FEDERAL AVIATION AGENCY
FLIGHT STANDARDS SERVICE
WASHINGTON 25, D. C.

September 25, 1961

CORRECTION

CIVIL AIR REGULATIONS DRAFT RELEASE NO. 61-17

Dated August 31, 1961

Subject: Use of Aircraft Simulators for Pilot Training and Proficiency Checks.

On Page 4, left column, line 12, change the words "where airspeeds apply, . . ." to read "time requirements apply, . . ."

62-3551

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August 31, 1961

CIVIL AIR REGULATIONS DRAFT RELEASE NO. 61-17

SUBJECT: Use of Aircraft Simulators for Pilot Training and Proficiency Checks

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The Flight Standards Service of the Federal Aviation Agency has under consideration amendments of Parts 40, 41, and 42 of the Civil Air Regulations to prescribe standards for approval of aircraft simulators, courses of training in aircraft simulators, and the use of synthetic trainers for proficiency check maneuvers. The reasons therefor are set forth in the explanatory statement of the attached proposal which is being published in the Federal Register as a notice of proposed rule making.

The Flight Standards Service desires that all persons who will be affected by the requirements of this proposal be fully informed as to its effect upon them and is therefore circulating copies in order to afford interested persons ample opportunity to submit comments as they may desire.

Because of the large number of comments which we anticipate receiving in response to this draft release, we will be unable to acknowledge receipt of each reply. However, you may be assured that all comment will be given careful consideration.

It should be noted that comments must be submitted in duplicate to the Docket Section of the Federal Aviation Agency, and in order to insure consideration must be received on or before November 9, 1961.

Gary C. Quill

Director,
Flight Standards Service

# FEDERAL AVIATION AGENCY

*FLIGHT STANDARDS SERVICE*

[14 CFR Parts 40, 41, 42]
[Regulatory Docket No. 873; Draft Release No. 61–17]

# NOTICE OF PROPOSED RULE MAKING

## Use of Aircraft Simulators for Pilot Training and Proficiency Checks

Pursuant to the authority delegated to me by the Administrator (14 CFR 405.27), notice is hereby given that there is under consideration a proposal to amend Parts 40, 41, and 42 of the Civil Air Regulations as hereinafter set forth.

Interested persons may participate in the making of the proposed rules by submitting such written data, views, or arguments as they may desire. Communications should be submitted in duplicate to the Docket Section of the Federal Aviation Agency, Room C–226, 1711 New York Avenue, N.W., Washington 25, D.C. All communications received on or before November 9, 1961, will be considered by the Administrator before taking action upon the proposed rules. The proposals contained in this notice may be changed in the light of comments received. All comments submitted will be available in the Docket Section for Examination by interested persons when the prescribed date for return of comments has expired.

Since 1954, those air carriers using aircraft simulators in their pilot training programs have been allowed to conduct all but four of their pilot-in-command proficiency check maneuvers in the simulator instead of the aircraft. Simulators used in accomplishing these proficiency check maneuvers are required to accurately simulate the flight characteristics and the performance of the particular aircraft through all ranges of normal and emergency operation. Maneuvers at minimum speeds, approach procedures on the letdown aid for which the lowest minimums are authorized, landing under circling approach conditions, and takeoffs and landings with engine failures must be accomplished in the aircraft on each proficiency check.

In 1957, Parts 40, 41, and 42 were amended to permit the substitution of an approved course of training in an aircraft simulator, at alternate 6-month intervals, for the proficiency check of the pilot in command. These amendments specified, in general terms, the characteristics and simulation requirements of a simulator when used in an approved course of training, and that same year the Civil Aeronautics Manuals were amended to specify the systems or conditions that the simulator should fully simulate. Since that time these rules and policies, together with a simulator flight test program developed by the FAA, have been used to evaluate the suitability of aircraft simulators for use in approved simulator training courses.

