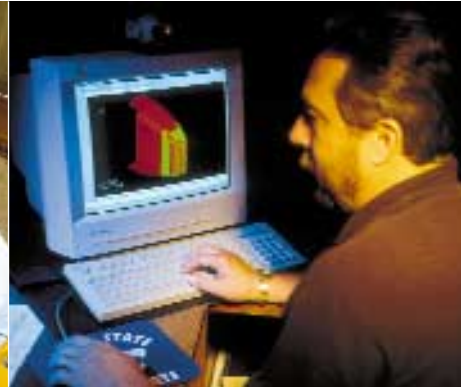
In an increasingly challenging global economic environment, airframe manufacturers must outsource more systems and detail manufacturing to suppliers they can rely on. With an emphasis on cost controls and shorter lead times, suppliers are being chosen for their ability to provide higher levels of system solutions to industry challenges.

Senior Aerospace Composites meets these challenges head on. We add value to our programs by continuously evaluating our engineering and fabrication capabilities for improvement and expansion, while keeping sight of our lean enterprise objectives. Senior Aerospace Composites offers:

- a capability to serve international markets
- value engineering
- design optimization
- extensive materials knowledge
- a wide range of process capabilities
- high-level assemblies
- a focus on cost reductions

As a customer-driven organization, we are dedicated to quality assurance, while providing customers with a broad range of materials and processes that will give them the best product at the greatest value.





# DESIGN AND PERFORMANCE VALUE ENGINEERING FOR DESIGN AND PERFORMANCE

As part of the Senior Aerospace, ISO-certified "Engineering Center of Excellence" initiative, Senior Aerospace Composites provides engineering support, at whatever level our customers require for design, analysis, testing, materials and process selection. We design to FAR certifications and use sophisticated computer-aided design programs such as CATIA, Unigraphics and Auto-CAD, to support our concurrent engineering practices.

We draw from our vast composite experience to push the design/manufacturing envelope. With an in-depth understanding of material properties, composite construction and fabrication processes, our engineers are able to customize the attributes of a component to meet customer design and performance criteria. Senior Aerospace Composites analyzes specifications on build-to-print requirements to suggest cost-reducing manufacturing alternatives. Design optimization is applied at a systems level to help reduce part count.

### IN-HOUSE TESTING

Our in-house testing lab ensures the quality of our components. We perform extensive tests throughout the manufacturing process including raw material receiving inspections, process control inspections, and both destructive and nondestructive testing in addition to:

- tension/compression/flexure
- flammability (FAA-approved burn chamber)
- pressure/leakage
- resin content/flow/specific gravity/viscosity
- process control testing

Independent laboratories are also used for other testing requirements. Ongoing research and development programs are analyzed in an effort to provide new material and process solutions to our customers.

### MATERIALS AND CONSTRUCTION

Senior Aerospace Composites combines composite expertise with engineering skills to provide our customers with the best low-cost, high-performance solutions. Based on customer performance criteria such as weight, stiffness, strength, noise attenuation and thermal properties, the appropriate materials, processes and part configurations are determined with cost and producibility concerns in mind.

A multitude of fabric and resin combinations has been analyzed to provide a variety of performance properties. Material choices typically include:

#### FABRIC

- Carbon Fiber (Graphite)
- Aramid (Kevlar)
- Fiberglass
- Others

#### RESIN

- Phenolic
- Epoxy
- Bismaleimide (BMI)
- Polyester
- Polyimide (Avamid R)
- Triazine (Stesalit)
- Others

#### CORE

- Nomex Honeycomb
- Aluminum Honeycom
- Foam Core
- Others



VALUE ENGINEERING FOR DESIGN AND PERFORMANCE  
VALUE ENGINEERING FOR DESIGN AND PERFORMANCE  
VALUE ENGINEERING FOR DESIGN AND PERFORMANCE  
VALUE ENGINEERING FOR DESIGN AND PERFORMANCE  
VALUE ENGINEERING FOR DESIGN AND PERFORMANCE  
VALUE ENGINEERING FOR DESIGN AND PERFORMANCE  
VALUE ENGINEERING FOR DESIGN AND PERFORMANCE  
VALUE ENGINEERING FOR DESIGN AND PERFORMANCE

# COMPOSITES



# COMPOSITES

INDUSTRY EXPECTATIONS QUALITY ASSURANCE THAT EXCEEDS INDUSTRY EXPECTATIONS QUALITY ASSURANCE THAT EXCEEDS

6

A reputation for quality has made Senior Aerospace Composites a “delegated source” for many customers. We have taken the initiative to develop a universal quality system that combines the most sophisticated process control verification programs in the industry including: Total Quality Management, Boeing D1-9000 Rev. A, The Malcolm Baldrige National Quality Program and MIL-I-45208. Senior Aerospace Composites provides quality assurance that meets or exceeds customer requirements.

