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 (FAA 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.)

4b.114 *Takeoff speeds.*

(a) The critical-engine-failure speed V_1, in terms of calibrated airspeed, shall be selected by the applicant, but it shall not be less than the minimum speed at which the controllability is demonstrated during the takeoff run to be adequate to permit proceeding safely with the takeoff, using normal piloting skill, when the critical engine is suddenly made inoperative.

(b) The minimum takeoff safety speed V_2, in terms of calibrated airspeed, shall be selected by the applicant so as to permit the rate of climb required in section 4b.120 (a) and (b), but it shall not be less than:

(1) 1.2 V_{S_1} for two-engine propeller-driven airplanes and for airplanes without propellers which have no provisions for obtaining a significant reduction in stalling speed with power on (one engine inoperative).

(2) 1.15 V_{S_1} for propeller-driven airplanes having more than two engines and for airplanes without propellers which have provisions for obtaining a significant reduction in stalling speed with power on (one engine inoperative).

(3) 1.10 times the minimum control speed V_{MC} established under section 4b.133.

(c) If engine failure is assumed to occur at or after the attainment of V_2, the demonstration in which the takeoff run is continued to include the takeoff climb, as provided in paragraph (a) of this section, shall not be required.

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.

For propeller-driven airplanes the difference between the two margins, based upon the number of engines installed in the airplane, is due to the fact that the application of power ordinarily reduces the stalling speed appreciably. In the case of the two-engine propeller-driven airplane, at least half of this reduction is eliminated by the failure of an engine. In the case of a four-engine propeller-driven airplane, certainly less than half and probably closer to one-quarter only of the difference is eliminated by the failure of an engine. The difference in the required factors, therefore, provides approximately the same margin over the actual stalling speed under the power conditions which are obtained after the loss of an engine no matter what the number of engines (in excess of one) may be. Unlike the propeller-driven airplane, the turbine engine airplane does not show any appreciable difference between the power-on and power-off stalling speeds. This is due to the absence of the propeller which ordinarily induces a slipstream with the application of power causing the wing to retain its lift to a speed lower than the power-off stalling speed. The applicant's selection of the two speeds specified will influence the nature of the testing required in establishing the takeoff flight path.

4b.114–1 *Selection of the takeoff speeds (FAA policies which apply to sec. 4b.114).*

(a) It should be possible to continue the takeoff acceleration after the failure of an engine at the speed, V_1, until a minimum safe flying speed has been attained. This condition should be demonstrated by test in order to determine that it can be safely accomplished. Throttling an opposite engine should not be permitted during the demonstration.

(b) It should not be necessary to demonstrate a takeoff that is continued after engine failure in the case where the applicant chooses to make the critical engine failure speed not less than the takeoff safety speed. If V_1 is less than V_2, the tests should include an actual takeoff during which the critical engine is made inoperative at the minimum V_1 speed and the takeoff continued after the speed V_2 is attained.

(c) The minimum takeoff safety speed should be at least 10 percent in excess of the minimum speed at which the airplane can be safely controlled when the critical engine is suddenly made inoperative under takeoff conditions in flight (See sec. 4b.133.)

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

4b.115 *Accelerate-stop distance.*

(a) The accelerate-stop distance shall be the sum of the following:

(1) The distance required to accelerate the airplane from a standing start to the speed V_1,

(2) Assuming the critical engine to fail at the speed V_1, the distance required to bring the airplane to a full stop from the point corresponding with the speed V_1.

(b) In addition to, or in lieu of, wheel brakes, the use of other braking means shall be acceptable in determining the accelerate-stop distance, provided that such braking means shall have been proven to be safe and reliable, that the manner of their employment is such that consistent results can be expected under normal conditions of operation, and that exceptional skill is not required to control the airplane.

(c) The landing gear shall remain extended throughout the accelerate-stop distance.

Discussion of Policies Relating to the Determination of the Accelerate-Stop Distance in Section 4b.115–1

In establishing an accelerate and stop distance it is obvious that when the throttles are suddenly closed, a finite time will elapse before the propellers and the rotating parts of the engine are decelerated from the takeoff r. p. m. to an idling r. p. m. During this period the propellers continue to exert thrust, until a certain zero thrust r. p. m. is reached as a result of the deceleration. For this reason the speed of the airplane continues to increase beyond that speed which exists at the moment the throttles are closed before it begins to decrease again. The period of time covered by the deceleration of the engine r. p. m. is also a very critical period for the application of brakes since there usually results a change in trim of the airplane which may necessarily require certain adjustments in the position of the controls.