Developments in the aviation industry within the last few years have brought about a substantial increase in the use of aircraft simulators for training and checking the proficiency of air carrier flight crewmembers. When the regulations were amended in 1959 to require approval of training programs and annual proficiency checks of pilots other than pilots in command, the air carriers were allowed to substitute an approved course of training in their simulators for these proficiency checks, at alternate 12-month intervals. In addition, the Agency, in approving training programs, has permitted a 25-percent reduction in aircraft flight training for those programs that include approved simulator training. Lesser reductions have been allowed for training in synthetic trainers or simulators that do not meet the standards for use in approved simulator courses. The simulator industry itself has made rapid advances, not only in the art of simulation, but also in expansion of the areas they simulate.

Because of the wide variety of uses for aircraft simulators, and the extensive possibilities they offer for improved training, we need a better method of approving their use in the various phases of air carrier training and flight checking. As the first step in developing such a method, we issued, on May 6, 1960, a discussion draft of proposed standards for aircraft simulators and approved simulator training courses. This draft included not only the systems simulation requirements that are now covered in the CAMs, but also proposed specific standards and tolerances for simulator performance and flight characteristics. The draft was distributed to air carriers, training aids manufacturers, associated aircraft industries, and technical personnel associations; and the proposed standards were subsequently discussed with various industry groups. The comments and suggestions of these interested persons and groups have been considered in the preparation of this notice.

The amendments proposed herein would define an aircraft simulator as an approved training device that fully simulates the systems, performance, and flight characteristics of a particular aircraft in accordance with standards specified by the Director, Flight Standards Service. This definition would provide a clear distinction between an aircraft simulator, which would be an approved device, and a synthetic trainer, which is a device an air carrier is approved to use for simulating certain operating conditions. These proposed amendments would also authorize an air carrier to conduct all but four of its pilot proficiency check maneuvers in an aircraft simulator, without further specific approval for each maneuver involved, and would require that aircraft simulators be used in con-

ducting approved courses of simulator training. In addition, the proposed amendments would allow individual approval for an air carrier to conduct specified pilot proficiency check maneuvers in a synthetic trainer, if the trainer adequately simulated the systems, performance, and flight characteristics of the applicable aircraft for those particular maneuvers. Although not covered by this proposal, the Flight Standards Service, in a separate notice, is proposing to allow a 25-percent reduction in aircraft flight time for those approved air carrier training programs that include a specified amount of training in an aircraft simulator.

Under this proposal, standards and procedures for approval of aircraft simulators and simulator training courses, as well as procedures for obtaining approval to use synthetic trainers in accomplishing pilot proficiency check maneuvers, would be published in an appendix to the Civil Aeronautics Manuals. Such standards would be used not only as a guide in approving aircraft simulators, but also in evaluating the adequacy of synthetic trainers for use in conducting air carrier training programs and pilot proficiency check maneuvers. The present CAM material on the use of synthetic trainers for pilot checks, and requirements for approval of simulator training courses, would be deleted.

We believe the adoption of these proposed standards as guidelines to the industry will stimulate further advances in the art of simulation, and will contribute to the development of training devices that will afford optimum training value for crewmembers, thereby increasing safety in air commerce. Standards adopted as a result of this notice would be reviewed periodically, and revised as experience and industry developments indicated.

In consideration of the foregoing, it is proposed to amend Parts 40, 41, and 42 of the Civil Air Regulations as follows:

1. By amending § 40.5 of Part 40 by adding in proper alphabetical order a new definition to read as follows:

*40.5 Definitions.* * * *

*Aircraft simulator.* An aircraft simulator is an approved training device that fully simulates the systems, performance, and flight characteristics of a particular airplane in accordance with standards specified by the Director, Flight Standards Service.

2. By amending § 40.302(b) by revising subparagraph (3) and by adding a new subparagraph (4) to read as follows:

*40.302 Pilot checks.* * * *

(b) *Proficiency check.* * * *

(3) An air carrier may use an aircraft simulator or a synthetic trainer to conduct proficiency check maneuvers required by subparagraph (2) of this paragraph, subject to the conditions set forth in subdivisions (i) through (iii) of this subparagraph.