With checks and controls throughout our system, we operate to rigorous industry standards and keep pace with customer demands for lower costs and shorter lead times. Our quality assurance system includes:

- CONFIGURATION MANAGEMENT ensures that the latest design is being produced
- COMPUTERIZED TRACKING tracks individual part numbers from raw materials throughout the manufacturing process
- RECEIVING INSPECTIONS verify all materials upon receipt, according to specifications or drawing
- IN-PROCESS INSPECTIONS using our Portable Coordinate Measuring Machine (PCMM), verify part configuration back to original design data
- QUALITY CALIBRATION PROGRAM ensures that variability from part to part is within industry tolerances per MIL-STD-45662A

- SUPPLY CHAIN MANAGEMENT tracks performance of suppliers to meet our quality standards

Senior Aerospace Composites instituted these quality systems to maintain the highest product integrity and reliability. Quality isn't just a word for us...it is a way of doing business.

#### MANUFACTURING PROCESSES WITH A REPUTATION FOR EXCELLENCE

Senior Aerospace Composites has one of the most comprehensive composites manufacturing facilities in the aerospace industry for the production of ducting, structural and non-structural assemblies, and interiors.

Applying the principles of lean enterprise and value-streaming concepts, we meet our customers' demands for an atmosphere that is responsive to change. By retaining close control and utilizing concurrent engineering and manufacturing programs, Senior Aerospace Composites can manage specification changes quickly and efficiently.

#### IN-HOUSE TOOLING

Senior Aerospace Composites controls costs, quality and scheduling by maintaining an in-house tooling facility. We fabricate coordinated tooling families including layup molds, trim, drill and assembly fixtures.





S

7



## MANUFACTURING PROCESSES

8

### COMPOSITE STRUCTURES LAMINATING

Composites structures are produced in our large environmentally controlled clean room where kit cutting and ply-configuration management are performed with our Eastman Automated Kit Cutter and Digitizer. Portable coordinate measuring machines are used to ensure correct dimensional attributes as required by the engineering mandates.

Senior Aerospace Composites takes advantage of the ability to add or remove materials at the design stage, and to strategically locate and orient plies to accommodate high-strength, low-weight requirements. In sandwich constructions, foam core, aluminum honeycomb or nomex honeycomb structures are traditionally used to reinforce the laminates. Depending upon the materials used, the parts are cured in either low-or high-pressure curing vessels. Programmable controls ensure proper curing stages.

### HIGH-PRESSURE CURING

A variety of structural and nonstructural components such as fairings, inlet ducts, radomes, tail cones and bulkheads are cured in high-pressure autoclaves. Our two autoclaves, the largest of which is 7.5' in diameter by 30' long, are computer-controlled in order to ensure processing per defined cure schedules. Autoclaves are equipped for cure cycles of 100 psi and 500°F.

### LOW-PRESSURE CURING

Nonstructural composite components such as duct assemblies, plenums, antenna enclosures, interior panels and cowlings utilize a low-pressure vacuum bag, oven cure process.

Senior Aerospace Composites has eight low-pressure laminating ovens; the largest has a maximum capacity of 10' x 20'. Leading and lagging thermocouples ensure cure cycles conform to customer specifications, typically between 250-350°F.

### COMPRESSION MOLDING

Compression molding is utilized to quickly form a fiber-reinforced composite material into a desired shape with the use of heat and pressure. Typical tooling consists of "matched steel dies" having net configuration when closed so detail parts are molded net to the final configuration including inserts and other integrated features. Some parts do require post processing in the trim and drill area as well as secondary bonding, assembly and paint finishing. Senior Aerospace Composites has presses of varying size and tonnage.