4b.115–1 *Determination of the accelerate-stop distance (FAA policies which apply to sec. 4b.115).*

(a) *Establish representative dimensions.* In order to establish a representative dimension for the distance that would be required in the event of an actual failure of an engine during takeoff and the election of the pilot to stay on the ground, a sufficient number of runs should be conducted starting from rest and ending at rest to determine the transition distance for piecing together the acceleration and deceleration portion of the runs. In determining this distance, the wing flaps should be in the takeoff position at least until the engines have been made inoperative, but they may thereafter be altered to aid the deceleration if it is demonstrated by the applicant that this may be done with reasonable ease and safety. The accelerate-stop tests should be demonstrated in accordance with the following provisions: These tests are predicated on the assumption that the airplane is not equipped with reverse pitch or automatic feathering propellers.[6]

(1) Accelerate and stop runs should be conducted at two weights and at one altitude, and one deceleration run to demonstrate braking capacity and deceleration characteristics associated with the maximum altitude at which it is desired to certificate the airplane. Altitude conditions should be simulated by adjusting power and air speed. At least one representative run should be made for each of three engine failure speeds at each weight. If more than one flap setting is to be used for takeoff, additional tests should be conducted to cover the flap range. (See sec. 4b.118–1 (d) (2).)

(2) If tests are not made at the maximum airport altitude, one landing or deceleration run should be made at an optional altitude for the purpose of demonstrating braking capacity and deceleration characteristics at maximum airport altitude and corresponding takeoff gross weight with the airplane at this maximum takeoff weight. The true ground speed at the start of the deceleration should correspond to that speed which would be experienced at the maximum airport altitude and weight. Discretion should be used in this test to assure remaining within safe structural and operational limits of the airplane.

(3) The accelerations may be made during takeoffs and the decelerations during landings at the takeoff configuration, providing a minimum of one acceleration and stop run is conducted at the maximum takeoff weight to determine the transition distance.

(4) Instrumentation should include means to record the airplane path relative to the runway against time in a manner to determine the horizontal distance-time history and a means should be provided to measure the wind velocity and direction, pressure altitude, engine r. p. m., manifold and/or torque pressure.

(i) The wind velocity should be measured adjacent to the runway at the height of 6 feet above the runway surface for test purposes. If wind effect on runway lengths is shown in the Airplane Flight Manual (see sec. 4b.740–1 (d) (2) (x)), the manual data should be based

[6] See section 4b.115–2 for policies covering automatic feathering propellers.

on reported wind velocities for a 50-foot tower height. Figure 2 should be used to calculate the wind velocity at the 50-foot height from the wind velocity measured at the 6-foot height.

(5) A special tolerance of not greater than ±2 percent of the maximum takeoff weight is allowed for the accelerate-stop distance tests.

(b) *Configuration.* The accelerate-stop tests should be conducted in the configuration that follows:

Weight—maximum takeoff and one lower.
C. G. position—most forward. (Most aft for reverse thrust decelerations.)
Wing flaps—takeoff position.
Landing gear—extended.
Operating engines—during acceleration, all engines operating at full takeoff power and r. p. m.; cowl flaps set in takeoff position (see sec. 4b.118–1 (d) (1)).
Inoperative engines—during deceleration, throttles closed; propellers windmilling in takeoff pitch (except for failed engine with automatic feathering, see sec. 4b.115–2); cowl flaps set in takeoff position (see sec. 4b.118–1 (d) (1)).

(c) *Test procedure and required data.*

(1) The airplane should be accelerated from full stop to each of three speeds up to V_1, the highest value of which should correspond to at least the maximum value desired for certification. The throttles should be closed at this speed and the airplane brought to a complete stop with the inoperative propellers windmilling (except when an auto-feathering device is installed).

(2) The airplane path relative to the runway should be recorded against time in a manner to determine the horizontal distance—time history.

(3) The following data should be recorded:
Pressure altitude.
Ambient air temperature.
Airplane gross weight.
R. P. M. (obtained during acceleration and deceleration).
Manifold pressure.
Torque pressure.
Carburetor air temperature.
Mixture setting.
Cowl flap position.
Wing flap position.
Time, distance, and airspeed at engine cut.
Slope of field.
Direction of run.

(4) In addition, humidity, wind direction, and wind velocity should be recorded adjacent to the runway at a height of 6 feet above the runway surface.

