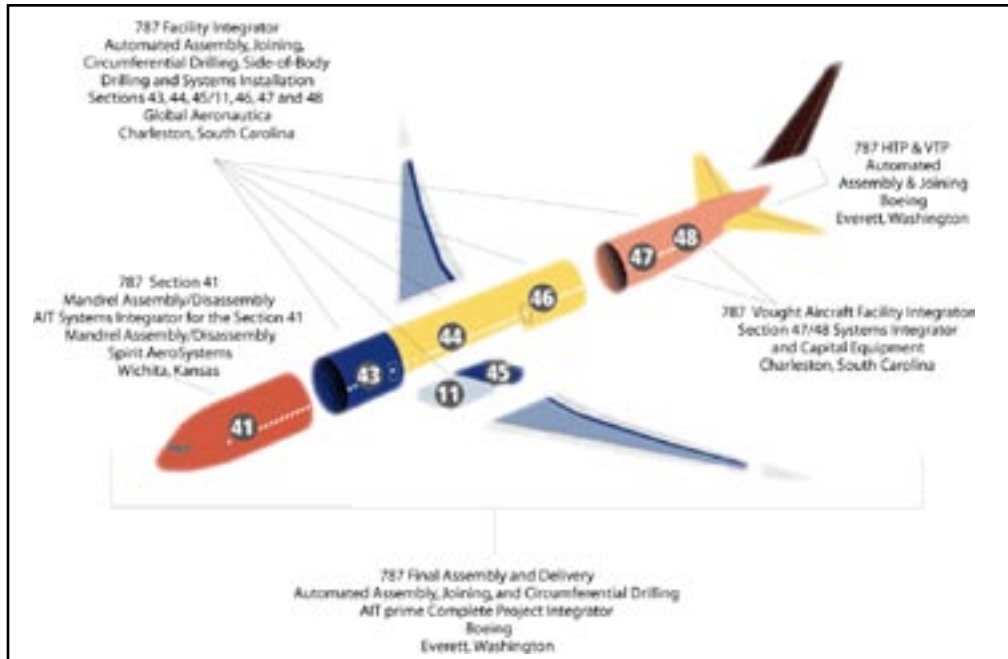




# 787 Dreamliner Integration Project

The Boeing 787 Dreamliner was the first commercial jet to be made of an advanced composite material – a combination of graphite and epoxy resin. AIT has worked on many projects before using composite materials in the construction of aircraft, but the 787 contained far more composite material than any other commercial aircraft had to date. This challenge allowed AIT to capitalize on our extensive experience and work on many different integration projects on the 787 with The Boeing Company, Vought Aircraft Industries, Global Aeronautica, and Spirit AeroSystems.



With this new material came many different innovative solutions in turnkey factory integration, assembly, and product development to achieve unprecedented levels of performance. For example, the new 787 required that only six large composite parts to be assembled to build the final airframe. That meant that the facilities used to manufacture and assemble these sections had to be completely reinvented. Plus, huge tools and overhead cranes, which were labor-intensive and took up vast amounts of floor space, had to be replaced with an AIT jig-crane-style materials handling system.

## Achievements:

- Met composite challenges head on by revolutionizing aircraft automation processes
- Significantly reduced labor and equipment costs for partners with technological advances in assembly automation
- Developed new flexible, automated drilling technologies
- Curtailed cycle and ramp-up times with turnkey solutions
- Created substantially more economical, clean, and safe factory environments for specific partners

AIT was in a unique position as the only supplier to manage the integration of all 787 Dreamliner subassemblies. The diagram below highlights the various projects and Sections of the 787 Dreamliner for which AIT served as Prime Contractor/Integrator.

**787 PROJECT** AIT worked with four individual Aerospace companies in five different locations with seven unique sections.

## The Boeing Company

For The Boeing Company in Everett, WA, AIT held several major responsibilities in the total scope of this program as their Prime Complete Project Integrator. For final assembly and body join, we delivered automated assembly systems and an automated positioning system for various section-to-fuselage joins.

