T-7A Advanced Pilot Training (APT)

In FY24, Boeing continued T-7A developmental testing (DT) using contractor-owned-and-operated prototype aircraft; and the Air Force began government-led DT using engineering-and-manufacturing-development (EMD) aircraft. The program office plans to begin IOT&E in FY27.

SYSTEM DESCRIPTION

The Advanced Pilot Training (APT) Family of Systems (FoS) includes the T-7A Red Hawk aircraft and ground-based training systems (GBTS). It replaces the Air Force's fleet of T-38C aircraft and associated simulators.

The T-7A is a two-seat trainer powered by a single afterburning turbofan engine. The aircraft uses digital avionics and fly-by-wire flight controls that emulate the characteristics of fifth-generation fighters. GBTS devices include the aircrew ground-egress trainer, part-task trainer, and three types of simulators with varying levels of fidelity. T-7A aircraft can be networked with each other and with the simulators via a training data link.

MISSION

Air Education and Training Command (AETC) will use the APT FoS to train student pilots and combat systems officers for assignments in fourth- and fifth-

generation fighter and bomber aircraft. Pilot training in the T-7A will include the basic and advanced fighter fundamentals taught in the T-38C and will add sustained high-g maneuvering, advanced sensor management, night-vision goggle operations, and in-flight refueling training.

PROGRAM

APT is an Acquisition Category IB program. The Air Force awarded the contract to Boeing in September 2018. DOT&E approved the Milestone B (MS B) TEMP in January 2018. After declaring a schedule breach in June 2022, the Air Force approved an updated program schedule, which moved the MS C decision threshold date from December 2023 to February 2026 and the full-rate production decision threshold date from September 2025 to January 2028. The MS C TEMP is currently under development.

AETC plans to procure 351 T-7A aircraft, 46 simulators, and associated GBTS for deployment to its five Undergraduate Pilot Training bases: Joint Base San Antonio-Randolph, Texas; Columbus AFB, Mississippi; Laughlin AFB, Texas; Vance AFB, Oklahoma; and Sheppard AFB, Texas.

» MAJOR CONTRACTORS

- The Boeing Company – St. Louis, Missouri
- Saab AB – Linköping, Sweden and Lafayette, Indiana

TEST ADEQUACY

Boeing flew a total of 548.5 hours in two contractor-owned-and-operated prototype aircraft (36.5 hours in FY24). DOT&E will not include test data from these prototype aircraft in its final evaluation of system performance as the prototypes are substantially different from the EMD aircraft contracted. The EMD aircraft will be used for government-led DT and operational testing. Boeing's FY24 DT focused on resolving safety-of-flight issues required for airworthiness certification. These issues including the escape system, flight control software, high angle-of-attack portion of the flight envelope, propulsion, noise and vibration, and departure resistance. The Air Force Operational Test and Evaluation Center (AFOTEC), Detachment 5, provided operational perspective and continuous feedback throughout Boeing's initial design efforts and early DT. AFOTEC published five periodic reports assessing progress towards operational effectiveness and suitability, with a total of 41 recommendations, 37 of which remain open. DOT&E concurs with AFOTEC's assessments and recommendations.

Government-led DT began in December 2023 at Edwards, California. Boeing has delivered three of the five contracted EMD aircraft; two of the aircraft ferried to Edwards in FY24. The Air Force flew 46.9 hours over 46 missions in EMD aircraft, testing wing flutter, flying qualities, and radio navigation test points. The majority of test points in the government DT test plan remain untested. These events include structural loads, subsystems, tanker formation, crew systems, On-Board Oxygen Generation System (OBOGS), mission systems, and high-angle-of-attack testing, which have the potential to drive further software and flight control changes. The program office expects to complete DT in 4QFY26, a delay of more than a year from what was projected in the FY23 Annual Report.

