



TTCAA Advisory Circular

Subject: APPROVAL OF AVIATION TRAINING DEVICES

Reference: TAC-058

Effective Date: 20-Aug-2019

1. Purpose

This TTCAA Advisory Circular (TAC) provides information and guidance for an Aviation Training Device (ATD). The guidance covers both Basic Aviation Training Device and Advance Aviation Training Device. This TAC also provides information and guidance for those persons who intend to use a BATD or AATD for activities involving pilot training and experience other than for practical tests, aircraft-type-specific training, or an aircraft type rating.

Note 1: *Practical Tests, aircraft type specific training, or aircraft type rating are not covered in this TAC.*

Note 2: *This TAC applies only to the evaluation and use of BATDs and AATDs. Flight Training devices and Full Flight Simulators will be covered in a separate Advisory Circular. Hence, this circular does not apply to full flight simulators (FFS) and flight training devices (FTD) that are used for Type Ratings, Flight Crew Member certification or qualification.*

APPROVED BY:

Francis Regis

Director General of Civil Aviation

Signature

Date

2. Cancellation

The TAC cancels and supersedes **TAC-048**

3. Background

Significant developments in computer flight simulation and visual graphics capability have led to the increased use of advanced flight simulation training devices in General Aviation (GA). The GA community is using this evolving simulation technology to provide increasingly effective training capabilities at reduced cost. This TAC reflects other major CAAs experience with simulation technology used to meet specific regulatory flight training and experience requirements.

4. Related Regulation(s)

TTCAR Nos. **1:34 (4), 1:43 (4), 1:60 (3), 1:112 (2) (c) (iii), 1:113, 1:114 (1), 1:114 (2)**

5. Definitions

- (a) **Aviation Training Device (ATD).** An ATD is a training device, other than a full flight simulator (FFS) or flight training device (FTD), that has been evaluated, qualified, and approved. In general, this includes a replica of aircraft instruments, equipment, panels, and controls in an open flight deck area or an enclosed aircraft cockpit. It includes the hardware and software necessary to represent a category and class of aircraft (or set of aircraft) operations in ground and flight conditions having the appropriate range of capabilities and systems installed in the device as described within this advisory circular (AC) for the specific basic or advanced qualification level.
- (b) **Basic Aviation Training Device (BATD).** A BATD is a device that:
- (1) Meets or exceeds the criteria outlined in Paragraph **9**, Basic Aviation Training Device (BATD) Requirements.
 - (2) Provides an adequate training platform and design for both procedural and operational performance tasks specific to the ground and flight training requirements for Private Pilot Licence, instrument rating and instrument recency of experience.
 - (3) Provides an adequate platform for both procedural and operational performance tasks required for instrument experience and pilot time.
 - (4) The TTCAA finds acceptable in a manner described in this TAC.

- (c) **Advanced Aviation Training Device (AATD).** An AATD is a device that:
- (1) Meets or exceeds the criteria outlined in Paragraph 9.
 - (2) Meets or exceeds the criteria outlined in Paragraph 10, Advanced Aviation Training Device (AATD) Requirements.
 - (3) Provides an adequate training platform for both procedural and operational performance tasks specific to the ground and flight training requirements for Private Pilot Licence, Instrument rating, Commercial Pilot Licence, and Flight Instructor Licence.
 - (4) Provides an adequate platform and design for both procedural and operational performance tasks required for instrument experience, the instrument proficiency check, and pilot time.
 - (5) The TTCAA finds acceptable in a manner described in this TAC.
- (d) **Qualification and Approval Guide (QAG).** The QAG is a required detailed description of the systems and design criteria for a BATD or AATD. The required design criteria for a BATD are described in Paragraph 9. The additional design criteria for an AATD are described in Paragraph 10. This will include all the required elements of design and functionality.

Note: *A manufacturer or operator who modifies an ATD in any manner must submit a revised QAG to the Authority in which the initial Letter of Authorization was granted. This is required to ensure the letter of authorization (LOA) remains valid. This requirement ensures that the standards of the initial approval are maintained, including model identification, design, system integrity, aerodynamic modeling, and other essential characteristics of the hardware/software components.*

6. Functions, Performance and Use of ATDs

ATDs cannot be used for practical tests, aircraft type specific training, or for an aircraft type rating. Operators, ATOs and other Aviation Organizations meeting the guidance and standards provided in this TAC will receive a letter of authorization (LOA) from the TTCAA approving them as either a BATD or AATD. The LOA will be valid for a 5-year period with a specific expiration. Instructors can successfully teach procedural skills (such as performing a before landing checklist) during ground training using ATDs. In addition, operational skills (such as flying a proper traffic pattern or a stabilized approach) can also be effectively taught with the use ATDs. These procedural and operational skills can then be positively transferred to appropriate actions in the aircraft.

