



U.S. Department
of Transportation
Federal Aviation
Administration

Advisory Circular

Subject: FAA Approval of Basic Aviation
Training Devices (BATD) and
Advanced Aviation Training Devices
(AATD)

Date: 7/14/08

AC No: 61-136

Initiated by: AFS-800

Change:

1. PURPOSE.

a. This advisory circular (AC) provides information and guidance for Aviation Training Device (ATD) manufacturers seeking Federal Aviation Administration (FAA) approval of basic aviation training devices (BATD) or advanced aviation training devices (AATD) under Title 14 of the Code of Federal Regulations (14 CFR) part 61, § 61.4(c). This AC also provides information and guidance for those persons who intend to use a BATD or AATD for activities involving pilot training or certification, other than for aircraft type specific training or for an aircraft type rating. The FAA will determine and approve appropriate uses for an ATD.

b. This AC also contains procedures regarding the approval for the use of an ATD under 14 CFR parts 61 and 141. Criteria specified in this AC are those used by the FAA to determine whether an ATD is qualified and, if qualified, whether it is qualified at the BATD or the AATD level.

c. While these guidelines are not mandatory, they are derived from extensive FAA and industry experience in determining methods of compliance with the pertinent 14 CFR regulations. Mandatory terms used in this AC such as “shall,” “must,” or “will” are used only in the sense of ensuring applicability when the compliance methods described in this AC are used to comply with the regulatory requirements. Applicable regulations are referenced to ensure compliance with those regulations. This AC does not change regulatory requirements; therefore, the provisions of the current regulation always control. This document does not interpret the regulations, as interpretations are issued only under established agency procedures. This AC applies only to the evaluation of BATDs and AATDs.

2. CANCELLATION. This AC provides information regarding the qualification and use of ATDs and expands upon existing guidance, including:

a. This AC cancels AC 61-126, Qualification and Approval of Personal Computer-Based Aviation Training Devices, dated 5/12/97.

b. This AC cancels AC 120-45, Airplane Flight Training Device Qualification, dated 2/5/92.

NOTE: Requests for approval of a personal computer-based aviation training device (PCATD) and a Level 1, 2 or 3 flight training device (FTD)

should now adhere to the requirements of this AC. Approvals for all other FTDs must adhere to the requirements of 14 CFR part 60.

3. RELATED CFR REFERENCES (current editions).

- a. 14 CFR part 61, §§ 61.4, 61.43, 61.45, 61.51, 61.57, 61.65, 61.109, 61.129, and 61.157.
- b. 14 CFR part 141, §§ 141.41, 141.55, 141.57, and appendices B, C, D, E, F, G, I, and K.

4. AC AUDIENCE. ATD manufacturers, student pilots, instructors, and others involved in flight training and operations under parts 61 or 141 should be familiar with the content of this AC.

a. This AC provides information and guidance relevant to the performance and the effective use of ATDs for pilot training or certification, other than for aircraft type specific training or for an aircraft type rating. Manufacturers of devices meeting the guidance and standards in this AC will receive a document from the FAA Flight Standards Service's General Aviation and Commercial Division, AFS-800, approving them as either a BATD or AATD with an accompanying authorized use statement. Local FAA district offices may use that document to approve the use of the specific ATD in a pilot school curriculum.

b. A new ATD that has not previously been assessed, must be satisfactorily assessed in those areas essential to completing the airman training and checking process to the extent recommended in the qualification issued and as outlined in Appendix 1 (General Information), Appendix 2 (Basic Aviation Training Device (BATD) Requirements), Appendix 3 (Advanced Aviation Training Device (AATD) Requirements), and Appendix 5 (Aviation Training Device (ATD) Approval Process Steps) of this AC.

5. RELATED READING MATERIAL.

- a. FAA-S-8081-4, Instrument Rating Practical Test Standards.
- b. FAA-S-8081-12, Commercial Pilot Practical Test Standards.
- c. FAA-S-8081-5, Airline Transport Pilot Practical Test Standards.
- d. FAA Order 8900.1, Volume 11, Chapter 10, Section 1, Approval and Authorized Use under 14 CFR Parts 61, 141, and 142.

6. BACKGROUND. During the past several years, significant developments in computer simulation and visual graphic processing ability have led to the increased use of advanced flight simulation training devices in General Aviation (GA). The GA community is using the new and emerging simulation technology to provide increasingly effective training capability at reduced cost. However, the FAA has determined that not all evaluated simulation technology is acceptable for GA training purposes. Therefore, the FAA is consolidating the existing guidance into this publication to formally recognize the suitability of certain GA flight simulation training devices. This AC reflects the FAA's experience with simulation technology since the development of AC 61-126 in 1991, its final issuance in 1997, and its use as approval guidance

for PCATDs. Operators may use these devices to meet specific regulatory flight training and certification requirements of parts 61 and 141.

a. Flight Task Procedural Skills. Instructors have typically taught flight task procedural skills almost exclusively during in-flight training and aeronautical knowledge during ground training. However, based on the available data, the FAA has determined that instructors can successfully teach procedural understanding of certain flight tasks during ground and flight training using the flight simulation devices described in this AC.

b. Flight Task Operational Performance Skills. Instructors have typically taught flight task operational performance skills in FAA-approved flight training devices or in flight simulators meeting approval criteria that differ from the criteria in this AC. Recent evaluations of ATD technology strongly suggests that instructors can effectively teach these skills during ground and flight training using the flight simulation device criteria described in this AC.

c. Evaluations of ATDs and Associated Aviation Training Software. The FAA evaluated many computer hardware and software applications at the request of manufacturers and potential users. The FAA conducted these evaluations to determine whether elements of pilot training and certification, recency of experience, and other requirements of parts 61 or 141 could be met using ATDs. Institutions such as Embry-Riddle Aeronautical University and the University of Illinois, under a FAA research grant, evaluated the training effectiveness of various ATD configurations. The FAA appreciates the help provided by these educational institutions in evaluating this emerging and innovative computer hardware and software technology. The FAA has determined that there is sufficient justification to allow specifically approved use of qualified ATDs. Pilots and instructors may use ATDs to meet the certain training requirements under the applicable rules of part 61 or part 141. However, instructors are encouraged to use either an approved BATD or an AATD in support of an integrated ground and flight training syllabus.

