CIVIL AERONAUTICS MANUAL 4b

U. S. Department of Commerce — Civil Aeronautics Administration

Civil Aeronautics Manuals and supplements thereto are issued by the office of Aviation Safety, Civil Aeronautics Administration, for the guidance of the public and are published in the Federal Register and the Code of Federal Regulations.

Supplement No. 1 — April 30, 1955

SUBJECT: Revisions to Civil Aeronautics Manual 4b dated September 1954.

Civil Aeronautics Manual 4b was published in 19 F. R. 4446 July 20, 1954 and became effective September 1, 1954. This supplement is issued to provide subscribers of CAM 4b with policies of the Administrator for determining the accelerate-stop distance and landing distance for airplanes incorporating a reverse thrust propeller installation. It also provides minor amendments to the policies regarding the brake capacity for downwind takeoffs and landings. Policies are also established for industry guidance on (1) the minimum quantity of anti-detonant fluid required for approval of systems on airplanes being certificated as well as the amount required for approval of airline operating practices; (2) use of automatic reset circuit breakers as circuit protective devices; and (3) the standards and methods for showing compliance with Civil Air Regulation requirements with regard to approved materials and strength properties, certain phases of control systems and components, and external doors. The following revisions to Civil Aeronautics Manual 4b should be made:

Ink revisions:

Page 5—Add a new section as follows:

4b.16–4 *Flight tests (CAA policies which apply to sec. 4b.16).* The policies outlined in section 4b.402–1 (c) and section 4b.402–1 (l) (3) will apply.

Page 15—Add a new section as follows:

4b.115–3 *Reverse thrust used in accelerate-stop distance (CAA policies which apply to sec. 4b.115).* The policies outlined in section 4b.402–1 (k) will apply.

Page 23—Add a new section as follows:

4b.122–3 *Reverse thrust used in determination of landing distance (CAA policies which apply to sec. 4b.122).* The policies outlined in section 4b.402–1 (l) will apply.

Page 24—Add a new section as follows:

4b.123–3 *Reverse thrust used in landing distance—landplanes (CAA policies which apply to sec. 4b.123 (c)).* The policies outlined in section 4b.402–1 (l) will apply.

Page 48—Add a new section as follows:

4b.450–1 *Cooling with reverse thrust (CAA policies which apply to sec. 4b.450).* The policies outlined in section 4b.402–1 (j) will apply.

Page 66—Add a new section as follows:

4b.740–2 *Reverse thrust operating limitations and procedures (CAA policies which apply to sec. 4b.740).* The policies outlined in section 4b.402–1 (b) will apply.

Remove and destroy the following pages:	*Insert in lieu thereof the following pages (Rev. 4/30/55):*
Table of Contents	Table of Contents
Pages 1 and 2	Pages 1 thru 2—1
Pages 11 and 12	Pages 11 thru 12—1
Pages 21 and 22	Pages 21 thru 22—1
Pages 37 thru 40	Pages 37 thru 40—3
Pages 43 thru 46	Pages 43 thru 46—4
Pages 51 and 52	Pages 51 thru 52—1
Pages 57 and 58	Pages 57 thru 58—1
Pages 69 and 70	Pages 69 thru 70—1

The miscellaneous amendments to Civil Aeronautics Manual 4b picked up by this supplement are effective April 30, 1955, unless otherwise indicated.

All new or revised material is indicated by brackets [ ].

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Appendices

(Rev. 4/30/55)

Airplane Airworthiness

Transport Categories

[4b.10–1 *Approval of reverse thrust propellers* (*CAA policies which apply to sec. 4b.10*). A reverse thrust propeller is a design feature which is not fully covered in the Civil Air Regulations. When an airplane incorporates a reverse thrust propeller installation, it will be approved in accordance with the policies set forth in section 4b.402–1, provided it has no feature or characteristic which renders its use unsafe in transport category airplanes.]

(Effective Apr. 30, 1955.)

4b.10–2 *Approval of automatic propeller feathering installations* (*CAA policies which apply to sec. 4b.10*). An automatic propeller feathering device is a design feature not specifically covered in the Civil Air Regulations. When an airplane incorporates an automatic feathering device, it will be acceptable under the provisions of section 4b.10 as providing an equivalent level of safety in showing compliance with sections 4b.115, 4b.116, 4b.120 and 4b.133 if it complies with policies prescribed in sections 4b.115–2, 4b.116–1, 4b.120–1, 4b.401–1, and 4b.700–1, and if there are no features or characteristics which make it unsafe for use on transport aircraft.

(19 F. R. 1817, Apr. 2, 1954, effective Apr. 2, 1954.)

[4b.10–3 *Minimum quantity of anti-detonant fluid required* (*CAA policies which apply to sec. 4b.10*). The use of anti-detonant fluid in limited quantities as a supplemental fluid for take-off power operations is a feature not specifically covered in the Civil Air Regulations. A system incorporating anti-detonant fluid will be acceptable under the provisions of section 4b.10 as providing a satisfactory level of safety from the standpoint of the quantity of fluid available if it complies with the policies contained in sections 4b.420–1 and 4b.718–1.]

(Effective Apr. 30, 1955.)

4b.16–1 *Applicant's flight test report* (*CAA policies which apply to sec. 4b.16*). The applicant should submit a report signed by his test pilot containing the results of flight tests which were conducted by him. It should certify that the airplane has been flown at least in all maneuvers necessary for proof of compliance with the flight requirements and it is his belief that the airplane will conform therewith. In the case of very large airplanes, this procedure may be modified as deemed necessary by the Administrator.

(19 F. R. 4446, July 20, 1954, effective Sept. 1, 1954.)

4b.16–2 *Preflight test planning* (*CAA policies which apply to sec. 4b.16* (*a*)).

(a) *Proposed official flight test program.* Before the airplane is presented for official type certification tests, the applicant should submit to the CAA a proposed flight test program which will indicate at least the following:

(1) The area, defined by the several selections described in section 4b.100–2, which is to be covered by the terms of the type certification.

(2) All proposed tests; the order in which they are to be conducted; the purpose of each test; and for each the airplane weight, c. g., position flap setting, power to be drawn, and, where appropriate, the altitude, the trim speed(s) and the speed(s) or speed range to be investigated. Appendix A presents a list of most of the flight and operation tests generally required for the type certification program together with information relative to the air-

plane configuration, test procedure, and special instrumentation for each test.

(3) Since most transport airplanes undergo many changes during their life span it is well to consider this fact in setting up a flight test program. Such changes as installation of different propellers, higher powered engines, etc., can often be predicted in advance.

(4) It is often desirable to simulate operation with higher power for the determination of flying qualities and other tests, thus simplifying the problem of approving the airplane when the power change becomes effective. Data of this nature obtained during CAA flight tests may often reduce further testing during the life of the airplane.

(5) When an airplane has been type certificated in the transport category and a change is made affecting performance and/or flying qualities, the following procedure is suggested:

(i) The effect of the change on each of the flight tests in the general flight program should be noted.