In February 2024, the program completed initial cold and hot weather testing at the McKinley Climatic Laboratory in Eglin, Florida. This initial round of testing revealed several problems that require a second test event at the McKinley Laboratory in 3QFY25.

IOT&E is scheduled to begin in FY27 at Joint Base San Antonio-Randolph, Texas. The APT Program Office, AFOTEC, and DOT&E are collaborating on a MS C TEMP. IOT&E entrance criteria include: four operationally representative aircraft, a full complement of GBTS devices plus one extra weapon system trainer, embedded training software integrated with mission planning in the aircraft and GBTS, and an operationally representative embedded-training, live-virtual-constructive gateway to connect aircraft and simulators. The program office is also working with Boeing to contract testing in the aircraft's transonic region prior to IOT&E. While the APT contract only requires a flight envelope up to Mach 0.95, the T-7A is capable

of supersonic flight. Student pilots are highly likely to exceed Mach 1.0 during T-7A designated missions, particularly during the advanced fighter fundamentals course.

PERFORMANCE

» EFFECTIVENESS

Available data are insufficient to provide a DOT&E assessment of operational effectiveness. The program appears to have a clear pathway to resolving known effectiveness issues, such as limited sortie duration and flight characteristics at high angles-of-attack, prior to MS C.

» SUITABILITY

Available data are insufficient to provide a DOT&E assessment of operational suitability. The program office continues to work through known suitability limitations, most notably the aircraft escape system, logistic supportability issues, and Automatic Ground Collision Avoidance System (AGCAS).

As reported in the FY22 and FY23 Annual Reports, the T-7A emergency escape system does not meet minimum safety requirements for the Air Force's airworthiness certification and is currently operating with high-risk acceptance for air worthiness. A February 2024 sled test showed improvement at medium-speed ejections for the ejection seat sequencing. The program executed a high-speed test in June 2024 where the seat sequenced correctly, but a seat hose interfered with the seat sequencer switch, which could lead to an incorrect ejection mode. In the same test, the redesigned canopy fracturing system pattern did not function properly. The program must successfully complete seven more sled tests before the escape system can be certified for airworthiness and IOT&E.

The program office also continued to make progress on the T-7A OBOGS. The draft T-7A OBOGS test plan calls for 46 data points collected over 10 ground and 100 hours of flight test events, including high and sustained-g maneuvering. The integrated test team will continue to collect OBOGS test data during future IOT&E, as system components age and approach regularly scheduled maintenance and replacement. DOT&E will evaluate OBOGS performance in accordance with the current military standards document (MIL-STD-3050A), which incorporates lessons learned from several fighter aircraft mishaps.

AGCAS is another known suitability limitation. Fighter aircraft employ AGCAS to prevent loss of life during sustained high-g maneuvers, which can cause the pilot to lose consciousness. While the formal requirements for APT did not include AGCAS, the program office is developing a strategy to start AGCAS integration in FY26.

» SURVIVABILITY

Currently available data are insufficient to provide any survivability assessment. The APT FoS uses a training data link to connect T-7A aircraft with each other and to ground-based training systems. During FY24, the APT Program Office updated the Mission-Based Cyber Risk Assessment and conducted a fourth adversarial cyber developmental assessment of aircraft hardware, using a manned flight hardware simulator and GBTS simulator devices. These events will define the scope and resources outlined in the MS C TEMP to conduct cyber survivability testing on operationally representative aircraft and GBTS during IOT&E.

RECOMMENDATIONS

The Air Force should:

1. Continue addressing AFOTEC's periodic report recommendations and make necessary design changes prior to the start of IOT&E.
2. Continue testing the emergency escape system and implement fixes as needed to meet minimum safety of flight requirements.
3. Complete the integration of AGCAS capability to reduce safety risks.
4. Incorporate on-aircraft and data link cyber risk assessments during integrated testing and IOT&E.
5. Complete testing above Mach 0.95, prior to beginning IOT&E, for safety of flight.
6. Submit the MS C TEMP for DOT&E approval.