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Advisory Circular

Subject: **Pilot Transition Courses for Complex Single Engine and Light, Twin-Engine Airplanes**

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Preface

This publication is intended for use by certificated airplane pilots who wish to transition to more complex single-engine or light twin-engine airplanes.

An extremely wide range is available today in the single-engine class and in the light twin-engine class of airplanes. Change from the simple to the sophisticated has occurred rapidly in recent years. Pilots who have been inactive or who have not been introduced to the more modern airplanes are encouraged to follow the syllabus of training offered in this advisory circular. Greater knowledge and skills are needed for the efficient and safe operation of today's more powerful aircraft.

This publication is offered as a guide to the procedures and standards to be followed for a thorough and comprehensive checkout in these airplanes. The conscientious application and adherence to the scope of coverage recommended in the syllabus should result in a more competent, effective, and efficient pilot.

The transition courses have been prepared by the Flight Standard Service of the Federal Aviation Administration and issued as Advisory Circular 61-9B.

Comments regarding this publication should be directed to Department of Transportation, Federal Aviation Administration, Flight Standards Technical Division, P.O. Box 25082, Oklahoma City, Oklahoma 73125.

TRAINING FOR CHECKOUTS

Pilots preparing to check out in additional types of airplanes may find it helpful to follow a prescribed set of procedures and standards in training. This guide outlines a course of training for each of the two classes of airplanes: the complex single-engine and the light twin-engine.

This training should be conducted by a competent flight instructor who is certificated in the class of airplane and who is thoroughly familiar with the make and model. Characteristics of classes of airplanes as well as makes and models vary considerably, one from another.

While this guide is complete in its outline of the material to be covered, the recommended syllabus for transition training is to be considered flexible. The arrangement of the subject matter may be changed and the emphasis may be shifted to fit the qualifications of the trainee, the airplane involved, and the circumstances of the training situation, provided the prescribed proficiency standards are achieved.

The training times indicated in the syllabuses are based on the capabilities of a pilot who is currently active and fully meets the present requirements for the issuance of at least a private pilot certificate. The time periods may be reduced for pilots with higher qualifications, or increased for pilots who do not meet the current certification requirements or who have had little recent flight experience.

Complex Single-Engine Airplanes

The syllabus in figure 1 is designed to prepare a certificated single-engine pilot, without previous experience in "complex" airplanes, to operate one such airplane type competently.

For purposes of this syllabus, a "complex" single-engine airplane is one equipped with flaps, a controllable propeller, and a retractable landing gear. Figure 1. Complex Single-Engine Airplane Transition Training Syllabus.

Light Twin-Engine Airplanes

The syllabus in figure 2 may be used for either of two purposes; (1) to check out a private or commercial pilot who holds a multiengine rating on a new type of light twin-engine airplane; or (2) to prepare a private or commercial pilot without previous multiengine experience to take the required multiengine class rating flight test from a qualified pilot examiner or FAA inspector. The training program assumes that the student is currently qualified in at least one complex airplane type.

To be fully effective, this syllabus should be followed and the training conducted by a flight instructor familiar with the performance and characteristics of light "twins" in general and with the significance and use of critical performance speeds. The instructor should be fully qualified in the airplane type concerned. Figure 2.

CHECKOUT PROCEDURES AND STANDARDS

Preflight Examination

Before taking off on his checkout flight, a pilot should pass a test on the airplane to be used, its systems, limitations, performance, emergency procedures, and approved operating procedures. This test may consist in part of a written quiz, or may be wholly an oral examination by the check pilot.

The preflight examination should cover at least:

a. The approved Airplane Flight Manual, Owner's Handbook, and official placards which prescribe operating procedures and limitations.

b. A working knowledge of cruising speeds at various altitudes, power settings, fuel consumption, endurance, takeoff and landing distances, and rates of climb and descent.

c. Normal and emergency operation of aircraft systems and special equipment.

d. Practical computation of various combinations of the permissible loadings using available loading diagrams or graphs.

e. A thorough line check of the airplane to be used, using a checklist provided by the manufacturer or operator. If no official checklist is available, the check must be made in accordance with an orderly procedure that covers all critical iitems. The presence of all required certificates, documents, and placards, and the fuel and oil supply should be checked. The inspection must cover all airworthiness items that can be investigated by an external examination. The pilot must know the significance of all unsatisfactory items noted, and the appropriate corrective action to be initiated by the pilot for each.