(ii) Those tests which are materially influenced by the change should be listed.

(iii) A test program should be prepared embodying such of these tests as are felt to be critical or representative. This program should be forwarded to the CAA with the reasons for selecting the pertinent items. Appendix B shows representative flight programs for various types of changes and may be helpful in the preparation of the programs.

(iv) A description should be submitted of the method(s) which the applicant purposes to use in order to reduce the observed data to standard conditions.

(v) A statement should be submitted of any intention on the part of the applicant to resort to calculation in lieu of, or for the purpose of generalizing test data, together with a description of the data upon which these calculations are to be based and the methods to be used therein.

(6) Since it will require time for the CAA to determine the adequacy of this entire program, it is strongly recommended that it be submitted as early as practicable, otherwise the commencement of the testing may be delayed.

(b) *Order of testing.* The Civil Air Regulations are so worded that the results of some flight tests have a definite bearing on the conduct of other tests. For this reason careful attention should be given to the order of testing. The exact order of testing will be determined only by considering the particular airplane and test program involved. Appendix D shows a general arrangement that may be of assistance to those applicants who are not familiar with the CAA flight test procedures. Tests which are particularly important in the early stages of the program are:

(1) *Airspeed calibration.* All tests involving airspeed depend upon the calibration.

(2) *Stall speed measurement.* Most of the performance tests and flying qualities are related to the stall speed.

(3) *Minimum control speed for takeoff.* The takeoff safety speed depends upon this item.

(4) *Engine cooling.* All en route climb speeds and cowl flap settings are related to this test.

(c) *Test groupings.*

(1) *Weight and c. g.* In addition to the regulatory relation of one test to another, efficient testing requires that consideration be given to the accomplishment of as many tests on a single flight as can be accommodated successfully. The tests shown in Appendix D have been grouped under various weight and center of gravity conditions in order to facilitate the development of a flight test program.

(2) *Special instrumentation.* Similarly, consideration should be given to grouping of tests that involve special instrumentation. Examples of these are takeoff and landing tests which usually require ground equipment to record horizontal distance, height, and time. Ground calibration of the airspeed indicating system can be accomplished at the same time. The CAA possesses certain instruments which may be used for obtaining test data, such as trailing airspeed bombs, sensitive altimeters, stop watches, carbon monoxide indicators, etc., as well as photographic equipment for measuring takeoff and flight landing paths. It is therefore recommended that the matter of instrumentation be discussed with the CAA before any decision is made with regard to the detailed

flight test program. A list containing those tests requiring special instrumentation is shown in Appendix E.

(3) *Data reduction.* If the overall elapsed time for the certification program is to be kept to a minimum, tests requiring considerable data reduction should be conducted as early in the program as possible. Most performance data, particularly landing and takeoff data, fall in this category.

4b.16-3 *Additional flight tests (CAA policies which apply to sec. 4b.16 (b)).*

(a) *General.* Routine CAR tests as prescribed in sections 4b.100 though 4b.743 will be conducted (in accordance with existing procedures) to determine performance, flying qualities, power plant characteristics, etc.

The official functional and reliability tests will be that portion of the tests conducted under the immediate supervision of the Type Certification Board,[1] as prescribed in (c) through (h) of this section, to show compliance with sections 4b.100 through 4b.743.

Supplementary experience consisting of other flight tests and experience with an airplane (of the same) type will be taken into consideration in establishing the extent of the official portions of the tests. This supplementary experience may be obtained by the manufacturer, military services, airlines, etc.

(19 F. R. 4446, July 20, 1954, effective Sept. 1, 1954.)

[1] A Type Certification Board is set up by the CAA field offices on each new type aircraft project.

using not more than zero propeller thrust. In cases where the flap positions have not been predetermined, it is permissible to conduct tests using four or more equally spaced flap angles.

(2) The stalling speed tests should be conducted in accordance with the procedure outlined in section 4b.160 (c). The airspeed should be recorded at the time the airplane stalls as indicated by the pilot.

(3) Since the trim speed (1.4 V_{s_1}) and the speed at which zero thrust r. p. m. is set (not more than 1.1 V_{s_1}) are a function of the stall speed, a practice run should be made in order to determine the approximate stalling speed.

(4) The following data should be recorded for each stall:

Pressure altitude.
Ambient air temperature.
Trim speed—1.4 V_s.
1.1 V_s.
R. P. M. for zero thrust at 1.1 V_s.
R. P. M. set in test.
Actual r. p. m. at stall.
Stall speed—V_s.
Deceleration rate $-\frac{dv}{dt}$.
Wing flap position.
Landing gear position.
Weight.
C. G. position.
Torque pressure.

4b.113–1 *Downwind takeoff (CAA policies which apply to sec. 4b.113).* Downwind takeoff data may be approved on the following basis to provide for situations where geographic locations and terrain indicate they are desirable:

(a) *Performance.* In determining the required distances for takeoff in downwind the data should be substantiated by actual flight tests. The general methods and procedures would be comparable to those for substantiating takeoff distances in no wind. The flight tests should be conducted in tailwind components up to 150 percent of the maximum velocity for which approval is desired except that the performance tests may be simulated in zero wind as outlined below:

(1) The accelerate portions of the "takeoff" and "accelerate-stop" should be demonstrated at speeds corresponding to the zero wind plus 150 percent of the tailwind component for which approval is desired. The calculated distances for entry in the Airplane Flight Manual should also be based on 1.5 times the tailwind component, see (3).

(2) The decelerate portion of the "accelerate-stop" should be demonstrated by stopping from a speed corresponding to V_1 plus 1.5 times the tailwind velocity for which certification is desired.

(3) In determining the takeoff distances for the Airplane Flight Manual performance data, 150 percent of the effect of the reported tailwind component should be taken into account. (See sec. 4b.740–1 (d) (2) (x).)

This may in some cases, permit calculating the required distances without further tests providing sufficiently high speed takeoffs and decelerations were made in the original type tests. However, except in the circumstances outlined in (d), actual takeoffs should be made under the conditions outlined in (b) to check the flight and ground handling characteristics.

(b) *Controllability.* Takeoffs should be made in steady downwind velocities equal to 1.5 times the maximum velocity for which approval is granted to check the controllability at the higher ground speeds with correspondingly reduced aerodynamic control forces, dynamic balance of landing gear, nose gear shimmy or vibration, etc.

[(c) *Brakes.* At present it is believed that for calculated accelerate-stop distances based on actual airplane deceleration tests, the existing brake capacity requirements are sufficient to cover accelerate-stops in downwind velocities of 10 m. p. h. measured at 50′ height. However, in wind velocities above 10 m. p. h. and in unusual cases or special types of operation additional tests or substantiation of the adequacy of the brakes may be necessary, and a revision to the braking system may be required.]

(Effective Apr. 30, 1955.)

(d) *Tolerances.*

(1) With regard to performance tests outlined in (a), approval may be given for calculated takeoff distances for reported tailwind velocities up to 10 m. p. h. measured at 50′

height without camera tests additional to those required for approval of the no wind data.

