



U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

**Subject: QUALIFICATION AND APPROVAL OF
PERSONAL COMPUTER-BASED
AVIATION TRAINING DEVICES**

**Date: 5/12/97
Initiated By: AFS-840**

**AC No: 61-126
Change:**

1. PURPOSE. This Advisory Circular (AC) provides information and guidance to potential training device manufacturers and aviation training consumers concerning a means, acceptable to the Administrator, by which personal computer-based aviation training devices (PCATD) may be qualified and approved for flight training toward satisfying the instrument rating training under the provisions of Title 14 of the Code of Federal Regulations (14 CFR) parts 61 and 141. While these guidelines are not mandatory, they are derived from extensive Federal Aviation Administration (FAA) and industry experience in determining compliance with the pertinent parts of 14 CFR. Mandatory terms used in this AC such as “shall” and “must” are used only in the sense of ensuring applicability of this method of compliance. PCATD's are distinct from flight training devices (FTD) qualified under AC 120-45, Airplane Flight Training Device Qualification, and flight simulators qualified under AC 120-40, Airplane Simulator Qualification. It also provides acceptable criteria under which the airplane or FTD flight-hour training time required for an instrument rating may be reduced by using PCATD's that have been determined to meet acceptable FAA standards. This AC details only one means of determining the acceptability of such devices for use in instrument training curricula.

2. RELATED 14 CFR SECTIONS. Sections of the regulations related to the information in this AC are in parts 61 and 141.

3. DEFINITIONS.

a. PCATD. A device which:

- (1) Meets or exceeds the criteria shown in Appendix 1.
- (2) Functionally provides a training platform for at least the procedural aspects of flight relating to an instrument training curriculum.
- (3) Has been qualified by the FAA.

b. Qualification Guide. Design criteria to assist in the evaluation and qualification process for PCATD's. A Qualification Guide is included in Appendix 1.

4. BACKGROUND. During the past several years, there has been significant development in training aid and training device technology. This includes the development of aviation-related computer hardware and software applications. There is considerable interest in making use of new technology which may provide increased training capability at decreased cost. This AC reflects the FAA's objective to formally recognize the potential of aviation training devices for use in general aviation instrument flight training.

a. Flight Task Procedural Skills. Flight task procedural skills have traditionally been trained almost exclusively during in-flight training. Ground training has been used to impart required aeronautical knowledge. Recent studies, however, have suggested that procedural understanding of instrument flight tasks can be taught during ground training using devices such as those described in this AC. Two of the most recent studies were conducted by the Embry Riddle Aeronautical University and the University of Illinois.

b. Evaluations of PCATD's and Associated Aviation Training Software. The FAA has evaluated several computer hardware and software applications at the request of manufacturers and potential users. These evaluations were conducted to determine whether certification or airman recency of experience requirements reasonably could be met using such devices under applicable provisions of part 61 or part 141. A study conducted by the University of Illinois, titled "Transfer of Training Effectiveness of Personal Computer-Based Aviation Training Devices: Final Report", dated October 1996, examined each task addressed in this AC. The director of the study affirmed that all instrument training tasks allowed by this AC have a positive transfer effectiveness, or no statistically-significant negative transfer effectiveness. Given this background, the FAA has determined that there is sufficient justification to allow the use of PCATD's meeting acceptable standards as creditable devices for meeting some of the training requirements for an instrument rating under the applicable provisions of part 61 or part 141.

5. AUTHORIZED USE.

a. Instruction by an Authorized Instructor. Qualified PCATD's may be highly beneficial when used under the guidance of an authorized instructor to achieve learning in certain procedural tasks such as area departures and arrivals, navigational aid tracking, holding pattern entries, instrument approaches, and missed approach procedures. Accordingly, the FAA has determined to continue the policy that any time instruction is to be used to log time toward meeting any requirement of the regulations, an authorized instructor must have presented the instruction.

b. Reducing Flight Hours Through Ground Training. This AC provides for some training time on PCATD's meeting acceptable FAA standards to be used to reduce the total flight hour that otherwise would have to be accomplished in an aircraft or a flight training device to meet the requirement for an instrument rating under part 61 or part 141. PCATD's determined to meet the criteria established by this AC may be used in lieu of, and for not more than, 10 hours of time that ordinarily may be acquired in a flight simulator or flight training device authorized for use under part 61 or part 141. However, the FAA has not authorized the use of PCATD's for conducting practical tests nor for accomplishing recency of experience requirements.

