C.A.R. 4b. 1964

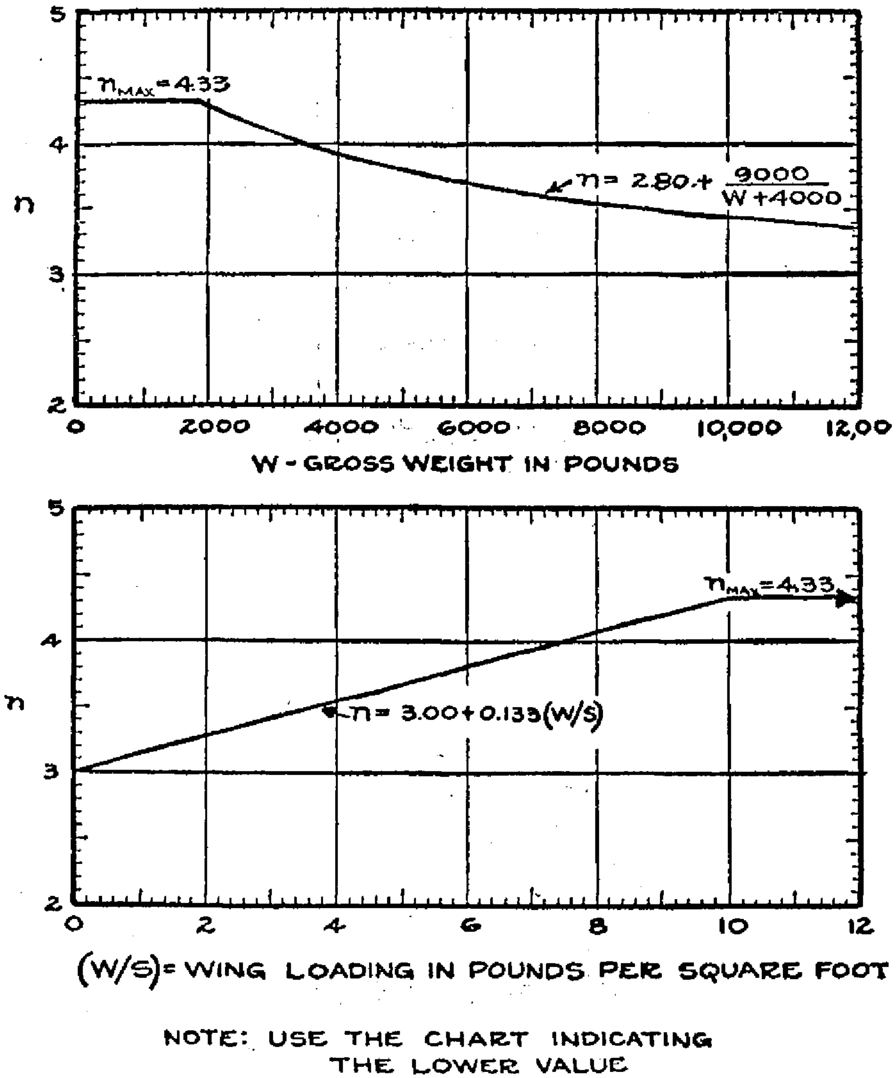


FIGURE 4a-10.—LIMIT LOAD FACTORS FOR LEVEL AND 3-POINT LANDING CONDITIONS.

PART 4b—AIRPLANE AIRWORTHINESS; TRANSPORT CATEGORIES

Subpart A—General

APPLICABILITY AND DEFINITIONS

CERTIFICATION

Subpart B—Flight

GENERAL

PERFORMANCE

Sec.

HULLS AND FLOATS

PERSONNEL AND CARGO ACCOMMODATIONS

EMERGENCY PROVISIONS

VENTILATION, HEATING, AND PRESSURIZATION

FIRE PROTECTION

MISCELLANEOUS

Subpart E—Powerplant Installation

INSTALLATION

Sec.

FUEL SYSTEM OPERATION AND ARRANGEMENT

FUEL SYSTEM CONSTRUCTION AND INSTALLATION

FUEL SYSTEM COMPONENTS

OIL SYSTEM

COOLING SYSTEM

INDUCTION AND EXHAUST SYSTEMS

POWERPLANT CONTROLS AND ACCESSORIES

POWERPLANT FIRE PROTECTION

Subpart F—Equipment

General

Instruments; Installation

Electrical Systems and Equipment

Lights

Safety Equipment

Miscellaneous Equipment

Subpart G—Operating Limitations and Information

General

Operating Limitations

Markings and Placards

Airplane Flight Manual

Airplane Identification Data

Authority: §§ 4b.0 to 4b.751 issued under sec. 205, 52 Stat. 984, as amended; 49 U. S. C. 425. Interpret or apply secs. 601, 603, 52 Stat. 1007, as amended, 1009, as amended; 49 U. S. C. 551, 553.

Authority Note: Additional citation of authority to Part 4b was appended by Amendment 4b–11, 24 F.R. 7072, Sept. 1, 1959, as follows: "(Sec. 313(a), 601, 603, 72 Stat. 752, 775, 776; 49 U.S.C. 1354(a), 1421, 1423)".

Source: §§ 4b.0 to 4b.751 appear at 15 F. R. 3543, June 8, 1950, as amended at 24 F.R. 5, Jan. 1, 1959, except as otherwise noted.

Note: Sections of this part bearing two or more numbers to the right of the decimal point separated by a dash, are rules, policies or interpretations issued by the former Civil Aeronautics Administration (now the Federal Aviation Agency). Sources are cited to text.

Special Civil Air Regulations

SR–389B

1. Contrary provisions of the Civil Air Regulations notwithstanding, no large airplane (more than 12,500 pounds maximum certificated take-off weight) type certificated under Civil Air Regulations effective prior to April 9, 1957, while carrying passengers for hire, shall be operated with occupants in excess of the number permitted by applying the provisions of § 4b.362 (a), (b), and (c) of Part 4b of the Civil Air Regulations as amended by Amendment 4b–4 effective December 20, 1951, except that airplane types listed in the following table may be operated with the listed maximum number of occupants (including all crew members) and the listed corresponding number of exits (including emergency exits and doors) heretofore approved by the Administrator for the emergency egress of passengers.

2. Additional occupants above the values listed in the table may be carried if additional exits are provided, except that in no case shall more than 8 additional occupants

be carried for any one additional exit. For the addition of exits comparable to at least a Type II or Type IV exit as prescribed in § 4b.362, a maximum of 8 additional occupants may be authorized and for exits not comparable to at least a Type II or Type IV exit, the Administrator after consideration, among other factors, of the type, size, and location of the exit, may authorize a lesser number of additional occupants.

3. For airplanes which have a ratio (as computed from the table in this special regulation) of maximum number of occupants to number of exits greater than 14:1 and for airplanes which do not have installed at least one full-size door-type exit in the side of the fuselage in the rearward portion of the cabin, the first additional exit approved by the Administrator for increased occupancy shall be a floor-level exit not less than 24 inches wide by 48 inches high located in the side of the fuselage in the rearward portion of the cabin. In no case shall an occupancy greater than 115 be allowed unless there is such an exit on each side of the fuselage.

4. The maximum number of occupants authorized (listed in the table) shall be reduced where the number of approved exits is less than that shown in the table. The reduction in the maximum number of occupants for each exit eliminated shall be determined by the Administrator taking due account of the effectiveness of the remaining exits for emergency evacuation, except that the maximum number of occupants shall be reduced by at least 8 for each eliminated exit. In no case, when exits are deleted, shall the resulting ratio of occupants to exits be greater than 14:1, and there shall be at least one exit on each side of the fuselage irrespective of the number of occupants.

Airplane type	Maximum number of occupants including all crew members	Corresponding number of exits authorized for passenger use
B-307	61	4
B-377	96	9
C-46	67	4
CV-240	53	6
CV-340 and CV-440	53	6
DC-3	35	4
DC-3 (Super)	39	5
DC-4	86	5
DC-6	87	7
DC-6B [1]	112	11
L-18	17	3
L-049, L-649, L-749	87	7
L-1049 series	96	9
M-202	53	8
M-404	53	7
Viscount 700 series	53	7

[1] The DC-6A, if converted to a passenger transport configuration, will be governed by the maximum number applicable to the DC-6B.

This regulation supersedes Special Civil Air Regulation No. SR-389A as amended by Amendment No. 1 and shall remain effective until superseded or rescinded by the Board or the Administrator of the Federal Aviation Agency, as appropriate.

(Sec. 313(a), 603, 604, 72 Stat. 752, 776, 778; 49 U.S.C. 1354(a), 1423, 1424) [24 F.R. 6, Jan. 1, 1959, as amended by Amdt. 1, 24 F.R. 7582, Sept. 19, 1959]

SR-406C

1. Contrary provisions of the Civil Air Regulations notwithstanding (in particular the provisions of § 42.15 (b) of Part 42), C-46 airplanes may be used in passenger operations conducted under Part 42 of the Civil Air Regulations. Such airplanes shall be operated in accordance with § 42.15 (a) of Part 42 and the provisions of this special regulation.

2. C-46 type airplanes, when used in passenger operations in accordance with paragraph 4 of this regulation, shall not be operated at weights exceeding those which are demonstrated to the Administrator will allow compliance with the performance requirements of Part 4b, except that in determining the maximum take-off weight, such weight shall be limited only to a value at which the airplane has a rate of climb equal to 0.035 $V_{s_1}{}^2$ in the take-off configuration at sea level with the landing gear retracted but with the propeller of the inoperative engine feathered rather than windmilling.

3. Provisionally, pending a determination by the Administrator of the weights at which C-46 airplanes will meet the standards prescribed by paragraph 2 of this regulation, the maximum take-off weight of such airplanes, when used in the manner herein referred to, shall not exceed 44,300 pounds: *Provided*, That in the case of C-46 airplanes equipped with Hamilton Standard propellers with blades Model Number 6491A-9 or approved equivalent which have been clipped in accordance with specifications approved by the Administrator, such provisional maximum weight shall be increased by 1,000 pounds until such time as the Administrator shall have determined by suitable tests another value to correspond to the additional efficiency obtainable by the use of such propellers, and thereafter by such other value.

4. The Administrator of the Federal Aviation Agency may authorize continued operation of C-46 airplanes in passenger service in accordance with paragraphs 2 and 3 of this regulation until January 1, 1957, if he finds that the applicant for such authorization has a bona fide, firm contract with the holder of a type certificate indicating that the required modifications will be completed prior to January 1, 1957, except that the Administrator may authorize during the period July 1, 1956, through July 15, 1956, such continued operation without a showing of such firm contract where the Administrator has previously permitted such operations based on genuine and diligent efforts to complete the required modifications. Such type certificate shall indicate that it meets the transport category requirements of Part 4b of the Civil Air Regulations in effect on July 20, 1950, with the exceptions authorized in SR-406A.

5. On and after July 1, 1956 (except as provided in paragraph 4), C-46 airplanes in passenger service shall comply with the provisions of Part 4b as in effect on July 20, 1950, except as otherwise provided hereinafter:

a. The provisions of §§ 4b.0 through 4b.19 of Part 4b, effective May 18, 1954, shall be complied with.

b. The provisions of §§ 4b.100 through 4b.190 need not be complied with.

c. The birdproof windshield requirements of § 4b.352 need not be complied with.

d. The provisions of §§ 4b.480 through 4b.490 effective May 16, 1953, shall be complied with in lieu of §§ 4b.480 through 4b.489 effective July 20, 1950, with the exception of subparagraph 4b.484 (a) (1) which shall be applicable as effective July 20, 1950, and paragraph 4b.487 (e) which has no counterpart in the 1950 regulations.

6. On and after January 1, 1957, C-46 airplanes in passenger service shall be recertificated in the transport category in accordance with paragraph 5 of this regulation, and shall comply with the provisions of §§ 4b.100 through 4b.190 with the following exception: In determining the take-off path in accordance with § 4b.116 and the one-engine-inoperative climb in accordance with § 4b.120 (a) and (b), the propeller of the inoperative engine may be assumed to be feathered if there is installed either an approved means for automatically indicating when the particular engine has failed or an approved means for automatically feathering the propeller of the inoperative engine.

7. In applying the provisions of paragraphs 5 and 6 of this regulation, where literal compliance with the requirements of §§ 4b.130 through 4b.190 of Subpart B and Subparts C, D, E, and F of Part 4b is extremely difficult to accomplish, and where the Administrator finds that service experience with the C-46 type airplane so justifies, the Administrator may authorize deviations from specific details of these requirements, taking into account the effect of design changes.

8. On or after January 1, 1957, C-46 airplanes in passenger service shall be operated in accordance with the performance operating limitations applicable to transport category airplanes.

9. C-46 airplanes which comply with the provisions of paragraphs 5 and 6 of this regulation may be used in passenger operations conducted under the provisions of Parts 40 and 41 provided they are operated in accordance with paragraph 8.

10. This Special Civil Air Regulation supersedes Special Civil Air Regulation SR-406B.

[21 F.R. 4917, July 3, 1956]

SR-411B

Notwithstanding the applicable structural provisions of the Civil Air Regulations, any air carrier or foreign air carrier may operate for the carriage of cargo only, the transport category airplanes specified in paragraph (1) of this regulation, at increased zero fuel and landing weights, under the conditions specified in paragraphs (2) through (6) of this regulation.

(1) Transport category airplanes certificated under the provisions of Part 4b, effective prior to March 13, 1956, as follows:

(a) DC-6A, DC-6B, DC-7B, DC-7C; and

(b) L-1049 B, C, D, E, F, G, H, L-1649A when modified in accordance with supplemental type certificate SA 4-1402.

(2) The zero fuel weight (maximum weight of the airplane with no disposable fuel and oil) and the structural landing weight may be increased beyond the maximum approved in full compliance with the applicable Civil Air Regulations: *Provided*, That any increase in the zero fuel weight shall not exceed 5 percent and that the increase in the structural landing weight shall not exceed the amount, in pounds, of the increase in zero fuel weight: *And provided further*, That the Administrator finds that the increase in either such weight is not likely to reduce seriously the structural strength, that the probability of sudden fatigue failure is not noticeably increased, and that the flutter, deformation, and vibration characteristics do not fall below those required by the applicable Civil Air Regulations. All other weight limitations established in accordance with the Civil Air Regulations applicable to the type airplane shall apply.