(2) With regard to controllability tests outlined in (b), approval may be given for reported downwind velocities up to 10 m. p. h. measured at 50′ height without additional flight tests.

(19 F. R. 1817, Apr. 2, 1954, effective Apr. 2, 1954.)

Discussion of Policies Relating to Determination of the Takeoff Field Length in Section 4b.113–2

The flight path specified in section 4b.113–2 (a) necessarily involves consideration of the level of skill of the pilot who happens to be flying the airplane at the time. The conditions under which this flight path is established provides for a reasonable level of skill by requiring certain minimum speeds which should be attained, as well as a sequence and timing in which it is assumed various configuration adjustments are made to the airplane, each of which have a measurable effect upon the resulting dimensions. The takeoff field length involves the determination of the distances traversed by the airplane for two alternative sequences of events. In the first case the airplane is accelerated to the critical engine failure speed, V_1 (see sec. 4b.114), at which speed all engines are made inoperative and the airplane decelerated to rest. In the second sequence of events the airplane is again accelerated to the same speed, but at that speed the critical engine only is made inoperative and the takeoff continued under certain specified conditions. The distance required to accelerate to the critical-engine-failure speed, V_1, is thus common to both sequences.

4b.113–2 *Determination of the takeoff field length (CAA policies which apply to sec. 4b.113).*

(a) The dimensions of a takeoff flight path should be such that, if the takeoff runway has a length equal to the greater of two possible dimensions of that flight path, an engine failure may occur at any point along the runway and the airplane be able either to stop within the length of the runway or to continue and clear all obstructions to flight until a safe landing is made.

(b) In the tests required by sections 4b.113 through 4b.116, generally one set of data at one altitude should be sufficient to determine takeoff distances for altitudes from sea level to 8,000 feet. If a greater range of airport altitudes is desired, the test should be conducted at two or more altitudes.

(19 F. R. 4451, July 20, 1954, effective Sept. 1, 1954.)

Discussion of Policies Relating to Selection of the Takeoff Speeds in Section 4b.114–1

Section 4b.114 (a) specifies a speed at which the engine is assumed to fail and which may be lower than the speed at which flight is possible. The operating requirements of section 40.72 of this chapter limit the takeoff operation of the airplane to a weight such that in the event of engine failure at the critical-engine-failure speed, (V_1), the airplane can be brought to rest within the length of the runway or the takeoff continued and a height of 50 feet attained at the end of the runway. It follows that for any airplane at a particular weight there is an optimum value for this critical-engine-failure speed which results in the minimum required runway length and further, this optimum condition is obtained when the two alternative distances are equal. In the case of an airplane having a comparatively high wing loading but low power loading, and particularly in the case of airplanes with four or more engines, this optimum may be appreciably below the speed at which flight is possible.

The V_2 speed specified in section 4b.114 (b) is a minimum speed at which it is considered safe to attempt to complete the takeoff with one engine inoperative. The limitation upon the takeoff safety speed, (V_2), based upon stalling speed, involves the power-off stalling speed with 20 percent and 15 percent margins as reasonable minimums to insure against inadvertent stalling of the airplane. The difference between the two margins, based upon the number of engines installed

(2) *Test procedures and required data.* See section 4b.118–1 for test procedure and required data in connection with climb tests.

(19 F. R. 4453, July 20, 1954, effective Sept. 1, 1954.)

4b.120–1 *Approval of automatic propeller feathering installations for use in establishing flaps in takeoff position climb (CAA policies which apply to sec. 4b.120 (a) and (b)).* The propeller of the inoperative engine may be in the feathered condition during either or both of the landing gear extended or retracted conditions if:

(a) The propeller would be completely feathered at the beginning of these segments of the takeoff flight path, or

(b) It can be shown that the network produced by the feathering propeller during the segment is positive using a datum based on feathered propeller drag. (See secs. 4b.10–2, 4b.401–1, and 4b.700–1.)

(19 F. R. 1818, Apr. 2, 1954, effective Apr. 2, 1954.)

4b.120–2 *Determination of one engine inoperative climb (CAA policies which apply to sec. 4b.120).*

(a) *Flaps in takeoff position; landing gear extended, section 4b.120 (a).* Policies outlined in section 4b.116–2 (b) (2) will apply.

(b) *Flaps in takeoff position; landing gear retracted, section 4b.120 (b).* Policies outlined in section 4b.116–2 (b) (3) will apply.

(c) *Flaps in en route position, section 4b.120 (c).*

(1) *Configuration.* This test should be conducted in the configuration that follows:

Weight—maximum takeoff and one lower.

C. G. position—optional (see sec. 4b.118–1 (c) (2)).

Wing flaps—optional.

Landing gear—retracted.

Operating engine(s)—maximum continuous r. p. m. and manifold pressure or full throttle, mixture setting at normal position, carburetor air heat control at cold and cowl flaps in CAA hot day cooling position.

Critical inoperative engine—throttle closed on engine most critical performancewise (see sec. 4b.118–1 (e) (2)), propeller feathered and cowl flaps in minimum drag position.

(2) *Test procedure and required data.* The airplane should be climbed at the en route climb speed. See section 4b.118–1 for test procedure and required data in connection with climb tests.

(d) *Flaps in approach position, section 4b.120 (d).*

(1) *Configuration.* This test should be conducted in the configuration that follows:

Weight—maximum landing and one lower.

C. G. position—optional (see sec. 4b.118–1 (c) (2)).

Wing flaps—approach position (V_{s_1} must not exceed 1.10 V_{s_0}).

Landing gear—retracted.

Operating engine(s)—takeoff r. p. m. and manifold pressure or full throttle, mixture setting at normal position, carburetor air heat control at cold and cowl flaps in approach position.

Critical inoperative engine—throttle closed on engine most critical performancewise (see sec. 4b.118–1 (e) (2)), propeller feathered and cowl flaps position optional.

(2) *Test procedure and required data.* The airplane should be climbed at the approach climb speed. See section 4b.118–1 for test procedure and required data in connection with climb tests.

(19 F. R. 4453, July 20, 1954, effective Sept. 1, 1954.)

4b.121–1 *Determination of two engine inoperative climb (CAA policies which apply to sec. 4b.121).*

(a) *Configuration.* This test should be conducted in the configuration that follows:

Weight—two optional weights.

C. G. position—optional (see sec. 4b.118–1 (c) (2)).

Wing flaps—optional.

Landing gear—retracted.

Operating engines—maximum continuous r. p. m. and manifold pressure or full throttle, mixture setting at normal position, carburetor air heat control at cold and cowl flaps in CAA hot day cooling position.

Critical inoperative engines—throttles closed on outboard engine most critical performancewise (see sec. 4b.118–1 (e) (2)), and on adjacent engine, propellers feathered and cowl flaps in minimum drag position.

(b) *Test procedure and required data.* See section 4b.118–1 for test procedure and required data in connection with climb tests.

