T-7A Advanced Pilot Training (APT)

Since receiving the contract award from the Air Force in FY18, Boeing has conducted developmental testing (DT) on the T-7A using contractor-owned, contractor-operated prototype aircraft. On June 28, 2023, after several program delays, the Air Force completed its first T-7A test flight in a production-representative Engineering and Manufacturing Development (EMD) aircraft. Government-led DT will begin in FY24 and IOT&E in FY26.

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 an unclassified data link.

MISSION

Air Education and Training Command (AETC) will use the APT FoS to train student pilots 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 on September 27, 2018. DOT&E approved the Milestone B Test and Evaluation Master Plan in January 2018. Due to the inability to meet the planned Milestone C threshold, the program office declared a schedule breech in June 2022. In April 2023, the Air Force approved an updated program schedule, which moves the Milestone C decision from December 2023 to February 2026 (threshold) and the full-rate production decision from September 2025 to January 2028 (threshold).

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

As of July 2023, Boeing flew 503 hours over 417 missions in two contractor-owned, contractor-operated prototype aircraft. The prototypes are substantially different from the EMD aircraft contracted for government-led DT and operational testing (OT). Therefore, DOT&E will not include test data from prototype aircraft in its final evaluation of system performance. Major differences between the aircraft include wing and empennage redesign, the escape system, on-board oxygen generating system (OBOGS), electrical system, and flight control software. Government-led DT is expected to begin in FY24 and complete in FY25; IOT&E is scheduled for 3QFY26 through 1QFY27.

Early program involvement by the Air Force Operational Test and Evaluation Center (AFOTEC) provided operational perspective and continuous feedback on Boeing's initial design efforts. AFOTEC Detachment 5 personnel stationed at the Boeing facility in St. Louis, Missouri, highlighted and helped resolve several significant program issues prior to government-led testing. In July 2023, AFOTEC published a 5th periodic report that added 7 new recommendations to the remaining 30 open recommendations from the previous reports. DOT&E concurs with AFOTEC's assessments and recommendations.

PERFORMANCE

» EFFECTIVENESS

Currently available data are inadequate to provide an independent assessment of operational effectiveness. However, prototype aircraft have demonstrated the necessary flying qualities, system, and subsystem performance to begin government-led DT. The program appears to have a clear pathway to resolving known effectiveness issues such as limited sortie duration and flight characteristics at high angle-of-attack.

» SUITABILITY

Currently available data are inadequate to provide an independent assessment of operational suitability. The program office continues to work through known suitability limitations, most notably the aircraft escape system, Automatic Ground Collision Avoidance System (AGCAS), and OBOGS.

As reported in FY22, the T-7A emergency escape system, including the canopy's bird strike resistance, does not meet minimum safety requirements for the Air Force's airworthiness certification. During the initial nine escape system tests, ejection events exceeded tolerances for impulse noise (acoustic pressure), probability of concussion, and probably of injury during parachute

deployment. While the system is still not compliant, a February 2023 test showed sufficient improvement for the Air Force to approve a waiver to begin government-led DT. The program added four additional escape system tests that will define the design changes required prior to delivering the T-7A to AETC.

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. Government-led DT will include aggressive maneuvering at low altitude to ensure current aircraft navigation and attitude heading reference systems support a future AGCAS upgrade.

Although not resolved, the program office has made progress on the T-7A OBOGS. In FY23, the program procured appropriate flight test instrumentation to collect operationally representative OBOGS data. The Air Force approved the instrument's airworthiness certification, and the program will begin collecting test data during government-led DT.

» SURVIVABILITY

Currently available data are inadequate to provide a survivability assessment. The APT program has made considerable progress to address cyber survivability, which DOT&E identified as a top critical issue in FY22. The APT FoS uses a training data link to connect T-7A aircraft with each other, and to ground based training systems. During FY23, the APT cyber integrated test team conducted an adversarial cyber development assessment of aircraft hardware and a cyber vulnerability identification (CVI) on the APT FoS data link. The test team shared the CVI findings with Boeing, which the contractor used to develop several software updates. The program office continues to pursue material and non-material solutions to other known cyber vulnerabilities. During IOT&E, DOT&E will independently assess cyber survivability to support the T-7A Milestone C and full-rate production decisions.

RECOMMENDATIONS

The Air Force should:

1. Continue addressing AFOTEC periodic report recommendations and make necessary design changes prior to the start of IOT&E.
2. Continue testing the emergency escape system (including canopy bird strike resistance) and implement fixes as needed to meet safety requirements.
3. Support AETC's future efforts to integrate AGCAS capability to reduce safety risks.
4. Incorporate on-aircraft and data link cyber assessments during integrated testing and IOT&E.