7. ACTION. Manufacturers choosing this AC as a method of compliance must satisfy all of the AC requirements to obtain approval of the device. Appendix 2 is exclusively for BATDs and Appendix 3 is exclusively for AATDs. Once the FAA determines that an ATD is satisfactory, and the applicable level of ATD is applied to the device, all approvals for use in pilot training and certification, including approvals for use under parts 61 and 141, must be in accordance with (IAW) this AC. Training offered in the device must not exceed FAA approval authorizations. No approvals or authorizations will be given for an aircraft type rating on an airman certificate.

8. AUTHORIZATIONS FOR PREVIOUSLY APPROVED DEVICES (“GRANDFATHERING”).

a. An operator may continue to use a device, as originally approved, to substitute for aircraft flight training or airman certification. These uses must not be for aircraft type specific training or for an aircraft type rating. The device may only be used if it was originally approved and continues to meet the criteria set forth for:

(1) PCATD;

(2) Level 2 or Level 3 FTD; or

(3) A device categorized as a Level 1 (“conferred status”) FTD.

b. Devices approved prior to this AC will not qualify for the new approval as a BATD or AATD.

ORIGINAL SIGNED BY

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APPENDIX 1. GENERAL INFORMATION**1. DEFINITIONS.**

a. Basic Aviation Training Device (BATD). A BATD is a device that:

(1) Meets or exceeds the criteria outlined in Appendix 2 (BATD Requirements) of this advisory circular (AC),

(2) Provides a training platform for at least the procedural aspects of flight relating to an integrated ground and flight instrument training curriculum, and

(3) The Federal Aviation Administration (FAA) finds acceptable in a manner as outlined in this AC.

b. Advanced Aviation Training Device (AATD). An AATD is a device that:

(1) Meets or exceeds the criteria outlined in Appendix 2;

(2) Meets or exceeds the criteria outlined in Appendix 3 (AATD Requirements);

(3) Provides a training platform for both procedural and operational performance tasks related to ground and flight training towards private pilot, commercial pilot, and airline transport pilot certificates, a flight instructor certificate, and instrument rating per Title 14 of the Code of Federal Regulations (14 CFR) parts 61 and 141; and

(4) The FAA finds acceptable in a manner as outlined in this AC.

c. Consensus Evaluation Team (CET). Persons assigned by the FAA to conduct an evaluation of an Aviation Training Device (ATD).

d. Integrated Ground and Flight Instrument Training Curriculum. This is a curriculum that uses a BATD for each flight task where an instructor teaches the required knowledge in the classroom and follows it with procedural training. It is not a regular curriculum in which an instructor teaches the required knowledge for each flight task and follows it with procedures without concern for applicable motor skills. When the student is proficient in knowledge and procedures for a task, the instructor adds the psychomotor skills for that task. For example, in an integrated ground and flight instrument training curriculum, an instructor typically teaches the required knowledge for an instrument landing system (ILS) approach through ground training. The instructor adds flight procedures in the ground-training environment. The student uses a BATD, or other acceptable flight simulation device, to practice these procedures in the simulated flight environment. After the student has gained the required knowledge and learns the procedures, the instructor then adds the psychomotor skill elements of the task. The instructor may do this by providing a flight environment in a specifically approved ATD, flight training device (FTD), a qualified and approved flight simulator, or an aircraft.

NOTE: The FAA recommends that instructors use an ATD in an integrated training curriculum because of the benefits that training curriculum provides.

e. Qualification and Approval Guide (QAG). The QAG is an outline of the design criteria for a BATD or AATD. The design criteria for a BATD are described in Appendix 2, paragraph 8. The design criteria for an AATD are described in Appendix 3, paragraph 3.

f. Revised QAG. A manufacturer or operator who modifies an ATD in any manner must submit a revised QAG to the FAA as described in Appendix 2. This requirement ensures that the desired standards of the originally approved ATD are maintained, including model identification, design, system integrity, aerodynamic modeling, and other essential characteristics of the hardware/software components. The requirement to submit a revised QAG does not preclude minor changes determined by the FAA to have minimal effect on the functional capability of the ATD. Further, it does not preclude changes limited to specific hardware/software “mix and match” elements clearly identified in an approved revision to a QAG for the specific device developed by the manufacturer and intended for sale to the public as an optional ATD model configuration. However, submitting a revised QAG will ensure that exceptions to the more desirable design standards in ATD configurations are minimized. It will also ensure that one-of-a-kind approvals are not issued to individual owners/operators for ATDs that were not intended for sale to the public unless found acceptable to AFS-800.