7. Approval Request and Process Overview

- 7.1 The organization seeking approval of an ATD must submit the following:
- (a) The Letter of Authorization from the Authority that granted initial certification of the device with an approved copy of the QAG
 - (b) Manufacturer designation of the ATD
 - (c) Location of the ATD
 - (d) Specific purpose of the ATD
 - (e) Course Curricula which include the use of ATDs.
 - (f) Quality System for the Training device.
- 7.2 Following submission of the approval request, the TTCAA will evaluate the device by way of subjective flight testing.
- 7.3 Once successful, a Letter of Approval will be issued by the TTCAA defining its specific use.

8. Approval of ATD under TTCAR No. 1 and TTCAR No. 9

To be approved for use for pilot training and experience requirements under TTCAR No. 1 and TTCAR No. 9, an ATD shall:

- (a) Be capable of providing procedural training in all areas of operation for which it is to be used. Those tasks should be specified in an acceptable training curriculum or as specifically authorized by the TTCAA.
- (b) Have the following documents available for review by the student and instructor (being able to retrieve these documents electronically is acceptable):
 - (1) The LOA for authorized use of the ATD.
 - (2) The approved QAG for the ATD being used.
 - (3) Performance information for the aircraft configurations being represented.

Note 1: *Relocation of the ATD will invalidate its approval and will require a re-assessment including flight testing*

Note 2: *Any change of parts that affect the appearance of the device and/or software update which alters the functions will invalidate the Letter of Approval.*

- (c) Successfully pass the startup self-test described in Paragraph 9 (c) (2). After the ATD self-test is complete, no software other than that necessary for the operation of the ATD will be utilized on the computer running the ATD software.
- (d) Remain in the approved configuration during the training session. Authorized ATD instruction should not proceed after a malfunction of the ATD system has occurred (e.g., failure of the visuals, flight controls, instruments, etc.). The operator should correct the ATD malfunction and repeat the startup test described in Paragraph 9 (c) (2) before resuming authorized instruction.

9. Basic Aviation Training Device

Certification of the device with an approved copy of the QAG is the initial means for determining whether a BATD is acceptable for use in pilot training or an ATO. A BATD found acceptable for use will typically be limited to training procedural tasks only. However, they may also be used to meet instrument experience requirements when specifically authorized. Each QAG must state the make and model of aircraft or family of aircraft being represented and used as the basis for the following criteria:

- (a) **Controls.** A BATD must provide certain physical controls and may provide some virtual controls.
 - (1) Physical flight and aircraft system controls should be recognizable as to their function and how they are to be manipulated solely from their appearance. Physical flight and aircraft system controls eliminate the use of interfaces such as a keyboard, mouse, or gaming joystick to control the represented aircraft model in simulated flight.
 - (2) For the purpose of this TAC, virtual control is any input device to control aspects of the simulation (such as setting aircraft configuration, location, and weather) and to program, pause, or freeze the device.
 - (3) Except for setup and/or fault mode entry, neither the keyboard nor the mouse may be used to set or position any feature of the BATD in the represented aircraft for the maneuvers or flight training to be accomplished. The pilot must operate the additional equipment needed in order to accomplish a training procedure as listed in this paragraph in the same manner in which it would be operated in the actual aircraft. This would include the landing gear, wing flaps, cowl flaps, and carburetor heat, mixture, propeller, and throttle controls.
 - (4) The physical arrangement, appearance, and operation of controls, instruments, and switches required by this paragraph should closely model the aircraft in the family of aircraft represented. The ATD is expected to recreate the appearance, arrangement, operation, and function of realistically placed physical switches and other required controls representative of an aircraft instrument panel that includes at least the following:
 - i. Master/battery;
 - ii. Magnetos for each engine (as applicable);
 - iii. Alternators or generators for each engine;
 - iv. Auxiliary power unit (APU) (if applicable);
 - v. Fuel boost pumps/prime boost pumps for each engine;
 - vi. Avionics master;
 - vii. Pitot heat; and
 - viii. Rotating beacon/strobe, navigation, taxi, and landing lights.
 - (5) When an TTCAA-approved BATD is in use, only the software package evaluated and approved by the TTCAA may be loaded for use on that system to avoid negative impact on available system resources.