6. GUIDELINES FOR QUALIFICATION OF PCATD'S.

a. One qualification is required for each model of PCATD. Normally, the qualification will be obtained by the manufacturer. It will be valid for all serial numbers of that model, provided that no value for a criterion in Appendix 1 is changed.

b. Should a PCATD be modified in any manner, a revised Qualification Guide must be submitted to the FAA, accompanied by a request for qualification as modified, as described in paragraph 6d below.

c. Qualified PCATD's may be used by part 61 schools without further approval, and should be used in accordance with the guidance provided in paragraph 7. Qualified PCATD's may be approved for use in a part 141 pilot school as outlined in paragraph 8.

d. To request qualification of a PCATD, manufacturers should send a request for qualification to the General Aviation and Commercial Division, Airman Certification Branch, AFS-840, 800 Independence Avenue, SW., Washington, DC 20591. The request for qualification must include a qualification guide stating a value for each item in Appendix 1. Each value must meet or exceed the minimum value stated in Appendix 1. The request for qualification should be submitted at least 60 days before any training using the PCATD involved is scheduled to commence. This time frame is necessary to permit the FAA to properly review and evaluate the PCATD. Upon finding the PCATD acceptable, the FAA will approve the qualification guide and return it to the manufacturer. The manufacturer must ensure that the PCATD meets the criteria stated in the qualification guide. The PCATD may be evaluated at the manufacturer's facility or at another site that may be mutually agreeable to the manufacturer and the FAA.

7. ACCEPTABILITY OF PCATD's FOR USE UNDER PART 61

a. To be acceptable for use in part 61, a PCATD must:

(1) Be capable of providing training in all elements for which it will be used. Those elements should be specified in a curriculum.

(2) Meet the description and criteria established in this AC.

b. The PCATD should be used in a curriculum which will provide for:

(1) A scope and content which should be in general compliance with part 141.

(2) Not more than 10 hours of flight instruction in a PCATD in lieu of 10 of the 20 hours of flight instruction allowed for a flight simulator or FTD. The 20-hour allowance for a flight simulator or an FTD and the 10-hour allowance for PCATD's are not additive. If a PCATD is used for the maximum of 10 hours, that 10 hours shall be a part of the 20-hour maximum allowance for a flight simulator or flight training device.

(3) Instructional materials for flight events.

(4) An outline of stage (phase) checks and criterion levels of performance.

8. APPROVAL OF PCATD's FOR USE UNDER PART 141.

a. To be approved for use under the provisions of part 141, a PCATD must:

(1) Meet the description and the criteria established in this AC.

(2) Be capable of providing training in all elements in which it will be used, as specified in the syllabus.

(3) Be used for not more than 10 hours of flight instruction time in lieu of 10 hours of the flight instruction time in a flight simulator or flight training device time allowed by part 141. The 10-hour allowance for use of a PCATD and the 15-hour allowance for flight simulator or flight training device under the provisions of part 141 are not additive. If a PCATD is used for the maximum of 10 hours, that 10 hours shall be a part of the 15-hour maximum allowance for a flight simulator or FTD.

b. Local Flight Standards District Offices (FSDO) may approve qualified PCATD's during the overall part 141 approval and certification process. The principal operations inspector for the part 141 school is responsible for approving how the PCATD is to be used in the certificate holder's part 141 curriculum. It is not the intent of the FAA to require each user to seek individual PCATD qualification from the jurisdictional FSDO.

9. REPORTING PCATD TRAINING DATA. While there is no requirement to do so, annually, during the anniversary month of FAA qualification or approval of a PCATD, as applicable, pilot schools and other persons utilizing PCATD's under parts 61 or 141 in accordance with this AC in an instrument rating curriculum are requested to provide the General Aviation and Commercial Division with the information shown below. This information will be used to validate the permissible use of PCATD's and to determine whether additional permissible use or regulatory amendment to provide for such use is warranted. The information provided should be sent to the address shown in paragraph 6d. 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 instrument rating course in which the PCATD 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; and

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

10. REQUEST FOR INFORMATION. Requests for additional information or guidance about using training devices should be directed to AFS-840 at (202) 267-8196.