(19 F. R. 4454, July 20, 1954, effective Sept. 1, 1954.)

4b.122–1 *Downwind landings (CAA policies which apply to sec. 4b.122).* Downwind landing data will be approved on the following basis to provide for situations where geographic locations and terrain indicate they are desirable, as well as for use with ILS:

(a) *Performance.* In determining the required distances for landing downwind, the data should be substantiated by actual flight tests. The general methods and procedures should be comparable to those for substantiating landing distances in no wind. The flight tests should be conducted in tailwind velocities up to the maximum velocity for which approval is desired except that the performance tests may be simulated in zero wind as outlined below:

(1) Landings should be demonstrated by approaching and contacting at speeds corresponding to the zero wind speed plus 150 percent of the tailwind velocity for which approval is desired.

(2) In determining the downwind landing distances for the Airplane Flight Manual data, 150 percent of the effect of the reported tailwind velocity should be taken into account. (See sec. 4b.740–1 (d) (2) (x).) This may in some cases, permit calculating the required distances without further tests providing sufficiently high speed landings and decelerations were made in the original type tests. However, except in the cases outlined in (d), actual landings should be made under the conditions described in (b) to check the flight and ground handling characteristics.

(b) *Controllability.* Landings should be made in steady downwind velocities equal to 1.5 times the maximum velocity for which approval is desired to check the controllability at the higher ground speed with correspondingly reduced aerodynamic control forces, dynamic balance of landing gear, nose gear shimmy or vibration, etc. Also actual approaches should be demonstrated under the above wind conditions at an approach angle corresponding to the maximum ILS beam angle (3° 18′) to determine the minimum altitude on the glide path from which the airplane can be readily flared for landing.

[(c) *Brakes.* At present it is believed that for calculated landing distance based on actual airplane deceleration tests, the existing brake capacity requirements are sufficient to cover landings in downwind velocities of 10 m. p. h. measured at 50′. However, in wind velocities above 10 m. p. h. and in unusual cases or special types of operation, additional tests or substantiation of the adequacy of the brakes may be necessary and a revision to the braking system may be required. In determining the landing distances under paragraph (a) of this section, normal braking as outlined in section 4b.123 "Landplanes" should not be exceeded.]

(Effective Apr. 15, 1955.)

(d) *Tolerances.*

(1) With regard to performance tests outlined in section 4b.122–1 (a), approval will be given for calculated landing distances for reported tailwind velocities up to 10 m. p. h. measured at 50 feet height without camera tests additional to those required for approval of the no wind data.

(2) With regard to controllability tests outlined in section 4b.122–1 (b), approval will be given for reported downwind velocities up to 10 m. p. h. measured at 50 feet without additional flight tests.

(19 F. R. 1818, Apr. 20, 1954, effective Apr. 20, 1954.)

Discussion of Policies Relating to Determination of the Landing Distances in Section 4b.122–2

The purpose of the requirement specified in section 4b.122 is to determine a distance from a point 50 feet above the takeoff surface to land and bring the airplane to rest. This procedure is representative of the actual operating technique and may serve as the basis for the specification of a landing runway length within which a pilot of average skill may reasonably be expected to be able to land the airplane safely under the most adverse weather or other operating conditions likely to be encountered in the actual operation.

The minimum approach speed of 1.3 V_{s_0} specified in section 4b.122 (a) is intended to provide a reasonable margin above the stalling speed. The "steady flaps appropriate for flight condition.

Trim speed—1.4 V_{s_1}.

(c) *Test procedure and required data.* This test may be conducted at any optional altitude (see sec. 4b.100–3 (c)). See section 4b.160 (c) regarding test procedure.

(1) The speed of the airplane should be reduced from the trim condition with the wings held level until the first of the following occurs:

(i) Full rudder or aileron deflection.

(ii) 180 lbs. rudder force.

(iii) Stall is reached.

(2) If full rudder or aileron deflection, or the 180 lbs. rudder force occurs first, the power should be reduced and the test repeated until sufficient control is available to complete the stall. The power may be reduced on the operating engine(s) before reapplying power on the operating engine or engines for the purpose of regaining level flight. The following data should be recorded at that point.:

Pressure altitude.
Ambient air temperature.
Indicated air speed.
Engines, r. p. m. and manifold pressure.
Torque pressure.
Carburetor air temperature.
Rudder force (if desirable).

(3) If stall is reached first, the same data should be recorded.

(19 F. R. 4460, July 20, 1954, effective Sept. 1, 1954.)

Discussion of Policies Relating to Stall Warning in Section 4b.162–1

Occurrence of stall warning at some specific speed margin above the stalling speed is no longer required. It has been found that certain other characteristics may exist which make an airplane less susceptible to inadvertent stalling than one in which a specific speed margin has been provided between the occurrence of stall warning and the actual stall.

4b.162–1 *Stall warning (CAA policies which apply to sec. 4b.162).*

(a) The adequacy of stall warning should depend on the relative ease with which an airplane might be inadvertently stalled following the occurrence of stall warning. For example, if unmistakable warning occurs only 2 percent above the stall speed but undue pilot effort is required to reduce the airspeed to the stall, the speed margin of 2 percent may be adequate. On the other hand, if conscious effort is required to avoid stalling the airplane, a positive type of warning initiated at a relatively high speed above the stall may be required.

(b) Suggested suitable stall warnings are, buffeting which may be defined as general shaking or vibration of the airplane or elevator shake of sufficient magnitude to be unmistakable; or a stall warning instrument such as a stick shaker. A visual stall warning device which requires the attention of the crew within the cockpit is not considered acceptable by itself

(19 F. R. 4460, July 20, 1954, effective Sept. 1, 1954.)

4b.170–1 *Procedure for demonstrating longitudinal stability and control on the ground (CAA policies which apply to sec. 4b.170).* Taxiing tests at velocities up to 70 percent of the stalling speed should be conducted on smooth and rough ground which may likely be encountered under normal operating conditions. Particular attention should be paid to the following:

(a) *Taxiing over rough ground.* There is some evidence to indicate that critical loads can be built up in taxiing over rough ground, even when the shock-absorbing system is entirely satisfactory with respect to capacity for landing purposes.

(b) *Brakes.* Their adequacy when maneuvering on the ground and their tendency to cause nosing-over should be investigated. Any bad tendency will normally be exaggerated when taxiing in a strong side or tail wind.

(19 F. R. 4460, July 20, 1954, effective Sept. 1, 1954.)

[4b.170–2 *Longitudinal stability and control with reverse thrust (CAA policies which apply to sec. 4b.170).* The policies outlined in section 4b.402–1 (a), (d), and (e) will apply.]

(Effective Apr. 30, 1955.)

4b.171–1 *Procedure for demonstrating direc-*

tional stability and control on the ground (*CAA policies which apply to sec. 4b.171*).

(a) Compliance with the requirement of section 4b.171 (a) may be demonstrated during tests for the establishment of the cross wind component velocity in accordance with section 4b.173.