## Automated 787 Final Assembly Systems and Body Join

- Delivered 2 Automated Assembly Systems and 1 Positioning System
- Features
  - Join Section 41 (FWD fuselage), Section 12 L&R (wings), and Section 47/48 (AFT fuselage) to the mid-fuselage
  - Include 14 positioners mounted to transportation structures that move independently or interlocked and indexed to factory floor for stability
  - Include 2 major subassemblies: forward/aft body positioners and left/right wing positioners; split further for transportation into left- and right-hand minor subassemblies
  - Provide real-time positional measurement data with an integrated indoor GPS
  - Design alignment and positioning systems to be rolled under aircraft dollies after aircraft brought into factory, reducing equipment needs and positioning steps
- Advantages: make floor space available/accessible for overall flexibility; automatically position structures for reduced errors and cycle times



### Process Highlights

The 14 Automated Positioning System components were moved into respective positions near the cradle dollies and then engaged to lift and move the airplane components. Once the system was rigidly joined together, a measurement system located the airplane sections; this information was then fed into AIT's system software application. From that data, the system calculated how much each section (nose, tail, left wing, and right wing) needed to be moved to ensure an exact fit to the adjoining sections. This precise alignment process ensured a smooth build.

As an example of automation advancements made with our equipment, the wings were joined to the fuselage in hours – not days. These efficient AIT assembly systems saved Boeing time and money by substantially reducing cycle time and costly errors.

Also for Boeing, AIT served as the Prime Complete Project Integrator for the full Circumferential Automated Drilling Machines – a newly developed technology to join the advanced composite structures.

### Circumferential Drilling Machine and Stands

- Delivered 4 circumferential join external-access stands and 8 portable automated drilling systems to drill/join forward and aft fuselage sections
- House two drilling systems in each stand for concurrent drilling of both forward and aft sections
- Enable 4 drill heads to operate independently and simultaneously at each circumferential splice
- Features
  - Drill and countersink in one pass
  - Use vision system for location and correction
  - Allow 100% access to plane with stands
  - Advantages: compact design creates a portable system; onboard control via inherently intuitive user interface; automation speeds drilling process



**TIME SAVINGS** ⬆️ With AIT's automation advancements, the wings were joined in hours – not days.

**SAVING LABOR COSTS** ⬇️ With the AIT Circumferential Drilling Machine, fewer operators could complete drilling in less time.

### Process Highlights

After each section was precisely located, the Circumferential Join Access Stands were moved into place, and the automated drilling process began. The Circumferential Drilling Machines drove around tracks while vacuumed fastened to the airplane skin. Operators monitored the process; however, once programmed, the drilling systems were on their own to complete the drilling operation.

### Horizontal Stabilizer/Vertical Fin/APU Installation (HVA) Tool

- Provided 2 subassembly platforms that join around aft fuselage
- Include jib-crane-style material handling system, alignment and positioning system for horizontal stabilizer/tail cone assembly, and elevator system for APU installation
- Features
  - Lift and move aft assemblies for join process
  - Ensure precision joining of aft components
- Advantages: substantially reduce large, labor-intensive crane systems of past; speed assembly process of new composite structures

AIT also provided total project integration for the three assembly systems - Horizontal Stabilizer, Vertical Fin, and Auxiliary Power Unit (APU) Installation Tool – using two subassembly platforms to facilitate the assembly join of aft fuselage. This new equipment revolutionized aircraft assembly and replaced the antiquated crane



systems that once dominated factory floor space and labor and also limited flexibility. The tool moves on a track system in the floor to advance the plane to its second position while on AIT's tool.

### Vought Aircraft Industries

Not only did AIT work with Vought to design a new factory flow for the 787 in Charleston, SC, but we also served as the Total Project Integrator for the 22-foot wide aft fuselage Sections 47/48. (Section 47 is the last passenger section, 19' diameter and 23' long. Section 48 is the first cargo hold, 14' diameter and 15' long.) As Systems Integrator, AIT brought together the component subsystems into one system and ensured that the subsystems function together as expected as one system.

In this context, we defined an entirely new process to build the aircraft in the 342,000-square-foot building – substantially raising the bar in streamlined, economical manufacturing. The new layout included 16 fabrication and assembly cells to accommodate the Section 47/48 manufacturing process.

