National Aeronautics and Space Administration

Marshall Space Flight Center
Composites Manufacturing

Engineering Solutions for Space Science and Exploration

Verifying tow paths for composite pressure vessel

Material Diagnostic Testing for process certification

Filament winding Advanced Composite Structures

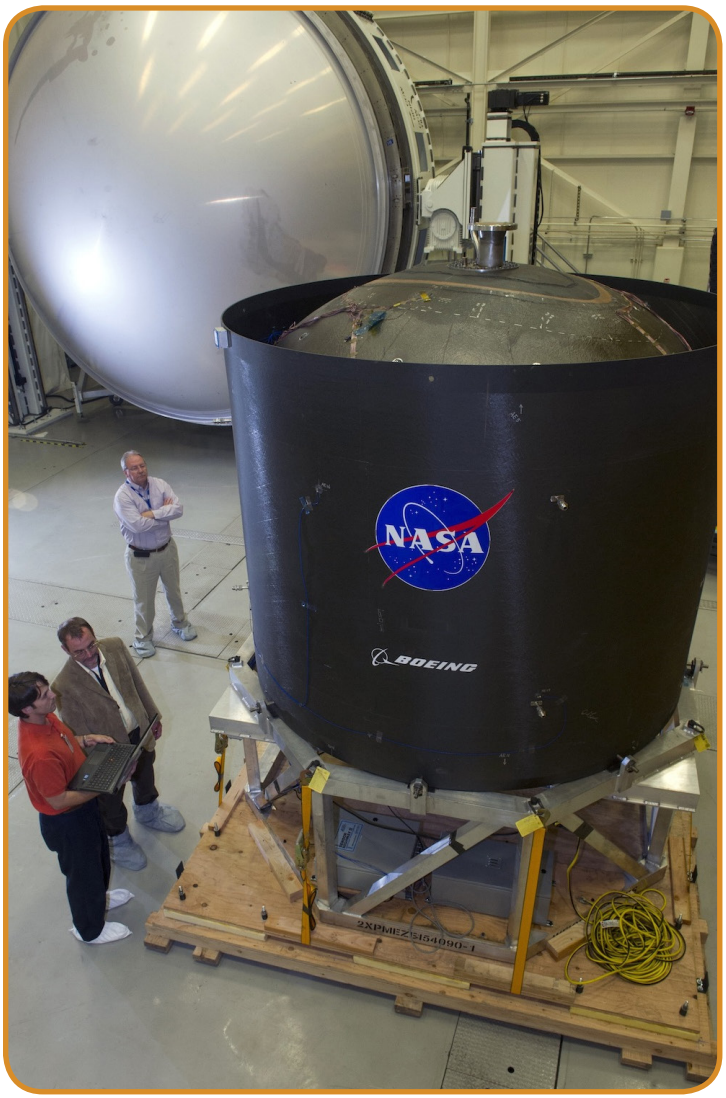
Composites Manufacturing Facility

The Composites Manufacturing

capability in the Materials and Processes Laboratory at Marshall Space Flight Center (MSFC) has a combination of state-of-the-art equipment, facilities, and experience that is unique to the agency when it comes to large scale structure developments. The facility is also closely connected to other groups that provide design, testing, and analysis. This enables the production of small-scale test articles, as well as full-scale production-like hardware. The majority of the manufacturing equipment is located in building 4707 which houses advanced fiber-placement, filament winding machines, ovens, autoclaves, and heated presses. The composites manufacturing is also in close proximity to digital manufacturing and additive manufacturing facilities. This layout allows for precise simulation and alignment of larger, complex structures.

The Laboratory is in the process of upgrading its composite manufacturing research capability infrastructure with a highly capable advanced fiber placement (AFP) process. The AFP process played a pivotal role in the revolutionary advancement for the Boeing 787 composite fuselage and subsequently the Airbus A350XWB. AFP is ideally capable of fabricating very large composite structures by virtue of unparalleled adaptability, productivity, efficiency, reliability, and repeatability.

MSFC also has several oven autoclaves that enable the curing of the large and complex structures produced by AFP. This has become a unique resource that can be used to advance aerospace and non-aerospace hardware development and to increase performance and affordability.



Receiving and inspection of 2.4-meter diameter cryogenic development tank

Capabilities

Large-Scale Clean Room for Composite Structure Assembly

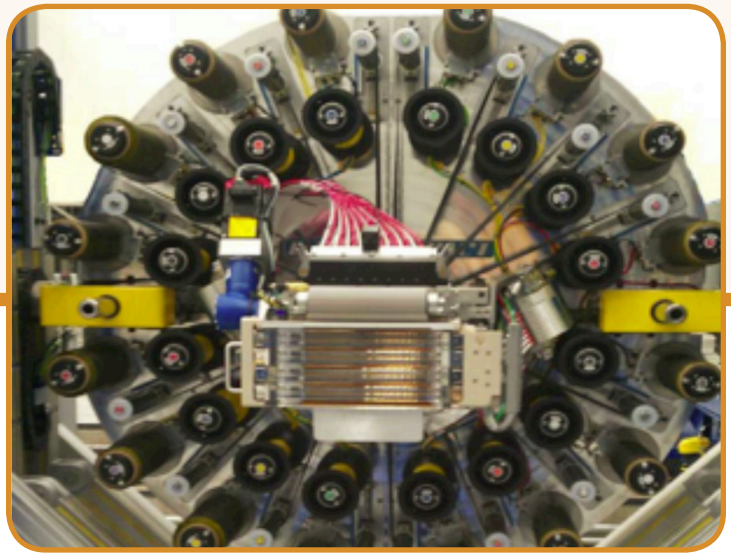
Large clean room with rotational hardware capable of assembling 18-ft diameter structures, 5,000-ft^2 clean work area, 10-ton monorail crane, 20-ton bridge crane, 400-ft^2 airlock with 2-ton electric hoist, and a 1,600-ft^2 tooling/prep area.

Composites Manufacturing:

- The Laboratory has a state-of-the art Advanced Fiber Placement Head–modular head used to dispense 16 carbon fiber tows onto a tool surface for production of composite structures. Uses clamp, feed and cut modules to control payout of each individual tow. The head has an on-board creel and is attached to the Motion Platform with a quick-change interface. It can be disconnected from the machine in the transfer stands. Head are individually configured to process 1/8", ¼" or ½" slit tow tape of specific geometric tolerances.
- There are two modern four-axis filament winding machines that are outfitted with state-of-the-art fiber tensioning systems. Structures can be made that are 1-in diameter up to a tube structure that is 4-ft diameter × 15 ft. long.
- The fiber-placement and filament winding equipment is versatile and can produce a large range of hardware to include large composite cryogenic tanks, high pressure vessels, launch tubes, telescope tubes, and solid motor-cases.

Additional Facilities:

- Three autoclaves: 18 × 20 ft. (up to 350 psi and 400 °F), 9 × 12 ft. (up to 150 psi and 600 °F), and a 4 × 6 ft. (up to 240 psi and 650 °F)
- There are several ovens and multiple presses used to cure vacuum bagged parts and wrapped pressure vessels. Ovens range from 2 × 2 ft. to 20 × 60 ft. with maximum operating temperatures up to 600 °F.
- Computer controlled cutting tables are used to accurately cut a variety of different composite materials.
- Several clean working areas and clean rooms of various sizes



Key Benefits

> The composites manufacturing facility enables the complete product development of large, and sometimes complex, composite structures. It is also well connected to other areas that can design, test and evaluate the hardware performance.

For more information, please visit www.nasa.gov/centers/marshall/about/business.html

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