



U.S. Department
of Transportation

**Federal Aviation
Administration**

Memorandum

Subject: ACTION: Action: Review and Concurrence, Equivalent Level of Safety; ACE-02-15 Date: December 5, 2002

From: Program Manager, ACE-117W Reply to: Tina L. Miller
316-946-4168

To: Manager, Small Airplane Directorate, ACE-100 ELOS# ACE-02-09 Rev. A

Attn: Roger Chudy, Project Officer, ACE-110

Background

On August 12, 1994, the Luscombe Aircraft Corporation in Altus, Oklahoma, made application to the FAA to amend Type Certificate Data Sheet A-804 by adding the new Model 11E. The Model 11E airplane is a derivative of the Model 11A that was type certified in October 1948 in accordance with the applicable requirements of CAR 03. The major exterior changes made to the Model 11A type design include:

- Installation of the Continental IO-360-ES engine rated at 185 HP.
- "Conventional" Landing Gear changed to Tricycle Landing Gear.
- New Engine Cowling contour.
- New Windshield contour.

The G-1 Issue Paper dated August 14, 2001, established the certification basis for the Model 11E as CAR 3 dated December 15, 1946, as amended by 3-1 through 3-4 and numerous sections of FAR Part 23 effective February 1, 1965. This certification basis includes the one-turn spin requirements of CAR 03.135-N or a demonstration that the airplane is characteristically incapable of spinning per the requirements of CAR 03.1350-NU. All spin entries required by the normal category spin test matrix contained in AC 23-15 were attempted in accordance with the FAA-Approved Luscombe Spin Flight Test Plan (Report No. 11E-FTP06, Rev. B). In no case could a full one-turn spin be produced. During all power-off entries, the aircraft response was typically sluggish and did not result in a spin entry, but instead, the test airplane remained fully controllable about the lateral and directional axes using normal control inputs. In every case, the airplane began a steep spiral with airspeed accelerating. The most energetic response noted while attempting to spin the test airplane was during power-on entries to the left. Under these conditions, the airplane exhibited an abrupt roll-off to a steep nose-down attitude for approximately one-quarter turn, at which point the airplane began a steep spiral with airspeed accelerating. Recovery from diving flight was complete by one-half turn using normal control inputs. Stall speed and characteristics testing demonstrated that the Model 11E is up-elevator limited, and a pronounced aerodynamic stall "break" does not occur.

Due to the structural design of the airplane, it is not possible to perform all of the "characteristically incapable of spinning" test requirements specified in CAR 03.1350-NU. Of

the four criteria specified, only sub-paragraphs (a) and (b) can be demonstrated with the Model 11E. These requirements are: (a) a demonstration at a maximum weight 5% in excess of the maximum to be approved, and (b) a demonstration at 3% aft of the rearmost center of gravity to be approved. The demonstrations specified in sub-paragraphs (c) and (d) cannot be accomplished without introducing major structural changes to the type design in the areas of the elevator and rudder. It is not possible to increase up-elevator travel by the 4° required by sub-paragraph (c) and rudder travel by the 7° required by sub-paragraph (d). Both elevator and rudder control surface travel is limited by contact with major airframe structural components and not by adjustable stops.

When FAR 23 was issued on February 1, 1965, the spin recovery criteria of CAR 03 was taken essentially unchanged into the new FAR 23.221. The FAA revised FAR 23.221 at Amendment 23-42, effective February 4, 1991. This revision replaced the previous “characteristically incapable of spinning” criteria with a new spin resistance criteria. Advisory Circular 23-15, dated January 2, 1997, provides additional guidance on the application of spin resistance criteria. This change recognized new design techniques that provide significant improvements in spin resistance in normal category airplanes. At the time of this change, the criteria for demonstrating an airplane is characteristically incapable of spinning were removed from the regulations. This change provides an alternative for the manufacturer to demonstrate that the design of an airplane makes it resistant to the development of a spin. Specific criteria are contained in the regulation and associated guidance material (AC 23-15) to accomplish such a demonstration.

Applicable Regulations

CAR 03.135-N, 03.1350-NU
FAR 23.221(a)(2)

Regulations Requiring an ELOS

CAR 03.135-N

Description of compensating features which allow the granting of the ELOS (including design changes, limitations or equipment needed for equivalency) and explanation of how features provide an equivalent level of safety to the level of safety intended by the regulation.