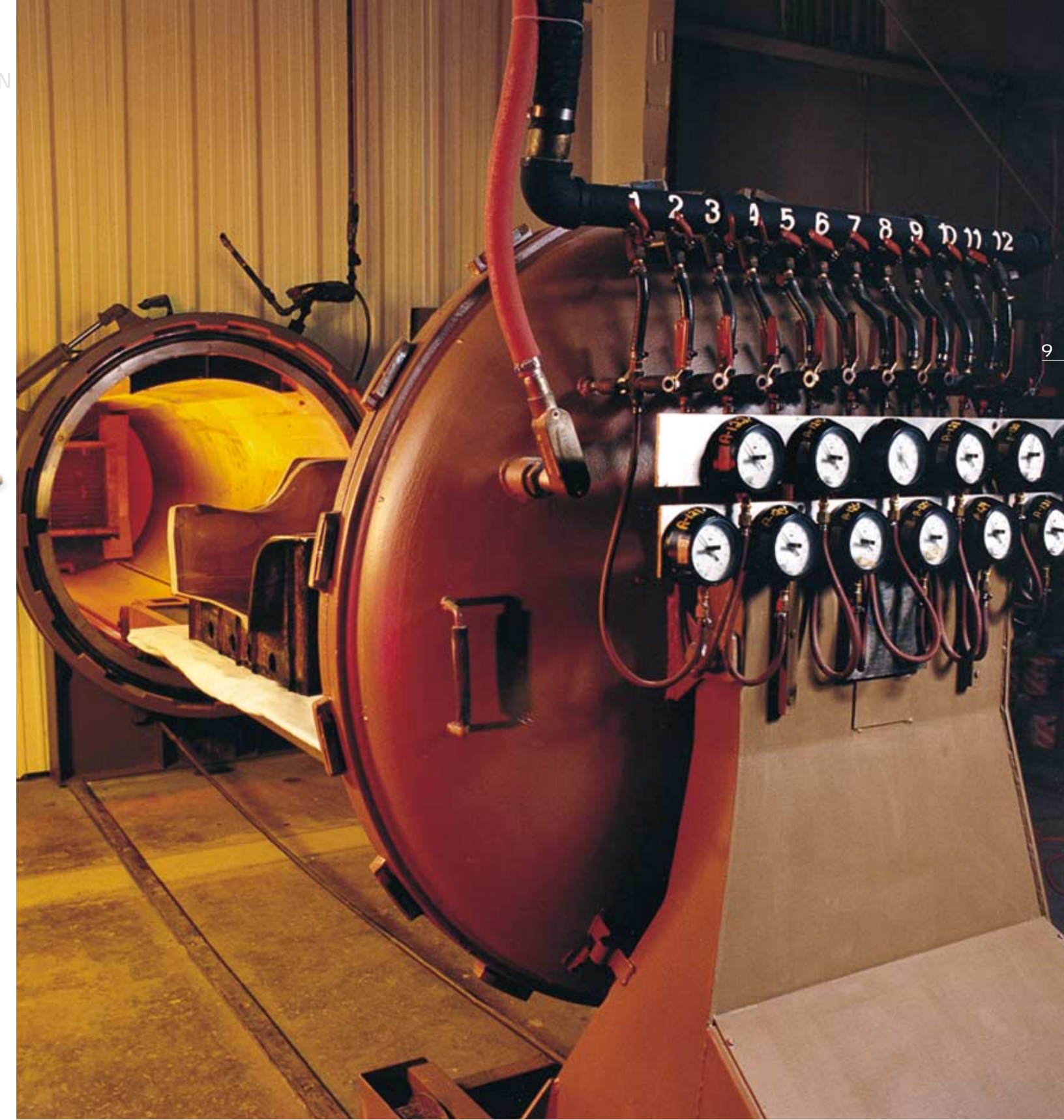
### RESIN TRANSFER MOLDING

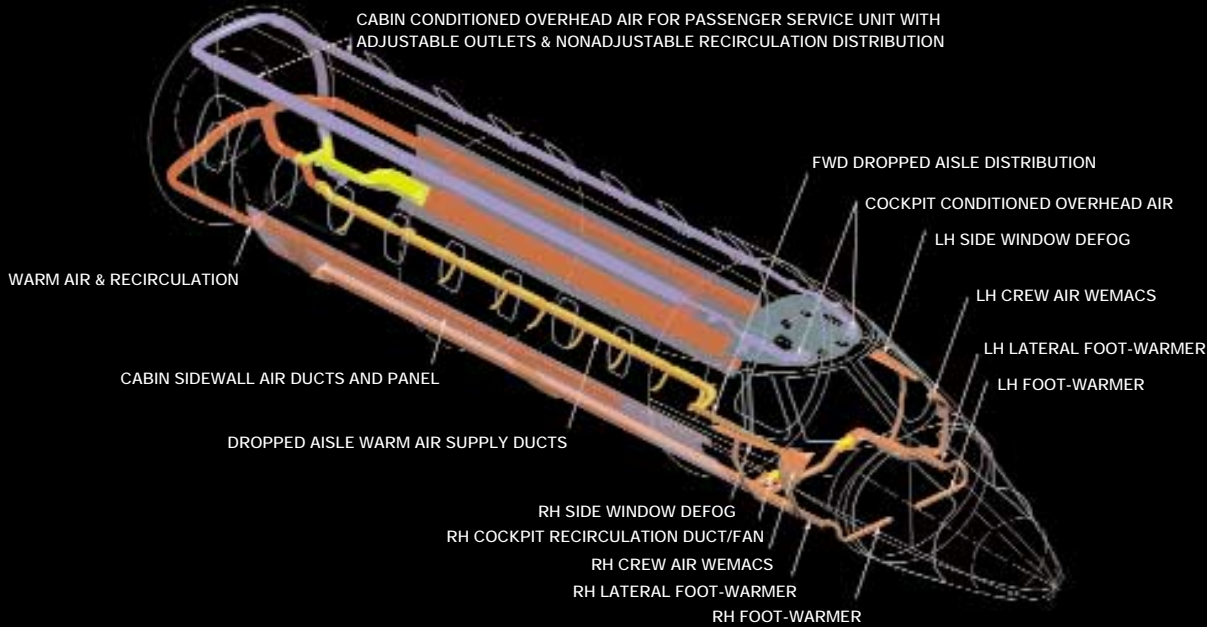
Parts can be produced net to the engineering configuration with resin transfer molding by placing dry fiber into a closed mold, then injecting resin into the tool using controlled flow and pump pressure. In some cases, trim and assembly may be required with added processing in the paint and finish area. We use compression presses for clamping pressure and matched steel or aluminum dies machined to a net configuration when closed. Typical materials used for this process are polyesters and epoxy resin systems reinforced with fiberglass and graphite fabrics. Preformed core structures are common.

### THERMOPLASTIC SHEET FORMING

Thermoplastic sheet forming process can be provided from materials such as Kydex, ABS, Lexan, Noryl and even acrylics.







COMPOSITE DUCTING HIGH PERFORMANCE COMPOSITE DUCTING HIGH PERFORMANCE COMPOSITE

Our recent developments with High Temperature - High Strength materials have advanced our abilities. These abilities include ducting capable of withstanding service temperature limits of 500+ degrees F with spikes to 600 degrees F. These duct assemblies have been tested in excess of 85PSI with thin light weight structures down to .030 Wall. Ducting previously considered for metallic materials only, may now be produced from these materials for weight and cost savings.

Improved properties for FST (Flame, Smoke, & Toxicity), outstanding levels of thermal oxidative stability combined with exceptional fluid resistance and a high level of durability are apparent with these materials. The use of Phenolic Novalac Resins and High Temperature Polyimide Resin systems form the basis for this development.

Senior Aerospace Composites uses its full range of process and material capabilities to produce rigid ducting. Our production staff have the experience and flexibility to handle numerous materials and processes including low-temperature, oven cure polyester and epoxy ducts: fire-resistant phenolic ducts: and high-temperature autoclave cure cyanate ester or bismaleimide ducting.

