Boeing 777 Fatigue Test Airplane Completes Record Number of Flights

The Boeing 777 fatigue test airplane has lived up to its name and is in for a much-deserved rest after having "flown" the equivalent of 120,000 flights. This represents 60 years of service, an unprecedented level of test validation for a new Boeing airplane model.

Housed in a cage of steel, tubes and wires, the 777 fatigue test airplane was built specifically to verify the durability of the airplane structure. The airplane is a structurally complete airframe minus the systems and interior components. One hundred computer-controlled hydraulic actuators simultaneously applied loads to the airframe to simulate all conditions experienced during typical in-service operations. This included pre- and post-flight taxi, pilot maneuvers, wind gusts and cabin pressurization.

From January 1995 until last week, when the test program ended, the airplane had been flying around the clock - approximately 250 flights a day, stopping only for routine inspections every other weekend. Each flight lasted approximately four minutes, subjecting the airframe to all loads anticipated during a 90-minute short-haul mission.

Fatigue tests are conducted until the airplane has simulated what amounts to two times its minimum design service objective (DSO) to provide the necessary confidence to make predictions of the total fleet of airplanes in service. On previous airplane programs, the minimum DSO was defined as at least 20 years of service. For example, the 757 and 767 fatigue airplanes each simulated 100,000 flights; twice their 20-year DSO of 50,000 flights.

Recognizing the merits of validating commercial airplanes beyond the traditional 20-year objective, the DSO for the much larger 777 was set at 30 years or 60,000 flights.

"A commercial airplane represents a huge investment for our airline customers," said Larry Rydell, chief engineer, 777 Structures. "It's, therefore, to be expected that they will be flying them longer in the future. This test will show us what to expect with an eventual aging fleet. We can anticipate maintenance requirements and thereby ensure continued safe, economical operation of the aircraft."

Fatigue testing provides key data that help design engineers identify the likelihood and causes of premature fatigue damage or wear on the airplane's structural components. If fatigue damage occurs in the fleet, it can be effectively addressed through service bulletins and eliminated through subsequent production changes. Earlier test data has been utilized in designing the longer-range 777-200 Increased Gross Weight (IGW) and stretched 777-300 airplanes.

During the next few weeks, test engineers will conduct a detailed structures inspection to validate recommended fleet inspection and repair techniques. The program will then enter its tear-down phase, during which the airplane will be selectively taken apart and analyzed to confirm that no hidden damage escaped the normal inspection methods.

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