2. PROCESS OVERVIEW. The manufacturer of a BATD or AATD should incorporate the most advanced simulation technology available to represent a generic category and class of aircraft. The manufacturer then provides AFS-800 with suitable documents describing the capability of the ATD IAW this publication.

a. The manufacturer should ensure that all functions and ground and flight performance attributes required by this publication are met by performing the maneuvers, procedures, and operational training tasks applicable to the ATD.

b. After AFS-800 conducts a “desk audit” of the required QAG documents, the FAA’s CET will conduct an evaluation of the ATD for consideration and approval. If the evaluation is successful, AFS-800 will provide specific approval of the ATD for use under the applicable rules in 14 CFR parts 61 and 141.

c. In addition, a 14 CFR part 141 certificated pilot school must obtain a specific authorization for the use of the ATD as part of that pilot school’s approved training curriculum. This authorization must come from the FAA Flight Standards District Office (FSDO) assigned to that pilot school.

3. INFORMATION. Direct all inquiries regarding the evaluation and approval of BATD or AATDs to FAA Flight Standards Service, General Aviation and Commercial Division, Certification and General Aviation Operations Branch, AFS-810, 800 Independence Avenue, S.W., Washington, DC 20591, or (202) 267-8212.

APPENDIX 2. BASIC AVIATION TRAINING DEVICE (BATD) REQUIREMENTS

1. PURPOSE. This appendix describes the process the FAA uses to approve a BATD for flight training IAW the requirements of 14 CFR parts 61 and 141.

2. AUTHORIZED USE.

a. Instruction by an Authorized Instructor. Flight simulation devices meeting acceptable FAA standards are very beneficial when used under the supervision of an authorized instructor. Pilots can use the devices to learn procedural tasks such as holding pattern entries, instrument approach procedures, missed approach procedures, and some operational performance tasks. An authorized instructor must administer and properly endorse the training to satisfy the regulatory requirements.

b. Authorized Use of a BATD to Credit Flight Experience as a Means to Obtaining Flight Experience in a Flight Simulator, FTD, or Aircraft. This appendix provides for a specific element of training time in a BATD meeting FAA standards instead of the total flight-hours that pilots would otherwise complete in a qualified flight simulator, FTD, or aircraft to meet the requirements of parts 61 or 141. The FAA will approve a BATD meeting the criteria found in this appendix for:

- Not more than 10 hours toward instrument rating flight instruction time under part 61, § 61.65(e)(2);
- Not more than 10 hours toward instrument rating flight instruction time under part 141, appendix C;
- Use in performing instrument recency of experience requirements of § 61.57(c)(1);
- Not more than 2.5 hours of training permitted under § 61.109(k)(1) in the introduction to the operation of flight instruments, except as limited by part 141 appendices; and
- The flight experience allowance for the use of a BATD and the flight experience allowance for an AATD, an FTD or a flight simulator towards obtaining an instrument rating may be combined. However, that combination may not exceed that allowed under § 61.65 (20 hours maximum) and may not exceed that allowed under part 141, appendix C, paragraph 4(b)(4) (50 percent maximum) of the required training.

NOTE: A part 141 certificated pilot school must obtain a specific authorization for the use of the ATD as part of that pilot school's approved training curriculum. This authorization must come from the FAA FSDO assigned to that pilot school.

3. CRITERIA FOR APPROVAL AND ACCEPTANCE OF A BATD.

a. The FAA approves each configuration of an ATD. Normally, the manufacturer requests this approval. The approval will be valid for all serial numbers that are part of that configuration, provided there is no change in that configuration, or in a value for a criterion in paragraph 8.

b. To request FAA approval of a BATD, manufacturers should send approval requests to:

(1) By regular mail: FAA Flight Standards Service, General Aviation and Commercial Division, Certification and General Aviation Operations Branch, AFS-810, 800 Independence Avenue, S.W., Washington, DC 20591.

(2) By e-mail: (call (202) 267-8212 for e-mail instructions).

NOTE: E-mail, with attached text format documents, is the preferred correspondence method.

c. The request for approval must include a QAG, which should:

(1) Contain a detailed description of the hardware and software components that comprise the device configuration presented for approval. A detailed description should be submitted for each device configuration if approval for more than one device configuration is desired. The description of the hardware and software components must include the manufacturer and model or version number of each component, or other such information necessary to correctly identify each component in the particular configuration;

(2) Contain a word-for-word listing of each title, number, and letter item listed in paragraph 8 of this appendix and state the following information for each item:

- The operation or role of the item as appropriate to the aircraft or family of aircraft being represented,
- The value for each quantitative requirement that either meets or exceeds the minimum values required by that paragraph, and
- If the aircraft or family of aircraft represented by the device does not have the referenced item, report it as in the following examples: “Carburetor Heat-N/A,” “Cowl Flaps-N/A,” or “Retractable Landing Gear-N/A.”

(3) Contain color photographs of the assembled unit in the intended device configuration. The photographs should be of a quality that clearly shows the overall component arrangement, features, ergonomics, and operation of each hardware control listed in paragraph 8, as appropriate to the aircraft or family of aircraft being represented;

(4) Be sent at least 90 days before any intended training or use of the device begins; and

(5) Provide operating instructions or manual including at least a detailed explanation of the device operating system, installation of components and/or modules, all commands and

menus, system setup, operation, troubleshooting suggestions, and appropriate aircraft operating information. The device operating manual and installation materials may be sent separately.

d. The requirements in paragraphs 3a and 3b are necessary to permit the FAA to tentatively determine the acceptability of a device as an ATD by conducting a comprehensive in-office evaluation (desk audit). The FAA will evaluate the proper identification, function, and location in a configuration representing a generic aircraft cockpit instrument panel and the associated flight controls for all instruments, equipment, panels, switches, systems, and controls.

e. If the desk audit is acceptable, AFS-810 will schedule an on-site evaluation of the operational device. FAA personnel will conduct this evaluation. The FAA may conduct an on-site evaluation at the manufacturer's facility or at another location agreeable to the manufacturer and the FAA. The on-site evaluation will stress all operational roles, verify adherence to values stated for each item required by this document, determine the acceptability of the device's use for flight instruction in the procedural tasks listed in paragraph 9 and establish the acceptability of operating instructions for the use of the device.