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

4b.115–2 *Approval of automatic propeller feathering installations for use in establishing accelerate-stop distance (FAA policies which apply to sec. 4b.115).* The accelerate-stop disance should be determined with the automatic propeller feathering installation feathering the propeller of the critical engine and with the other throttles closed at the instant of attainment of V_1. (See secs. 4b.10–2, 4b.401–1, 4b.700–1, and Civil Air Regulations Part 4b Interpretation No. 1, sec. 4b.133(a).)

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

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

(20 F. R. 2277, Apr. 8,19 55, effective Apr. 30, 1955.)

4b.115–4 *Accelerate-stop distance with an antiskid device installed (FAA policies which apply to sec. 4b.115).* The policies outlined in section 4b.337–4 will apply.

(21 F. R. 2558, Apr. 19, 1956, effective May 15, 1956.)

4b.116 *Takeoff path.* The takeoff path shall be considered to consist of the following five consecutive elements:

(a) The distance required to accelerate the airplane to the speed V_2, assuming the critical engine to fail at the speed V_1.

(b) The horizontal distance traversed and the height attained by the airplane in the time required to retract the landing gear when operating at the speed V_2 with:

(1) The critical engine inoperative, its propeller:

(i) Windmilling with the propeller control in a position normally used during takeoff until (if applicable) its rotation has been stopped (see paragraph (c) (1) of this section),

(ii) If applicable, stopped for the remainder of the gear retraction time.

(2) The landing gear extended.

(c) If applicable, the horizontal distance traversed and the height attained by the airplane in the time elapsed from the end of element (b) until the rotation of the inoperative propeller has been stopped when:

(1) The operation of stopping the propeller is initiated not earlier than the instant the airplane has attained a total height of 50 feet above the takeoff surface,

(2) The airplane speed is equal to V_2,

(3) The landing gear is retracted,

(4) The inoperative propeller is windmilling with the propeller control in a position normally used during takeoff.

(d) The horizontal distance traversed and the height attained by the airplane in the time elapsed from the end of element (c) until the time limit on the use of takeoff power is reached, while operating at the speed V_2, with:

(1) The inoperative propeller stopped,

(2) The landing gear retracted.

(e) The slope of the flight path followed by the airplane in the configuration of element (d), but drawing not more than maximum continuous power on the operating engine(s).

4b.116–1 *Approval of automatic propeller feathering installations for use in establishing the takeoff path (FAA policies which apply to sec. 4b.116).* The takeoff path may be modified by permitting a feathered propeller instead of windmilling after the necessary time interval has elapsed from the instant of engine failure to complete feathering of the propeller. If it can be shown that the net work produced by the feathering propeller from the instant of engine failure to completion of feathering under all types of engine failure is positive using a datum based on feathered propeller drag, then it is permissible to assume that the propeller of the failed engine is in the feathered drag condition from the instant of attainment of the takeoff climb speed V_2. (See secs. 4b.10–2, 4b.401–1, and 4b.700–1.)

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

Discussion of Policies Relating to the Determination of the Takeoff Path in Section 4b.116–2

The takeoff path elements in section 4b.116 are intended to reflect, as closely as possible, the probable order in which a pilot would make changes to the airplane configuration in the actual case of an engine failure. They are conservative in their nature in an effort to simplify the testing required to establish the flight path. For example, it is assumed that the pilot will initiate gear retraction at the takeoff safety speed, V_2, immediately after the wheels leave the ground but that climbing performance does not increase during the retraction period over that with the gear fully extended. In the case of non-automatic propeller feathering systems it is assumed that the pilot would not initiate propeller feathering, if an engine fails during the ground run, prior to attaining a height of 50 feet, and further that the climb performance of the airplane remains the same as with the propeller wind-milling until the propeller feathering cycle is completed. However, in the case of an airplane with a slow retracting gear, propeller feathering may be started at the 50-foot height prior to the completion of the gear retraction as noted in section 4b.116 (c). It is also assumed that the cowl flaps on the inoperative engine will be closed when the airplane enters the third takeoff climb segment with the gear retracted and propeller feathered.

4b.116-2. *Determination of the takeoff path (FAA policies which apply to sec. 4b.116).*

(a) *Recommended procedure.* The recommended procedure for obtaining the takeoff path is to determine the ground and climb portions separately and piece the corrected data together. The takeoff flight path should be demonstrated in accordance with the following provisions:

(1) Three accelerations should be made during which the airplane is accelerated from a complete stop using all engines to speeds bracketing speed V_1 at which speed the critical engine fuel mixture is cut and the acceleration continued to speed V_2 with the inoperative engine propeller windmilling[7] in the takeoff pitch setting. If V_1 is less than V_2, a takeoff should be made on one of the above runs when the critical engine is failed at the lowest V_1 speed.