(b) Compliance with the requirement of section 4b.171 (b) may be demonstrated during power off landings in other tests.

(c) Compliance with the requirement of section 4b.171 (c) may be demonstrated during taxiing prior to takeoff or after landing from other flight tests.

(19 F. R. 4460, July 20, 1954, effective Sept. 1, 1954.)

[4b.171–2 *Directional stability and control with reverse thrust* (*CAA policies which apply to sec. 4b.171*). The policies outlined in section 4b.402–1 (a), (d), and (e) will apply.]

(Effective Apr. 30, 1955.)

4b.172–1 *Shock absorbing mechanism tests* (*CAA policies which apply to sec. 4b.172*). The shock absorbing mechanism should be checked for satisfactory operation while taxiing, taking off and landing during other tests in the type certification program.

(19 F. R. 4460 July 20, 1954, effective Sept. 1, 1954.)

4b.173—1 *Crosswind demonstration* (*CAA policies which apply to sec. 4b.173*).

(a) A crosswind component of not less than 0.2 V_{s_0} should be established during type tests. Consequently, two results are possible:

(1) A crosswind component may be established at a value which is not marginal with the airplane's handling characteristics. This value should be included in the Operating Procedures section of the Airplane Flight Manual. The operation of the aircraft in crosswinds greater than the value specified is not necessarily a hazard. Thus operation in crosswinds of a greater value is entirely within the discretion of the operator.

(2) A critical crosswind component may be established at a value which is considered the maximum up to which it is safe to operate the airplane on the ground, including takeoffs and landings. This value should be shown in the Operating Limitations section of the Airplane Flight Manual. Operation of the airplane in crosswinds above the maximum safe value is considered hazardous and the operator should do so only on the same emergency basis that a pilot would be justified in exceeding any of the operating limitations such as air speed, engine r. p. m., c. g. limitations, etc.

(3) An operator may of course restrict the operation of his airplane to crosswind components of any value equal to or less than that established during the type certification tests.

(b) *Configuration.* This test should be conducted in the configurations that follow:

Weight—maximum takeoff and landing.

C. G. position—most aft.

Flaps—takeoff and maximum landing positions.

(c) *Test procedure and required data.* At least three takeoffs and landings should be made in crosswind components of 0.2 V_{s_0} mph (or greater at applicant's option) to demonstrate satisfactory controllability and handling characteristics. The magnitude and direction of the crosswind should be established by the use of appropriate meteorological instruments.

(19 F. R. 4460, July 20, 1954, effective Sept. 1, 1954.)

[4b.173–2 *Ground handling characteristics with reverse thrust* (*CAA policies which apply to sec. 4b.173*). The policies outlined in section 4b.402–1 (a) and (d) will apply.]

(Effective Apr. 30, 1955.)

4b.180–1 *Water handling qualities* (*CAA policies which apply to sec. 4b.180*). Policies outlined in section 4b.182–2 will apply.

(19 F. R. 4461, July 20, 1954, effective Sept. 1, 1954.)

4b.181–1 *Crosswind demonstration* (*CAA policies which apply to sec. 4b.181*). Policies outlined in section 4b.173–1 will apply.

(19 F. R. 4461, July 20, 1954, effective Sept. 1, 1954.)

4b.182–1 *Procedure for demonstrating control and stability on the water* (*CAA policies which apply to sec. 4b.182*).

(a) In order to check water stability, taxiing tests should be made in a crosswind determined in accordance with section 4b.181.

(b) Porpoising tendencies should be investigated and reported for extreme loading conditions.

(c) The ability to maneuver up to and while on the step should be investigated and the results reported.

(d) Compliance with the spray requirements may be substantiated while taxiing, taking off, and landing during other tests in the type certification program.

(e) If water rudders are provided, their effectiveness should be checked.

(f) Water taxiing ability should be investigated by actually taxiing the seaplane with appropriate use of power.

(19 F. R. 4461, July 20, 1954, effective Sept. 1, 1954.)

[4b.182–2 *Control and stability on the water with reverse thrust* (*CAA policies which apply to sec. 4b.182*). The policies outlined in section 4b.402–1 (a), (d), (f), and (h) will apply.]

(Effective Apr. 30, 1955.)

4b.190–1 *Determination of flutter and vibration qualities during dive* (*CAA policies which apply to sec. 4b.190*).

(a) The airplane should be observed for flutter and vibration tendencies during other tests in the type certification program. In case the design speed is limited at altitude by Mach number, the dive should be conducted at a combination of pressure altitude and equivalent airspeed to permit attaining the desired maximum Mach number and dynamic pressure simultaneously. Stability and control qualities should be noted during the dive.

(b) *Configuration.* This test should be conducted in the configurations that follow:

(1) *Maximum takeoff weight.*

C. G. position—most aft.

Wing flaps—retracted and takeoff position.

Landing gear—retracted.

Engines—power as desired.

Cooling controls—optional.

Pneumatic boots—inoperative.

(2) *Maximum landing weight.*

C. G. position—most rearward

Wing flaps—approach and landing positions.

Landing gear—extended.

Engines—power as desired.

Cooling controls—optional.

Pneumatic boots—inoperative.

(c) *Test procedure and required data.* The speed of the airplane should be slowly increased, from a steady flight high speed condition, until the maximum calibrated design dive speed for maximum takeoff weight is attained. The power and trim may be adjusted during the dive. The dive should be entered at a sufficiently high altitude to insure safe recovery. In case the design speed is limited at altitude by Mach number, the airplane should be dived at constant Mach number (maximum design or highest desired by the applicant—but in no case less than that specified in section 4b.210 (b) (5)) until the maximum equivalent design dive speed is attained. The test should be repeated at maximum landing weight with flaps and gear extended diving to the maximum design flap speed or speeds. *CAUTION:* Throughout these tests any control displacements should be executed gently.

(1) The following data should be recorded for each test:

Pressure altitude.

Ambient air temperature.

Indicated air speed.

Machmeter reading (if applicable).

Engines, r. p. m. and manifold pressure.

Wing flap position.

Landing gear position.

Weight.

C. G. position.

(19 F. R. 4461, July 20, 1954, effective Sept. 1, 1954.)

4b.250–1 *Water loads—Alternate standards* (*CAA policies which apply to sec. 4b.250.*) ANC–3 provides a level of safety equivalent to, and may be applied in lieu of section 4b.250.

(17 F. R. 10102, Nov. 7, 1952, effective Oct. 31, 1952.)

[4b.300–1 *Turnbuckle safetying* (*CAA policies which apply to sec. 4b.300*). The procedure outlined in section 4b.329–2 should be followed in safetying turnbuckles.]

(Effective Apr. 30, 1955.)

[4b.301–1 *Acceptability of materials* (*CAA policies which apply to sec. 4b.301*).

[(a) Materials conforming to established industry or military specifications or to Technical Standard Orders issued by the Administrator are acceptable for use on transport category airplanes. Where new or improved materials are used or where the materials are not covered by specifications sufficient information and data should be submitted to the Administrator to enable him to assess the suitability of the material. In all cases it is the responsibility of the applicant to demonstrate the adequacy of the materials employed.]