- If the on-site evaluation is acceptable, the FAA will approve the QAG for the ATD configuration presented.
- If the on-site evaluation is unacceptable, the FAA will advise the applicant of the changes or corrections necessary for the FAA's reconsideration. If deemed necessary, the FAA will conduct a follow-up on-site evaluation.
- If the FAA evaluates a revision to the QAG that was previously found acceptable and validated by an on-site evaluation, the FAA may conduct another on-site evaluation of the revised ATD configuration.

f. Once the FAA finds a QAG acceptable and approves the device as a BATD, the manufacturer must ensure that all ATDs manufactured in that configuration continue to meet the criteria stated in the associated QAG or in a FAA-approved revision to that QAG.

g. The ATD manufacturer must include copies of the following documents with each ATD manufactured and delivered for sale under an acceptable QAG:

- A copy of the AFS-800 manager's letter of approval and authorized use of the ATD,
- A copy of the ATD QAG for all aircraft configuration(s) represented,
- A list of the ATD major hardware and software components as mentioned in paragraphs 3c(1) and 4a of this appendix, and
- Aircraft performance information for the aircraft or family of aircraft being represented.

h. An ATD may not be operated unless the documents listed in paragraph 3g are readily available for viewing. These documents must remain with the ATD owner, or operator if leased from the owner, when the ATD is authorized for use.

i. A manufacturer or operator who changes an ATD in any manner must send a revised QAG to the FAA for approval as described in paragraphs 3b and 3c. An ATD that has been changed from the most recent QAG criteria may not be used for any authorized purpose until the FAA approves the changes.

j. ATDs may be used without further approval for pilot training that is not conducted under part 141. However, such pilot training operations must follow the information provided in paragraph 5 when using an ATD. The FAA may approve an ATD (found acceptable) for use by a part 141-certificated pilot school as outlined in paragraph 6. Also, as with a part 141-certificated pilot school, the FAA may withdraw its acceptance and approval of any device for any types of pilot training if the device no longer meets the ATD criteria in this AC.

4. COMPATIBILITY OF SOFTWARE AND HARDWARE COMPONENTS.

a. An approved ATD consists primarily of two components: software (programming) and hardware (central processor, monitor or display, appropriate flight and power controls, and avionics). The software and hardware components must be compatible because the hardware sends “values” from sensors to the software by means of voltage and digital inputs (e.g., avionics frequencies, switches, and buttons). Hardware and software compatibility are assured when the hardware manufacturer and the software developer work in close cooperation to develop the correct union of inputs for the ATD.

b. In some cases, the hardware manufacturer and the software developer do not work together in developing the ATD. Instead, the software is “licensed for use” to the ATD manufacturer and incorporated into the device. In those cases, the manufacturer must attest in writing that all hardware technical requirements (analog and digital input values) are compatible with the software used in the ATD. To do so, the manufacturer should obtain a “compatibility statement” from the software developer, which may, at the FAA’s discretion, be used to satisfy this requirement. The following is an example compatibility statement:

“This is to certify that <Name of Software Company or Developer> has demonstrated that the operating system and/or functional kernel(s) <Software part number and version/revision>, is fully compatible with <Name of ATD Manufacturer, Make and Model> and can assure that the communications/transport data latency is not greater than 300 milliseconds all analog and digital input signals meet the performance criteria established for software performance by the ATD manufacturer.”

c. Only the owner or co-developer can validate certification of the transport delay time stated in paragraph 4b and the correct analog and digital inputs necessary to ensure that the software performs IAW the source code demands. Similarly, the software developer must determine the minimum computer requirements to effectively run the software.

5. APPROVAL OF BATD FOR USE UNDER PART 61. To be approved for use for pilot training and certification under part 61, a BATD should:

a. Be capable of providing procedural training in all elements for which it is to be used. Those elements should be specified in an acceptable training curriculum or as specifically authorized by the FAA and meet the description and suggested criteria outlined in this appendix.

b. Have the following documents available for inspection by the student and instructor:

- The list of ATD components as required by paragraph 3c,
- A copy of AFS-800's letter of approval and authorized use of the ATD, and
- A copy of the QAG for the ATD being used.

c. Successfully pass the start-up self-test described in paragraph 8c(2). If the device is being used in a course of training for a pilot certificate or rating, a person authorized by the FAA to provide ground or flight instruction should observe this test. After the ATD self-test is complete, no other software of any kind may be started on the computer running the ATD software.

d. Remain in the approved configuration during the training session. Authorized ATD instruction may not proceed after a malfunction of the ATD system has occurred. The operator must correct the ATD malfunction and repeat the start-up test described in paragraph c of this section before resuming authorized instruction. In addition, a BATD may be used in a training curriculum that provides for:

- A similar scope and content of a syllabus that is used under part 141;
- Instructional materials for flight events;
- A means of showing progress, such as an outline of stage (phase) checks and criterion levels of performance; and
- The authorized use as approved in the AFS-800 letter of approval.