(3) Each airplane shall be inspected in accordance with the special inspection procedures for operations at increased weights established and issued by the manufacturer of the particular type airplane and approved by the Administrator.

(4) Each airplane operated by an air carrier under this regulation shall be operated in accordance with the passenger-carrying transport category performance operating limitations prescribed in Part 40, 41, or 42. Operation of airplanes by a foreign air carrier is not permitted under the authority of this

regulation unless the country of registry requires the airplanes to be operated in accordance with such performance operating limitations or the equivalent thereof.

(5) The Airplane Flight Manual for each airplane operated under the provisions of this regulation shall be appropriately revised to include the operating limitations and information required for operation with the increased weights.

(6) An airplane operated at increased weights under the provisions of this regulation shall be inspected in accordance with the special inspection procedures for return to passenger service established and issued by the airplane manufacturer and approved by the Administrator, before it is used in passenger service, except as provided for the carriage of persons under Special Civil Air Regulation No. SR-432A.

This regulation supersedes Special Civil Air Regulation No. SR-411A.

(Secs. 313(a), 601, 603, 604, 610; 72 Stat. 752, 775, 776, 778, 780; 49 U.S.C. 1354, 1421, 1423, 1424, 1430) [27 F.R. 6322, July 4, 1962]

SR-422

Contrary provisions of the Civil Air Regulations notwithstanding, all turbine-powered transport category airplanes for which a type certificate is issued after the effective date of this Special Civil Air Regulation shall comply with the following:

1. The provisions of Part 4b of the Civil Air Regulations, effective on the date of application for type certificate; and such of the provisions of all subsequent amendments to Part 4b, in effect prior to the effective date of this special regulation, as the Administrator finds necessary to insure that the level of safety of turbine-powered airplanes is equivalent to that generally intended by Part 4b.

2. In lieu of §§ 4b.110 through 4b.125, and 4b.743 of Part 4b of the Civil Air Regulations, the following shall be applicable:

PERFORMANCE

4T.110 *General.* (a) The performance of the airplane shall be determined and scheduled in accordance with, and shall meet the minima prescribed by, the provisions of §§ 4T.110 through 4T.123. The performance limitations, information, and other data shall be given in accordance with § 4T.743.

(b) Unless otherwise specifically prescribed, the performance shall correspond with ambient atmospheric conditions and still air. Humidity shall be accounted for as specified in paragraph (c) of this section.

(c) The performance as affected by engine power and/or thrust shall be based on a relative humidity of 80 percent at and below standard temperatures and on 34 percent at and above standard temperatures plus 50° F. Between these two temperatures the relative humidity shall vary linearly.

(d) The performance shall correspond with the propulsive thrust available under the particular ambient atmospheric conditions, the particular flight condition, and the relative humidity specified in paragraph (c) of this section. The available propulsive thrust shall correspond with engine power and/or thrust not exceeding the approved power and/or thrust less the installational losses and less the power and/or equivalent thrust absorbed by the accessories and services appropriate to the particular ambient atmospheric conditions and the particular flight condition.

4T.111 *Airplane configuration, speed, power, and/or thrust; general.* (a) The airplane configuration (setting of wing and cowl flaps, air brakes, landing gear, propeller, etc.), denoted respectively as the take-off, en route, approach, and landing configurations, shall be selected by the applicant except as otherwise prescribed.

(b) It shall be acceptable to make the airplane configurations variable with weight, altitude, and temperature, to an extent found by the Administrator to be compatible with operating procedures required in accordance with paragraph (c) of this section.

(c) In determining the accelerate-stop distances, take-off flight paths, take-off distances, and landing distances, changes in the airplane's configuration and speed, and in the power and/or thrust shall be in accordance with procedures established by the applicant for the operation of the airplane in service, except as otherwise prescribed. The procedures shall comply with the provisions of subparagraphs (1) through (3) of this paragraph.

(1) The Administrator shall find that the procedures can be consistently executed in service by crews of average skill.

(2) The procedures shall not involve methods or the use of devices which have not been proven to be safe and reliable.

(3) Allowance shall be made for such time delays in the execution of the procedures as may be reasonably expected to occur during service.

4T.112 *Stalling speeds.* (a) The speed V_{s_0} shall denote the calibrated stalling speed, or the minimum steady flight speed at which the airplane is controllable, in knots, with:

(1) Zero thrust at the stalling speed, or engines idling and throttles closed if it is shown that the resultant thrust has no appreciable effect on the stalling speed;

(2) If applicable, propeller pitch controls in the position necessary for compliance with subparagraph (1) of this paragraph;

(3) The airplane in the landing configuration;

(4) The center of gravity in the most unfavorable position within the allowable landing range;

(5) The weight of the airplane equal to the weight in connection with which V_{s_0} is being used to determine compliance with a particular requirement.

(b) The speed V_{s_1} shall denote the calibrated stalling speed, or the minimum steady flight speed at which the airplane is controllable, in knots, with:

(1) Zero thrust at the stalling speed, or engines idling and throttles closed if it is shown that the resultant thrust has no appreciable effect on the stalling speed;

(2) If applicable, propeller pitch controls in the position necessary for compliance with subparagraph (1) of this paragraph; the airplane in all other respects (flaps, landing gear, etc.) in the particular configuration corresponding with that in connection with which V_{s_1} is being used;

(3) The weight of the airplane equal to the weight in connection with which V_{s_1} is being used to determine compliance with a particular requirement.

(c) The stall speeds defined in this section shall be the minimum speeds obtained in flight tests conducted in accordance with the procedure of subparagraphs (1) and (2) of this paragraph.

(1) With the airplane trimmed for straight flight at a speed of 1.4 V_s and from a speed sufficiently above the stalling speed to insure steady conditions, the elevator control shall be applied at a rate such that the airplane speed reduction does not exceed one knot per second.

(2) During the test prescribed in subparagraph (1) of this paragraph, the flight characteristics provisions of § 4b.160 shall be complied with.

4T.113 *Take-off; general.* (a) The take-off data in §§ 4T.114 through 4T.117 shall be determined under the conditions of subparagraphs (1) and (2) of this paragraph.

(1) At all weights, altitudes, and ambient temperatures within the operational limits established by the applicant for the airplane.

(2) In the configuration for take-off (see § 4T.111).

(b) Take-off data shall be based on a smooth, dry, hard-surfaced runway, and shall be determined in such a manner that reproduction of the performance does not require exceptional skill or alertness on the part of the pilot. In the case of seaplanes or float planes, the take-off surface shall be smooth water, while for skiplanes it shall be smooth dry snow. In addition, the take-off data shall be corrected in accordance with subparagraphs (1) and (2) of this paragraph for wind and for runway gradients within the operational limits established by the applicant for the airplane.

(1) Not more than 50 percent of nominal wind components along the take-off path opposite to the direction of take-off, and not less than 150 percent of nominal wind components along the take-off path in the direction of take-off.

(2) Effective runway gradients.

4T.114 *Take-off speeds.* (a) The critical-engine-failure speed V_1, in terms of calibrated air speed, shall be selected by the applicant, but shall not be less than the minimum speed at which controllability by primary aerodynamic controls alone is demonstrated during the take-off run to be adequate to permit proceeding safely with the take-off using average piloting skill, when the critical engine is suddenly made inoperative.

(b) The minimum take-off safety speed V_2, in terms of calibrated air speed, shall be selected by the applicant so as to permit the gradient of climb required in § 4T.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 the one-engine-inoperative power-on stalling speed;

(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 the one-engine-inoperative power-on stalling speed;

(3) 1.10 times the minimum control speed V_{MC}, established in accordance with § 4b.133.

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

4T.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 in service, and that exceptional skill is not required to control the airplane.

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

4T.116 *Take-off path.* The take-off path shall be considered to extend from the standing start to a point in the take-off where a height of 1,000 feet above the take-off surface is reached or to a point in the take-off where the transition from the take-off to the en route configuration is completed and a speed is reached at which compliance with § 4T.120 (c) is shown, whichever point is at a higher altitude. The conditions of paragraphs (a) through (i) of this section shall apply in determining the take-off path.

(a) The take-off path shall be based upon procedures prescribed in accordance with § 4T.111 (c).

(b) The airplane shall be accelerated on or near the ground to the speed V_2 during which time the critical engine shall be made inoperative at speed V_1 and shall remain inoperative during the remainder of the take-off.

(c) Landing gear retraction shall not be initiated prior to reaching the speed V_2.

(d) The slope of the airborne portion of the take-off path shall be positive at all points.

(e) After the V_2 speed is reached, the speed throughout the take-off path shall not be less than V_2 and shall be constant from the point where the landing gear is completely retracted until a height of 400 feet above the take-off surface is reached.

(f) Except for gear retraction and propeller feathering, the airplane configuration shall not be changed before reaching a height of 400 feet above the take-off surface.

(g) At all points along the take-off path starting at the point where the airplane first reaches a height of 400 feet above the take-off surface, the available gradient of climb shall not be less than 1.4 percent for two-engine airplanes and 1.8 percent for four-engine airplanes.

(h) The take-off path shall be determined either by a continuous demonstrated take-off, or alternatively, by synthesizing from segments the complete take-off path.

(i) If the take-off path is determined by the segmental method, the provisions of subparagraphs (1) through (4) of this paragraph shall be specifically applicable.

(1) The segments of a segmental take-off path shall be clearly defined and shall be related to the distinct changes in the configuration of the airplane, in power and/or thrust, and in speed.

(2) The weight of the airplane, the configuration, and the power and/or thrust shall be constant throughout each segment and shall correspond with the most critical condition prevailing in the particular segment.

(3) The segmental flight path shall be based on the airplane's performance without ground effect.

(4) Segmental take-off path data shall be checked by continuous demonstrated take-offs to insure that the segmental path is conservative relative to the continuous path.

4T.117 *Take-off distance.* The take-off distance shall be the horizontal distance along the take-off path from the start of the take-off to the point where the airplane attains a height of 35 feet above the take-off surface as determined in accordance with § 4T.116.

4T.118 *Climb; general.* Compliance shall be shown with the climb requirements of §§ 4T.119 and 4b.120 at all weights, altitudes, and ambient temperatures, within the operational limits established by the applicant for the airplane. The airplane's center of gravity shall be in the most unfavorable position corresponding with the applicable configuration.

4T.119 *All-engine-operating landing climb.* In the landing configuration, the steady gradient of climb shall not be less than 4.0 percent, with:

(a) All engines operating at the available take-off power and/or thrust;

(b) A climb speed not in excess of 1.4 V_{s_0}.

4T.120 *One-engine-inoperative climb*—(a) *Take-off; landing gear extended.* In the take-off configuration at the point of the flight path where the airplane's speed first reaches V_2, in accordance with § 4T.116 but without ground effect, the steady gradient of climb shall be positive with:

(1) The critical engine inoperative, the remaining engine(s) operating at the available take-off power and/or thrust existing in accordance with § 4T.116 at the time the airplane's landing gear is fully retracted;

(2) The weight equal to the airplane's weight existing in accordance with § 4T.116 at the time retraction of the airplane's landing gear is initiated;

(3) The speed equal to the speed V_2.

(b) *Take-off; landing gear retracted.* In the take-off configuration at the point of the flight path where the airplane's landing gear is fully retracted, in accordance with § 4T.116 but without ground effect, the steady gradient of climb shall not be less than 2.5 percent for two-engine airplanes and not less than 3.0 percent for four-engine airplanes, with:

(1) The critical engine inoperative, the remaining engine(s) operating at the take-off power and/or thrust available at a height of 400 feet above the take-off surface and existing in accordance with § 4T.116;

(2) The weight equal to the airplane's weight existing in accordance with § 4T.116 at the time the airplane's landing gear is fully retracted;

(3) The speed equal to the speed V_2.

(c) *Final take-off.* In the en route configuration, the steady gradient of climb shall not be less than 1.4 percent for two-engine airplanes and not less than 1.8 percent for four-engine airplanes, at the end of the take-off path as determined by § 4T.116, with:

(1) The critical engine inoperative, the remaining engine(s) operating at the available maximum continuous power and/or thrust;

(2) The weight equal to the airplane's weight existing in accordance with § 4T.116

at the time retraction of the airplane's flaps is initiated;

(3) The speed equal to not less than 1.25 V_{s_1}.

(d) *Approach.* In the approach configuration such that V_{s_1} does not exceed 1.10 V_{s_0}, the steady gradient of climb shall not be less than 2.2 percent for two-engine airplanes and not less than 2.8 percent for four-engine airplanes, with:

(1) The critical engine inoperative, the remaining engine(s) operating at the available take-off power and/or thrust;

(2) The weight equal to the maximum landing weight;

(3) A climb speed not in excess of 1.5 V_{s_1};

4T.121 *En route flight paths.* With the airplane in the en route configuration, the flight paths prescribed in paragraphs (a) and (b) of this section shall be determined at all weights, altitudes, and ambient temperatures within the limits established by the applicant for the airplane.

(a) *One engine inoperative.* The one-engine-inoperative net flight path data shall be determined in such a manner that they represent the airplane's actual climb performance diminished by a gradient of climb equal to 1.4 percent for two-engine airplanes and 1.3 percent for four-engine airplanes. It shall be acceptable to include in these data the variation of the airplane's weight along the flight path to take into account the progressive consumption of fuel and oil by the operating engine(s).

(b) *Two engines inoperative.* For airplanes with four engines, the two-engine-inoperative net flight path data shall be determined in such a manner that they represent the airplane's actual climb performance diminished by a gradient of climb equal to 0.6 percent. It shall be acceptable to include in these data the variation of the airplane's weight along the flight path to take into account the progressive consumption of fuel and oil by the operating engines.

(c) *Conditions.* In determining the flight paths prescribed in paragraphs (a) and (b) of this section, the conditions of subparagraphs (1) through (4) of this paragraph shall apply.

(1) The airplane's center of gravity shall be in the most unfavorable position.

(2) The critical engine(s) shall be inoperative, the remaining engine(s) operating at the available maximum continuous power and/or thrust.