(i) Maneuvers at minimum speeds, approach procedures on the letdown aid for which the lowest minimums are authorized, landings under circling approach conditions, and takeoffs and landings with engine failures shall be given in the appropriate airplane on each proficiency check. When a synthetic trainer is used to conduct a portion of the proficiency check, any additional maneuvers that have not been approved by the Administrator or his authorized representative for accomplishment in the trainer shall also be given in the appropriate airplane.

(ii) The aircraft simulator shall simulate the systems, performance, and flight characteristics of the particular airplane used in conducting the proficiency check. For each maneuver approved for accomplishment in a synthetic trainer, the air carrier shall show that the trainer meets the appropriate standards for simulation of the systems, performance, and flight characteristics of the particular airplane used in conducting the proficiency check.

(iii) That portion of the proficiency check given in an aircraft simulator or a synthetic trainer shall be conducted by a check pilot or a representative of the Administrator.

(4) Subsequent to the initial pilot proficiency check, an approved course of training in an appropriate aircraft simulator, if satisfactorily completed, may be substituted at alternate 6-month intervals for the proficiency check required by subparagraph (1) of this paragraph. The course of training shall be approved in accordance with standards and procedures prescribed by the Director, Flight Standards Service.

3. By deleting §§ 40.302–3, 40.302–4, and 40.302–5.

4. By amending § 40.305 by redesignating paragraphs (b) and (c) as paragraphs (c) and (d), and adding a new paragraph (b) to read as follows:

*40.305 Proficiency check; second in command.* * * *

(b) An air carrier may use an aircraft simulator or a synthetic trainer to conduct proficiency check maneuvers required by paragraph (a) of this section, subject to the conditions set forth in subparagraphs (1) through (3) of this paragraph.

(1) Slow flight, approach procedures on the letdown aid for which the lowest minimums are authorized, landings under circling approach conditions, and takeoffs and landings with engine failures shall be given in the appropriate airplane on each proficiency check. When a synthetic trainer is used to conduct a portion of the proficiency check, any additional maneuvers that have not been approved by the Administrator or his authorized representative for accomplishment in the trainer shall also be given in the appropriate airplane.

(2) The aircraft simulator shall simulate the systems, performance, and flight characteristics of the particular airplane used in conducting the proficiency check. For each maneuver approved for accomplishment in a synthetic trainer, the air carrier shall show that the trainer meets the appropriate standards for simulation of the systems, performance, and flight characteristics of the particular airplane used in conducting the proficiency check.

(3) That portion of the proficiency check given in an aircraft simulator or a synthetic trainer shall be conducted by a check pilot or a representative of the Administrator.

5. By adding an appendix to Part 40 to read as follows:

## APPENDIX

### Standards and procedures for approval of aircraft simulators, courses of training in aircraft simulators, and the use of synthetic trainers for proficiency check maneuvers

APPROVAL OF AIRCRAFT SIMULATORS

1. *Application for approval.* The air carrier shall submit an application for approval of an aircraft simulator, in triplicate, to the FAA Principal Operations Inspector. The application shall include the following:

(a) For those items listed in section 3 of this appendix, information and data necessary to show that the simulator adequately simulates the minimum and maximum limits of the systems for the airplane being simulated, as shown in the approved Airplane Flight Manual and/or the maintenance section of the air carrier's manual;

(b) A list of any instruments, controls, equipment, or other items pertinent to training or proficiency checking that are in the airplane being simulated, but have not been incorporated in the simulator; and any deficiencies in the area of performance and flight characteristics; and

(c) Comparative data sheets showing that the performance and flight characteristics of the aircraft simulator have been flight checked and found to be within the limits prescribed for the items listed in section 4 of this appendix. The airplane data used for comparison purposes shall be applicable to the currently certificated airplane. Such data may be obtained:

(1) From the approved Airplane Flight Manual, Type Inspection Reports, or other flight test data provided by the airplane manufacturer, if satisfactory to the Administrator; or