Flight Maneuvers and Procedures

Coordination and Planning Maneuvers

Standard coordination and planning maneuvers should be performed to demonstrate that the pilot is familiar with the airplane's performance and flight control responses. These may be very simple maneuvers or relatively complex, ranging from medium-banked turns (20á to 30á) and 720á power turns to chandelles and lazy eights. Coordination and planning maneuvers should be demonstrated in both directions, at various speeds within the normal airspeed range of the airplane, and with various flap and landing gear configurations.

The pilot should perform all standard coordination maneuvers without completely deflecting the ball outside the center reference lines of a standard slip-skid indicator. Prolonged turns should be stopped within 10á of the assigned heading, and altitude should be maintained within 100 ft. of the assigned altitude during level flight maneuvers.

Ground Pattern Maneuvers

Any of several standard training maneuvers may be used to demonstrate that the pilot is able to accurately control his path over the ground, and anticipate turns to new courses. Among these are S-turns across a road, rectangular courses, turns about a point, or eights around pylons. The demonstration of rectangular courses may be accomplished in the airport traffic pattern if other traffic permits.

The pilot should be able to maintain the desired track over the ground by crabbing into any existing wind, anticipating the crab on recovery from turns, and maintaining proper coordination of the rudder and aileron controls. During pattern maneuvers, he should hold his altitude within 100 ft. of the altitude assigned. He should be able to operate by ground references without prolonged diversion of attention from his engine instruments and his vigilance for other traffic.

Flight at Minimum Controllable and Landing Approach Airspeeds

Climbs, descents, and level flight on straight courses and in medium banked turns should be demonstrated at minimum controllable and landing approach airspeeds with appropriate power settings. The minimum controllable speed used should be such that any further reduction in airspeed or increase in load factor would result in immediate indications of a stall. The landing approach speed should be 1.3 to 1.4 times the power-off stalling speed in cruise configuration.

The pilot should also demonstrate the smooth, prompt transition from cruising to landing approach airspeed, and the use of flaps and gear to effect descents from level flight at approach speed without changing the power setting.

The pilot should be able to control his airplane positively and smoothly at the appropriate speed, and maintain an airspeed within 5 kts. of the desired speed. He should make the transition from cruising speed to landing approach speed without varying more than 10á from the desired heading nor more than 100 ft. from the desired altitude.

Stalls from All Normally Anticipated Flight Attitudes

The recovery from stalls entered with and without power should be demonstrated. Emphasis should be placed on the recovery from the three critical stall situations: takeoff and departure, approach to landing, and accelerated stalls.

Recovery should be initiated as soon as the first physical indication of a stall is recognized, except that in single-engine airplanes at least one stall should be allowed to develop until the nose pitches through level flight attitude before recovery is initiated. Stall warners should be deactivated for stall demonstrations, except in airplanes for which they are required equipment. Stall recoveries should be demonstrated with and without power, and with various configurations of gear and flaps.

Stall recovery performance will be evaluated on the basis of prompt stall recognition and smooth positive recovery action. The pilot's ability to establish a precise stall entry situation is not a requirement, so he may be coached or assisted in setting up the required stall situations. Recovery should be effected smoothly with coordinated use of the flight controls and the least loss of altitude consistent with prompt recovery of positive flight control

Maximum Performance Operations

Short-field and soft-field takeoffs and landings should be required in accordance with procedures specified in the Airplane Flight Manual or Owner's Handbook and the FAA Flight Test Guides. Special attention should be paid to flap and trim settings, power usage, and the use of correct airspeeds. The use of the best angle-of-climb and rate-of-climb airspeeds becomes more critical as speeds increase and the cleanness and efficiency of airplanes improve.