(2) The takeoff flap setting should be maintained throughout the takeoff flight path. If more than one flap setting is to be used for takeoff, additional tests should be included to cover the flap range (see sec. 4b.118-1(d)(2)).

(3) See section 4b.115-1 (a) (4) for instrumentation requirements.

(4) A special tolerance of not greater than ±2 percent of the maximum takeoff weight is allowable for the ground portion of the accelerate distance.

(*b*) *General test program.*

(1) *Accelerate to takeoff safety speed,* V_2 *section 4b.116 (a).*

(i) *Configuration.* These tests should be conducted in the configuration that follows:

Weight—maximum takeoff and one lower.

C. G. position—most forward.

Wing flaps—takeoff position.

Landing gear—extended.

Operating engine(s)—takeoff r. p. m. and manifold pressure, cowl flaps in takeoff position (see sec. 4b.118-1 (d) (1)).

Critical inoperative engine—fuel mixture cut on engine most critical performancewise (see sec. 4b.118-1 (e) (2)), propeller windmilling in takeoff pitch (feathered if automatic feathering device is installed) and cowl flaps in takeoff position (see sec. 4b.118-1 (d) (1)).

(ii) *Test procedure and required data.* The airplane should be accelerated from a complete stop to the V_1 speed with all engines operating. The critical engine fuel mixture should be cut at the V_1 speed and the acceleration should be continued until V_2 speed is reached with the propeller of the inoperative engine windmilling in the takeoff pitch. The airplane's path relative to the runway should be recorded against time in a manner to determine the horizontal distance-time history. In addition the following data should be recorded:

Pressure altitude.

Ambient air temperature.

Airplane gross weight.

R. P. M.

Manifold pressure.

Torque pressure.

Mixture setting.

Cowl flap position.

Wing flap position.

Time, distance, and speed at engine cut.

Time, distance, and speed when V_2 is reached.

Slope of field.

Direction of run.

In addition, humidity, wind direction, and wind velocity should be recorded adjacent to the runway at a height of 6 feet above the runway surface.

(2) *Initial takeoff flight path segment test, section 4b.116 (b).*

(i) *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—takeoff position.

Landing gear—extended.

Operating engine(s)—takeoff r. p. m. and manifold pressure or full throttle, mixture setting for takeoff, carburetor air heat control at cold

[7] When a satisfactory fully automatic propeller feathering device is installed on the airplane, advantage of such a device may be used in showing compliance with this section. See section 4b.116-1 for policies covering automatic propeller feathering systems.

and cowl flaps in takeoff position (see sec. 4b.118-1 (d) (1)).

Critical inoperative engine—throttle closed on engine most critical performancewise (see sec. 4b.118-1 (e) (2)), propeller windmilling in takeoff pitch, (feathered if automatic feathering device is installed, see sec. 4b.120-1), mixture setting at idle cut-off and cowl flaps in takeoff position (see sec. 4b.118-1 (d) (1)).

(ii) *Test procedure and required data.* The airplane should be climbed at the takeoff safety speed, V_2. See section 4b.118-1 for test procedure and required data in connection with climb tests.

(3) *Second takeoff flight path climb segment test, section 4b.116 (c).*

(i) *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—takeoff position.

Landing gear—retracted.

Operating engine(s)—takeoff r. p. m. and manifold pressure or full throttle, mixture setting for takeoff, carburetor air heat control at cold and cowl flaps in takeoff position (see sec. 4b.118-1 (d) (1)).

Critical inoperative engine—throttle closed on engine most critical performancewise (see sec. 4b.118-1 (e) (2)), propeller windmilling in takeoff pitch, (feathered if automatic feathering device is installed, see sec. 4b.120-1), mixture setting at idle cut-off and cowl flaps in takeoff position (see sec. 4b.118-1 (d) (1)).

(ii) *Test procedure and required data.* The airplane should be climbed at the takeoff safety speed, V_2. See section 4b.118-1 for test procedure and required data in connection with climb test.

(4) *Third takeoff flight path climb segment test, section 4b.116 (d).*

(i) *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—takeoff position.

Landing gear—retracted.

Operating engine(s)—takeoff r. p. m. and manifold pressure or full throttle, mixture setting for takeoff, carburetor air heat control at cold and cowl flaps in takeoff position (see sec. 4b.118-1 (d) (1)).

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.

(ii) *Test procedure and required data.* The airplane should be climbed at the takeoff safety speed, V_2. See section 4b.118-1 for test procedure and required data in connection with climb tests.