(Effective Apr. 30, 1955.)

[4b.306–1 *Material strength properties (CAA policies which apply to sec. 4b.306 (c)).*

[(a) In the case of structures where the applied loads are eventually distributed through a single member within an assembly, the failure of which would result in the loss of the structural integrity of the component involved, the guaranteed minimum design mechanical properties ("A" values) listed in ANC–5 [9a] should be used for design.

[(b) Redundant structures wherein failure of individual elements would result in the applied load being safely distributed to other load carrying members, may be designed on the basis of the "90 percent probability" ("B" values).

[(c) When strength testing is employed to establish design allowables, such as in the case of sheet-stiffener compression tests, the test results should be reduced through use of a materials correction factor to values which would be met by material having the design allowable material properties for the part under consideration. The ANC–5 Bulletin outlines methods of accomplishing this reduction but these are by no means considered as the only methods available.

[(d) Use of design values greater than the guaranteed minimums is permissible in applications where only guaranteed minimum values are normally permitted provided that the higher values are substantiated by "premium selection" of the material. These increased design allowables will be acceptable providing that a specimen or specimens of each individual item are tested prior to its use, to assure that the strength properties of the particular item will equal or exceed the properties to be used in design. Such quality control should also be exercised for the manufacture of spare parts.]

(Effective Apr. 30, 1955.)

4b.324–1 *Procedure for demonstrating wing flaps that are not interconnected (CAA policies which apply to sec. 4b.324 (a)).* If the wing flaps are not mechanically interconnected, tests should be conducted to simulate flap malfunctioning (to the extent of the flaps being retracted on one side and extended on the other) during takeoffs, approaches, and landings to demonstrate that the airplane is safe under these conditions.

(19 F. R. 4461, July 20, 1954, effective Sept. 1, 1954.)

[4b.329–1 *Installation of turnbuckles (CAA policies which apply to sec. 4b.329 (a)).* Fork ends of turnbuckles should not be attached directly to control surface horns or to bellcrank arms unless a positive means (such as the use of shackles, links, universal joints, spacer bushings, ball bearings, etc.) is used to prevent binding of turnbuckles relative to the horns or bellcrank arms or unless it can be shown that turnbuckles have adequate strength assuming one end fixed to the horn or arm and the design cable loads pulling off the other end at 5° to the turnbuckle axis. There should be no interference between the horns or bellcrank arms and the fork ends of turnbuckles throughout the range of motion of the control surfaces.]

(Effective Apr. 30, 1955.)

[4b.329–2 *Safetying of turnbuckles (CAA policies which apply to sec. 4b.329).* Section 4b.300 requires in part that there be no design features or details which experience has shown to be hazardous or unreliable. Experience has shown that the reliability of turnbuckles should be insured by safetying with wire as shown in Figure 5. After safetying the turnbuckle, no more than three threads should be exposed on either side of the turnbuckle barrel and the ends of each safety wire should be securely fastened by at least four wraps. A turnbuckle safetying guide is given in table 1.

[[9a] The ANC–5 Bulletin "Strength of Metal Aircraft Elements" specifies "A" and "B" values for allowable design properties. The "A" values are those which the material producer has indicated to be the minimum he expects for the given material. The only values considered guaranteed values are the tensile ultimate and tensile yield "A" values which have been published by the material producer for the grain direction accepted for commercial guarantees. The "B" values represent design properties which the materials producers have indicated will be met or exceeded by 90 percent of the material supplied by them. More detailed information on the derivation of related design mechanical properties can be obtained by referring to section 3.111 "Design Mechanical Properties" of the ANC–5 Bulletin.]

[TABLE 1. TURNBUCKLE SAFETYING GUIDE

Cable size	Minimum Breaking Strength, Pounds				Type of wrap	Diameter of safety wire	Material (Annealed Condition)
	MIL-C-1511 Steel (Carbon) Flexible, Preformed		MIL-C-5424 Steel (Corrosion-Resisting) Flexible, Preformed				
	7 x 7	7 x 19	7 x 7	7 x 19			
Inch						*Inch*	
1/16	480		480		Single	0.040	Copper, brass, galvanized or tinned steel, soft iron, or monel.
3/32	920		920		Single	.040	Copper, brass, galvanized or tinned steel, soft iron, or monel.
1/8		2000		1760	Single	.040	Stainless steel.
1/8		2000		1760	Double	.040	Copper, brass, galvanized or tinned steel, soft iron, or monel.
5/32 and greater		2800		2400	Double	.040	Galvanized or tinned steel, soft iron, stainless steel, or monel.
5/32 and greater		2800		2400	Double	.051	Copper, brass.

NOTES

1. The swaged and unswaged turnbuckle assemblies are covered by AN Standard Drawings.
2. *Certain of the AN Std. swaged terminal parts specify a safety wire hole size of .047 in.* This hole may be reamed sufficiently to accomodate the .040 and .051 diameter wires.
3. The double wrap procedure given in Navy Specification PO-42A, Amendment No. 1, or the safetying procedure described by Air Force-Navy Aeronautical Design Standard AND 10482, may be used in lieu of the method shown in Figure 5.]

(Effective Apr. 30, 1955.)

[4b.329-3 *Approval of control system components (CAA policies which apply to sec. 4b.329 (a)).* The Administrator does not issue specific approvals as such for cables, cable fittings, turnbuckles, splices, pulleys, etc., for general use on aircraft. Approval is limited to its use as part of a specific airplane design. Conformance with established industry or military specifications or adequate substantiation of the manufacturer's own design, are the procedures utilized in complying with the "approved type" requirement.]

(Effective Apr. 30, 1955.)

[4b.329-4 *Cable terminals (CAA policies which apply to sec. 4b.329 (a)).* The selection of cable terminal locations and their proximities should minimize the possibility of interferences with structure, fairleads, other terminals, etc., and the possibility of pairing wrong cables during maintenance or overhaul.]

(Effective Apr. 30, 1955.)

[4b.329-5 *Bellcrank and idler installation (CAA policies which apply to sec. 4b.329 (b)).* The design of such items as bellcrank arms, tab drums, idlers, etc., should minimize the possibility of inadvertent installation in the reversed direction, or, as an alternative, to preclude the possibility of jamming or interference that might result from such reversed installation.]

(Effective Apr. 30, 1955.)

[4b.329-6 *Ball and roller bearings (CAA policies which apply to sec. 4b.329 (b) (3)).* The "approved ratings" of ball and roller bearings referred to are the ratings established in ANC-5, "Strength of Metal Aircraft Elements".]

(Effective Apr. 30, 1955.)

4b.334-1 *Procedure for testing landing gear retracting system (CAA policies which apply to sec. 4b.334).*

(a) *General, section 4b.334 (a).* The ability to extend and retract the landing gear at a speed of at least 1.6 V_{s_1} should be demonstrated.

