Federal Aviation Agency

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CONSOLIDATED REPRINT
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SUBJECT: APPROVAL BASIS FOR AUTOMATIC STABILIZATION EQUIPMENT (ASE) INSTALLATIONS IN ROTORCRAFT

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1. PURPOSE. This circular sets forth acceptable means, not the sole means, by which compliance may be shown with the flight requirements for ASE installations in accordance with the reference regulations in 2 below.

2. REFERENCE REGULATIONS.

   a. CAR's 6.10 and 7.10, Eligibility for type certificates.

   b. CAR's 6.601 and 7.601, Functional and installational requirements.

   c. CAR's 6.606(b) and 7.606(b), Hazards.

3. DISCUSSION.

   a. Parts 6 and 7 rotorcraft airworthiness regulations do not speak specifically to flight requirements for the installation of ASE equipment. The referenced regulations do, however, set forth objective standards for the installation of optional equipment such as the automatic stabilization equipment, etc. This type of equipment has been installed and approved on several helicopters in the past, and the criteria set forth in this document are essentially the same as those utilized in the determination of compliance for these past approvals.

   b. Basically, the means of compliance contained herein are similar to that required for autopilot installations, and provide for the equipment to:

      (1) Function properly (reference 6.601 and 7.601).
      (2) Not create any unsafe conditions in normal operation (reference 6.10 and 7.10).
      (3) Not create any hazard in the event of malfunction or failure (reference 6.606(b) and 7.606(b).

4. ACCEPTABLE MEANS OF COMPLIANCE.

a. An analysis of the automatic stabilization equipment system components and associated systems should be made to determine to what extent a single failure will produce signals in the system which will adversely affect the flight control system. These signals should be introduced during flight test as required in paragraph b(1).

b. To preclude hazardous conditions which may result from any failure or malfunctioning of the automatic stabilization equipment, or its inadvertent use by the human pilot, the following conditions should be investigated by flight tests:

(1) A signal about any axis equivalent to the cumulative effect of any single failure (or if multiple axis failure can result from the malfunction of any single component, combined signals from all affected axes) should be induced into the automatic stabilization equipment during all maneuvers and flight regimes appropriate to its use.

(2) If the equipment is to be approved without flight restrictions (operating at all times), such malfunctions should be demonstrated to be satisfactory during takeoff, climb, cruising, landing, maneuvering, and hovering.

(3) If a flight restriction is provided, it should be determined as appropriate for the type and its operation. Appropriate operating limitations should be specified and significant information regarding the restriction should be made available to the pilot in the operating procedures section of the rotorcraft flight manual. A means shall be provided to engage and disengage the equipment and a visual means should be provided to indicate when the equipment is operating.

(4) When corrective action is taken with appropriate time delay after the rotorcraft response to the malfunction, neither the simulated failure nor the subsequent corrective action should create either hazardous loads or speeds, or dangerous attitude or flightpath deviations.

(5) Recovery should be demonstrated with the use of normal controls or by manual use of an emergency disconnect, if such a device is provided, after the appropriate time delay. The pilot should be able to return the rotorcraft to its normal flight attitude under full manual control without exceeding the loads and speeds previously described and without engaging in any dangerous maneuvers during recovery.

(6) The following time delays should be used and are considered appropriate for the various flight regimes and maneuvers:

(a) One to three seconds delay for cruising flight. (The time delay selected should be based upon the degree of stability provided and the amount of alertness required of the pilot. For example, three seconds are required for a fixed wing transport aircraft in cruising flight).

NOTE: If the improved stability and the resultant higher degree of relaxation by the pilot has justified time delays greater than one-second minimum in cruise, then a reexamination is in order of the engine failure time delays used during the original type certification prior to the ASE installation. (CAR 6.121(e) and CAR 7.121(e)).

(b) One second delay for climbing flight.

(c) Zero second delay for takeoff, landing, hovering, and maneuvering flight.

(7) If any significant loss of altitude is experienced in any flight regime or maneuver, it should be provided as emergency operation information.

(8) The automatic stabilization equipment should be installed such that lateral, directional, and longitudinal controllability (CAR 6.121) are not affected adversely. It should be demonstrated that with a critical malfunction at critical airspeeds (such as V_{ne} and maximum sideward flight) it is possible for the pilot to maintain complete control of the rotorcraft.

(9) The automatic stabilization equipment should be able to perform its intended function throughout all maneuvers appropriate to its type. All such maneuvers should be accomplished smoothly.

(10) If trim controls are provided in the automatic stabilization system, they should be of such design and so installed that any failure will not create a hazardous condition. If an inadvertent out-of-trim condition can be developed, its effect on the ASE or the rotorcraft should be investigated. These trim controls should be such that when installed, the controls should operate in the plane and with the sense of motion of the rotorcraft. Each control means should have the direction of motion plainly marked thereon or adjacent to the control.

(11) The automatic stabilization equipment should be so installed that its operation will not be adversely affected by spurious signals from other sources, or as a result of normal variations in the automatic stabilization system power source, or feedback by other equipment operating from the same power source.

(12) A positive means should be provided to indicate to the pilot when the automatic stabilization equipment is ready for operation or when the gyroscopic components are uncaged, unless it is impossible to engage the equipment before it is ready for operation.

(13) A visual means should be provided to indicate when the equipment is operative. If the design is such and the installation made such that it is possible to render a channel inoperative separately, then a visual means should be provided to indicate when each channel is operative.

(14) The automatic stabilization equipment should be so installed and adjusted that the control authority for each axis can be maintained within tolerance in normal operation. These tolerances should be established and included on the aircraft specifications with the associated amount of control authority for each appropriate axis.

(15) The following information should be provided in the rotorcraft flight manual:

(a) Any applicable operating limitations.
(b) The normal operating procedures.
(c) The emergency operating procedures, including a statement of altitude lost in any flight regime, if it is appropriat

c. Although the preceding material refers to automatic stabilization equipment which may be interpreted as stability about all axes, it is intended also that this guidance material should be applicable to single axis stability augmentors, where appropriate.

d. Approval of automatic stabilization equipment in accordance with this material does not constitute approval of the equipment or the rotorcraft for instrument flight.

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