

IQ INNOVATION

QUARTERLY

INNOVATION. INSIGHT. INSIDE AEROSPACE.

Matters of Precision

A focus on near-microscopic levels of detail was the catalyst in resuming 787 Dreamliner deliveries

PLUS: All Hands on Deck
Flight deck updates up front appeal to pilots' senses.

POINT OF LIGHT

787 chief mechanic Kevin Landy inspects a forward pressure bulkhead join surface.



GREEN MEANS GO

787 technician TJ Heyward evaluates a passenger door surround of a Dreamliner being built at Boeing South Carolina. The green light indicates the surface meets specification.

Matters of Precision

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Matters of Precision



PHOTO: BOEING

Boeing resumed 787 Dreamliner deliveries in August 2022, thanks to the efforts of Boeing teammates across the enterprise to find innovative solutions addressing nonconformances in some of the airplane's joins. Those solutions included using tools in the build process that are capable of confirming tolerances to near-microscopic levels.

"When Boeing designs an airplane, we do so to ensure the airplane will meet all requirements," said Steve Chisholm, vice president and chief engineer for Mechanical and Structural Engineering.

"We have a responsibility to our customers and regulators to ensure the airplanes we deliver conform to engineering design specifications. That is the level of precision our teams work to every day."

OPEN-DOOR POLICY

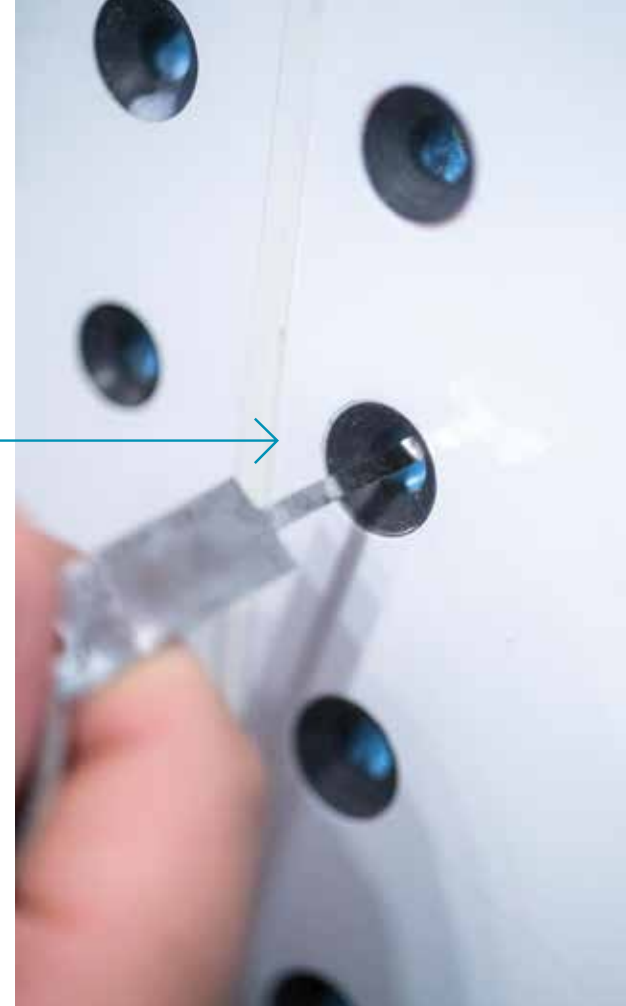
Manufacturing engineer Anna Svanidze (left) and technician Isabel Lopez check for conformance during fit-up of the aftbody fuselage passenger door surround structure.



Close enough is not good enough when it comes to building a commercial airplane, even when measuring to the thousandth of an inch (fractions of a millimeter).

In 2020, the Boeing 787 team discovered some instances of nonconformance. Certain parts of the fuselage joins, where the airplane's primary sections are connected, did not meet the program's exacting design specifications.

Through the use of precision measuring equipment, the team detected some areas that were beyond the maximum tolerance defined by the airplane's design requirements and accepted by the U.S. Federal Aviation Administration (FAA) as part of the airplane's certification.