If no other satisfactory means of decelerating the airplane are provided (such as dive brakes or other high drag devices), the ability of the landing gear retracting mechanism and wheel well doors to withstand the flight loads should be demonstrated under the following conditions:

Power required for level flight.

Airspeed, at least 0.67 V_C.

Landing gear extended.

(b) *Emergency operation, section 4b.334 (c).* Extending the landing gear by use of the emergency system for demonstrating compliance with the requirement of this section may be accomplished during other tests in the flight program.

(c) *Operation test, section 4b.334 (d).* The time required to retract the landing gear at speed V_2 (see sec. 4b.116 (b)) should be demonstrated in flight under the following conditions:

Weight—optional.

C. G. position—optional.

Operating engine(s)—takeoff power.

Critical inoperative engine—propeller windmilling on engine most critical from the gear retraction standpoint.

It is also desirable to obtain the time required to extend the landing gear for purposes of information.

(19 F. R. 4461, July 20, 1954, effective Sept. 1, 1954.)

Discussion of Policies Relating to Brake Tests in Section 4b.337–1

The requirements of section 4b.337 are based upon the fact that compliance with the operating rules of section 40.70 of this subchapter will require great dependence upon the presence and proper functioning of brakes unless the runways involved are unusually long.

The nature and extent of the tests to show compliance with section 4b.337 (a) will necessarily depend upon a great many things such as the general arrangement of the landing gear, the design of the brake system, the extent to which the capacity of the brakes is used in establishing the landing distance required by section 4b.122, the amount of available performance data for the brakes, etc. The simplest possible procedure appears to be to determine the average deceleration during a landing ground roll without the use of brakes and then establish the landing distance required by section 4b.122 by using the brakes to the extent necessary to double the mean deceleration so established. It appears likely, however, that this procedure would result in excessive landing distance and might seriously limit the use of the airplane in operation.

4b.337–1 *Brake tests (CAA policies which apply to sec. 4b.337).* If it is desired by the applicant to make the maximum possible use of the brakes in establishing the landing distance, and if also the contribution of the brakes to the total deceleration is relatively large, the brake system should be designed to permit the application of slightly less than half the braking deceleration developed under the conditions specified in this section. The following dual system is recommended: Dual wheel elements (drums or disc units), transmitting elements, power sources, master cylinders, etc., connected to a single pedal on each rudder pedal, such that the failure of any single one of these would leave half the total braking capacity symmetrically disposed about the plane of symmetry of the airplane. With such a system it should be possible to show compliance with section 4b.337 (a) by means of calculation based upon the test data necessary to establish the landing distance plus the brake data calculated by the aircraft manufacturer.

If the system is designed so that under the conditions here specified appreciably less than half the total braking capacity remains or if the remaining capacity is asymmetrically disposed, tests should be conducted to determine that half the mean deceleration may in fact be developed and/or that the airplane may be safely controlled directionally while doing so.

(a) *General, section 4b.337 (a).* Such tests should be conducted as is deemed necessary to show compliance with the subject regulation.

The deceleration rates should be determined as described in section 4b.123–2 (b) (3).

(b) *Brake controls, section 4b.337 (b).* General brake control force and operation should be noted throughout the flight test program to determine that they are satisfactory.

(c) *Parking brake controls, section 4b.337 (c).* During engine run-up prior to takeoff for other tests, the parking brake control should be set, and without further attention, a demonstration should be made to determine that sufficient braking is maintained to prevent the airplane from rolling on a paved runway while takeoff power is applied on the most critical engine.

(19 F. R. 4461, July 20, 1954, effective Sept. 1, 1954.)

4b.337–2 *Brake systems. (CAA policies which apply to sec. 4b.337.)* In order to obtain a minimum landing distance under section 4b.122 and at the same time meet the deceleration requirement of section 4b.337 (a) (2) in event of failure of the normal brake system, it is a common practice to provide an alternate brake system. When hydraulic (or pneumatic) brakes are used in the normal brake system, this alternate means usually consists of a duplicate hydraulic or pneumatic brake system and is commonly referred to as the "emergency brake system." The following items should be considered in the design of such systems:

(a) *Relationship between normal and emergency brake systems.* The systems for actuating the normal brake and the emergency brake should be so separated that a failure in, or the leakage of fluid from, one system will not render the other system inoperative. A hydraulic brake assembly may be common to both the normal and emergency brake systems if it is shown that the leakage of hydraulic fluid resulting from failure of the sealing elements in the brake assembly would not reduce the braking effectiveness below that specified in section 4b.337 (a) (2).

(b) *Brake control valves.* In the normal brake system of all aircraft, the brake control valves should be of a type such that the pilots may exercise variable control of the pressure to the brakes. The foregoing provision need not corresponding to the actual accelerate-stop conditions which prevailed during the airplane type certification tests.

(4) If, in compliance with (1) of this paragraph, velocity-time data are submitted in lieu of torque-speed data, then sufficient spot-check calculations of the velocity-time data should be made to insure an accuracy comparable to the accuracy of torque-speed data. Inasmuch as torque-speed data are useful for airplane modification and design purposes, it is desirable that comparable and complete torque-speed data be included in the data submitted.

(5) Dynamometer time history recordings of brake pressure, torque, speed, and calculations for aerodynamic drag, tire rolling friction, and dynamometer mass correction, and all pertinent airplane data, should be submitted, together with an analysis showing the detailed calculations and charts necessary to establish the speed-distance relationship and comparison with the original airplane deceleration test data.

(f) *Landing distance test.* In order to substantiate landing distances, at least three dynamometer runs, using the critical combinations of landing weight and contact speed, should be conducted on the same brake unit. Landing distance data, compiled in accordance with the method described in (e) for accelerate-stop evaluation, should be submitted. The landing distance data, which are comparable to those of (e) for the accelerate-stop data, should compare favorably with the corrected airplane flight test results obtained with the original brakes in order to substantiate the adequacy of the replacement brakes, insofar as landing distances are concerned.

(g) *Aircraft functional tests.* The brakes should be tested on the airplane to determine their functional characteristics as indicated in (a) (2). Functioning characteristics should be observed during taxi and engine run-up conditions and at least three normal takeoffs and landings, at the maximum landing weight, should be conducted. During these tests, the brakes should be checked for any undesirable characteristics such as "grabbing," "fading," etc., and should at least be visually inspected, without dismantling, at the completion of the test in order to determine any evidence of malfunction or failure. If no malfunctioning has occurred, this visual inspection is adequate, but if malfunctioning does occur, a thorough inspection should be conducted. If any characteristics arise which indicate that stopping distances would exceed the original values in the CAA Approved Airplane Flight Manual, then the Administrator may require actual camera recorded airplane deceleration tests or any other tests deemed necessary to establish the adequacy of the brakes.

(19 F. R. 4463, July 20, 1954, effective Sept. 1, 1954.)

4b.350-1 *Noise and vibration characteristics (CAA policies which apply to sec. 4b.350 (g)).* Noise and vibration characteristics should be observed throughout the flight test program. If possible, noise levels should be measured and recorded in decibels.