(2) By flight tests conducted in accordance with the provisions of Part 4b of the Civil Air Regulations in the air carrier's own airplane. If this procedure is used, performance and flight characteristics data for the c.g. limits and weights used during training will be satisfactory. A representative of the Administrator will participate in the flight test program conducted by the air carrier. Before starting these flights, an outline of the tests to be conducted in the airplane shall be prepared and coordinated by the air carrier with the assigned FAA inspector. This outline shall contain procedures to be followed and data to be obtained during each phase of the flight testing program. Any data so obtained will be acceptable for use by other air carriers using the same type of equipment, when appropriate arrangements are made with the air carrier originating the data.

2. *Provisions for aircraft simulator maintenance and modification.* The air carrier shall provide the following personnel, procedures, and facilities for maintenance and modification of the aircraft simulator:

(a) An adequate number of qualified maintenance personnel;

(b) Adequate procedures for preflight inspection of the simulator similar to those for the airplane being simulated;

(c) A daily discrepancy log to be used by the simulator instructor or check airman at the termination of each training or check flight;

(d) A preventive maintenance schedule to be followed in maintaining the simulator, including simulator overhaul periods; and

(e) A modification program for keeping the configuration, performance, and flight characteristics of the simulator the same as those of the airplane being simulated.

NOTE: The air carrier may also include, as a part of the simulator maintenance program, provisions for continuation of training activities for a specified period of time with certain simulator components inoperative. Such provisions shall be limited to instruments or equipment not essential for accomplishing the particular phase of training involved.

3. *Minimum standards for simulation of airplane systems.* The simulator shall simulate at least the following items and systems of the airplane being simulated: *Provided,* That no system or item will be required for approval if it is not necessary to the performance of the normal and emergency operating procedures specified in the air carrier's manual for such airplane:

(a) All normal cockpit noise related to engine or aerodynamic noise (adjustable volume is permissible);

(b) All flight controls;

(c) Gust locks;

(d) Trim tabs;

(e) Landing gear operation;

(f) Wheel brakes;

(g) Steering mechanisms used on the ground;

(h) Wing flaps and spoilers;

(i) Powerplant operations;

(j) Propeller controls and circuity;

(k) Antidetonation injection systems (when applicable);

(l) Fuel and oil systems;

(m) Cockpit. The simulator shall represent a full scale mockup, including normal flight crew stations and accommodations for the instructor or check airman, and shall be representative of a typical fleet airplane.

(n) Circuit breaker stations manageable by the flight crew in the flight compartment (those not related to essential flight equipment or systems need not be operative);

(o) Hydraulic systems;

(p) Fire detection and extinguishing systems;

(q) Pneumatic systems (including emergency airbrakes);

(r) Electrical systems;

(s) Interior cockpit lights;

(t) Exterior light controls;

(u) Pressurization and air-conditioning systems (instrument indication and warning signals);

(v) Deicing and anti-icing systems;

(w) Supplemental breathing systems (the systems may be charged with or vented to air); and

(x) Other special systems peculiar to certain airplanes as necessary in view of the training value of the systems.

4. *Minimum standards of tolerance for performance and flight characteristics.* The simulator shall simulate the performance and flight characteristics of the particular airplane being simulated in accordance with the standards of tolerance specified in this section.

(a) *Performance.* (Weight and c.g. optional unless otherwise noted). For those items listed below, where where airspeeds apply, the maximum tolerance shall be ± 2 seconds or ± 10 percent, whichever is greater, unless otherwise specifically noted. For those items where air speeds apply, the maximum tolerance shall be ± 5 knots, except in the case of the difference between stall and stall-warning airspeed, and the difference in this instance shall be within ± 2 knots of that for the appropriate airplane but in no case shall the stall occur before the stall warning. For those items where climb rates apply, a maximum tolerance of ± 50 feet or 10 percent, whichever is greater, shall be acceptable.

(1) Propeller feathering time (if applicable).