In multiengine airplanes, it is important for the pilot to know and observe two sets of performance speeds: one for normal use and one applicable to operation with one engine inoperative. To demonstrate maximum performance short-field and soft-field takeoffs, lift-off should be initiated just below the all-engine best angle-of-climb speed, unless it is slower than the engine-out minimum control speed, in which case the engine-out minimum control speed should be used. The best all-engine angle-of-climb speed should be attained, and maintained to the height of an assumed obstruction, such as a fence or row of trees, after which normal climb speed should be smoothly attained.

Optimum power, loading, and flap settings for various density altitudes may be found in the Airplane Flight Manual or Owner's Handbook. In efficient high-performance airplanes the proper application of these factors will produce a significantly better performance which can be readily demonstrated.

Control by Reference to Flight Instruments

During his checkout in a new airplane type, the pilot should demonstrate his ability to control the airplane manually in flight by reference to instruments. No IFR flight procedures, as such, need be performed, but the pilot should be able to perform the following maneuvers smoothly and with confidence, using all instrumentation installed in the airplane.

1. Level flight, climbs, turns, and descents. Climbs and descents should be performed at constant airspeeds, using standard rates of climb and descent, usually 400 to 500 ft. per minute depending on the performance of the airplane used. Turns should be performed at the standard rate, and be stopped within 10á of an assigned heading.

2. Recovery from unusual attitudes. The pilot should be able to recover positively and smoothly from both nose-high and nose-low unusual attitudes established by the check pilot. The attitudes used should be moderate displacements from normal flight, characteristic of errors due to diversion of attention from the instruments during instrument flight. They should include climbing turns, incipient power spirals, increasing or decreasing angles of bank, and significant variations in airspeed. Recovery should be smoothly effected to a straight and level flight by reference to instruments without imposing any excessive load factors or involving airspeeds which are dangerously close to the placarded maximum speed or to stalling speed.

Use of Radio, Autopilot, and Special Equipment

Radio

The pilot should demonstrate the use of all radio equipment in the airplane for communications and VFR navigation. The pilot should be able to operate each transmitter and receiver and use radio navigation equipment to establish bearings and tracks by radio signals received. He should be able to operate DME (distance measuring equipment) and transponder if installed, and have a general knowledge of their principles of operation and limitations.

Operation of radio equipment should include a knowledge of the location of associated fuses and circuit breakers, and how to replace or reset them. It should also include a general knowledge of the capabilities and limitations of each radio installation.

Autopilot

If an autopilot is installed, the pilot should demonstrate its use, including indexing, engaging, disengaging, and resetting course and altitude while it is engaged, if permissible.

He should also demonstrate a working knowledge of its limitations, possible malfunctions, overpowering by the pilot, and emergency disengagement.

Special Equipment

The pilot should be familiar with and demonstrate the use of any special equipment installed, such as flight director, oxygen systems, pressurization systems, and automatic feathering devices. The demonstration should include a working knowledge of the limitations and the common failures of the equipment, and of the special precautions to be taken in equipment operation.

Emergencies

Emergency Operation of Aircraft Systems

The emergency operation of all airplane systems should be performed when practicable. Such operations should include the emergency extension of gear and flaps, the use of boost pumps, fuel transfer, replacement or resetting of fuses or circuit breakers, and the isolation of specified electrical circuits. The operation of pressure fire extinguisher systems, and such operations as the emergency extension of the landing gear by CO_2 should be explained and simulated. The emergency operation of the pressurization and oxygen system should be covered on airplanes so equipped.

Forced Landings (Single-Engine Airplanes Only)

The examiner should close the throttle smoothly at unannounced times during the checkout, and request the applicant to proceed as he would in the event of an actual power failure. No simulated forced landing will be given where an actual safe landing would be impossible. At least once, during the checkout, the pilot should demonstrate a landing from a glide with the engine throttled at traffic pattern altitude. Performance will be evaluated on the basis of the pilot's judgment, planning, technique, and safety.