(19 F. R. 4463, July 20, 1954, effective Sept. 1, 1954.)

4b.351-1 *Procedure for demonstrating pilot compartment visibility (CAA policies which apply to sec. 4b.351).*

(a) *Nonprecipitation conditions.* Such tests as are deemed necessary to show compliance with section 4b.351 (a) should be conducted.

(b) *Precipitation conditions, section 4b.351 (b).*

(1) The operation of the windshield wiper should be checked in actual or simulated precipitation conditions in order to demonstrate that adequate vision is provided for takeoff and landing at speeds up to 1.6 V_{s_1}.

(2) The windshield de-icing system should be checked for distribution and operation.

(19 F. R. 4463, July 20, 1954, effective Sept. 1, 1954.)

[4b.351-2 *Vision with reverse thrust (CAA policies which apply to sec. 4b.351).* The policies outlined in section 4b.402-1 (g) and (h) will apply.]

(Effective Apr. 20, 1955.)

4b.353-1 *Control tests (CAA policies which apply to sec. 4b.353).* Such tests as are deemed necessary to show compliance with the control movements and locations specified in section 4b.353 should be conducted.

(19 F. R. 4464, July 20, 1954, effective Sept. 1, 1954.)

[4b.356-1 *External doors (CAA policies which apply to sec. 4b.356).* The provisions of section 4b.356 should be applied to all cabin and crew compartment external doors usable for entrance or egress. It is not restricted to the main cabin door. Cargo and service doors not suitable for emergency egress need only comply with section 4b.356 (e) and safeguarding against opening in flight as a result of mechanical failure.]

(Effective Apr. 30, 1955.)

[4b.356–2 *Auxiliary latching devices* (*CAA policies which apply to sec. 4b.356* (*b*)). (a) The use of auxiliary latching devices is permitted. Such devices would include dual locking handles, other types of locking and safetying devices, and two position handles, and where one operation such as pushing or pulling on the handle unlocks the latching mechanism and the second operation of turning the handle unlatches the door for opening. Auxiliary safetying devices should be used only as an additional safety factor and should not be used as a means of correcting an inadequate design of the primary locking or latching means. The advantages to be gained from the installation of auxiliary or dual safety devices (safety chains and dual handle main locking means) should be weighed against the need to easily and rapidly open the door in case of emergencies so that the overall level of safety is as high as practicable.

[(b) All locking or safety means, including safety chains and latches of any kind, should be so positioned and designed that their presence, location and means of operation are obvious to one not familiar with door designs.

[(1) The means of fastening safety devices should be sufficiently simple to make removal easy.

[(2) Any emergency release mechanism installed to release the safety device should operate with a simple motion and upon the application of relatively small forces.

[(3) All locking devices should be readily operable from both inside and outside of the airplane and be appropriately marked both inside and outside.

[(c) Auxiliary safety devices meeting the standards of (b) may be fastened in place during the entire flight. It will not be necessary to have such devices unlatched during takeoff and landing. Auxiliary safety devices such as safety chains or bars that do not meet the standards of paragraph (b) of this section may be used provided operating instructions are installed at or near the device and a placard is installed requiring the removal of such devices prior to takeoff and landing.]

(Effective Apr. 30, 1955.)

[4b.356–3 *Power operated external doors* (*CAA policies which apply to sec. 4b.356*(*b*)). Power operated doors should be so designed that the door can be opened by manual means even when power is inactivated. The loss of power should not cause the door to become unlatched.[10a]]

(Effective Apr. 30, 1955.)

[4b.356–4 *Means for safeguarding against inadvertent opening in flight* (*CAA policies which apply to sec. 4b.356* (*b*)). Auxiliary latching devices may be used to reduce the probability of inadvertent opening in flight provided they meet the standards and conditions covered in section 4b.356–2.

[(a) It is acceptable to create a limited access zone in front of the door to eliminate the possibility of a passenger using the door handle as a steadying means and thereby inadvertently opening the door. Although providing a restricted zone by means of a barrier may appear to conflict with the requirements of section 4b.362 (g) for an unobstructed passageway to Type I and II emergency exits, it is considered that it would contribute sufficiently to the overall safety of the aircraft occupants to be permitted. This device may be a rope, chain, rigid bar or gate. Such installations should be waist high to provide the maximum benefits for an adult and the end fastenings should be simple to make removal easy. It is not considered acceptable to install full-length auxiliary doors, but waist-high rigid gates would be acceptable provided they open toward the door and will not block the opening of the cabin door in any way. The locking means should

[[10a] Since emergency landings, such as in the wheels-up condition, may reasonably result in the severance of electrical wires or rupture of hydraulic and pneumatic lines, the power which may be needed for operation of the doors or exits may be lost. Similarly, it is conceivable that under emergency conditions, the electrical power source may be purposely interrupted to reduce the possibility of fire.]

Summary of Appendices

APPENDIX A contains a list of the tests normally required to show compliance with the regulations (see sec. 4b.16–2 (a) (2)). The tests are divided into the following four groups: (1) Performance; (2) Flying qualities; (3) Power plant tests, and (4) Functional and miscellaneous tests. Each item is referenced to its appropriate regulation. These regulations are given in numerical order in the text along with policy material and testing procedure for demonstrating compliance with the subject requirement.

APPENDIX B is a sample of typical flight test programs that would be necessary to substantiate changes in the airplane configuration, such as change in propeller, engine power, aerodynamic drag, etc. Obviously, a hard and fast rule cannot be set up to handle every case, and the required test program will vary depending upon the conditions surrounding each case as well as a consideration of any marginal conditions existing in the original design (see sec. 4b.16–2 (a) (5)).

APPENDIX C presents a general order of testing that has been found convenient from past experience in flight testing. This is presented only as a general guide (see sec. 4b.16–2 (b)).

APPENDIX D has been prepared to facilitate the development of a flight test schedule, by grouping the individual tests according to weight and center-of-gravity location (see sec. 4b.16–2 (c) (1)).

APPENDIX E contains a list of only those tests requiring special instrumentation and a description of pertinent instrument(s) (see sec. 4b.16–2 (c) (2)).

Abbreviations Used in Appendix

Alt.—Altitude
Appr.—Approach
App.—Appropriate
C. G.—Center of Gravity
Crit.—Critical
Eng.—Engine
Ext.—Extended
Feath.—Feathered
F.T.—Full Throttle
Fwd.—Forward
Inop.—Inoperative
Land.—Landing
Long.—Longitudinal
Max. Cont.—Maximum Continuous
M. P.—Manifold Pressure
M. P. H.—Miles per Hour
O. A. T.—Outside Air Temperatures
Oper.—Operating
Opt.—Optional
Prop.—Propeller
R/C—Rate of Climb
Req'd.—Required
Retr.—Retracted
Stab.—Stability
Stat.—Static
Temp.—Temperature
Thrott.—Throttle
T. O.—Takeoff
Wt.—Weight