When operating as a seamless member of the customer's integrated product team we can present material and process suggestions that offer cost savings, enhanced performance and part count reductions from the concept stage through to final production - clearly a benefit to our customer. We provide high-level solutions for our customers ducting needs.

We have the ability to fabricate ducting to meet unusually complex geometry and precise tolerances including:

- 10 foot long centerline ducts from Kelvar reinforced with aramid-fibre honeycomb core
- Ducting for the radar cooling pack on high performance fighter aircraft that withstands 85 psi
- High pressure Graphite reinforced ducting used on executive jet aircraft lavatory waste drain systems
- Silicone-lined, rigid ducting with flexible bellows and silicone cuffs for ease of fit up and less installation time.





A GROWI NG MARKET AI RCRAFT I NTERI ORS A

GROWI NG MARKET AI RCRAFT I NTERI ORS A GROWI NG MARKET AI RCRAFT

The Interiors Program at Senior Aerospace Composites gives our customers complete flexibility. We can provide aircraft interiors as individual components or as complete packages in kit form, ready to install. Our material and process selections meet FAA requirements for fire, smoke and toxicity.

Kits include lower kick panels, side-wall ducting panels, window reveal panels and overhead panels complete with oxygen boxes, lights, signage, PSU units and other interior components. These interior kits meet the standards set by the most demanding airframe manufacturers. Interior components are available for military applications, commercial programs including executive jet aircraft and transport aircraft, as well as fixed and rotary-wing aircraft.

Interior panels can improve the acoustic properties of aircraft cabins. Through interdivisional cooperation, Senior Aerospace Composites can engineer acoustic solutions with a combination of interior panels and insulation.

Combining our engineering talents with process applications has made the success of our Interiors Program a reality for our customers.