APPENDIX 1. PERSONAL COMPUTER-BASED AVIATION TRAINING DEVICE (PCATD) QUALIFICATION GUIDE

This Qualification Guide provides a means for qualifying PCATD's for use as FTD's in part 61 or approved part 141 instrument training curricula. This Qualification Guide may be used to determine that a PCATD meets or exceeds minimum acceptable FAA design criteria. PCATD's qualified in accordance with this AC may be used for instrument training tasks only. They may not be used for testing or checking.

Each Qualification Guide submitted to the FAA for evaluation must state what type airplane or family of airplanes is being replicated and used as the basis for the following criteria.

PCATD DESIGN CRITERIA

Controls. A PCATD must provide some physical controls and may provide some virtual controls.

1. Physical controls should be recognizable as to their function and how they can be manipulated solely from their appearance. Physical controls eliminate the use of either a keyboard or mouse to control the simulated aircraft.

2. For the purposes of this guide, virtual control is any input device to control aspects of the simulation (such as setting aircraft configuration, location, and wind) and to program, pause, or freeze the device. Virtual controls should be primarily for instructor use.

Control Requirements.

1. A physical, self-centering, displacement yoke or control stick that allows continuous adjustment of pitch and bank.

2. Physical, self-centering rudder pedals that allow continuous adjustment of yaw.

3. A physical throttle lever or power lever that allows continuous movement from idle to full power settings.

4. Physical controls for the following items, as applicable to the aircraft or family of aircraft replicated:

- a. Flaps
- b. Propellers
- c. Mixtures
- d. Pitch trim

- e. Communication and navigation radios
 - f. Clock or timer
 - g. Gear handle
 - h. Transponder
 - i. Altimeter
 - j. Microphone with push to talk switch
 - k. Carburetor heat
 - l. Cowl flaps
5. Control inputs.

a. Time from control input to recognizable system response (transport delay) must be 300 milliseconds or less. This standard must be certified by the manufacturer in the qualification guide submitted for qualification. Users will not be required to verify this standard when requesting approval of a PCATD. Normally, FAA inspectors will not be expected to measure or verify this maximum delay time as a part of the PCATD approval process.

b. The control inputs must be tested by the computer and software at each start 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 must consider the items listed under Display Requirements (see paragraphs 1 through 4 below.)

Display Requirements.

1. Instruments and indicators.
- a. An adjustable altimeter with incremental markings each 20 feet or less, operable throughout the normal operating range of the aircraft or family of aircraft replicated.
 - b. A heading indicator with incremental markings each 5°, or less, displayed on a 360° circle. Arc segments of less than 360° may be selectively displayed if desired or required, as applicable to the aircraft or family of aircraft replicated.
 - c. An airspeed indicator with incremental markings as shown on the aircraft or family of aircraft replicated; however, airspeed markings of less than 40 knots need not be displayed.
 - d. A vertical speed indicator with incremental markings each 100 feet per minute (fpm) for both climb and descent, for the first 1000 fpm of climb and descent, and at each 500 fpm climb and descent for the remainder of a minimum ± 2000 fpm total display, or as applicable to the aircraft or family of aircraft being replicated.

e. A turn and bank indicator with incremental markings for a rate of 3° per second turn for left and right turns. The 3° per second rate index must be inside of the maximum deflection of the indicator.

f. 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 replicated.

g. An attitude indicator with incremental markings each 5° of pitch or less, from 20° pitch up to 40° pitch down or as applicable to the aircraft or family of aircraft replicated. Bank angles must be identified at “wings level” and at 10, 20, 30, and 60° of bank (with an optional additional identification at 45°) in left and right banks.

h. Engine instruments as applicable to the aircraft or family of aircraft being replicated, providing markings for normal ranges and minimum and maximum limits.

i. A suction gauge or instrument pressure gauge, as applicable, with a display applicable to the aircraft or family of aircraft replicated.

j. A flap setting indicator which displays the current flap setting. Setting indications must be typical of that found in an actual aircraft.

k. A pitch trim indicator with a display that shows zero trim and appropriate indices of aircraft nose down and aircraft nose up trim, as would be found in an aircraft.

l. Communication radio(s) with display(s) of the radio frequency in use.

m. Navigation radio(s), including an ADF and a VOR with ILS indicator (each with an aural identification feature), and a marker beacon receiver. As applicable, the incremental markings noted below must be present.