- (b) **Control Requirements.** Physical flight and aircraft system controls must be provided as follows:
- (1) A self-centering displacement yoke or control stick that allows continuous adjustment of pitch and bank.
 - (2) Self-centering rudder pedals that allow continuous adjustment of yaw and corresponding reaction in heading and roll.
 - (3) Throttle or power control(s) that allows continuous movement from idle to full-power settings and corresponding changes in pitch and yaw, as applicable.
 - (4) Mixture/condition, propeller, and throttle/power control(s) as applicable to the aircraft or family of aircraft represented.
 - (5) Controls for the following items, as applicable to the category and class of aircraft represented:
 - i. Wing flaps,
 - ii. Pitch trim,
 - iii. Communication and navigation radios,
 - iv. Clock or timer,
 - v. Gear handle (if applicable),
 - vi. Transponder,
 - vii. Altimeter,
 - viii. Carburetor heat (if applicable), and
 - ix. Cowl flaps (if applicable).
- (c) **Control Inputs**
- (1) Time from control input to recognizable system response must be without delay (i.e., not appear to lag in any way).
 - (2) The control inputs must be tested by the computer and software at each startup and displayed as a confirmation message or a warning message that the transport delay time or any design parameter is out of original tolerances. It should not be possible to continue the training session unless the problem is resolved, and all components are functioning properly. This test should consider the items listed under “Display Requirements” in the subparagraph below.
- (d) **Display Requirements.**
- (1) Instruments and indicators replicated and properly located as appropriate to the aircraft represented:
 - i. Flight instruments in a standard configuration representing the traditional “round” flight instruments. An electronic primary flight display (PFD) with reversionary and backup flight instruments will also be acceptable.
 - ii. A sensitive altimeter with incremental markings each 20 feet or less, operable throughout the normal operating range of the aircraft or family of aircraft represented.
 - iii. A magnetic direction indicator.
 - iv. A heading indicator with incremental markings each 5 degrees or less, displayed on a 360-degree circle. Arc segments of less than 360 degrees may be selectively displayed if desired or required, as applicable to the aircraft or family of aircraft represented.

- v. An airspeed indicator with incremental markings as shown on the aircraft or family of aircraft represented; airspeed markings of less than 40 knots need not be displayed.
- vi. A vertical speed indicator with incremental markings each 100 fpm for both climb and descent, for the first 1,000 feet per minute (fpm) of climb and descent, and at each 500 fpm climb and descent for the remainder of a minimum $\pm 2,000$ fpm total display, or as applicable to the aircraft or family of aircraft being represented.
- vii. A gyroscopic rate-of-turn indicator or equivalent with appropriate markings for a rate of 3 degrees per second turn for left and right turns. If a turn and bank indicator is used, the 3 degrees per second rate index must be inside of the maximum deflection of the indicator.
- viii. A slip and skid indicator with coordination information displayed in the conventional skid ball format where a coordinated flight condition is indicated with the ball in the center position. A split image triangle indication may be used if applicable to the aircraft or family of aircraft being represented.
- ix. An attitude indicator with incremental markings each 5 degrees of pitch or less, from 20-degree pitch up to 40-degree pitch down or as applicable to the aircraft or family of aircraft represented. Bank angles must be identified at "wings level" and at 10, 20, 30, and 60 degrees of bank (with an optional additional identification at 45 degrees) in left and right banks.
- x. Engine instruments as applicable to the aircraft or family of aircraft being represented, providing markings for normal ranges and minimum and maximum limits.
- xi. A suction gauge or instrument pressure gauge with a display applicable to the aircraft represented.
- xii. A flap setting indicator that displays the current flap setting. Setting indications should be typical of that found in an actual aircraft.
- xiii. A pitch trim indicator with a display that shows zero trim and appropriate indices of airplane nose down and airplane nose up trim, as would be found in an aircraft.
- xiv. Communication radio(s) with display(s) of the radio frequency in use.
- xv. Navigation radio(s) capable of replicating both precision and non-precision instruments, including approach procedures (each with an aural identification feature), and a marker beacon receiver. For example, an instrument landing system (ILS), non-directional radio beacon (NDB), Global Positioning System (GPS), Localizer (LOC) or Very high frequency Omnidirectional Range (VOR). Graduated markings as indicated below must be present on each course deviation indicator (CDI) as applicable. The marking should include:
 - (A) One-half dot or less for course/glideslope (GS) deviation (i.e., VOR, LOC, or ILS), and
 - (B) Five degrees or less for bearing deviation for automatic direction finder (ADF) and radio magnetic indicator (RMI), as applicable.
- xvi. A clock with incremental markings for each minute and second, or a timer with a display of minutes and seconds.
- xvii. A transponder that displays the current transponder setting.