6. APPROVAL OF BATD FOR USE UNDER PART 141. Local FSDO may approve BATDs as part of an overall part 141 curriculum approval and certification process. Pilot schools that want to use a BATD as part of their training curriculum must notify their principal operations inspector (POI). The POI is responsible for approving how the BATD is to be used in the certificate holder's part 141 curriculum. To be approved for use under part 141, a BATD should:

a. Be capable of providing training in all elements in which it will be used, as specified in the syllabus, and meet the description and suggested criteria outlined in this appendix.

b. Have the following documents available for inspection by the student and instructor:

- The list of ATD components required in paragraph 3c,
- A copy of AFS-800's letter of approval and authorized use of the ATD, and
- A copy of the QAG for the ATD being used.

c. Successfully pass the start-up self-test described in paragraph 8c of this appendix. A person authorized by the FAA to provide ground or flight instruction should observe this test.

After the ATD self-test is complete, no other software of any kind may be started on the computer running the ATD software.

d. Remain in the approved configuration during the training session. Authorized ATD instruction may not proceed after a malfunction of the ATD system has occurred. The operator must correct the ATD malfunction and repeat the start-up test described in paragraph c of this section before resuming authorized instruction.

e. Be used in an integrated ground and flight training curriculum which provides for:

- The scope and content of a curriculum in compliance with part 141,
- The authorized use as approved in the AFS-800 letter of approval,
- Instructional materials for flight events, and
- An outline of stage (phase) checks and criterion levels of performance.

7. REPORTING ATD TRAINING DATA. Pilot schools and other persons utilizing an ATD approved IAW this publication, previous draft versions of this publication, or AC 61-126 are requested to provide AFS-800 with the information below on an annual basis. The information will be used to continually validate the authorized use of the ATD and to determine whether additional uses or regulatory amendments to provide for other uses are warranted. The information provided should be sent to the regular mailing address or email address (preferred) per paragraph 3. The report should contain:

a. The name and address of the individual, organization, and pilot school certificate number (if applicable) providing the training,

b. The number of persons enrolled in the course in which the ATD is used,

c. The number of flight hours each graduate required to satisfactorily complete the course of training,

d. The number of graduates who passed the instrument rating practical test the first time,

e. A list of recurring ATD malfunctions to assist the FAA in tracking problems with a specific device, and

f. Any other information deemed helpful in determining the level of effectiveness of the devices used as authorized under the provisions of this document (e.g., the portion of the curriculum attributable to the ATD used, the grading scheme used, and how the instructional management of training using the simulation device differs from that using an aircraft).

8. BATD DESIGN CRITERIA. The QAG is the primary means for finding a BATD acceptable for use in part 61 pilot training or approved part 141 pilot school training curricula. The QAG will be used to determine that an ATD meets or exceeds minimum FAA design criteria

outlined in this appendix. A BATD found acceptable for use IAW this appendix 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 submitted to the FAA for evaluation 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 purposes of this AC, 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. Virtual controls should be primarily for the instructor's use.

(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. See the control requirements listed below for necessary equipment as applicable to the aircraft model represented. The pilot must operate the additional equipment needed in order to accomplish a training procedure as listed in this appendix in the same manner in which it would be operated in the represented aircraft. For example, landing gear, wing flaps, cowl flaps, carburetor heat control, and mixture, propeller, and throttle controls.

(4) The physical arrangement, appearance, and operation of controls, instruments, and switches required by this appendix should model at least one aircraft in the family of aircraft represented as closely as practicable. Manufacturers are expected to use their best efforts to recreate the appearance, arrangement, operation, and function of realistically placed physical switches and other required controls representative of a generic aircraft instrument panel that includes at least the following:

- Master/battery;
- Magnetos for each engine (as applicable);
- Alternators for each engine;
- Fuel boost pumps for each engine;
- Avionics master;
- Pitot heat; and
- Rotating beacon/strobe, navigation, taxi, and landing lights.

(5) When an FAA-approved BATD is in use, only the software package evaluated and approved by the FAA may be loaded for use to avoid negative impact on available system resources. This may require a separate user profile for ATD operation.

b. Control Requirements. Physical flight and aircraft system controls must be provided as follows:

(1) Airplane.

(a) A self-centering displacement yoke or control stick that allows continuous adjustment of pitch and bank;

(b) Self-centering rudder pedals that allow continuous adjustment of yaw;

(c) Throttle or power control(s) that allows continuous movement from idle to full power settings;

(d) Mixture/condition, propeller, and throttle/power control(s) as applicable to the aircraft or family of aircraft represented; and

(e) Controls for the following items, as applicable to the airplane or family of airplanes represented:

- Wing flaps,
- Pitch trim,
- Communication and navigation radios,
- Clock or timer,
- Gear handle (if applicable),
- Transponder,
- Altimeter,
- Microphone with push-to-talk switch,
- Carburetor heat (if applicable), and
- Cowl flaps (if applicable).

(2) Helicopter.

(a) A cyclic control stick that tilts the main rotor disk by changing the pitch angle of the rotor blades in their cycle of rotation;

(b) A collective pitch control that changes the pitch angle of all main rotor blades simultaneously;

(c) Throttle/power control that allows continuous movement from idle to full power settings;

(d) Anti-torque pedals that allow continuous adjustment of the tail rotor/heading;

(e) Mixture/condition control applicable to the helicopter or family of helicopter represented; and

(f) Controls for the following items, as applicable to the helicopter or family of helicopters represented:

- Communication and navigation radios,
- Clock or timer,

- Transponder,
- Altimeter,
- Microphone with push-to-talk switch and/or a push-to-talk switch on the yoke/stick/cyclic control, and
- Carburetor heat (if applicable).

c. Control Inputs: Airplane and Helicopter.

(1) Time from control input to recognizable system response (transport delay) must be 300 milliseconds or less. The manufacturer listed in the approval guide submitted for FAA approval must certify to this standard.