(3) Means for controlling the engine cooling air supply shall be in the position which provides adequate cooling in the hot-day condition.

(4) The speed shall be selected by the applicant.

4T.122 *Landing distance.* The landing distance shall be the horizontal distance required to land and to come to a complete stop (to a speed of approximately 3 knots in the case of seaplanes or float planes) from a point at a height of 50 feet above the landing surface. Landing distances shall be determined for standard temperatures at all weights, altitudes, and winds within the operational limits established by the applicant for the airplane. The conditions of paragraphs (a) through (f) of this section shall apply.

(a) The airplane shall be in the landing configuration. During the landing, changes in the airplane's configuration, in power and/or thrust, and in speed shall be in accordance with procedures established by the applicant for the operation of the airplane in service. The procedures shall comply with the provisions of § 4T.111 (c).

(b) The landing shall be preceded by a steady gliding approach down to the 50-foot height with a calibrated air speed of not less than 1.3 V_{s_0}.

(c) The landing distance shall be based on a smooth, dry, hard-surfaced runway, and shall be determined in such a manner that reproduction does not require exceptional skill or alertness on the part of the pilot. In the case of seaplanes or float planes, the landing surface shall be smooth water, while for skiplanes it shall be smooth dry snow. During landing, the airplane shall not exhibit excessive vertical acceleration, a tendency to bounce, nose over, ground loop, porpoise, or water loop.

(d) The landing distance shall be corrected for not more than 50 percent of nominal wind components along the landing path opposite to the direction of landing and not less than 150 percent of nominal wind components along the landing path in the direction of landing.

(e) During landing, the operating pressures on the wheel braking system shall not be in excess of those approved by the manufacturer of the brakes, and the wheel brakes shall not be used in such a manner as to produce excessive wear of brakes and tires.

(f) If the Administrator finds that a device on the airplane other than wheel brakes has a noticeable effect on the landing distance and if the device depends upon the operation of the engine and the effect of such a device is not compensated for by other devices in the event of engine failure, the landing distance shall be determined by assuming the critical engine to be inoperative.

4T.123 *Limitations and information*—(a) *Limitations.* The performance limitations on the operation of the airplane shall be established in accordance with subparagraphs (1) through (4) of this paragraph. (See also § 4T.743.)

(1) *Take-off weights.* The maximum take-off weights shall be established at which compliance is shown with the generally applicable provisions of this regulation and with § 4T.120 (a), (b), and (c) for altitudes and ambient temperatures within the operational limits of the airplane (see subparagraph (4) of this paragraph).

(2) *Landing weights.* The maximum landing weights shall be established at which compliance is shown with the generally ap-

plicable provisions of this regulation and with §§ 4T.119 and 4T.120 (d) for altitudes and ambient temperatures within the operational limits of the airplane (see subparagraph (4) of this paragraph).

(3) *Take-off and accelerate-stop distances.* The minimum distances required for take-off shall be established at which compliance is shown with the generally applicable provisions of this regulation and with §§ 4T.115 and 4T.117 for weights, altitudes, temperatures, wind components, and runway gradients, within the operational limits of the airplane (see subparagraph (4) of this paragraph).

(4) *Operational limits.* The operational limits of the airplane shall be established by the applicant for all variable factors required in showing compliance with this regulation (weight, altitude, temperature, etc.). (See §§ 4T.113 (a) (1) and (b), 4T.118, 4T.121, and 4T.122.)

(b) *Information.* The performance information on the operation of the airplane shall be scheduled in compliance with the generally applicable provisions of this regulation and with §§ 4T.116, 4T.121, and 4T.122 for weights, altitudes, temperatures, wind components, and runway gradients, as these may be applicable, within the operational limits of the airplane (see paragraph (a) (4) of this section). In addition, the performance information specified in subparagraphs (1) through (3) of this paragraph shall be determined by extrapolation and scheduled for the ranges of weights between the maximum landing and maximum take-off weights established in accordance with paragraphs (a) (1) and (2) of this section. (See also § 4T.743.)

(1) Climb in the landing configuration (see § 4T.119);

(2) Climb in the approach configuration (see § 4T.120 (d));

(3) Landing distance (see § 4T.122).

AIRPLANE FLIGHT MANUAL

4T.743 *Performance limitations, information, and other data—*(a) *Limitations.* The airplane's performance limitations shall be given in accordance with § 4T.123 (a).

(b) *Information.* The performance information prescribed in § 4T.123 (b) for the application of the operating rules of this regulation shall be given together with descriptions of the conditions, air speeds, etc., under which the data were determined.

(c) *Procedures.* For all stages of flight, procedures shall be given with respect to airplane configurations, power and/or thrust settings, and indicated air speeds, to the extent such procedures are related to the limitations and information set forth in accordance with paragraphs (a) and (b) of this section.

(d) *Miscellaneous.* An explanation shall be given of significant or unusual flight or ground handling characteristics of the airplane.

3. In lieu of §§ 40.70 through 40.78, 41.27 through 41.36 (d), and 42.70 through 42.83, of Parts 40, 41, and 42 of the Civil Air Regulations, respectively, the following shall be applicable:

OPERATING RULES

40T.80 *Transport category airplane operating limitations.* (a) In operating any passenger-carrying transport category airplane certificated in accordance with the performance requirements of this regulation, the provisions of §§ 40T.80 through 40T.84 shall be complied with, unless deviations therefrom are specifically authorized by the Administrator on the ground that the special circumstances of a particular case make a literal observance of the requirements unnecessary for safety.

(b) The performance data in the Airplane Flight Manual shall be applied in determining compliance with the provisions of §§ 40T.81 through 40T.84. Where conditions differ from those for which specific tests were made, compliance shall be determined by approved interpolation or computation of the effects of changes in the specific variables if such interpolations or computations give results substantially equalling in accuracy the results of a direct test.

40T.81 *Airplane's certificate limitations.* (a) No airplane shall be taken off at a weight which exceeds the take-off weight specified in the Airplane Flight Manual for the elevation of the airport and for the ambient temperature existing at the time of the take-off. (See §§ 4T.123 (a) (1) and 4T.743 (a).)

(b) No airplane shall be taken off at a weight such that, allowing for normal consumption of fuel and oil in flight to the airport of destination, the weight on arrival will exceed the landing weight specified in the Airplane Flight Manual for the elevation of the airport of destination and for the ambient temperature anticipated there at the time of landing. (See §§ 4T.123 (a) (2) and 4T.743 (a).)

(c) No airplane shall be taken off at a weight which exceeds the weight shown in the Airplane Flight Manual to correspond with the minimum distance required for take-off on the runway to be used. The take-off distance shall correspond with the elevation of the airport, the effective runway gradient, and the ambient temperature and wind component existing at the time of take-off. (See §§ 4T.123 (a) (3) and 4T.743 (a).)

(d) No airplane shall be operated outside the operational limits specified in the Airplane Flight Manual. (See §§ 4T.123 (a) (4) and 4T.743 (a).)

40T.82 *Take-off obstacle clearance limitations.* No airplane shall be taken off at a weight in excess of that shown in the Airplane Flight Manual to correspond with a take-off path which clears all obstacles either by at least a height equal to ($35+0.01D$) feet vertically, where D is the distance out along the intended flight path from the end of the runway in feet, or by at least 200 feet horizontally within the airport boundaries and by at least 300 feet horizontally after passing beyond the boundaries. In determining the allowable deviation of the flight path in order to avoid obstacles by at least the distances prescribed, it shall be assumed that the airplane is not banked before reaching a height of 50 feet as shown by the take-off path data in the Airplane Flight Manual, and that a maximum bank thereafter does not exceed 15 degrees. The take-off path considered shall be for the elevation of the airport, the effective runway gradient, and for the ambient temperature and wind component existing at the time of take-off. (See §§ 4T.123 (b) and 4T.743 (b).)

40T.83 *En route limitations.*—(a) *One engine inoperative.* No airplane shall be taken off at a weight in excess of that which, according to the one-engine-inoperative en route net flight path data shown in the Airplane Flight Manual, will permit compliance with either subparagraph (1) or subparagraph (2) of this paragraph at all points along the route. The net flight path used shall be for the ambient temperatures anticipated along the route. (See §§ 4T.123 (b) and 4T.743 (b).)

(1) The slope of the net flight path shall be positive at an altitude of at least 1,000 feet above all terrain and obstructions along the route within 5 miles on either side of the intended track.

(2) The net flight path shall be such as to permit the airplane to continue flight from the cruising altitude to an alternate airport where a landing can be made in accordance with the provisions of § 40T.84 (b), the net flight path clearing vertically by at least 2,000 feet all terrain and obstructions along the route within 5 miles on either side of the intended track. The provisions of subdivisions (i) through (vii) of this subparagraph shall apply.

(i) The engine shall be assumed to fail at the most critical point along the route.

(ii) The airplane shall be assumed to pass over the critical obstruction following engine failure at a point no closer to the critical obstruction than the nearest approved radio navigational fix, except that the Administrator may authorize a procedure established on a different basis where adequate operational safeguards are found to exist.

(iii) The net flight path shall have a positive slope at 1,000 feet above the airport used as the alternate.

(iv) An approved method shall be used to account for winds which would otherwise adversely affect the flight path.

(v) Fuel jettisoning shall be permitted if the Administrator finds that the operator has an adequate training program, proper instructions are given to the flight crew, and all other precautions are taken to insure a safe procedure.

(vi) The alternate airport shall be specified in the dispatch release and shall meet the prescribed weather minima.

(vii) The consumption of fuel and oil after the engine becomes inoperative shall be that which is accounted for in the net flight path data shown in the Airplane Flight Manual.

(b) *Two engines inoperative.* No airplane shall be flown along an intended route except in compliance with either subparagraph (1) or subparagraph (2) of this paragraph.

(1) No place along the intended track shall be more than 90 minutes away from an airport at which a landing can be made in accordance with the provisions of § 40T.84 (b), assuming all engines to be operating at cruising power.

(2) No airplane shall be taken off at a weight in excess of that which, according to the two-engine-inoperative en route net flight path data shown in the Airplane Flight Manual, will permit the airplane to continue flight from the point where two engines are assumed to fail simultaneously to an airport where a landing can be made in accordance with the provisions of § 40T.84 (b), the net flight path having a positive slope at an altitude of at least 1,000 feet above all terrain and obstructions along the route within 5 miles on either side of the intended track or at an altitude of 5,000 feet, whichever is higher. The net flight path considered shall be for the ambient temperatures anticipated along the route. The provisions of subdivisions (i) through (iii) of this subparagraph shall apply. (See §§ 4T.123 (b) and 4T.743 (b).)

(i) The two engines shall be assumed to fail at the most critical point along the route.

(ii) If fuel jettisoning is provided, the airplane's weight at the point where the two engines are assumed to fail shall be considered to be not less than that which would include sufficient fuel to proceed to the airport and to arrive there at an altitude of at least 1,000 feet directly over the landing area.

(iii) The consumption of fuel and oil after the engines become inoperative shall be that which is accounted for in the net flight path data shown in the Airplane Flight Manual.

40T.84 *Landing limitations—*(a) *Airport of destination.* No airplane shall be taken off at a weight in excess of that which, in accordance with the landing distances shown in the Airplane Flight Manual for the elevation of the airport of intended destination and for the wind conditions anticipated there at the time of landing, would permit the airplane to be brought to rest at the airport of intended destination within 60 percent of the effective length of the runway from a point 50 feet directly above the intersection of the obstruction clearance plane and the runway. The weight of the airplane shall be assumed to be reduced by the weight of the fuel and oil expected to be consumed in flight to the airport of intended destination. Compliance shall be shown with the conditions of subparagraphs (1) and (2) of this paragraph. (See §§ 4T.123 (b) and 4T.743 (b).)

(1) It shall be assumed that the airplane is landed on the most favorable runway and direction in still air.

(2) It shall be assumed that the airplane is landed on the most suitable runway considering the probable wind velocity and direction and taking due account of the ground handling characteristics of the airplane and of other conditions (i. e., landing aids, terrain, etc.). If full compliance with the provisions of this subparagraph is not shown, the airplane may be taken off if an alternate airport is designated which permits compliance with paragraph (b) of this section.

(b) *Alternate airport.* No airport shall be designated as an alternate airport in a dispatch release unless the airplane at the weight anticipated at the time of arrival at such airport can comply with the provisions of paragraph (a) of this section, provided that the airplane can be brought to rest within 70 percent of the effective length of the runway.

[22 F. R. 5947, July 27, 1957; 22 F. R. 6274, Aug. 6, 1957]

SR–422A

Contrary provisions of the Civil Air Regulations notwithstanding all turbine-powered transport category airplanes for which a type certificate is issued after August 27, 1957, shall comply with Special Civil Air Regulation No. SR–422 or, alternatively, with the following provisions, except that those airplanes for which a type certificate is issued after September 30, 1958, shall comply with the following provisions:

1. The provisions of Part 4b of the Civil Air Regulations, effective on the date of application for type certificate; and such of the provisions of all subsequent amendments to Part 4b, in effect prior to August 27, 1957, as the Administrator finds necessary to insure that the level of safety of turbine-powered airplanes is equivalent to that generally intended by Part 4b.

2. In lieu of §§ 4b.110 through 4b.125, and 4b.743 of Part 4b of the Civil Air Regulations, the following shall be applicable:

PERFORMANCE

4T.110 *General.* (a) The performance of the airplane shall be determined and scheduled in accordance with, and shall meet the minima prescribed by, the provisions of §§ 4T.110 through 4T.123. The performance limitations, information, and other data shall be given in accordance with § 4T.743.

(b) Unless otherwise specifically prescribed, the performance shall correspond with ambient atmospheric conditions and still air. Humidity shall be accounted for as specified in paragraph (c) of this section.

(c) The performance as affected by engine power and/or thrust shall be based on a relative humidity of 80 percent at and below standard temperatures and on 34 percent at and above standard temperatures plus 50° F. Between these two temperatures the relative humidity shall vary linearly.