(2) Landing gear operating time.

(3) Wing flap operating time.

(4) Calibration of gyrocompass and turn-and-bank indicator in standard rate turns and 30 degree banked turns, through a range of 90 degrees.

(5) Takeoff acceleration time.

(6) Stall speeds and stall-warning speeds over a range of weights and flap settings.

(7) Engine power (thrust) calibration at takeoff and maximum continuous ratings over an altitude range: as follows:

(i) Reciprocating engines: For a given BMEP and RPM, the MAP tolerance shall be ± 1 inch.

(ii) Turbine engines: For a given EPR, $N_1$ and $N_2$ tolerances shall be ± 2 percent, and

(iii) Critical altitude: The tolerance for critical altitude shall be ± 800 feet.

(iv) Tolerances in subdivisions (i) and (ii) of this subparagraph shall be allowed for speed versus power, and climb rates.

(8) Speed versus power in level flight at cruise altitude.

(9) Rates of climb versus altitude in the following configurations:

(i) Takeoff gear down (one engine inoperative),

(ii) Takeoff gear up (one engine inoperative),

(iii) Final takeoff (one engine inoperative),

(iv) All engines en route,

(v) One-engine-inoperative en route climb,

(vi) Two-engine-inoperative en route climb (for airplanes with four or more engines),

(vii) Approach (one engine inoperative), and

(viii) Landing.

NOTE: Include two weights in at least one configuration, and two temperatures in at least one other configuration.

(10) Rates of climb versus airspeed for one takeoff and one en route configuration.

(11) MP/BMEP/RPM relationships shall conform to airplane data. EPR/Compressor/RPM relationships shall conform to airplane data.

(b) *Flight characteristics.* (Weight and c.g. optional unless otherwise noted). For those items listed below where control forces apply, the maximum tolerance shall be ± 8 pounds or ± 25 percent, whichever is the greater, except that in regard to rudder forces the tolerances shall be ± 10 pounds or 20 percent, whichever is greater. In no case shall there be a force reversal. For those items where time requirements apply, the maximum tolerance shall be ± 2 seconds or ± 25 percent, whichever is greater. In those areas for which limitations are not set forth, such as compressibility trim change, nature of stall warning, Dutch roll characteristics, emergency descents, and features peculiar to certain types of airplanes, a representative of the Administrator will specify appropriate limitations, taking into consideration their training value.

(1) Static longitudinal stability in the following configurations (this range of tolerance shall be applied within 15 percent of trim speed and return to trim shall be within ± 5 knots):

(i) Landing,

(ii) Approach,

(iii) Cruise (high and low altitude), and

(iv) Climb.

NOTE: Include a c.g. range for at least one of the above configurations.

(2) Longitudinal control forces for configuration changes as follows (control forces required to maintain speed will be indicative of trim changes):

(i) Flap retraction—power off and power on,

(ii) Flap extension,

(iii) Power (thrust) application, and

(iv) Go-around from balked landing.

(3) Aileron forces versus wheel deflection.

(4) Rudder forces versus pedal deflection.

(5) Minimum control speed.

(6) Stall characteristics, including nature of stall warning and instrument indications during recovery. Stall tests shall also be conducted in 30 degree banked turns.

(7) Stick force per "g."

(8) Roll rates.

(9) Features, peculiar to the airplane, such as Dutch roll, compressibility trim changes, etc., where these features have a significant effect on procedures or handling characteristics.

(10) Buffeting demonstrations as experienced in stalls, or, as applicable, high Mach numbers up to design Mach limits.

(11) Other items required by a representative of the Administrator.

5. *Minimum standards of tolerance for simulator navigational recorders (course and altitude).* At any altitude, and on any heading, the distance traveled by the recorder with zero wind in a particular time interval shall be equivalent to ± 5 percent of the horizontal component of the true airspeed multiplied by the time interval. The track of the course recorder on the chart with no wind shall agree with the true heading

of the simulator within ± 3 degrees, which shall include allowances for instrument error. This shall apply when the simulator is turning as well as flying a straight course. The track of the altitude recorder shall indicate within ± 20 feet the actual glide path as shown on the flight instruments during simulated ILS or PAR approaches, when within 20 miles of the station.