(2) The control inputs must be tested by the computer and software at each start-up and displayed as a confirmation message or a warning message that the transport delay time or any design parameter is out of original tolerances. This test should consider the items listed under “Display Requirements” in paragraph d below.

d. Display Requirements.

(1) Instruments and Indicators as appropriate and applicable to the aircraft or family of aircraft represented:

- Flight instruments in a standard configuration, represented either as separate traditional “round” flight instruments, or as an electronic primary flight instrument display with reversionary and back-up flight instruments.
- 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.
- A magnetic compass which displays incremental markings typical of that shown in the aircraft or family of aircraft represented.
- 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.
- 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.
- A vertical speed indicator with incremental markings each 100 feet per minute (fpm) for both climb and descent, for the first 1,000 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.

- 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.
- 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.
- 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.
- Engine instruments as applicable to the aircraft or family of aircraft being represented, providing markings for normal ranges and minimum and maximum limits.
- A suction gauge or instrument pressure gauge, as applicable, with a display applicable to the aircraft or family of aircraft represented.
- A flap setting indicator that displays the current flap setting. Setting indications should be typical of that found in an actual aircraft.
- 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.
- Communication radio(s) with display(s) of the radio frequency in use.
- Navigation radio(s) capable of replicating both precision and non-precision instrument, including approach procedures (each with an aural identification feature), and a marker beacon receiver. For example, an 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 indication as applicable. The marking should include:
 - One-half dot or less for course/glide slope deviation (i.e., VOR, LOC, or ILS),
 - 5 degrees or less for bearing deviation for automatic direction finder (ADF) and radio magnetic indicator (RMI), as applicable,
 - A clock with incremental markings for each minute and second, or a timer with a display of minutes and seconds,

- o A magnetic compass with incremental markings each 10 degrees or less; The compass must display the proper lead or lag during turns,
- o A transponder panel that displays the current transponder setting, and
- o A fuel quantity indicator(s) that displays the fuel remaining, either in analog or digital format, as appropriate for the aircraft or family of aircraft represented.

(2) All instrument displays listed above must be visible during all flight operations. The update rate of all displays must provide an image of the instrument that:

- Does not appear to be out of focus or illegible,
- Does not appear to “jump” or “step” to a distracting degree during operation, and
- Does not appear with distracting jagged lines or edges.

(3) Display update must be at a frequency of 10 hertz (Hz) or higher. Each display must sense a change and react at a value less than the stated. 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:

- Airspeed indicator: change of 5 knots,
- Attitude indicator: change of 2 degrees in pitch and bank,
- Altimeter: change of 10 feet,
- Turn and bank: change of ¼ standard rate turn,
- Heading indicator: change of 2 degrees,
- Vertical speed indicator (VSI): change of 100 fpm,
- Tachometer: change of 25 rpm or 2 percent of turbine speed,
- VOR/ILS: change of 1 degree for VOR or ¼ of 1 degree for ILS,
- ADF: change of 2 degrees,
- GPS: change as appropriate for the model of GPS-based navigator represented, and
- 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).

e. Flight Dynamics Requirements.

(1) 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.

(2) Aircraft performance parameters (such as maximum speed, cruise speed, stall speed, maximum climb rate, hovering/sideward/forward/rearward flight) should be comparable to the aircraft or family of aircraft being represented.

(3) 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.

(4) 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.

(5) 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.

f. Instructional Management Requirements.

(1) The instructor must be able to pause/freezing the system at any point for the purpose of administering instruction regarding the task.

(2) 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:

- Aircraft geographic location,
- Aircraft heading,
- Aircraft airspeed,
- Aircraft altitude, and
- Wind direction, speed, and turbulence.

(3) The system must be capable of recording both a horizontal and vertical track of aircraft movement for later playback and review.

(4) 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.

(5) 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. All navigational data must be based on procedures as published per 14 CFR part 97.

g. Task Requirements List. An ATD having the features specified above may be approved for use in procedural training in the instrument flight tasks listed in this appendix.

9. CURRICULUM CONTENT. The FAA strongly encourages that the instrument tasks below be incorporated in an integrated ground and flight instrument training curriculum in which a BATD is in use.

a. Flight by Reference to Instruments.

- Straight and level flight,
- Change of airspeed,
- Constant airspeed climbs,
- Constant airspeed descents,
- Constant rate climbs,
- Constant rate descents,
- Level turns, including standard rate turns,
- Climbing turns,
- Descending turns, and
- Steep turns.

b. Abnormal and Emergency Procedures.

- Partial Panel,
- Timed turns,
- Compass turns (and associated errors),
- Instrument failures, and
- Procedures for turbulence.

c. Radio Navigation Procedures.

- Use of VOR, LOC, ILS, & Area Navigation (RNAV) including GPS,
- Holding patterns (VOR, ILS, LOC, Intersection, & Waypoints),
- Use of distance measuring equipment (DME),
- Use of ADF/NDB (optional), and
- Use of autopilot (AP)/flight director (FD) (optional).

d. Instrument Approach Procedures.

- Precision.
 - ILS, and
 - Wide area augmentation system (WAAS) with vertical navigation (optional).
- Nonprecision.
 - VOR,
 - LOC,
 - RNAV (including GPS),
 - WAAS (optional),
 - ADF/NDB (optional),
 - ILS / LOC backcourse, and
 - Missed approach procedures for all of the procedures above.

e. Communications Procedures.

- Air traffic control (ATC) clearances,
- Departure clearances,
- En route clearances,
- Arrival clearances,
- Radio advisories and warnings,
- Automated terminal information service (ATIS) and common traffic advisory frequency (CTAF), and
- Significant meteorological information (SIGMET), Airmen's Meteorological Information (AIRMET), Notices to Airmen (NOTAM), Flight Service Station (FSS) communications, and flight plan changes.

f. Cross-Country Procedures.