(d) The performance shall correspond with the propulsive thrust available under the particular ambient atmospheric conditions, the particular flight condition, and the relative humidity specified in paragraph (c) of this section. The available propulsive thrust shall correspond with engine power and/or thrust not exceeding the approved power and/or thrust less the installational losses and less the power and/or equivalent thrust absorbed by the accessories and services appropriate to the particular ambient atmospheric conditions and the particular flight condition.

4T.111 *Airplane configuration, speed, power, and/or thrust; general.* (a) The airplane configuration (setting of wing and cowl flaps, air brakes, landing gear, propeller, etc.), denoted respectively as the take-off, en route, approach, and landing configurations, shall be selected by the applicant except as otherwise prescribed.

(b) It shall be acceptable to make the airplane configurations variable with weight, altitude, and temperature, to an extent found by the Administrator to be compatible with operating procedures required in accordance with paragraph (c) of this section.

(c) In determining the accelerate-stop distances, take-off flight paths, take-off distances, and landing distances, changes in the airplane's configuration and speed, and in the power and/or thrust shall be in accordance with procedures established by the applicant for the operation of the airplane in service, except as otherwise prescribed. In addition, procedures shall be established for the execution of balked landings and missed approaches associated with the conditions prescribed in §§ 4T.119 and 4T.120 (d), respectively. All procedures shall comply with the provisions of subparagraphs (1) through (3) of this paragraph.

(1) The Administrator shall find that the procedures can be consistently executed in service by crews of average skill.

(2) The procedures shall not involve methods or the use of devices which have not been proven to be safe and reliable.

(3) Allowance shall be made for such time delays in the execution of the procedures as may be reasonably expected to occur during service.

4T.112 *Stalling speeds.* (a) The speed V_s shall denote the calibrated stalling speed, or the minimum steady flight speed at which the airplane is controllable, in knots, with:

(1) Zero thrust at the stalling speed, or engines idling and throttles closed if it is shown that the resultant thrust has no appreciable effect on the stalling speed;

(2) If applicable, propeller pitch controls in the position necessary for compliance with subparagraph (1) of this paragraph; the airplane in all other respects (flaps, landing gear, etc.) in the particular configuration corresponding with that in connection with which V_s is being used;

(3) The weight of the airplane equal to the weight in connection with which V_s is being used to determine compliance with a particular requirement;

(4) The center of gravity in the most unfavorable position within the allowable range.

(b) The stall speed defined in this section shall be the minimum speed obtained in flight tests conducted in accordance with the procedure of subparagraphs (1) and (2) of this paragraph.

(1) With the airplane trimmed for straight flight at a speed of 1.4 V_s and from a speed sufficiently above the stalling speed to insure steady conditions, the elevator control shall be applied at a rate such that the airplane speed reduction does not exceed one knot per second.

(2) During the test prescribed in subparagraph (1) of this paragraph, the flight characteristics provisions of § 4b.160 of Part 4b of the Civil Air Regulations shall be complied with.

4T.113 *Take-off; general.* (a) The take-off data in §§ 4T.114 through 4T.117 shall be determined under the conditions of subparagraphs (1) and (2) of this paragraph.

(1) At all weights, altitudes, and ambient temperatures within the operational limits established by the applicant for the airplane.

(2) In the configuration for take-off (see § 4T.111).

(b) Take-off data shall be based on a smooth, dry, hard-surfaced runway and shall be determined in such a manner that reproduction of the performance does not require exceptional skill or alertness on the part of the pilot. In the case of seaplanes or float planes, the take-off surface shall be smooth water, while for skiplanes it shall be smooth dry snow. In addition, the take-off data shall be corrected in accordance with subparagraphs (1) and (2) of this paragraph for wind and for runway gradients within the operational limits established by the applicant for the airplane.

(1) Not more than 50 percent of nominal wind components along the take-off path opposite to the direction of take-off, and not less than 150 percent of nominal wind components along the take-off path in the direction of take-off.

(2) Effective runway gradients.

4T.114 *Take-off speeds.* (a) The critical-engine-failure speed V_1, in terms of calibrated air speed, shall be selected by the applicant, but shall not be less than the minimum speed at which controllability by primary aerodynamic controls alone is demonstrated during the take-off run to be adequate to permit proceeding safely with the take-off using average piloting skill, when the critical engine is suddenly made inoperative.

(b) The take-off safety speed V_2, in terms of calibrated air speed, shall be selected by the applicant so as to permit the gradient of climb required in § 4T.120 (a) and (b), but it shall not be less than:

(1) 1.2 V_s for two-engine propeller-driven airplanes and for airplanes without propellers which have no provisions for obtaining a significant reduction in the one-engine-inoperative power-on stalling speed;

(2) 1.15 V_s for propeller-driven airplanes having more than two engines and for airplanes without propellers which have provisions for obtaining a significant reduction in the one-engine-inoperative power-on stalling speed;

(3) 1.10 times the minimum control speed V_{MC}, established in accordance with § 4b.133 of Part 4b of the Civil Air Regulations;

(4) The rotation speed V_R plus the increment in speed attained in compliance with § 4T.116 (e).

(c) The minimum rotation speed V_R, in terms of calibrated air speed, shall be selected by the applicant, except that it shall not be less than:

(1) The speed V_1;

(2) A speed equal to 95 percent of the highest speed obtained in compliance with subparagraph (1) or (2), whichever is applicable, and with subparagraph (3) of paragraph (b) of this section;

(3) A speed which permits the attainment of the speed V_2 prior to reaching a height of 35 feet above the take-off surface as determined in accordance with § 4T.116 (e);

(4) A speed equal to 110 percent of the minimum speed above which the airplane, with all engines operating, can be made to lift off the ground and to continue the take-off without displaying any hazardous characteristics.

4T.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 in service, and that exceptional skill is not required to control the airplane.

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

4T.116 *Take-off path.* The take-off path shall be considered to extend from the standing start to a point in the take-off where a height of 1,500 feet above the take-off surface is reached or to a point in the take-off where the transition from the take-off to the en route configuration is completed and a speed is reached at which compliance with § 4T.120 (c) is shown, whichever point is at a higher altitude. The conditions of paragraphs (a) through (i) of this section shall apply in determining the take-off path.

(a) The take-off path shall be based upon procedures prescribed in accordance with § 4T.111 (c).

(b) The airplane shall be accelerated on the ground to the speed V_1 at which point the critical engine shall be made inoperative and shall remain inoperative during the remainder of the take-off. Subsequent to attaining speed V_1, the airplane shall be accelerated to speed V_2 during which time it shall be permissible to initiate raising the nose gear off the ground at a speed not less than the rotation speed V_R.

(c) Landing gear retraction shall not be initiated until the airplane becomes airborne.

(d) The slope of the airborne portion of the take-off path shall be positive at all points.

(e) The airplane shall attain the speed V_2 prior to reaching a height of 35 feet above the take-off surface and shall continue at a speed as close as practical to, but not less than, V_2 until a height of 400 feet above the take-off surface is reached.

(f) Except for gear retraction and propeller feathering, the airplane configuration shall not be changed before reaching a height of 400 feet above the take-off surface.

(g) At all points along the take-off path starting at the point where the airplane first reaches a height of 400 feet above the take-off surface, the available gradient of climb shall not be less than 1.2 percent for two-engine airplanes and 1.7 percent for four-engine airplanes.

(h) The take-off path shall be determined either by a continuous demonstrated take-off, or alternatively, by synthesizing from segments the complete take-off path.

(i) If the take-off path is determined by the segmental method, the provisions of subparagraphs (1) through (4) of this paragraph shall be specifically applicable.

(1) The segments of a segmental take-off path shall be clearly defined and shall be related to the distinct changes in the configuration of the airplane, in power and/or thrust, and in speed.

(2) The weight of the airplane, the configuration, and the power and/or thrust shall be constant throughout each segment and shall correspond with the most critical condition prevailing in the particular segment.

(3) The segmental flight path shall be based on the airplane's performance without ground effect.

(4) Segmental take-off path data shall be checked by continuous demonstrated take-offs to insure that the segmental path is conservative relative to the continuous path.

4T.117 *Take-off distance and take-off run*—(a) *Take-off distance.* The take-off distance shall be the greater of the distances established in accordance with subparagraphs (1) and (2) of this paragraph.

(1) The horizontal distance along the take-off path from the start of the take-off to the point where the airplane attains a height of 35 feet above the take-off surface, as determined in accordance with § 4T.116.

(2) A distance equal to 115 percent of the horizontal distance along the take-off path, with all engines operating, from the start of the take-off to the point where the airplane attains a height of 35 feet above the take-off surface, as determined by a procedure consistent with that established in accordance with § 4T.116.

(b) *Take-off run.* If the take-off distance is intended to include a clearway (see item 5 of this regulation), the take-off run shall be determined and shall be the greater of the distances established in accordance with subparagraphs (1) and (2) of this paragraph.

(1) The horizontal distance along the take-off path from the start of the take-off to a point equidistant between the point where the airplane first becomes airborne and the point where it attains a height of 35 feet above the take-off surface, as determined in accordance with § 4T.116.

(2) A distance equal to 115 percent of the horizontal distance along the take-off path, with all engines operating, from the start of the take-off to a point equidistant between the point where the airplane first becomes airborne and the point where it attains a height of 35 feet above the take-off surface, as determined by a procedure consistent with that established in accordance with § 4T.116.

4T.117a *Take-off flight path.* (a) The take-off flight path shall be considered to begin at a height of 35 feet above the take-off surface at the end of the take-off distance as determined in accordance with § 4T.117 (a).

(b) The net take-off flight path data shall be determined in such a manner that they represent the airplane's actual take-off flight paths, determined in accordance with paragraph (a) of this section, diminished by a gradient of climb equal to 1.0 percent.

4T.118 *Climb; general.* Compliance shall be shown with the climb requirements of §§ 4T.119 and 4T.120 at all weights, altitudes, and ambient temperatures, within the operational limits established by the applicant for the airplane. The airplane's center of gravity shall be in the most unfavorable position corresponding with the applicable configuration.

4T.119 *All-engine-operating landing climb.* In the landing configuration the steady gradient of climb shall not be less than 3.2 percent, with:

(a) All engines operating at the power and/or thrust which is available 8 seconds after initiation of movement of the power and/or thrust controls from the minimum flight idle to the take-off position;

(b) A climb speed not in excess of 1.3 V_s.

4T.120 *One-engine-inoperative climb*—(a) *Take-off; landing gear extended.* In the take-off configuration existing at the point of the flight path where the airplane first becomes airborne, in accordance with § 4T.116 but without ground effect, the steady gradient of climb shall be positive for two-engine airplanes and shall not be less than 0.5 percent for four-engine airplanes, with:

(1) The critical engine inoperative, the remaining engine(s) operating at the available take-off power and/or thrust existing in accordance with § 4T.116 at the time retraction of the airplane's landing gear is initiated, unless subsequently a more critical power operating condition exists along the flight path prior to the point where the landing gear is fully retracted;

(2) The weight equal to the airplane's weight existing in accordance with § 4T.116 at the time retraction of the airplane's landing gear is initiated;

(3) The speed equal to the speed V_2.

(b) *Take-off; landing gear retracted.* In the take-off configuration existing at the point of the flight path where the airplane's landing gear is fully retracted, in accordance with § 4T.116 but without ground effect, the steady gradient of climb shall not be less than 2.5 percent for two-engine airplanes and not less than 3.0 percent for four-engine airplanes, with:

(1) The critical engine inoperative, the remaining engine(s) operating at the available take-off power and/or thrust existing in accordance with § 4T.116 at the time the landing gear is fully retracted, unless subsequently a more critical power operating condition exists along the flight path prior to the point where a height of 400 feet above the take-off surface is reached;

(2) The weight equal to the airplane's weight existing in accordance with § 4T.116 at the time the airplane's landing gear is fully retracted;

(3) The speed equal to the speed V_2.

(c) *Final take-off.* In the en route configuration, the steady gradient of climb shall not be less than 1.2 percent for two-engine airplanes and not less than 1.7 percent for four-engine airplanes, at the end of the take-off path as determined by § 4T.116, with:

(1) The critical engine inoperative, the remaining engine(s) operating at the available maximum continuous power and/or thrust;

(2) The weight equal to the airplane's weight existing in accordance with § 4T.116 at the end of the take-off path;

(3) The speed equal to not less than 1.25 V_s.

(d) *Approach.* In the approach configuration such that the corresponding V_s for this configuration does not exceed 110 percent of the V_s corresponding with the related landing configuration, the steady gradient of climb shall not be less than 2.2 percent for two-engine airplanes and not less than 2.7 percent for four-engine airplanes with:

(1) The critical engine inoperative, the remaining engine(s) operating at the available take-off power and/or thrust;

(2) The weight equal to the maximum landing weight;

(3) A climb speed established by the applicant in connection with normal landing procedures, except that it shall not exceed 1.5 V_s (see § 4T.111 (c)).

4T.121 *En route flight paths.* With the airplane in the en route configuration, the flight paths prescribed in paragraphs (a) and (b) of this section shall be determined at all weights, altitudes, and ambient temperatures within the limits established by the applicant for the airplane.

(a) *One engine inoperative.* The one-engine-inoperative net flight path data shall be determined in such a manner that they represent the airplane's actual climb performance diminished by a gradient of climb equal to 1.1 percent for two-engine airplanes and 1.6 percent for four-engine airplanes. It shall be acceptable to include in these data the variation of the airplane's weight along the flight path to take into account the progressive consumption of fuel and oil by the operating engine(s).

(b) *Two engines inoperative.* For airplanes with four engines, the two-engine-inoperative net flight path data shall be determined in such a manner that they represent the airplane's actual climb performance diminished by a gradient of climb equal to 0.5 percent. It shall be acceptable to include in these data the variation of the airplane's weight along the flight path to take into account the progressive consumption of fuel and oil by the operating engines.

(c) *Conditions.* In determining the flight paths prescribed in paragraphs (a) and (b) of this section, the conditions of subparagraphs (1) through (4) of this paragraph shall apply.

(1) The airplane's center of gravity shall be in the most unfavorable position.

(2) The critical engine(s) shall be inoperative, the remaining engine(s) operating at the available maximum continuous power and/or thrust.

(3) Means for controlling the engine cooling air supply shall be in the position which provides adequate cooling in the hot-day condition.

(4) The speed shall be selected by the applicant.