(1) One-half dot or less for course/glide slope deviation (i.e., VOR/ILS).

(2) 5° or less for bearing deviation for ADF and RMI, as applicable.

n. A clock with sweep second hand and incremental markings each minute and second or a timer with a display of minutes and seconds.

o. A magnetic compass with incremental markings each 10° or less. The compass should display the proper lead or lag during turns.

p. A transponder panel which displays the current transponder setting.

q. A fuel quantity indicator(s) which displays the fuel remaining, either in analog or digital format, as appropriate for the aircraft or family of aircraft replicated.

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:

a. Does not appear to be out of focus.

- b. Does not appear to “jump” or “step” to a distracting degree during operation.
 - c. Does not appear with distracting jagged lines or edges.
3. Display update must be 10 Hz or faster. 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:
- a. Airspeed indicator: Change of 5 knots.
 - b. Attitude indicator: Change of 2° in pitch and bank.
 - c. Altimeter: Change of 10 feet.
 - d. Turn and bank: Change of 1/4 standard rate turn.
 - e. Heading indicator: Change of 2°.
 - f. VSI: Change of 100 fpm.
 - g. Tachometer: Change of 25 rpm or 2% of turbine speed.
 - h. VOR/ILS: Change of 1° for VOR or 1/4 of 1° for ILS.
 - i. ADF: Change of 2°.
 - j. 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.

Flight Dynamics Requirements.

1. Flight dynamics of the PCATD must be comparable to the way the training aircraft represented performs and handles. There is no requirement for a PCATD 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 (maximum speed, cruise speed, stall speed, maximum climb rate) must be comparable to the aircraft or family of aircraft being replicated.
3. Aircraft vertical lift component must change as a function of bank, comparable to the way the aircraft or family of aircraft being replicated performs and handles.
4. Changes in flap setting, slat setting (if any), and gear position (if any) must be accompanied by changes in flight dynamics, comparable to the way the aircraft or family of aircraft replicated 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 must be comparable to the way the aircraft or family of aircraft replicated performs and handles.

Instructional Management Requirements.

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

2. If a training session will begin with the aircraft already 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
- e. Engine power
- f. 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 the beginning of a training session, and to simulate failure of any of the instruments during a training session without stopping or freezing the simulation to effect the failure.

5. The PCATD must have at least a navigational area data base 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 in 14 CFR part 97.

Task Requirements List.

A PCATD having the features specified above will be qualified for use in procedural training in the instrument flight tasks listed below. These instrument tasks must be incorporated in an integrated ground and flight instrument training curriculum:

1. Flight by Reference to Instruments
 - a. Straight and level flight
 - b. Change of airspeed

- c. Constant airspeed climbs
 - d. Constant rate climbs
 - e. Constant airspeed descents
 - f. Constant rate descents
 - g. Level turns, including standard rate turns
 - h. Climbing turns
 - i. Descending turns
 - j. Steep turns
2. Abnormal and Emergency Procedures
- a. Timed turns
 - b. Compass turns
 - c. Instrument failures
 - d. Procedures for turbulence
3. Radio Navigation Procedures
- a. VOR navigation
 - b. NDB navigation
 - c. Localizer & ILS navigation
 - d. VOR holding pattern
 - e. NDB holding pattern
 - f. Localizer holding pattern
 - g. Intersection holding pattern
 - h. Use of RNAV, including GPS
 - I. Use of DME
4. Instrument Approach Procedures
- a. Precision approaches

- b. Nonprecision approaches
 - c. ILS back course approach
 - d. Missed approach
5. Communications Procedures
- a. Air traffic control clearances
 - i. Departure clearances
 - ii. Enroute clearances
 - iii. Arrival clearances
 - b. Radio advisories and warnings
 - i. ATIS and CTAF
 - ii. SIGMETS, AIRMETS, NOTAMS, FSS communications, and flight plan changes
6. Cross-country Procedures
- a. Departure
 - b. Enroute
 - c. Arrival