- Departure,
- En route, and
- Arrival.

APPENDIX 3. ADVANCED AVIATION TRAINING DEVICE (AATD) REQUIREMENTS

1. PURPOSE. This appendix describes how the FAA will evaluate AATDs for approval and specific authorized use. A BATD incorporating additional specific advanced design simulation criteria will be evaluated for approval as an AATD on the basis of meeting or exceeding the minimum criteria outlined in this appendix.

2. AUTHORIZED USE. Except for specific aircraft type training and testing, an AATD may be approved and authorized for use in accomplishing certain required tasks, maneuvers, or procedures as applicable under 14 CFR parts 61 and 141 as follows:

- Logging instrument flight experience,
- Instrument rating (maximum 20 hours),
- Instrument rating practical test (per FAA-S-8081-4 (circling-to-land not authorized)),
- Instrument proficiency check (per FAA-S-8081-4 (circling-to-land not authorized)),
- Private pilot certificate (maximum 2.5 hours),
- Commercial pilot certificate (maximum 50 hours),
- Commercial pilot practical test (per FAA-S-8081-12),
- Airline transport pilot certificate (maximum 25 hours),
- Airline transport pilot practical test (per FAA-S-8081-5), and
- Part 141 as limited by the applicable appendices, or under a special curriculum approved under part 141, § 141.57.

NOTE: The flight experience allowance for the use of a AATD and the flight experience allowance for a FTD or a flight simulator towards obtaining an instrument rating may be combined. However, that combination may not exceed that allowed under § 61.65 (20 hours maximum) and may not exceed that allowed under part 141, appendix C, paragraph 4(b)(4) (50 percent maximum) of the required training.

NOTE: A part 141 certificated pilot school must obtain a specific authorization for the use of the ATD as part of that pilot school's approved training curriculum. This authorization must come from the FAA FSDO assigned to that pilot school.

3. AATD DESIGN CRITERIA. Devices presented for approval as AATDs must first meet and appropriately exceed the requirements for BATD approval criteria contained in Appendix 2. Additionally, an AATD should display sufficient aircraft cockpit design, ergonomic features, and performance characteristics beyond BATD approval criteria to warrant the authorized use the FAA determines to be appropriate for AATD simulation devices. Since it is highly desirable for the pilot to mentally immerse him/herself in a realistic aircraft cockpit when using an AATD, design features significantly exceeding those of a BATD cockpit layout are critically important.

- a.** An AATD must include the following features and components:

(1) A realistic shrouded (enclosed) or un-shrouded (open) cockpit design and instrument panel arrangement representing either a generic or specific model aircraft cockpit;

(2) Cockpit knobs/system controls/switches/switch panels in realistic sizes and design appropriate to each intended functions, 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 approximately life sized that exhibit neither stepping nor excessive transport delay, and arranged so as to observe trends and provide a realistic scan pattern;

(4) Digital avionics panel;

(5) GPS navigator;

(6) Three axis autopilot, and, as appropriate, a Flight Director. 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) A visual system that provides acceptable 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; and

(9) 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:

- Oversee tracks along airways, holding entries and patterns, and localizer and glide slope alignment/deviation (or other approaches with a horizontal and vertical track);
- Function as ATC in providing vectors, etc., change in weather conditions, ceilings, visibilities, wind speed and direction, light/moderate/severe turbulence, and icing conditions; and
- 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 keyboard or mouse.

b. The following features and components are not required for the FAA's approval of an AATD, but are encouraged:

(1) Automate ATC communications, scenario-based training, or line-oriented flight training type training which the instructor can evaluate pilot performance without having to act as ATC;

(2) Cockpit seating and ergonomics that can be adjusted up or down and in and out to accommodate the correct spatial orientation for the pilot in relation to the cockpit, instruments, and glare shield, if equipped; and

(3) 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.

4. FUNCTION AND SUBJECTIVE TEST CRITERIA. Devices eligible as AATDs for creditable use should conform to an acceptable aircraft cockpit/instrument panel arrangement. The simulated systems and subsystems should be able to perform operational functions and performance maneuvers that closely mimic the represented aircraft. Specific attention should be given to ergonomic and human factors such as those shown above. These devices must be clearly eligible to receive a consensus evaluation for consideration of approval and added creditable use based on technical merit of design and function that mentally challenges the pilot's performance in both procedural and operational performance practical test standards (PTS) tasks as if it were a real aircraft. The criteria listed in paragraph 3 above and the graphical outline checklist shown in Figure 1 below will be used to help determine whether the advanced design and performance of the simulation device merits FAA approval as an AATD under this publication. The FAA CET will use following checklist during the evaluation of an AATD:

FIGURE 1. ADVANCED ATD CHECKLIST

Functions and Maneuvers	Satisfactory? Yes/No
a. Preparation for Flight	
(1) Preflight	
b. Pre-Takeoff	
(1) Engine start	
(2) Brake operation	
c. Takeoff	
(1) AIRPLANE Takeoff	
(i) Power plant checks	
(ii) Acceleration characteristics	
(iii) Nose wheel and rudder steering	
(iv) Effect of crosswind	
(v) Instrument	
(vi) Landing gear, wing flap operation	
(2) HELICOPTER Takeoff	
(i) Power plant checks	
(ii) From Hover	
(iii) From Ground	
(iv) Vertical	
(v) Running	
d. In-flight Operation	
(1) AIRPLANE In-flight Operation	
(i) Climb	
(a) Normal	
(b) One engine inoperative procedures	
(ii) Cruise	