4T.122 *Landing distance.* The landing distance shall be the horizontal distance required to land and to come to a complete stop (to a speed of approximately 3 knots in the case of seaplanes or float planes) from a point at a height of 50 feet above the landing surface. Landing distances shall be determined for standard temperatures at all weights, altitudes, and winds within the operational limits established by the applicant for the airplane. The conditions of paragraphs (a) through (g) of this section shall apply.

(a) The airplane shall be in the landing configuration. During the landing, changes in the airplane's configuration, in power and/or thrust, and in speed shall be in accordance with procedures established by the applicant for the operation of the airplane in service. The procedures shall comply with the provisions of § 4T.111 (c).

(b) The landing shall be preceded by a steady gliding approach down to the 50-foot height with a calibrated air speed of not less than 1.3 V_s.

(c) The landing distance shall be based on a smooth, dry, hard-surfaced runway, and shall be determined in such a manner that reproduction does not require exceptional skill or alertness on the part of the pilot. In the case of seaplanes or float planes, the landing surface shall be smooth water, while for skiplanes it shall be smooth dry snow. During landing, the airplane shall not exhibit excessive vertical acceleration, a tendency to bounce, nose over, ground loop, porpoise, or water loop.

(d) The landing distance shall be corrected for not more than 50 percent of nominal wind components along the landing path opposite to the direction of landing and not less than 150 percent of nominal wind components along the landing path in the direction of landing.

(e) During landing, the operating pressures on the wheel braking system shall not be in excess of those approved by the manufacturer of the brakes, and the wheel brakes shall not be used in such a manner as to produce excessive wear of brakes and tires.

(f) In addition to, or in lieu of, wheel brakes, the use of other braking means shall be acceptable in determining the landing distance, provided 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 in service, and that exceptional skill is not required to control the airplane.

(g) If the characteristics of a device (e. g., the propellers) dependent upon the operation of any of the engines noticeably increase the landing distance when the landing is made with the engine inoperative, the landing distance shall be determined with the critical engine inoperative unless the Administrator finds that the use of compensating means will result in a landing distance not greater than that attained with all engines operating.

4T.123 *Limitations and information*—(a) *Limitations.* The performance limitations on the operation of the airplane shall be established in accordance with subparagraphs (1) through (4) of this paragraph. (See also § 4T.743.)

(1) *Take-off weights.* The maximum take-off weights shall be established at which compliance is shown with the generally applicable provisions of this regulation and with the take-off climb provisions prescribed in § 4T.120 (a), (b), and (c) for altitudes and ambient temperatures within the operational limits of the airplane (see subparagraph (4) of this paragraph).

(2) *Landing weights.* The maximum landing weights shall be established at which compliance is shown with the generally applicable provisions of this regulation and with the landing and take-off climb provisions prescribed in §§ 4T.119 and 4T.120 for altitudes and ambient temperatures within the operational limits of the airplane (see subparagraph (4) of this paragraph).

(3) *Accelerate-stop distance, take-off distance, and take-off run.* The minimum distances required for take-off shall be established at which compliance is shown with the generally applicable provisions of this regulation and with §§ 4T.115 and 4T.117 (a), and with 4T.117 (b) if the take-off distance is intended to include a clearway, for weights, altitudes, temperatures, wind components, and runway gradients, within the operational limits of the airplane (see subparagraph (4) of this paragraph).

(4) *Operational limits.* The operational limits of the airplane shall be established by the applicant for all variable factors required in showing compliance with this regulation (weight, altitude, temperature, etc.). (See §§ 4T.113 (a) (1) and (b), 4T.118, 4T.121, and 4T.122.)

(b) *Information.* The performance information on the operation of the airplane shall be scheduled in compliance with the generally applicable provisions of this regulation and with §§ 4T.117a (b), 4T.121, and 4T.122 for weights, altitudes, temperatures, wind components, and runway gradients, as these may be applicable, within the operational limits of the airplane (see subparagraph (a) (4) of this section). In addition, the performance information specified in subparagraphs (1) through (3) of this paragraph shall be determined by extrapolation and scheduled for the ranges of weights between the maximum landing and maximum take-off weights established in accordance with subparagraphs (a) (1) and (a) (2) of this section. (See also § 4T.743.)

(1) Climb in the landing configuration (see § 4T.119);

(2) Climb in the approach configuration (see § 4T.120 (d));

(3) Landing distance (see § 4T.122).

AIRPLANE FLIGHT MANUAL

4T.743 *Performance limitations, information, and other data*—(a) *Limitations.* The airplane's performance limitations shall be given in accordance with § 4T.123 (a).

(b) *Information.* The performance information prescribed in § 4T.123 (b) for the application of the operating rules of this regulation shall be given together with descriptions of the conditions, air speeds, etc., under which the data were determined.

(c) *Procedures.* Procedures established in accordance with § 4T.111 (c) shall be given to the extent such procedures are related to the limitations and information set forth in accordance with paragraphs (a) and (b) of this section. Such procedures, in the form of guidance material, shall be included with the relevant limitations or information, as applicable.

(d) *Miscellaneous.* An explanation shall be given of significant or unsual flight or ground handling characteristics of the airplane.

3. In lieu of §§ 40.70 through 40.78, 41.27 through 41.36 (d), and 42.70 through 42.83, of Parts 40, 41, and 42 of the Civil Air Regulations, respectively, the following shall be applicable:

OPERATING RULES

40T.80 *Transport category airplane operating limitations.* (a) In operating any passenger-carrying transport category airplane certificated in accordance with the performance requirements of this regulation, the provisions of §§ 40T.80 through 40T.84 shall be complied with, unless deviations therefrom are specifically authorized by the Administrator on the ground that the special circumstances of a particular case make a literal observance of the requirements unnecessary for safety.

(b) The performance data in the Airplane Flight Manual shall be applied in determining compliance with the provisions of §§ 40T.81 through 40T.84. Where conditions differ from those for which specific tests were made, compliance shall be determined by approved interpolation or computation of the effects of changes in the specific variables if such interpolations or computations give results substantially equalling in accuracy the results of a direct test.

40T.81 *Airplane's certificate limitations.* (a) No airplane shall be taken off at a weight which exceeds the take-off weight specified in the Airplane Flight Manual for the elevation of the airport and for the ambient temperature existing at the time of the take-off. (See §§ 4T.123 (a) (1) and 4T.743 (a).)

(b) No airplane shall be taken off at a weight such that, allowing for normal consumption of fuel and oil in flight to the airport of destination and to the alternate airports, the weight on arrival will exceed the landing weight specified in the Airplane Flight Manual for the elevation of each of the airports involved and for the ambient temperatures anticipated at the time of landing. (See §§ 4T.123 (a) (2) and 4T.743 (a).)

(c) No airplane shall be taken off at a weight which exceeds the weight shown in the Airplane Flight Manual to correspond with the minimum distances required for take-off. These distances shall correspond with the elevation of the airport, the runway to be used, the effective runway gradient, and the ambient temperature and wind component existing at the time of take-off. (See §§ 4T.123 (a) (3) and 4T.743 (a).) If the take-off distance includes a clearway as defined in Item 5 of this regulation, the take-off distance shall not include a clearway distance greater than one-half of the take-off run.

(d) No airplane shall be operated outside the operational limits specified in the Airplane Flight Manual. (See §§ 4T.123 (a) (4) and 4T.743 (a).)

40T.82 *Take-off obstacle clearance limitations.* No airplane shall be taken off at a weight in excess of that shown in the Airplane Flight Manual to correspond with a net take-off flight path which clears all obstacles either by at least a height of 35 feet vertically or by at least 200 feet horizontally within the airport boundaries and by at least 300 feet horizontally after passing beyond the boundaries. In determining the allowable deviation of the flight path in order to avoid obstacles by at least the distances prescribed, it shall be assumed that the airplane is not banked before reaching a height of 50 feet as shown by the take-off path data in the Airplane Flight Manual, and that a maximum bank thereafter does not exceed 15 degrees. The take-off path considered shall be for the elevation of the airport, the effective runway gradient, and for the ambient temperature and wind component existing at the time of take-off. (See §§ 4T.123 (b) and 4T.743 (b).)

40T.83 *En route limitations*—(a) *One engine inoperative.* No airplane shall be taken off at a weight in excess of that which, according to the one-engine-inoperative en route net flight path data shown in the Airplane Flight Manual, will permit compliance with either subparagraph (1) or subparagraph (2) of this paragraph at all points along the route. The net flight path used shall be for the ambient temperatures anticipated along the route. (See §§ 4T.123 (b) and 4T.743 (b).)

(1) The slope of the net flight path shall be positive at an altitude of at least 1,000 feet above all terrain and obstructions along the route within 5 miles on either side of the intended track.

(2) The net flight path shall be such as to permit the airplane to continue flight from the cruising altitude to an alternate airport where a landing can be made in accordance with the provisions of § 40T.84 (b), the net flight path clearing vertically by at least 2,000 feet all terrain and obstructions along the route within 5 miles on either side of the intended track. The provisions of subdivisions (i) through (vii) of this subparagraph shall apply.

(i) The engine shall be assumed to fail at the most critical point along the route.

(ii) The airplane shall be assumed to pass over the critical obstruction following engine failure at a point no closer to the critical obstruction than the nearest approved radio navigational fix, except that the Administrator may authorize a procedure established on a different basis where adequate operational safeguards are found to exist.

(iii) The net flight path shall have a positive slope at 1,500 feet above the airport used as the alternate.

(iv) An approved method shall be used to account for winds which would otherwise adversely affect the flight path.

(v) Fuel jettisoning shall be permitted if the Administrator finds that the operator has an adequate training program, proper instructions are given to the flight crew, and all other precautions are taken to insure a safe procedure.

(vi) The alternate airport shall be specified in the dispatch release and shall meet the prescribed weather minima.

(vii) The consumption of fuel and oil after the engine becomes inoperative shall be that which is accounted for in the net flight path data shown in the Airplane Flight Manual.

(b) *Two engines inoperative.* No airplane shall be flown along an intended route except in compliance with either subparagraph (1) or subparagraph (2) of this paragraph.

(1) No place along the intended track shall be more than 90 minutes away from an airport at which a landing can be made in accordance with the provisions of § 40T.84 (b), assuming all engines to be operating at cruising power.

(2) No airplane shall be taken off at a weight in excess of that which, according to the two-engine-inoperative en route net flight path data shown in the Airplane Flight Manual, will permit the airplane to continue flight from the point where two engines are assumed to fail simultaneously to an airport where a landing can be made in accordance with the provisions of § 40T.84 (b), the net flight path having a positive slope at an altitude of at least 1,000 feet above all terrain and obstructions along the route within 5 miles on either side of the intended track or at an altitude of 2,000 feet, whichever is higher. The net flight path considered shall be for the ambient temperatures anticipated along the route. The provisions of subdivisions (i) through (iii) of this subparagraph shall apply. (See §§ 4T.123 (b) and 4T.743 (b).)

(i) The two engines shall be assumed to fail at the most critical point along the route.

(ii) The airplane's weight at the point where the two engines are assumed to fail shall be considered to be not less than that which would include sufficient fuel to proceed to the airport and to arrive there at an altitude of at least 1,500 feet directly over the landing area and thereafter to fly for 15 minutes at cruise power and/or thrust.

(iii) The consumption of fuel and oil after the engines become inoperative shall be that which is accounted for in the net flight path data shown in the Airplane Flight Manual.

40T.84 *Landing limitations*—(a) *Airport of destination.* No airplane shall be taken off at a weight in excess of that which, in accordance with the landing distances shown in the Airplane Flight Manual for the elevation of the airport of intended destination and for the wind conditions anticipated there at the time of landing, would permit the airplane to be brought to rest at the airport of intended destination within 60 percent of the effective length of the runway from a point 50 feet directly above the intersection of the obstruction clearance plane and the runway. The weight of the airplane shall be assumed to be reduced by the weight of the fuel and oil expected to be consumed in flight to the airport of intended destination. Compliance shall be shown with the conditions of subparagraphs (1) and (2) of this paragraph. (See §§ 4T.123 (b) and 4T.743 (b).)

(1) It shall be assumed that the airplane is landed on the most favorable runway and direction in still air.

(2) It shall be assumed that the airplane is landed on the most suitable runway considering the probable wind velocity and direction and taking due account of the ground handling characteristics of the airplane and of other conditions (i. e., landing aids, terrain, etc.). If full compliance with the provisions of this subparagraph is not shown, the airplane may be taken off if an alternate airport is designated which permits compliance with paragraph (b) of this section.

(b) *Alternate airport.* No airport shall be designated as an alternate airport in a dispatch release unless the airplane at the weight anticipated at the time of arrival at such airport can comply with the provisions of paragraph (a) of this section, provided that the airplane can be brought to rest within 70 percent of the effective length of the runway.

4. [Deleted] (See § 91.37 [New] of this chapter.)

5. The following definitions shall apply:

DEFINITIONS

Clearway. A clearway is an area beyond the airport runway not less than 300 feet on either side of the extended center line of the runway, at an elevation no higher than the elevation at the end of the runway, clear of all fixed obstacles, and under the control of the airport authorities.

[23 F. R. 5160, July 8, 1958; 23 F. R. 5378, July 16, 1958, as amended by Doc. No. 1580, Amdt. 1-1, 28 F.R. 6703, June 29, 1963]

SR-422B

Contrary provisions of the Civil Air Regulations notwithstanding, all turbine-powered transport category airplanes for which a type certificate is issued after August 29, 1959, shall comply with all of the following requirements, except that, turbopropeller-powered airplanes previously type certificated with the same number of reciprocating engines need only comply with the performance requirements of paragraph 2. Applicants for a type certificate for a turbine-powered transport category airplane may elect and are authorized to meet the requirements of this Special Civil Air Regulation prior to August 29, 1959, in which case however, all of the following provisions must be complied with.

1. The provisions of Part 4b of the Civil Air Regulations, effective on the date of application for type certificate; and such of the provisions of all subsequent amendments to Part 4b, in effect prior to August 27, 1957, as the Administrator finds necessary to ensure that the level of safety of turbine-powered airplanes is equivalent to that generally intended by Part 4b.