- xviii. A fuel quantity indicator(s) that displays the fuel remaining, either in analog or digital format, appropriate for the aircraft or family of aircraft represented.

NOTE: *The minimum instrument and equipment requirements specified under TTCAR No. 7 must be functional during the training session.*

- (2) All instrument displays listed in paragraph 9 (d) must be visible during all flight operations. Allowances can be made for multifunction electronic displays that may not display all instruments simultaneously. The update rate of all displays must provide an image of the instrument that:
 - i. Does not appear to be out of focus or illegible.
 - ii. Does not appear to “jump” or “step” to a distracting degree during operation.
 - iii. Does not appear with distracting jagged lines or edges.
 - iv. Does not appear to lag relative to the action and use of the flight controls.
- (3) Control inputs should be reflected by the flight instruments in real time and without a perceived delay in action. Display updates must display all changes (within the total range of the replicated instrument) that are equal to or greater than the values stated below:
 - i. Airspeed indicator: change of 5 knots.
 - ii. Attitude indicator: change of 2 degrees in pitch and bank.
 - iii. Altimeter: change of 10 feet.
 - iv. Turn and bank: change of ¼ standard rate turn.
 - v. Heading indicator: change of 2 degrees.
 - vi. Vertical speed indicator (VSI): change of 100 fpm.
 - vii. Tachometer: change of 25 rpm or 2 percent of turbine speed.
 - viii. VOR/ILS: change of 1 degree for VOR or ¼ of 1 degree for ILS.
 - ix. ADF: change of 2 degrees.
 - x. GPS: change as appropriate for the model of GPS based navigator represented.
 - xi. Clock or timer: change of 1 second.
- (4) Displays must reflect dynamic behavior of an actual aircraft display (e.g., a VSI reading of 500 fpm must reflect a corresponding movement in altimeter and an increase in power must reflect an increase in the rpm indication or power indicator).

(5) Flight Dynamics Requirements.

- i. Flight dynamics of the ATD should be comparable to the way the represented training aircraft performs and handles. However, there is no requirement for an ATD to have control loading to exactly replicate any particular aircraft. An air data-handling package is not required for determination of forces to simulate during the manufacturing process.
- ii. Aircraft performance parameters (such as maximum speed, cruise speed, stall speed, maximum climb rate, and hovering/sideward/forward/rearward flight) should be comparable to the aircraft or family of aircraft being represented. A performance table will need to be included in the QAG for each aircraft configuration for sea level and 5,000 feet.
- iii. Aircraft vertical lift component must change as a function of bank comparable to the way the aircraft or family of aircraft being represented performs and handles.
- iv. Changes in flap setting, slat setting, gear position, collective control, or cyclic control must be accompanied by changes in flight dynamics comparable to the way the aircraft or family of aircraft represented performs and handles.
- v. The presence and intensity of wind and turbulence must be reflected in the handling and performance qualities of the simulated aircraft and should be comparable to the way the aircraft or family of aircraft represented performs and handles.

(6) Instructional Management Requirements.

- i. The instructor must be able to pause the system at any point for the purpose of administering instruction regarding the task.
- ii. If a training session begins with the “aircraft in the air” and ready for the performance of a particular procedural task, the instructor must be able to manipulate the following system parameters independently of the simulation:
 - (A) Aircraft geographic location,
 - (B) Aircraft heading,
 - (C) Aircraft airspeed,
 - (D) Aircraft altitude, and
 - (E) Wind direction, speed, and turbulence.
- iii. The system must be capable of recording both a horizontal and vertical track of aircraft movement during the entire training session for later playback and review.
- iv. The instructor must be able to disable any of the instruments prior to or during a training session and be able to simulate failure of any of the instruments without stopping or freezing the simulation to affect the failure.
- v. The ATD must have at least a navigational area database that is local to the training facility to allow reinforcement of procedures learned during actual flight in that area.