### Section 47/48 Systems Integrator and Capital Equipment

- Designed new factory flow with Vought to accommodate lean manufacturing techniques, innovative composites fabrication and assembly, and integration technologies
- Served as Systems Integrator to provide turnkey integration, support, capital equipment, tooling, and automation for the entire process
- Delivered 2 Mandrel Handling Systems (1 for assembly, 1 for disassembly) as well as assembly tooling and capital equipment



**MOATT** ⚡ Dubbed the "Mother of All Tooling Towers" by Boeing, they anticipate assembling one 787 every three days with our HVA Tool.

**MANDREL ASSEMBLY** ⚡ Aft fuselage Section 47 is held by AIT's Mandrel Assembly System.

#### • Features

- Automatically assemble and disassemble carbon fiber mandrel segments
- Position/move sections effectively throughout facility
- Install internal subassemblies
- Join 47/48 sections
- Advantages: speed assembly/disassembly processes; maximize use of floor space with flexible systems; less expensive equipment to fabricate

Once the sections were complete at the Vought facility, AIT equipment towed the sections to Global Aeronautica's proximate facility in Charleston.

### Global Aeronautica

As sole supplier, AIT was engaged for two separate projects with Global Aeronautica. For the first project, AIT was the Prime Contractor/Integrator to design, fabricate, and install the 787 Dreamliner automated flexible positioning and assembly system used to join the Section 45/11 (center wing well and center wing box) mate to Sections 43, 44, and 46 (forward and center fuselage sections, 19' diameter and 84' long when joined).

As their Facility Integrator, AIT also worked with Global Aeronautica to design the factory flow of their new 334,000-square-foot building, where they integrate, test, and apply surface finish to more than 60% of the 787 fuselage. As such, AIT served as Facility Integrator for the mid- and aft-body joins assembly lines, which encompassed joined Sections 43, 44, 45/11, 46 with Sections 47/48. The Integrator scope for the assembly line included seven separate positions, each with individual system integration components and transportation between. In its role, AIT provided turnkey integration, support, capital equipment, tooling, and automation for the entire process.



**NEW SPACE/NEW WAYS** AIT worked with Global Aeronautica to redefine the mandrel assembly process in its new 334,000-square-foot facility.



**NOSE SECTION** Section 41 is the 22-foot wide forward fuselage section of the 787 Dreamliner, held in position with AIT mandrel handler.

### Large-Scale Design

AIT worked with Vought and Global Aeronautica to design the factory flow of their new 342,000- and 334,000-square foot buildings, respectively.

### Facility Integrator/Mid-, Aft-Body, and Wing Box Joins

- Delivered Automated Flexible Positioning and Assembly System to join Sections 45/11 with Sections 43, 44, and 46
- Include automated transfer dollies and integrated work platforms
- Measure key features on four section assemblies for precise alignment
- Position accurately with feedback from integrated Laser Trackers
- Served as Facility Integrator for mid- and aft-body (Sections 43, 44, 45/11, 46, 47, 48) join assembly lines
- Provide components for major barrel join, under wing and over wing system integration, as well as fairing and continued over and under wing installations
- Provide systems install for Sections 47 and 48, and systems install for both mid- and aft-bodies
- Utilized automated Circumferential and Side of Body Drilling Machines
- Drill upper portion of fuselage sections
- Advantages: substantially reduce labor costs; streamline assembly line process; improve quality with laser tracking and in-process quality check

### Spirit AeroSystems

AIT served as the main supplier for the Section 41 Mandrel Assembly and Disassembly Systems at the Spirit AeroSystems 321,000-square-foot facility in Wichita, KS. AIT's Mandrel Handling Systems automatically assemble and disassemble the carbon fiber lay-up mandrel segments as part of the overall production process. The 787's Section 41 is the 22-foot wide forward fuselage nose section.

- Section 41 Mandrel Assembly/Disassembly Systems Integration
- Served as systems integrator and main supplier for mandrel assembly/disassembly
- Delivered Mandrel Handling System
- Assembly station: 1 mandrel handler and 2 ring manipulators
- Disassembly station: 1 mandrel handler, 2 ring manipulators, 4 section manipulators
- Advantages: speed and streamline assembly/disassembly processes; create leaner labor force with automation

Our precision-engineered technology and automation have enhanced the industry's ability to manufacture the Boeing 787 Dreamliner aircraft in less time and with greater exactness and flexibility. ☺