2. In lieu of §§ 4b.110 through 4b.125, 4b.133, and 4b.743 of Part 4b of the Civil Air Regulations, the following shall be applicable:

PERFORMANCE

4T.110 *General.* (a) The performance of the airplane shall be determined and scheduled in accordance with, and shall meet the minima prescribed by, the provisions of §§ 4T.110 through 4T.123. The performance limitations, information, and other data shall be given in accordance with § 4T.743.

(b) Unless otherwise specifically prescribed, the performance shall correspond with ambient atmospheric conditions and still air. Humidity shall be accounted for as specified in paragraph (c) of this section.

(c) The performance as affected by engine power and/or thrust shall be based on a relative humidity of 80 percent at and below standard temperatures and on 34 percent at and above standard temperatures plus 50° F. Between these two temperatures the relative humidity shall vary linearly.

(d) The performance shall correspond with the propulsive thrust available under the particular ambient atmospheric conditions, the particular flight condition, and the relative humidity specified in paragraph (c) of this section. The available propulsive thrust shall correspond with engine power and/or thrust not exceeding the approved power and/or thrust less the installational losses and less the power and/or equivalent thrust absorbed by the accessories and services appropriate to the particular ambient atmospheric conditions and the particular flight condition.

4T.111 *Airplane configuration, speed, power, and/or thrust; general.* (a) The airplane configuration (setting of wing and cowl flaps, air brakes, landing gear, propeller, etc.), denoted respectively as the takeoff, en route, approach, and landing configurations, shall be selected by the applicant except as otherwise prescribed.

(b) It shall be acceptable to make the airplane configurations variable with weight, altitude, and temperature, to an extent found by the Administrator to be compatible with operating procedures required in accordance with paragraph (c) of this section.

(c) In determining the accelerate-stop distances, takeoff flight paths, takeoff distances, and landing distances, changes in the airplane's configuration and speed, and in the power and/or thrust shall be in accordance with procedures established by the applicant for the operation of the airplane in service, except as otherwise prescribed. In addition, procedures shall be established for the execution of balked landings and missed approaches associated with the conditions prescribed in §§ 4T.119 and 4T.120(d), respectively. All procedures shall comply with the provisions of subparagraphs (1) through (3) of this paragraph.

(1) The Administrator shall find that the procedures can be consistently executed in service by crews of average skill.

(2) The procedures shall not involve methods or the use of devices which have not been proven to be safe and reliable.

(3) Allowance shall be made for such time delays in the execution of the procedures as may be reasonably expected to occur during service.

4T.112 *Stalling and minimum control speeds.* (a) The speed V_s shall denote the calibrated stalling speed, or the minimum steady flight speed at which the airplane is controllable, in knots, with:

(1) Zero thrust at the stalling speed, or engines idling and throttles closed if it is shown that the resultant thrust has no appreciable effect on the stalling speed;

(2) If applicable, propeller pitch controls in the position necessary for compliance with subparagraph (1) of this paragraph; the airplane in all other respects (flaps, landing gear, etc.) in the particular configuration corresponding with that in connection with which V_s is being used;

(3) The weight of the airplane equal to the weight in connection with which V_s is being used to determine compliance with a particular requirement;

(4) The center of gravity in the most unfavorable position within the allowable range.

(b) The stall speed defined in this section shall be the minimum speed obtained in flight tests conducted in accordance with the procedure of subparagraphs (1) and (2) of this paragraph.

(1) With the airplane trimmed for straight flight at a speed chosen by the applicant, but not less than 1.2 V_s nor greater than 1.4 V_s, and from a speed sufficiently above the stalling speed to ensure steady conditions, the elevator control shall be applied at a rate such that the airplane speed reduction does not exceed 1 knot per second.

(2) During the test prescribed in subparagraph (1) of this paragraph, the flight characteristics provisions of § 4b.160 of Part 4b of the Civil Air Regulations shall be complied with.

(c) The minimum control speed V_{MC}, in terms of calibrated air speed, shall be determined under the conditions specified in this paragraph so that, when the critical engine is suddenly made inoperative at that speed, it is possible to recover control of the airplane with the engine still inoperative and to maintain it in straight flight at that speed, either with zero yaw or, at the option of the applicant, with an angle of bank not in excess of 5 degrees. V_{MC} shall not exceed 1.2 V_s with:

(1) Engines operating at the maximum available takeoff thrust and/or power;

(2) Maximum sea level takeoff weight or such lesser weight as might be necessary to demonstrate V_{MC};

(3) The airplane in the most critical takeoff configuration existing along the flight path after the airplane becomes airborne, except that the landing gear is retracted;

(4) The airplane trimmed for takeoff;

(5) The airplane airborne and the ground effect negligible;

(6) The center of gravity in the most unfavorable position;

(d) In demonstrating the minimum speed specified in paragraph (c) of this section, the rudder force required to maintain control shall not exceed 180 pounds and it shall not be necessary to reduce the power and/or thrust of the operative engine(s).

(e) During recovery from the maneuver specified in paragraph (c) of this section, the airplane shall not assume any dangerous attitude, nor shall it require exceptional skill, strength, or alertness on the part of the pilot to prevent a change of heading in excess of 20 degrees before recovery is complete.

4T.113 *Takeoff; general.* (a) The takeoff data in §§ 4T.114 through 4T.117 shall be determined under the conditions of subparagraphs (1) and (2) of this paragraph.

(1) At all weights, altitudes, and ambient temperatures, within the operational limits established by the applicant for the airplane.

(2) In the configuration for takeoff (see § 4T.111).

(b) Takeoff data shall be based on a smooth, dry, hard-surfaced runway and shall be determined in such a manner that reproduction of the performance does not require exceptional skill or alertness on the part of the pilot. In the case of seaplanes or float planes, the takeoff surface shall be smooth water, while for skiplane it shall be smooth, dry snow. In addition, the takeoff data shall include operational correction factors in accordance with subparagraphs (1) and (2) of this paragraph for wind and for runway gradients, within the operational limits established by the applicant for the airplane.

(1) Not more than 50 percent of nominal wind components along the takeoff path opposite to the direction of takeoff, and not less than 150 percent of nominal wind components along the takeoff path in the direction of takeoff.

(2) Effective runway gradients.

4T.114 *Takeoff speeds.* (a) The critical-engine-failure speed V_1, in terms of calibrated air speed, shall be selected by the applicant, but shall not be less than the minimum speed at which controllability by primary aerodynamic controls alone is demonstrated during the takeoff run to be adequate to permit proceeding safely with the takeoff using average piloting skill, when the critical engine is suddenly made inoperative.

(b) The minimum takeoff safety speed $V_{2\,min}$, in terms of calibrated air speed, shall not be less than:

(1) 1.2 V_s for two-engine and three-engine propeller-driven airplanes and for airplanes without propellers which have no provisions for obtaining a significant reduction in the one-engine-inoperative power-on stalling speed;

(2) 1.15 V_s for propeller-driven airplanes having more than three engines and for airplanes without propellers which have provisions for obtaining a significant reduction in the one-engine-inoperative power-on stalling speed;

(3) 1.10 times the minimum control speed V_{MC}.

(c) The takeoff safety speed V_2, in terms of calibrated air speed, shall be selected by the applicant so as to permit the gradient of climb required in § 4T.120(b), but it shall not be less than:

(1) The speed $V_{2\,min}$;

(2) The rotation speed V_R (see paragraph (e) of this section) plus the increment in speed attained prior to reaching a height of 35 feet above the takeoff surface in compliance with § 4T.116(e).

(d) The minimum unstick speed V_{MU}, in terms of calibrated air speed, shall be the speed at and above which the airplane can be made to lift off the ground and to continue the takeoff without displaying any hazardous characteristics. V_{MU} speeds shall be selected by the applicant for the all-engines-operating and the one-engine-inoperative conditions. It shall be acceptable to establish the V_{MU} speeds from free air data: *Provided,* That these data are verified by ground takeoff tests.

NOTE: In certain cases, ground takeoff tests might involve some takeoffs at the V_{MU} speeds.

(e) The rotation speed V_R, in terms of calibrated air speed, shall be selected by the applicant in compliance with the conditions of subparagraphs (1) through (4) of this paragraph.

(1) The V_R speed shall not be less than:

(i) The speed V_1;

(ii) A speed equal to 105 percent of V_{MC};

(iii) A speed which permits the attainment of the speed V_2 prior to reaching a height of 35 feet above the takeoff surface as determined in accordance with § 4T.116(e);

(iv) A speed which, if the airplane is rotated at its maximum practicable rate, will result in a lift-off speed V_{LOF} (see paragraph (f) of this section) not less than 110 percent of V_{MU} in the all-engines-operating condition nor less than 105 percent of V_{MU} in the one-engine-inoperative condition.

(2) For any given set of conditions (weight, configuration, temperature, etc.), a single value of V_R speed obtained in accordance with this paragraph shall be used in showing compliance with both the one-engine-inoperative and the all-engines-operating takeoff provisions.

(3) It shall be shown that the one-engine-inoperative takeoff distance determined with a rotation speed 5 knots less than the V_R speed established in accordance with subparagraphs (1) and (2) of this paragraph does not exceed the corresponding one-engine-inoperative takeoff distance determined with the established V_R speed. The determination of the takeoff distances shall be in accordance with § 4T.117(a)(1).

(4) It shall be demonstrated that reasonably expected variations in service from the takeoff procedures established by the applicant for the operation of the airplane (see § 4T.111(c)) (e.g. over-rotation of the airplane, out of trim conditions), will not result in unsafe flight characteristics nor in marked increases in the scheduled takeoff distances established in accordance with § 4T.117(a).

(f) The lift-off speed V_{LOF}, in terms of calibrated air speed, shall be the speed at which the airplane first becomes airborne.

4T.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 in service, and that exceptional skill is not required to control the airplane.

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

(d) If the accelerate-stop distance is intended to include a stopway with surface characteristics substantially different from those of a smooth hard-surfaced runway, the takeoff data shall include operational correction factors for the accelerate-stop distance to account for the particular surface characteristics of the stopway and the variations in such characteristics with seasonal weather conditions (i.e., temperature, rain, snow, ice, etc.), within the operational limits established by the applicant.

4T.116 *Takeoff path.* The takeoff path shall be considered to extend from the standing start to a point in the takeoff where a height of 1,500 feet above the takeoff surface is reached or to a point in the takeoff where the transition from the takeoff to the en route configuration is completed and a speed is reached at which compliance with § 4T.120 (c) is shown, whichever point is at a higher altitude. The conditions of paragraphs (a) through (i) of this section shall apply in determining the takeoff path.

(a) The takeoff path shall be based upon procedures prescribed in accordance with § 4T.111(c).

(b) The airplane shall be accelerated on the ground to the speed V_1 at which point the critical engine shall be made inoperative and shall remain inoperative during the remainder of the takeoff. Subsequent to attaining speed V_1, the airplane shall be accelerated to speed V_2 during which time it shall be permissible to initiate raising the nose gear off the ground at a speed not less than the rotation speed V_R.

(c) Landing gear retraction shall not be initiated until the airplane becomes airborne.

(d) The slope of the airborne portion of the takeoff path shall be positive at all points.

(e) The airplane shall attain the speed V_2 prior to reaching a height of 35 feet above the takeoff surface and shall continue at a speed as close as practical to, but not less than, V_2 until a height of 400 feet above the takeoff surface is reached.

(f) Except for gear retraction and propeller feathering, the airplane configuration shall not be changed before reaching a height of 400 feet above the takeoff surface.

(g) At all points along the takeoff path starting at the point where the airplane first reaches a height of 400 feet above the takeoff surface, the available gradient of climb shall not be less than 1.2 percent for two-engine airplanes, 1.5 percent for three-engine airplanes, and 1.7 percent for four-engine airplanes.

(h) The takeoff path shall be determined either by a continuous demonstrated takeoff, or alternatively, by synthesizing from segments the complete takeoff path.

(i) If the takeoff path is determined by the segmental method, the provisions of subparagraphs (1) through (4) of this paragraph shall be specifically applicable.

(1) The segments of a segmental takeoff path shall be clearly defined and shall be related to the distinct changes in the configuration of the airplane, in power and/or thrust, and in speed.

(2) The weight of the airplane, the configuration, and the power and/or thrust shall be constant throughout each segment and shall correspond with the most critical condition prevailing in the particular segment.

(3) The segmental flight path shall be based on the airplane's performance without ground effect.

(4) Segmental takeoff path data shall be checked by continuous demonstrated takeoffs up to the point where the airplane's performance is out of ground effect and the airplane's speed is stabilized, to ensure that the segmental path is conservative relative to the continuous path.

NOTE: The airplane usually is considered out of ground effect when it reaches a height above the ground equal to the airplane's wing span.

4T.117 *Takeoff distance and takeoff run.* (a) *Takeoff distance.* The takeoff distance shall be the greater of the distances established in accordance with subparagraphs (1) and (2) of this paragraph.

(1) The horizontal distance along the takeoff path from the start of the takeoff to the point where the airplane attains a height of 35 feet above the takeoff surface, as determined in accordance with § 4T.116.

(2) A distance equal to 115 percent of the horizontal distance along the takeoff path, with all engines operating, from the start of the takeoff to the point where the airplane attains a height of 35 feet above the takeoff surface, as determined by a procedure con-

sistent with that established in accordance with § 4T.116.

(b) *Takeoff run.* If the takeoff distance is intended to include a clearway (see item 5 of this regulation), the takeoff run shall be determined and shall be the greater of the distances established in accordance with subparagraphs (1) and (2) of this paragraph.

(1) The horizontal distance along the takeoff path from the start of the takeoff to a point equidistant between the point where the speed V_{LOF} is reached and the point where the airplane attains a height of 35 feet above the takeoff surface, as determined in accordance with § 4T.116.

(2) A distance equal to 115 percent of the horizontal distance along the takeoff path, with all engines operating, from the start of the takeoff to a point equidistant between the point where the speed V_{LOF} is reached and the point where the airplane attains a height of 35 feet above the takeoff surface, as determined by a procedure consistent with that established in accordance with § 4T.116.