6. *Cancellation of approval.* The failure of an aircraft simulator to meet the standards and tolerances specified in this section shall be sufficient reason for cancelling the approval of such simulator.

APPROVAL OF AIRCRAFT SIMULATOR TRAINING COURSES

11. *Application for approval.* The air carrier shall submit an application for approval of a course of training in an aircraft simulator, in triplicate, to the FAA Principal Operations Inspector. The application shall include a simulator training course curriculum and sufficient descriptive material to evaluate the scope and adequacy of the course of training to be accomplished, and to determine that the course meets the standards prescribed in section 12.

12. *Standards for approval of simulator training courses.*

(a) The simulator training course curriculum shall include at least those items specified in subparagraphs (1) through (3) of this paragraph.

(1) Simulator flight training and instruction of at least 4 hours in all normal and emergency operating procedures, as shown in the approved Airplane Flight Manual; the maneuvers required by § 40.302(b) and/or § 40.305; and those maneuvers peculiar to the particular airplane being simulated, such as Dutch roll, etc. Flight maneuvers that require visual reference to the ground need not be included.

(2) Ground training consisting of at least 2 hours of simulator briefing and debriefing instructions.

(3) Minimum performance standards for flight crewmembers. Such standards shall not be less than the current requirements established for proficiency checks in the particular airplane being simulated.

(b) Approval of the aircraft simulator(s) to be used in the training course shall have been based on simulation of the particular airplane(s) operated by the air carrier: *Provided*, That another air carrier's simulator may be used if the applicant shows that the instrumentation, radio equipment, control arrangement, systems, performance, and flight characteristics are consistent with his own airplane(s).

(c) The air carrier shall provide an adequate number of simulator instructors. Each such instructor shall hold a valid airline transport pilot certificate with an appropriate type rating for the airplane being simulated. Satisfactory completion of the approved simulator course shall be certified to by a company check airman or a representative of the Administrator.

(d) The air carrier shall establish and maintain a record system that shows, for each trainee or crewmember participating in the course of training, the course instruction, course time, and grades received.

13. *Revisions to approved course of training.* Requests for revisions of the approved training course shall be submitted and handled in the same manner established for initial approval.

APPROVAL TO USE SYNTHETIC TRAINERS FOR PROFICIENCY CHECK MANEUVERS

21. *Application for approval.* The air carrier shall submit for approval a list of the maneuvers to be accomplished in the synthetic trainer. Such application shall be submitted, in triplicate, to the FAA Principal Operations Inspector.

22. *Procedure for approval.* A representative of the Administrator will evaluate and determine the adequacy of maneuvers simulated, and will specify those that may be accomplished in the trainer.

23. *Use of aircraft simulators or synthetic trainers owned or operated by another air carrier.* The use of another air carrier's simulator or trainer is permissible, provided the instrumentation, radio equipment, control arrangement, systems, performance, and flight characteristics are consistent with those of the aircraft operated. Specific approval by the Administrator or his authorized representative is required to conduct a portion of the proficiency check in another air carrier's aircraft simulator. Check airmen used in conducting the checks shall be those designated for the air carrier operating the airplane.

24. *Cancellation of approval.* The failure of a synthetic trainer to meet the standards and tolerances required for approval to use such trainer for proficiency check maneuvers shall be sufficient reason for cancelling such approval.

* * * * *

6. By promulgating amendments to Parts 41 and 42 of the Civil Air Regulations similar to those proposed herein.

These amendments are proposed under the authority of sections 313(a), 601, 604, and 605 of the Federal Aviation Act of 1958; (72 Stat. 752, 775, 778; 49 U.S.C. 1354(a), 1421, 1424, 1425).

George F. Pickett

*Director,*
Flight Standards Service

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