Engine-Out Emergencies (Multiengine Airplanes)

A pilot checking out for the first time in a multiengine airplane should practice and become thoroughly familiar with the control and performance problems which result from the failure of power in one engine during any normal flight condition. He should practice the control operations and precautions necessary in such cases, and be prepared to demonstrate these on his multiengine rating flight test.

1. Propeller feathering or engine shutdown. The feathering of one propeller should be performed in all airplanes equipped with propellers which can be safely feathered and unfeathered in flight. If the airplane used is not equipped with featherable propellers, or, is equipped with propellers which cannot be safely feathered and unfeathered in flight, one engine should be shut down in accordance with the procedures in the Airplane Flight Manual or Owner's Handbook. The prescribed propeller setting should be used, and the emergency setting of all ignition, electrical, hydraulic, and fire extinguisher systems should be demonstrated.

   Proficiency will be evaluated on the basis of the control of heading, airspeed, and altitude; the prompt identification of a simulated power failure; and the accuracy of shutdown and restart procedures as prescribed in the Airplane Flight Manual or Owner's Handbook.

   Feathering for training and checkout purposes should be performed only under such conditions and at such altitudes and positions that a safe landing on an established airport could be readily accomplished in the event of difficulty in unfeathering.

2. Engine-out minimum control speed (VMC) demonstration (small multiengine airplanes only). Every small multiengine airplane checkout (except airplanes with centerline thrust) should include a demonstration of the airplane's engine-out minimum control speed. The engine-out minimum control speed given in the Airplane Flight Manual, Owner's Handbook, or other manufacturer's published limitations is determined during original airplane certification under conditions specified in the Federal Aviation Regulations. These conditions are normally not duplicated during training or on flight tests. It is also recognized that in all airplanes there is a density altitude above which the stalling speed is higher than the engine-out minimum control speed.

   A thorough discussion, prior to flight, of the factors affecting engine-out minimum control speed will be required. This discussion and the following demonstration will satisfy the operational objective in regard to identifying the controllability problems which can result from flight at too slow an airspeed when an engine failure occurs. The demonstration should be performed at a safe altitude. This maneuver will demonstrate the engine-out minimum control speed for the existing conditions and makes no effort to duplicate VMC as determined for airplane certification.

   With the gear and flaps up, the airplane will be placed in a climb attitude representative of that following a normal takeoff. With both engines developing as near rated takeoff power as possible, power on the critical engine (usually the left) will be reduced to idle (windmilling, not shutdown), The airspeed will then be reduced slowly with the elevators uuntil directional control can no longer be maintained. At this point, recovery will be initiated by simultaneously reducing power on the operating engine and reducing the angle of attack by lowering the nose. Should indications of a stall occur prior to reaching this point, recovery will be initiated by reducing the angle of attack. In this case, a minimum engine-out control speed demonstration is not possible under existing conditions.

If it is found that the minimum engine-out control speed is reached before indications of a stall are encountered, the pilot should demonstrate his ability to control the airplane and initiate a safe climb in the event of a power failure at the published engine-out minimum control speed.

For this demonstration, with the gear and flaps set for takeoff, the airspeed should be slowed at reduced power to the minimum speed determined above. Rated takeoff power should be applied smoothly, and a climb initiated at the minimum engine-out minimum control speed specified in the approved Airplane Flight Manual or Owner's Handbook. The check pilot should throttle one engine to simulate a loss of power, and request the pilot to maintain heading and continue a climb (or minimum sink) at the engine-out best rate-of-climb airspeed.

The gear and flaps should be retracted in accordance with the emergency procedures prescribed in the Airplane Flight Manual, or Owner's Handbook, and the throttle on the windmilling engine may be advanced sufficiently to simulate a feathered propeller (on airplanes with feathering propellers only).

Performance will be evaluated on the basis of the pilot's being able to maintain his heading within 15á and his bank within 10á, and the accuracy of his operation and trim procedures. Any attempt to continue level or climbing flight at less than the published minimum engine-out control speed after a simulated or actual power failure will result in immediate disqualification on a flight test in a multiengine airplane.