4T.117a *Takeoff flight path.* (a) The takeoff flight path shall be considered to begin at a height of 35 feet above the takeoff surface at the end of the takeoff distance as determined in accordance with § 4T.117(a).

(b) The net takeoff flight path data shall be determined in such a manner that they represent the airplane's actual takeoff flight paths, determined in accordance with § 4T.116 and with paragraph (a) of this section, reduced at each point by a gradient of climb equal to 0.8 percent for two-engine airplanes, equal to 0.9 percent for three-engine airplanes and equal to 1.0 percent for four-engine airplanes. It shall be acceptable to apply the prescribed reduction in climb gradient as an equivalent reduction in the airplane's acceleration along that portion of the actual takeoff flight path where the airplane is accelerated in level flight.

4T.118 *Climb; general.* Compliance shall be shown with the climb requirements of §§ 4T.119 and 4T.120 at all weights, altitudes, and ambient temperatures, within the operational limits established by the applicant for the airplane. The airplane's center of gravity shall be in the most unfavorable position corresponding with the applicable configuration.

4T.119 *All-engine-operating landing climb.* In the landing configuration the steady gradient of climb shall not be less than 3.2 percent, with:

(a) All engines operating at the power and/or thrust which are available 8 seconds after initiation of movement of the power and/or thrust controls from the minimum flight idle to the takeoff position;

(b) A climb speed not in excess of 1.3 V_s.

4T.120 *One-engine-inoperative climb.* (a) *Takeoff; landing gear extended.* In the critical takeoff configuration existing along the flight path between the points where the airplane reaches the speed V_{LOF} and where the landing gear is fully retracted, in accordance with § 4T.116 but without ground effect, the steady gradient of climb shall be positive for two-engine airplanes and shall not be less than 0.3 percent for three-engine airplanes, and not less than 0.5 percent for four-engine airplanes, with:

(1) The critical engine inoperative, the remaining engine(s) operating at the available takeoff power and/or thrust existing in accordance with § 4T.116 at the time retraction of the airplane's landing gear is initiated, unless subsequently a more critical power operating condition exists along the flight path prior to the point where the landing gear is fully retracted;

(2) The weight equal to the airplane's weight existing in accordance with § 4T.116 at the time retraction of the airplane's landing gear is initiated;

(3) The speed equal to the speed V_{LOF}.

(b) *Takeoff; landing gear retracted.* In the takeoff configuration existing at the point of the flight path where the airplane's landing gear is fully retracted, in accordance with § 4T.116 but without ground effect, the steady gradient of climb shall not be less than 2.4 percent for two-engine airplanes, not less than 2.7 percent for three-engine airplanes, and not less than 3.0 percent for four-engine airplanes, with:

(1) The critical engine inoperative, the remaining engine(s) operating at the available takeoff power and/or thrust existing in accordance with § 4T.116 at the time the landing gear is fully retracted, unless subsequently a more critical power operating condition exists along the flight path prior to the point where a height of 400 feet above the takeoff surface is reached;

(2) The weight equal to the airplane's weight existing in accordance with § 4T.116 at the time the airplane's landing gear is fully retracted;

(3) The speed equal to the speed V_2.

(c) *Final takeoff.* In the en route configuration, the steady gradient of climb shall not be less than 1.2 percent for two-engine airplanes, not less than 1.5 percent for three-engine airplanes, and not less than 1.7 percent for four-engine airplanes, at the end of the takeoff path as determined by § 4T.116, with:

(1) The critical engine inoperative, the remaining engine(s) operating at the available maximum continuous power and/or thrust;

(2) The weight equal to the airplane's weight existing in accordance with § 4T.116 at the end of the takeoff path.

(3) The speed equal to not less than 1.25 V_s.

(d) *Approach.* In the approach configuration corresponding with the normal all-engines-operating procedure such that V_s related to this configuration does not exceed 110 percent of the V_s corresponding with the related landing configuration, the steady gradient of climb shall not be less than 2.1 percent for two-engine airplanes, not less than 2.4 percent for three-engine airplanes,

and not less than 2.7 percent for four-engine airplanes with:

(1) The critical engine inoperative, the remaining engine(s) operating at the available takeoff power and/or thrust;

(2) The weight equal to the maximum landing weight;

(3) A climb speed established by the applicant in connection with normal landing procedures, except that it shall not exceed 1.5 V_s (see § 4T.111(c)).

4T.121 *En route flight paths.* With the airplane in the en route configuration, the flight paths prescribed in paragraphs (a) and (b) of this section shall be determined at all weights, altitudes, and ambient temperatures, within the operational limits established by the applicant for the airplane.

(a) *One engine inoperative.* The one-engine-inoperative net flight path data shall be determined in such a manner that they represent the airplane's actual climb performance diminished by a gradient of climb equal to 1.1 percent for two-engine airplanes, 1.4 percent for three-engine airplanes, and 1.6 percent for four-engine airplanes. It shall be acceptable to include in these data the variation of the airplane's weight along the flight path to take into account the progressive consumption of fuel and oil by the operating engine(s).

(b) *Two engines inoperative.* For airplanes with three or four engines, the two-engine-inoperative net flight path data shall be determined in such a manner that they represent the airplane's actual climb performance diminished by a gradient of climb equal to 0.3 percent for three-engine airplanes and equal to 0.5 percent for four-engine airplanes. It shall be acceptable to include in these data the variation of the airplane's weight along the flight path to take into account the progressive consumption of fuel and oil by the operating engines.

(c) *Conditions.* In determining the flight paths prescribed in paragraphs (a) and (b) of this section, the conditions of subparagraphs (1) through (4) of this paragraph shall apply.

(1) The airplane's center of gravity shall be in the most unfavorable position.

(2) The critical engine(s) shall be inoperative, the remaining engine(s) operating at the available maximum continuous power and/or thrust.

(3) Means for controlling the engine cooling air supply shall be in the position which provides adequate cooling in the hot-day condition.

(4) The speed shall be selected by the applicant.

4T.122 *Landing distance.* The landing distance shall be the horizontal distance required to land and to come to a complete stop (to a speed of approximately 3 knots in the case of seaplanes or float planes) from a point at a height of 50 feet above the landing surface. Landing distances shall be determined for standard temperatures at all weights, altitudes, and winds, within the operational limits established by the applicant for the airplane. The conditions of paragraphs (a) through (g) of this section shall apply.

(a) The airplane shall be in the landing configuration. During the landing, changes in the airplane's configuration, in power and/or thrust, and in speed shall be in accordance with procedures established by the applicant for the operation of the airplane in service. The procedures shall comply with the provisions of § 4T.111(c).

(b) The landing shall be preceded by a steady gliding approach down to the 50-foot height with a calibrated air speed of not less than 1.3 V_s.

(c) The landing distance shall be based on a smooth, dry, hard-surfaced runway, and shall be determined in such a manner that reproduction does not require exceptional skill or alertness on the part of the pilot. In the case of seaplanes or floatplanes, the landing surface shall be smooth water, while for skiplanes it shall be smooth, dry snow. During landing, the airplane shall not exhibit excessive vertical acceleration, a tendency to bounce, nose over, ground loop, porpoise, or water loop.

(d) The landing distance data shall include operational correction factors for not more than 50 percent of nominal wind components along the landing path opposite to the direction of landing and not less than 150 percent of nominal wind components along the landing path in the direction of landing.

(e) During landing, the operating pressures on the wheel braking system shall not be in excess of those approved by the manufacturer of the brakes, and the wheel brakes shall not be used in such a manner as to produce excessive wear of brakes and tires.

(f) In addition to, or in lieu of, wheel brakes, the use of other braking means shall be acceptable in determining the landing distance, provided 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 in service, and that exceptional skill is not required to control the airplane.

(g) If the characteristics of a device (e.g., the propellers) dependent upon the operation of any of the engines noticeably increase the landing distance when the landing is made with the engine inoperative, the landing distance shall be determined with the critical engine inoperative unless the Administrator finds that the use of compensating means will result in a landing distance not greater than that attained with all engines operating.

4T.123 *Limitations and information.* (a) *Limitations.* The performance limitations on the operation of the airplane shall be established in accordance with subparagraph (1) through (4) of this paragraph. (See also § 4T.743.)

(1) *Takeoff weights.* The maximum takeoff weights shall be established at which com-

pliance is shown with the generally applicable provisions of this regulation and with the takeoff climb provisions prescribed in § 4T.120 (a), (b), and (c) for altitudes and ambient temperatures, within the operational limits of the airplane (see subparagraph (4) of this paragraph).

(2) *Landing weights.* The maximum landing weights shall be established at which compliance is shown with the generally applicable provisions of this regulation and with the landing and takeoff climb provisions prescribed in §§ 4T.119 and 4T.120 for altitudes and ambient temperatures, within the operational limits of the airplane (see subparagraph (4) of this paragraph).

(3) *Accelerate-stop distance, takeoff distance, and takeoff run.* The minimum distances required for takeoff shall be established at which compliance is shown with the generally applicable provisions of this regulation and with §§ 4T.115 and 4T.117(a), and with 4T.117(b) if the takeoff distance is intended to include a clearway, for weights, altitudes, temperatures, wind components, and runway gradients, within the operational limits of the airplane (see subparagraph (4) of this paragraph).

(4) *Operational limits.* The operational limits of the airplane shall be established by the applicant for all variable factors required in showing compliance with this regulation (weight, altitude, temperature, etc.). (See §§ 4T.113 (a)(1) and (b), 4T.115(d), 4T.118, 4T.121, and 4T.122.)

(b) *Information.* The performance information on the operation of the airplane shall be scheduled in compliance with the generally applicable provisions of this regulation and with §§ 4T.117a(b), 4T.121, and 4T.122 for weights, altitudes, temperatures, wind components, and runway gradients, as these may be applicable, within the operational limits of the airplane (see subparagraph (a)(4) of this section). In addition, the performance information specified in subparagraphs (1) through (3) of this paragraph shall be determined by extrapolation and scheduled for the ranges of weights between the maximum landing and maximum takeoff weights established in accordance with subparagraphs (a)(1) and (a)(2) of this section. (See also § 4T.743.)

(1) Climb in the landing configuration (see § 4T.119);

(2) Climb in the approach configuration (see § 4T.120(d));

(3) Landing distance (see § 4T.122).

AIRPLANE FLIGHT MANUAL

4T.743 *Performance limitations, information, and other data.*—(a) *Limitations.* The airplane's performance limitations shall be given in accordance with § 4T.123(a).

(b) *Information.* The performance information prescribed in § 4T.123(b) for the application of the operating rules of this regulation shall be given together with descriptions of the conditions, air speeds, etc., under which the data were determined.

(c) *Procedures.* Procedures established in accordance with § 4T.111(c) shall be given to the extent such procedures are related to the limitations and information set forth in accordance with paragraphs (a) and (b) of this section. Such procedures, in the form of guidance material, shall be included with the relevant limitations or information, as applicable.

(d) *Miscellaneous.* An explanation shall be given of significant or unusual flight or ground handling characteristics of the airplane.

3. In lieu of §§ 40.70 through 40.78, 41.27 through 41.36(d), and 42.70 through 42.83, of Parts 40, 41, and 42, respectively, of the Civil Air Regulations, the following shall be applicable:

OPERATING RULES

40T.80 *Transport category airplane operating limitations.* (a) In operating any passenger-carrying transport category airplane certificated in accordance with the performance requirements of this regulation, the provisions of §§ 40T.80 through 40T.84 shall be complied with, unless deviations therefrom are specifically authorized by the Administrator on the ground that the special circumstances of a particular case make a literal observance of the requirements unnecessary for safety.

(b) The performance data in the Airplane Flight Manual shall be applied in determining compliance with the provisions of §§ 40T.81 through 40T.84. Where conditions differ from those for which specific tests were made, compliance shall be determined by approved interpolation or computation of the effects of changes in the specific variables if such interpolations or computations give results substantially equalling in accuracy the results of a direct test.

40T.81 *Airplane's certificate limitations.* (a) No airplane shall be taken off at a weight which exceeds the takeoff weight specified in the Airplane Flight Manual for the elevation of the airport and for the ambient temperature existing at the time of the takeoff. (See §§ 4T.123(a)(1) and 4T.743(a).)

(b) No airplane shall be taken off at a weight such that, allowing for normal consumption of fuel and oil in flight to the airport of destination and to the alternate airports, the weight on arrival will exceed the landing weight specified in the Airplane Flight Manual for the elevation of each of the airports involved and for the ambient temperatures anticipated at the time of landing. (See §§ 4T.123(a)(2) and 4T.743(a).)

(c) No airplane shall be taken off at a weight which exceeds the weight at which, in accordance with the minimum distances for takeoff scheduled in the Airplane Flight Manual, compliance with subparagraphs (1) through (3) of this paragraph is shown. These distances shall correspond with the elevation of the airport, the runway to be used, the effective runway gradient, and the ambient temperature and wind component

existing at the time of takeoff. (See §§ 4T.123 (a)(3) and 4T.743(a).)

(1) The accelerate-stop distance shall not be greater than the length of the runway plus the length of the stopway if present.

(2) The takeoff distance shall not be greater than the length of the runway plus the length of the clearway if present, except that the length of the clearway shall not be greater than one-half of the length of the runway.

(3) The takeoff run shall not be greater than the length of the runway.

(d) No airplane shall be operated outside the operational limits specified in the Airplane Flight Manual. (See §§ 4T.123(a)(4) and 4T.743(a).)

40T.82 *Takeoff obstacle clearance limitations.* No airplane shall be taken off at a weight in excess of that shown in the Airplane Flight Manual to correspond with a net takeoff flight path which clears all obstacles either by at least a height of 35 feet vertically or by at least 200 feet horizontally within the airport boundaries and by at least 300 feet horizontally after passing beyond the boundaries. In determining the allowable deviation of the net takeoff flight path in order to avoid obstacles by at least the distances prescribed, it shall be assumed that the airplane is not banked before reaching a height of 50 feet as shown by the net takeoff flight path data in the Airplane Flight Manual, and that a maximum bank thereafter does not exceed 15 degrees. The net takeoff flight path considered shall be for the elevation of the airport, the effective runway gradient, and for the ambient temperature and wind component existing at the time of takeoff. (See §§ 4T.123(b) and 4T.743(b).)