The FAA has evaluated the test results achieved by the DER pilot, and concurs that the characteristics of the Luscombe Model 11E are such that all attempts to demonstrate one-turn spins as specified in CAR 03.135-N result in a steep spiral with airspeed accelerating. Attempts to demonstrate a one-turn spin by the FAA produced the same results as those attained by the applicant. In spite of aggressive attempts to develop a spin, accomplishment of all spins attempted in accordance with the FAA-Approved Luscombe Spin Flight Test Plan (Report No. 11E-FTP06, Rev. B; reference the spin matrix contained in AC 23-15), in no case could a full one-turn spin be produced. The most dynamic response was obtained following an aggressive accelerated power-on entry to the left. In this case, the airplane exhibited an abrupt roll-off to a nose-down attitude for approximately one-quarter turn, and then entered a steep spiral with airspeed accelerating. Recovery from diving flight was complete by one-half turn using normal control inputs. Stall speeds and characteristics testing further demonstrated that the Model 11E is up-elevator limited, and a pronounced aerodynamic stall “break” does not occur.

It is impractical to demonstrate the “characteristically incapable of spinning” test requirements specified in CAR 03.1350-NU due to the structural design of the Luscombe Model 11E airplane.

Both elevator and rudder control surface travel is limited by contact with major airframe structural components and not by adjustable stops. Major structural design changes in the areas of the elevator and rudder would be required to permit an increase of 4° in up-elevator and of ±7° in rudder travel. Of the four criteria specified in CAR 03.1350-NU, only sub-paragraphs (a) and (b) could be demonstrated with the Model 11E. These requirements are: (a) a demonstration at a maximum weight 5% in excess of the maximum to be approved, and (b) a demonstration at 3% aft of the rearmost center of gravity to be approved. The demonstrations specified in sub-paragraphs (c) and (d) cannot practically be accomplished.

Applicant's Position

The Luscombe Aircraft Model 11E meets the level of safety intended by the spin airworthiness standards of the Certification Basis established by the G-1 Issue Paper of August 14, 2001. In spite of exhaustive attempts, it has not been possible to cause the airplane to enter a spin condition. In every spin entry attempted, the aircraft entered a steep spiral with airspeed accelerating. Although Luscombe believes that these characteristics may be considered to literally meet the intent of the one turn spin recovery requirements of CAR 03.135-N, the applicant recognizes that the particular interpretation of this rule would play a significant role in this finding. Therefore, Luscombe proposes a finding by the FAA that the stall, post-stall, and spiral characteristics exhibited by the Model 11E provide an equivalent level of safety to the one turn spin recovery requirements contained in CAR 03.135-N. To further support this request, Luscombe revised Luscombe Report 11E-FTP06 (Luscombe Spin Flight Test Plan) to include the additional flight testing required to demonstrate compliance with the spin resistance requirements that were added to Part 23 of the Federal Aviation Regulations in Amendment 23-42, effective 2/4/91. During these tests, the airplane has been shown to be spin resistant for forward cg locations with any flap/power combination. Only at aft cg with 75 percent power could the spin resistant requirements of FAR 23.221 not be satisfied. The one-ball-offset wings level stall characteristics could not be satisfactorily accomplished and the 30-degree left and right rolls with coordinated rudder required an exceptional level of pilot skill. Another factor is that the pitch attitude is between 25 and 35 degrees nose up with full aft stick in the 75 percent power/aft cg configuration, which is steep enough to rapidly get the pilot's attention. The airplane recovers immediately and accelerates quickly when full aft stick is relaxed, and demonstrates exceptional stall warning characteristics in the form of a pronounced buffeting.

Luscombe Aircraft Corporation believes that compliance has been demonstrated with the requirements specified in CAR 03.135-N. However, in that the Model 11E could not demonstrate a full one-turn spin, an equivalent level of safety finding is satisfactory with Luscombe Aircraft Corporation. The Luscombe Model 11E has exhibited an exceptional level of safety in the stall/post stall flight regime. Luscombe believes that the combination of stall, post stall, resistance to spinning, and spiral characteristics demonstrated by the Model 11E provides a level of safety equivalent to that required by the regulations.

FAA approval and documentation of the ELOS

The FAA agrees that the proposal detailed above in the applicant's position section of this memo provides a level of safety that is equivalent to or better than that provided by compliance with the one turn spin recovery option specified in CAR 03.135-N. Therefore, the FAA agrees that the Luscombe Model 11E has demonstrated an equivalent level of safety to the one turn spin recovery requirements specified in CAR 03.135-N.

Compensating Features

- a. Spin resistant at forward cg (ref. FAR 23.221(a)(2)) at any power and flap setting.
- b. Spin resistant at aft cg at idle power with any flap setting.
- c. Exceptional stall warning characteristics.
- d. Immediate recovery to normal flight and rapid acceleration when full aft stick is relaxed.
- e. Steep spiral with accelerating airspeed if pro-spin control inputs are held at any power and flap setting.
- f. The excessive pitch attitude during power on stalls is sufficient to get the pilot's attention.

Ronald K. Rathgeber

Ronald K. Rathgeber, Manager
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Concur

Signature: *David E. Show*
Manager, SAD Standard Staff, ACE-110

Date: 12/16/02

Concur

Signature: *David E. Show*
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~~FOR~~ Date: 12/16/02