3. Engine-out best rate-of-climb demonstration. The pilot should practice and demonstrate the use of the best engine-out rate-of-climb speed shown in,the Airplane Flight Manual or Owner's Handbook.

This speed should be demonstrated with one engine set to simulate the drag of a feathered propeller or a propeller actually feathered, except that in airplanes without feathering propellers one engine should be cut off or idling. The prescribed speed should be carefully maintained for at least 1 minute after the airspeed has stabilized, and the resulting gain or loss of altitude should be carefully noted. For comparison, climbs may be attempted at other airspeeds within the normal operating range of the airplane used.

4. Effects of configuration on engine-out performance. The pilot should also practice and demonstrate the effects (on engine-out performance) of various configurations of gear, flaps, and both; the use of carburetor heat; and the failure to feather the propeller on an inoperative engine. Each configuration should be maintained, at best engine-out rate-of-climb speed long enough to determine its effect on the climb (or sink) achieved. Prolonged use of carburetor heat at high power settings should be avoided.

5. Maneuvering with an engine-out. Engine-out maneuvering is usually practiced in conjunction with the feathering demonstration described in para. 1, above. It is acceptable, however, to conduct this demonstration with one engine set to simulate the drag of a feathered propeller if the airplane is equipped with feathering propellers. In airplanes which are not so equipped, maneuvering should be demonstrated with an engine cut off completely, or idling.

Straight and level flight and medium (20á to 30á) banked turns toward and away from the inoperative engine should be practiced. The pilot should be able to maintain altitude within 100 ft. of the initial altitude if the airplane is capable of level flight with an engine out, or the airspeed within 5 kts. of the best rate-of-climb speed in an airplane that is not capable of level flight under the existing conditions.

6. Approach and landing with an engine-out. At least once during his checkout, the pilot should perform an approach and landing with an engine throttled to simulate the drag of a

feathered propeller, or, if featherable propellers are not installed, an engine throttled to idling.

Evaluation will be based on the correct operation of the airplane systems, the appropriate handling of trim, observance of the proper traffic pattern or approach path, airspeed and altitude control, accuracy of touchdown, and control during rollout.

Emergency Descents (Pressurized Airplanes Only)

During checkout in a pressurized airplane, the pilot should practice and demonstrate emergency descents, such as may be necessitated by explosive decompression, in accordance with procedures prescribed in the Airplane Flight Manual or Owner's Handbook.

Descents should be initiated and stabilized, but prolonged descents should be avoided because of possible hazard to air traffic. The airspeed or Mach number used for the demonstration should be approximately 10 percent less than the airplane's structural limitation (VMO, MMO) to provide a margin for error. When a Mach limitation is controlling at operational altitudes for the airplane used, the descents should be arranged to require the transition from the observance of a Mach limitation to an airspeed limitation. No emergency descents should be practiced near or through clouds.

FLIGHT INSTRUCTORS' ENDORSEMENTS AND RECOMMENDATIONS

Logbook Endorsements

A flight instructor who has checked out a certificated pilot in a new type of airplane, single-engine or multiengine, should enter and certify the checkout in the pilot's logbook. Such certification should include the date, precise designation of the airplane type involved, and the extent of the checkout conducted. Figure 3 is an example of such a certification.

FIGURE 3. Flight Instructor's Certification

Multiengine Rating Recommendation

A certificated flight instructor who has checked out a certificated pilot in a multiengine airplane should execute the certification in the pilot's logbook illustrated in Figure 3.

If the pilot does not already hold a multiengine rating, the flight instructor should also provide him with an official recommendation for the multiengine rating practical test, using FAA Form 8420-3, as depicted in figure 4.

Instructor's Recommendation

Graduation Certificate

An agency or operation that conducts transition courses for pilots, at pilot training clinics or in the course of its regular pilot training operations may wish to award formal graduation certificates in addition to the regular endorsements and recommendations. A sample for such a graduation certificate is illustrated in figure 5.