10. Advanced Aviation Training Device

Devices presented for approval as an AATD must first meet or exceed the requirements for BATD approval criteria contained in Paragraph 9. An AATD must display sufficient aircraft cockpit design, ergonomic features, and performance characteristics beyond that of the BATD approval criteria to qualify for the authorized uses appropriate for the AATD simulation devices. Since it is highly desirable for the pilot to be mentally immersed in a realistic aircraft cockpit when using an AATD, design features must significantly exceed those of a BATD cockpit layout.

- (a) An AATD must include the following features and components:
- (1) A realistic shrouded (enclosed) or unshrouded (open) cockpit design and instrument panel arrangement representing a specific model aircraft cockpit.
 - (2) Cockpit knobs, system controls, switches, and/or switch panels in realistic sizes and design appropriate to each intended function, in the proper position and distance from the pilot's seated position, and representative of the category and class of aircraft being represented.
 - (3) Primary flight and navigation instruments appropriately sized and properly arranged that exhibit neither stepping nor excessive transport delay.
 - (4) Digital avionics panel.
 - (5) Global Positioning System (GPS) navigator with moving map display.
 - (6) Two-axis autopilot, and, as appropriate, a flight director (FD). This is not required for an ATD representing a helicopter.
 - (7) Pitch trim (manual or electric pitch trim) permitting indicator movement either electrically or analog in an acceptable trim ratio.
 - (8) An independent visual system, panel, or screen that provides realistic cues in both day and night visual flight rules (VFR) and instrument flight rules (IFR) meteorological conditions to enhance a pilot's visual orientation in the vicinity of an airport including:
 - i. Adjustable visibility parameters; and
 - ii. Adjustable ceiling parameters.
 - (9) A pilot seat appropriate to the aircraft configuration.
 - (10) Rudder pedals secured to the cockpit floor structure, or that can be physically secured to the floor beneath the device in proper relation to cockpit orientation.
 - (11) Push-to-talk switch on the control yoke.
 - (12) A separate instructor station to permit effective interaction without interrupting the flight in overseeing the pilot's horizontal and vertical flight profiles in real time and space. This must include the ability to:
 - i. Oversee tracks along airways, holding entries and patterns, and Localizer (LOC) and glideslope (GS) alignment/deviation (or other approaches with a horizontal and vertical track).
 - ii. Function as air traffic control (ATC) in providing vectors, etc., change in weather conditions, ceilings, visibilities, wind speed and direction, light/moderate/severe turbulence, and icing conditions.
 - iii. Invoke failures in navigation and instruments, radio receivers, landing gear and flaps, engine power (partial and total), and other aircraft systems (pitot, electric, static, etc.) by using either a keyboard or mouse.
 - (13) Capable of simulating all of the emergency procedures for which a checklist is prescribed in the aircraft pilot's operating handbook (POH) or flight manual.
- (b) The following features and components are not required for the TTCAA's approval of an AATD, but are encouraged:
- (1) Automated ATC communications, scenario-based training, or line-oriented type training in which the instructor can evaluate pilot performance without having to act as ATC;
 - (2) Multi-panel or wrap-around visual system providing 120 degrees or more of horizontal vision;
 - (3) Loss of performance and aerodynamic changes from ice accretion; and

- (4) Realistic aircraft engine sound appropriate to the aircraft configuration, power settings, and speed.
- (5) A magnetic compass with incremental markings each 5 degrees, that displays the proper lead or lag during turns, and displays incremental markings typical of that shown in the aircraft.

Note: *The TTCAA will allow touch screen functionality to be used in an ATD for those functions or tasks executed in an aircraft that are simple push-button actions (or similar) to replicate similar actions on the instrument panel or flight deck, to control aircraft systems or avionics. However, for actions that require a twisting or turning action of a physical knob, and/or require a gripping or pulling action of a physical lever or handle to actuate a system in the aircraft, the trainer must have a similar physical knob/lever/handle representation in the AATD.*