(a) Performance characteristics (speed vs. power)	
(b) Normal and steep turns	
(c) Performance turns	
(d) Approach to stalls, i.e., stall warning (cruise, takeoff/approach, and landing configuration)	
(e) High angle of attack maneuvers (cruise, takeoff/approach, and landing)	
(f) In-flight engine shutdown	
(g) In-flight engine restart	
(iii) Descent	
(a) Normal	
(b) Maximum rate	
(2) HELICOPTER In-flight Operation	
(i) Hovering	
(a) Forward	
(b) Rearward	
(c) Sideward	
(d) Turns	
(ii) Climb	
(iii) Cruise	
(a) Performance characteristics	
(b) Turns	
i. Recovery	
ii. Skidding	
iii. Slipping	
(c) In-flight engine shutdown	
(d) In-flight engine restart	
(iv) Descent	
e. Approaches	
(1) Non-precision	
(i) GPS-WAAS	
(ii) GPS-LAAS	
(iii) All engines operating	
(iv) One or more engines inoperative	
(v) Approach procedures (NDB, VOR, DME Arc, LOC/BC, LOC, LDA, SDF, ASR, LNAV/VNAV, GPS, & LPV, and additional types when developed and certified)	
(vi) Missed approach (all engines operational, one or more engines inoperative)	
(2) Precision	
(i) PAR – normal	
(ii) ILS	
(iii) GLS	
(iv) Effects of crosswind	
(v) With engine(s) inoperative	

(vi) Missed approach	
(A) Normal	
(B) With engine(s) inoperative	
(C) From steep glide slope	
f. Surface Operations (AIRPLANE-Post Landing)	
(1) Landing roll	
(2) Braking operation	
(3) Reverse thrust operation, if applicable	
g. Any Flight Phase	
(1) Aircraft and power plant systems	
(i) Electrical	
(ii) Flaps (AIRPLANE)	
(iii) Fuel and oil	
(iv) Landing gear (AIRPLANE)	
(2) Flight management and guidance systems	
(i) Automatic pilot	
(ii) Flight director/system displays	
(iii) Navigation systems	
(iv) Stall warning/avoidance (AIRPLANE)	
(v) Multi function displays	
(vi) Primary flight displays	
(3) Airborne procedures	
(i) Holding	
(4) Engine shutdown and parking	
(i) Systems operation	
(ii) Parking brake operation (AIRPLANE)	

5. REQUESTING FAA APPROVAL OF AATD. The manufacturer/developer of an AATD is encouraged to use the sample shown in Figure 1 above when making application for FAA approval. This application must be submitted to AFS-800 (per Appendix 2, paragraph 3b), along with a complete QAG and a description of how the identified device exceeds BATD approval criteria and meets the AATD approval criteria listed in this appendix.

**APPENDIX 4. SAMPLE LETTER OF APPLICATION REQUESTING FAA'S
EVALUATION AND APPROVAL OF AN ADVANCED AVIATION TRAINING
DEVICE (AATD)**

Dear <NAME>:

Date:

[Name of manufacturer/developer] requests an evaluation of its [make, model, serial number] proposed advanced aviation training device (AATD) for approval by the Federal Aviation Administration (FAA) at [location where the evaluation is requested]. This device is fully described in the accompanying Qualification and Approval Guide (QAG), descriptive literature and performance attributes, and photographs. This device has been evaluated by the manufacturer and is believed to adequately meet the applicable requirements for approval as an AATD. Appropriate hardware and software configuration control procedures have been established and are listed for your review and approval.

The following [manufacturer's/developer's name] personnel have assessed this device:

Name _____ Qualification & Title _____

Name _____ Qualification & Title _____

who attest that:

It conforms to [the generic or specific make, model, category and class of aircraft] and that the simulated systems and subsystems function equivalently to those found in that aircraft;

The performance and handling qualities have been assessed and have been determined to adequately represent the designated category and class of aircraft; and

The device contains the following design features [list design features] significantly beyond those required for a basic aviation training device (BATD).

Sincerely,

[Signature of Manufacturer or Authorized Representative]

[Printed Name of Signatory]

Enclosure – QAG for [model name of device]

APPENDIX 5. AVIATION TRAINING DEVICE (ATD) APPROVAL PROCESS STEPS

1. Requester sends request for approval letter and QAG via regular mail or as text files attached to an e-mail to FAA AFS-800 (see note below).
2. FAA AFS-800 receives request for approval letter and QAG.
3. If request for approval and QAG are found to be initially acceptable, then skip Step 4 and go to Step 5.
4. If request letter for approval or QAG is found to be initially unacceptable, then the FAA will contact the requester to discuss the needed changes to the document. Go back to Step 1.
5. AFS-800 conducts "desk" audit of QAG. If "desk" audit results are found acceptable, then skip Step 6 and go to Step 7.
6. If "desk" audit results are found unacceptable, then the FAA will contact the requester to discuss the needed changes to the QAG. Go back to Step 5.
7. FAA CET evaluator conducts a performance-based on-site evaluation of the device.
8. If the evaluation results are found acceptable, then skip Step 9 and go to Step 10.
9. If the evaluation results are found unacceptable, then the FAA CET evaluator will contact the requester to discuss the issues that need to be resolved. Go back to Step 7.
10. FAA AFS-800 issues a letter of approval along with the approved QAG to requester via regular mail and/or by e-mail.

NOTE: E-mail is the preferred correspondence method. Please call FAA Flight Standards Service General Aviation and Commercial Division, AFS-800, at 202-267-8212 for e-mail instructions.