TIGHT-SPOT TOOL

A feeler gauge is used to check for near-microscopic gaps between surfaces to be joined.

Although the immediate safety of the airplane was not compromised, the join did not meet the design standard. Despite the potential business impact, the decision was made to pause deliveries, inspect yet-to-deliver airplanes and correct any nonconformances. The objective is perfection.

There can be a variance of no more than 0.005 inch (0.13 millimeter) — roughly the width of a human hair — over a given 5-inch (13-centimeter) span along the join surface.

LIKE PAPER

A technician demonstrates the overall thickness of airplane shims — comparable to a sheet of paper or a human hair.

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**STEVE CHISHOLM,
VICE PRESIDENT AND CHIEF ENGINEER,
MECHANICAL AND STRUCTURAL ENGINEERING**

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MINDING THE GAPS

787 chief mechanic Matthew Bucalo checks for gap tolerance between join surfaces.



“ We asked our suppliers to inspect the join surfaces on the fuselage sections they produce, and what we found was a skin flatness variance that was present in multiple locations. This variance could result in minute gaps in the join which, while no thicker than a human hair or a sheet of paper, were outside of our design requirements.”

**MARK STOCKTON,
SENIOR DIRECTOR,
787 ENGINEERING**

FITNESS

Bucalo inspects shims before a structure pre-join fit-up check.



To understand whether this was an isolated condition or it existed in other parts of the airplane, Boeing reached out to 787 suppliers that fabricate other portions of the Dreamliner fuselage.

“We asked our suppliers to inspect the join surfaces on the fuselage sections they produce, and what we found was a skin flatness variance that was present in multiple locations,” said Mark Stockton, senior director for 787 Engineering. “This variance could result in minute gaps in the join which, while no thicker than a human hair or a sheet of paper, were outside of our design requirements.”

Boeing instigated a tip-to-tail review, with production and quality teams checking thousands of points on each undelivered airplane. Anything found beyond design tolerance was reworked to ensure conformance. Technical expertise from across the Boeing enterprise was engaged to help fully understand the condition and develop solutions.



UP TO SPEC

787 chief mechanic Kevin Landy checks measurements during the installation of a 787 forward pressure bulkhead.



New capabilities were tested and incorporated into the production process to verify skin flatness conformance following the fabrication of the fuselage section. The team adapted a tool, originally developed in the automotive industry, as a shop aid to identify areas where the join surface potentially didn't meet flatness requirements. Following the final preparation of the fuselage join surface, a laser scanner is now used to confirm conformance to design specifications.

"I was extremely proud to see the company live our values in identifying the issue and proactively taking the actions that we did to address them," said Lisa Fahl, senior director for 787 Quality. "Some of those actions included the adoption of new tools and processes to ensure conformance with even greater fidelity than before."

With Dreamliner deliveries resumed, the future of the 787 program is bright. The Boeing Commercial Market Outlook forecasts a need for more than 7,000 twin-aisle airplanes over the next 20 years. The Dreamliner's combination of efficiency, reliability, capability and sustainability makes it a favorite among airlines and passengers around the world and positions the airplane favorably to capture a significant share of that market.

PURPLE POWER

The scanning tool Heyward is using was adapted from the automotive industry. The purple light indicates the machine is calibrating.

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**LISA FAHL,
SENIOR DIRECTOR,
787 QUALITY**



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LINING IT UP

Heyward uses a scanning tool to verify the join surface meets design tolerance for flatness.

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“There are some characteristics of Boeing that will never change,” said Lane Ballard, vice president and general manager for the 787 program. “We will always prioritize safety and quality, and we firmly believe in a culture of continuous learning and improvement.”

GUIDING LIGHT

A technician uses a laser scanner to perform a final confirmation on the aftbody fuselage join surface.

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**LANE BALLARD,
VICE PRESIDENT AND
GENERAL MANAGER,
787 PROGRAM**

“The 787 join verification work has given our team an even greater understanding of this airplane, something that will be invaluable as we look to the program’s future. The learnings are driving additional stability across our 787 production system and will benefit other current and future Boeing commercial airplane programs.” **IQ**