(5) *Fourth takeoff flight path climb segment test, section 4b.116 (e).*

(i) *Configuration.* This configuration should be the same as for the third takeoff flight path climb segment except that maximum continuous power is used on the operating engine(s).

(ii) *Test procedure and required data.* The airplane should be climbed at the takeoff safety speed, V_2. See section 4b.118-1 for test procedure and required data in connection with climb tests.

(19 F. R. 4452, July 20, 1954, effective Sept. 1, 1954; amended 22 F. R. 6963, Aug. 29, 1957, effective Sept. 15, 1957.)

4b.117 *Temperature accountability.* Operating correction factors for takeoff weight and take-off distance shall be determined to account for temperatures above and below standard, and when approved by the Administrator they shall be included in the Airplane Flight Manual. These factors shall be obtained as follows:

(a) For any specific airplane type, the average full temperature accountability shall be computed for the range of weights of the airplane, altitudes above sea level, and ambient temperatures required by the expected operat-

in normal position, carburetor air heat control cold and cowl flaps in approach position.

(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 ***One-engine-inoperative climb.***

(a) ***Flaps in takeoff position; landing gear extended.*** **The steady rate of climb without ground effect shall not be less than 50 ft./min. at any altitude within the range for which takeoff weight is to be specified in the certificate, with:**

(1) Wing flaps in the takeoff position (see secs. 4b.111 and 4b.323),

(2) Cowl flaps in the position normally used during takeoff,

(3) Center of gravity in the most unfavorable position permitted for takeoff,

(4) The critical engine inoperative, its propeller windmilling with the propeller control in a position normally used during takeoff,

(5) All other engines operating at the takeoff power available at such altitude,

(6) The speed equal to the minimum takeoff safety speed V_2 (see sec. 4b.114 (b)),

(7) The weight equal to maximum takeoff weight for that altitude,

(8) Landing gear extended.

(b) ***Flaps in takeoff position; landing gear retracted.*** **With the landing gear retracted the steady rate of climb in feet per minute shall not be less than 0.035 $V_{s_1}^2$ with all other conditions as described in paragraph (a) of this section.**

(c) ***Flaps in en route position.*** **The steady rate of climb in feet per minute at any altitude at which the airplane is expected to operate, at any weight within the range of weights to be specified in the airworthiness certificate, shall be determined and shall, at a standard altitude of 5,000 feet and at the maximum takeoff weight, be at least**

$$\left(0.06-\frac{0.08}{N}\right)V_{s_0}^2,$$

where N is the number of engines installed, with:

(1) The landing gear retracted,

(2) Wing flaps in the most favorable position,

(3) Cowl flaps or other means of controlling the engine cooling air supply in the position which provides adequate cooling in the hot-day condition,

(4) Center of gravity in the most unfavorable position,

(5) The critical engine inoperative, its propeller stopped,

(6) All remaining engines operating at the maximum continuous power available at the altitude.

(d) ***Flaps in approach position.*** **The steady rate of climb in feet per minute shall not be less than 0.04 $V_{s_0}^2$ at any altitude within the range for which landing weight is to be specified in the certificate, with:**

(1) The landing gear retracted,

(2) Wing flaps set in position such that V_{s_1} does not exceed 1.10 V_{s_0},

(3) Cowl flaps in the position normally used during an approach to a landing,

(4) Center of gravity in the most unfavorable position permitted for landing,

(5) The critical engine inoperative, its propeller stopped,

(6) All remaining engines operating at the takeoff power available at such altitude,

(7) The weight equal to the maximum landing weight for that altitude,

(8) A climb speed not in excess of 1.5 V_{s_1}.

4b.120–1 *Approval of automatic propeller feathering installations for use in establishing flaps in takeoff position climb (FAA 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 (FAA 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 FAA 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 *Two-engine-inoperative climb.* For airplanes with four or more engines, the steady rate of climb at any altitude at which the airplane is expected to operate, and at any weight within the range of weights to be specified in the Airplane Flight Manual, shall be determined with:

(a) The landing gear retracted,

(b) Wing flaps in the most favorable position,

(c) Cowl flaps or other means of controlling the engine cooling air supply in the position which will provide adequate cooling in the hot-day condition,

(d) Center of gravity in the most unfavorable position,

(e) The two critical engines on one side of the airplane inoperative and their propellers stopped,

(f) All remaining engines operating at the maximum continuous power available at that altitude.

4b.121–1 *Determination of two-engine-inoperative climb (FAA 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 FAA hot day cooling position.

Critical inoperative engines—throttles closed on outboard engine most critical