40T.83 *En route limitations.* All airplanes shall be operated in compliance with paragraph (a) of this section. In addition, no airplane shall be flown along an intended route if any place along the route is more than 90 minutes away from an airport at which a landing can be made in accordance with § 40T.84(b), assuming all engines to be operating at cruising power, unless compliance is shown with paragraph (b) of this section.

(a) *One engine inoperative.* No airplane shall be taken off at a weight in excess of that which, according to the one-engine-inoperative en route net flight path data shown in the Airplane Flight Manual, will permit compliance with either subparagraphs (1) or (2) of this paragraph at all points along the route. The net flight path shall have a positive slope at 1,500 feet above the airport where the landing is assumed to be made after the engine fails. The net flight path used shall be for the ambient temperatures anticipated along the route. (See §§ 4T.123(b) and 4T.743(b).)

(1) The slope of the net flight path shall be positive at an altitude of at least 1,000 feet above all terrain and obstructions along the route within 5 statute miles (4.34 nautical miles) on either side of the intended track.

(2) The net flight path shall be such as to permit the airplane to continue flight from the cruising altitude to an airport where a landing can be made in accordance with the provisions of § 40T.84(b), the net flight path clearing vertically by at least 2,000 feet all terrain and obstructions along the route within 5 statute miles (4.34 nautical miles) on either side of the intended track. The provisions of subdivisions (i) through (vi) of this subparagraph shall apply.

(i) The engine shall be assumed to fail at the most critical point along the route.

(ii) The airplane shall be assumed to pass over the critical obstruction following engine failure at a point no closer to the critical obstruction than the nearest approved radio navigational fix, except that the Administrator may authorize a procedure established on a different basis where adequate operational safeguards are found to exist.

(iii) An approved method shall be used to account for winds which would otherwise adversely affect the flight path.

(iv) Fuel jettisoning shall be permitted if the Administrator finds that the operator has an adequate training program, proper instructions are given to the flight crew, and all other precautions are taken to ensure a safe procedure.

(v) The alternate airport shall be specified in the dispatch release and shall meet the prescribed weather minima.

(vi) The consumption of fuel and oil after the engine is assumed to fail shall be that which is accounted for in the net flight path data shown in the Airplane Flight Manual.

(b) *Two engines inoperative.* No airplane shall be taken off at a weight in excess of that which, according to the two-engine-inoperative en route net flight path data shown in the Airplane Flight Manual, will permit the airplane to continue flight from the point where two engines are assumed to fail simultaneously to an airport where a landing can be made in accordance with the provisions of § 40T.84(b), the net flight path clearing vertically by at least 2,000 feet all terrain and obstructions along the route within 5 statute miles (4.34 nautical miles) on either side of the intended track. The net flight path considered shall be for the ambient temperatures anticipated along the route. The provisions of subparagraphs (1) through (5) of this paragraph shall apply. (See §§ 4T.123(b) and 4T.734(b).)

(1) The two engines shall be assumed to fail at the most critical point along the route.

(2) The net flight path shall have a positive slope at 1,500 feet above the airport where the landing is assumed to be made after failure of two engines.

(3) Fuel jettisoning shall be permitted if the Administrator finds that the operator has an adequate training program, proper instructions are given to the flight crew, and all other precautions are taken to ensure a safe procedure.

(4) The airplane's weight at the point where the two engines are assumed to fail shall be considered to be not less than that which would include sufficient fuel to proceed to the airport and to arrive there at an altitude of at least 1,500 feet directly over the landing area and thereafter to fly for 15 minutes at cruise power and/or thrust.

(5) The consumption of fuel and oil after the engines are assumed to fail shall be that which is accounted for in the net flight path data shown in the Airplane Flight Manual.

40T.84 *Landing limitations*—(a) *Airport of destination.* No airplane shall be taken off at a weight in excess of that which, in accordance with the landing distances shown in the Airplane Flight Manual for the elevation of the airport of intended destination and for the wind conditions anticipated there at the time of landing, would permit the airplane to be brought to rest at the airport of intended destination within 60 percent of the effective length of the runway from a point 50 feet directly above the intersection of the obstruction clearance plane and the runway. The weight of the airplane shall be assumed to be reduced by the weight of the fuel and oil expected to be consumed in flight to the airport of intended destination. Compliance shall be shown with the conditions of subparagraphs (1) and (2) of this paragraph. (See §§ 4T.123(b) and 4T.743(b).)

(1) It shall be assumed that the airplane is landed on the most favorable runway and direction in still air.

(2) It shall be assumed that the airplane is landed on the most suitable runway considering the probable wind velocity and direction and taking due account of the ground handling characteristics of the airplane and of other conditions (i.e., landing aids, terrain, etc.) If full compliance with the provisions of this subparagraph is not shown, the airplane may be taken off if an alternate airport is designated which permits compliance with paragraph (b) of this section.

(b) *Alternate airport.* No airport shall be designated as an alternate airport in a dispatch release unless the airplane at the weight anticipated at the time of arrival at such airport can comply with the provisions of paragraph (a) of this section, provided that the airplane can be brought to rest within 70 percent of the effective length of the runway.

4. [Deleted] (See § 91.37 [New] of this chapter.)

5. The following definitions shall apply:

(a) *Clearway.* A clearway is an area beyond the runway, not less than 500 feet wide, centrally located about the extended center line of the runway, and under the control of the airport authorities. The clearway is expressed in terms of a clearway plane, extending from the end of the runway with an upward slope not exceeding 1.25 percent, above which no object nor any portion of the terrain protrudes, except that threshold lights may protrude above the plane if their height above the end of the runway is not greater than 26 inches and if they are located to each side of the runway.

NOTE: For the purpose of establishing takeoff distances and takeoff runs, in accordance with § 4T.117 of this regulation, the clearway plane is considered to be the takeoff surface.

(b) *Stopway.* A stopway is an area beyond the runway, not less in width than the width of the runway, centrally located about the extended center line of the runway, and designated by the airport authorities for use in decelerating the airplane during an aborted takeoff. To be considered as such, a stopway must be capable of supporting the airplane during an aborted takeoff without inducing structural damage to the airplane. (See also § 4T.115(d) of this regulation.)

(Secs. 313(a), 601, 603, 604, 72 Stat. 752, 775, 776, 778; 49 U.S.C. 1354(a), 1421, 1423, 1424) [24 F.R. 5630, July 14, 1959; 24 F.R. 5688, July 15, 1959, as amended by Amdt. 1, 27 F.R. 12400, Dec. 14, 1962; Amdt. 2, 27 F.R. 12926, Dec. 29, 1962; Doc. No. 1580, Amdt. 1-1, 28 F.R. 6703, June 29, 1963]

SR-450A

Contrary provisions of the Civil Air Regulations notwithstanding, the following requirements shall be applicable to transport category airplanes certificated under the provisions of Part 4b in effect prior to May 3, 1962:

1. *Turbine-powered airplanes.* (a) On or before March 1, 1963: (1) The airspeed operating limitations in the Airplane Flight Manual shall be revised by deleting the term "normal operating limit speed" and the corresponding symbols "V_{NO}/M_{NO}", together with statements explaining the significance of this term, and inserting in lieu thereof the term "maximum operating limit speed", the corresponding symbols "V_{MO}/M_{MO}", and the following statement explaining the significance of the new term:

The maximum operating limit speed shall not be deliberately exceeded in any regime of flight (climb, cruise, or descent), except where a higher speed is specifically authorized for flight test or pilot training operations, or in approved emergency procedures.

(2) Airspeed placards and instrument markings shall be consistent with subparagraph (1) of this paragraph. Where color markings are used on airspeed or Mach indicators, the red radial line shall be at V_{MO}/M_{MO}. Where a maximum allowable airspeed indicator is used, the limit hand shall indicate V_{MO}/M_{MO}.

(b) On or before February 1, 1964, each airplane shall be equipped with a speed warning device which shall provide aural warning to the pilots, which is distinctly different from aural warnings used for other purposes, whenever the speed exceeds V_{MO} plus 6 knots or $M_{MO}+0.01$. The upper limit of the production tolerances permitted for the warning device shall be at a speed not greater than the prescribed warning speed.

2. *Reciprocation engine-powered airplanes.* On or before March 1, 1963, the airspeed operating limitations in the Airplane Flight Manual shall be revised as necessary to state that the normal operating limit speed, or the maximum structural cruising speed (whichever term is used in the particular manual), shall not be deliberately exceeded in any regime of flight (climb, cruise, or descent), except where a higher speed is specifically authorized for flight test or pilot training operations, or in approved emergency procedures.

This regulation supersedes Special Civil Air Regulation No. SR-450.

(Secs. 313(a), 601, 603, 604; 72 Stat. 752, 775, 776, 778; 49 U.S.C. 1354, 1421, 1423, 1424) [27 F.R. 8760, Sept. 1, 1962]

CROSS REFERENCES: For Special Civil Air Regulation with respect to display of experimental exterior lighting systems approved for use on aircraft, see SR-392D in Part 3 of this subchapter.

For Special Civil Air Regulations establishing the basis for approval by the Administrator of modifications on individual DC-3 and L-18 airplanes, see SR-407 in Part 1 of this subchapter.

For Special Civil Air Regulation with respect to trial operation of transport category airplanes in cargo service at increased zero fuel and landing weights, see SR-411A in Part 4a of this subchapter.

For Special Civil Air Regulation with respect to Class I and Class II provisional type and airworthiness certificates for the operation of aircraft, see SR-425C in Part 1 of this subchapter.

For Special Civil Air Regulation with respect to performance credit for use of standby power on transport category airplanes, see SR-426 in Part 1 of this subchapter.

Subpart A—General

APPLICABILITY AND DEFINITIONS

§ 4b.0 Applicability of this part.

This part establishes standards with which compliance shall be demonstrated for the issuance of and changes to type certificates for transport category airplanes. This part, until superseded or rescinded, shall apply to all transport category airplanes for which applications for type certification in the transport category are made after the effective date of this part (November 9, 1945).

[15 F. R. 3543, June 8, 1950, as amended by Amdt. 4b-1, 19 F. R. 2249, April 20, 1954]

§ 4b.1 Definitions.

As used in this part terms are defined as follows:

(a) *Administration*—(1) *Administrator.* The Administrator is the Administrator of the Federal Aviation Agency.

(2) *Applicant.* An applicant is a person or persons applying for approval of an airplane or any part thereof.

(3) *Approved.* Approved, when used alone or as modifying terms such as means, devices, specifications, etc., shall mean approved by the Administrator. (See § 4b.18.)

(b) *General design*—(1) *Standard atmosphere.* The standard atmosphere is an atmosphere (see NACA Technical Report 1235) defined as follows:

(i) The air is a dry, perfect gas,

(ii) The temperature at sea level is 59° F.,

(iii) The pressure at sea level is 29.92 inches Hg,

(iv) The temperature gradient from sea level to the altitude at which the temperature equals −69.7° F. is −0.003566° F./ft. and zero thereabove,

(v) The density ρ_o at sea level under the above conditions is 0.002377 pounds sec.^{2}/ft.^{4}.

(2) *Maximum ambient atmospheric temperature.* The maximum ambient atmospheric temperature is the temperature selected by the applicant as the maximum operational limit.

(3) *Airplane configuration.* Airplane configuration is a term referring to the position of the various elements affecting the aerodynamic characteristics of the airplane (e. g., wing flaps, landing gear).

(4) *Aerodynamic coefficients.* Aerodynamic coefficients are nondimensional coefficients for forces and moments. They correspond with those adopted by the National Aeronautics and Space Administration (formerly the National Advisory Committee for Aeronautics).

(5) *Critical engine(s).* The critical engine is that engine(s) the failure of which gives the most adverse effect on the airplane flight characteristics relative to the case under consideration.

(6) *Critical-engine-failure speed.* The critical-engine-failure speed is the airplane speed used in the determination of the take-off at which the critical engine is assumed to fail. (See § 4b.114.)

(7) *Continuous maximum icing.* The maximum continuous intensity of atmospheric icing conditions is defined by

the variables of the cloud liquid water content, the mean effective diameter of the cloud droplets, the ambient air temperature, and the inter-relationship of these three variables as shown in Figure 4b–24a. The limiting icing envelope in terms of altitude and temperature is given in Figure 4b–24b. The inter-relationship of cloud liquid water content with drop diameter and altitude is determined from Figures 4b–24a and 4b–24b. The cloud liquid water content for continuous maximum icing conditions of a horizontal extent other than twenty miles is determined by the value of liquid water content of Figure 4b–24a multiplied by the appropriate factor from Figure 4b–24c. (See § 4b.640.)

(8) *Intermittent maximum icing.* The intermittent maximum intensity of atmospheric icing conditions is defined by the variables of the cloud liquid water content, the mean effective diameter of the cloud droplets, the ambient air temperature, and the inter-relationship of these three variables as shown in Figure 4b–25a. The limiting icing envelope in terms of altitude and temperature is given in Figure 4b–25b. The inter-relationship of cloud liquid water content with drop diameter and altitude is determined from Figures 4b–25a and 4b–25b. The cloud liquid water content for intermittent maximum icing conditions of a horizontal extent other than three miles is determined by the value of cloud liquid water content of Figure 4b–25a multiplied by the appropriate factor in Figure 4b–25c. (See § 4b.640.)

NOTE: There is some indication that the upper altitude limit might extend to 30,000 feet pressure altitude, and the lower limit of ambient temperature may be as low as −40° F. Because of this, the portions in this region of Figures 4b–25a and 4b–25b are shown by dashed lines.

(c) *Weights*—(1) *Maximum weight.* The maximum weight of the airplane is that maximum at which compliance with the requirements of this part is demonstrated. (See § 4b.101 (a).)

(2) *Minimum weight.* The minimum weight of the airplane is that minimum at which compliance with the requirements of this part is demonstrated. (See § 4b.101 (c).)

(3) *Empty weight.* The empty weight of the airplane is a readily reproducible weight which is used in the determination of the operating weights. (See § 4b.104.)

(4) *Design maximum weight.* The design maximum weight is the maximum weight of the airplane used in structural design for flight load conditions. (See § 4b.210.)

(5) *Design minimum weight.* The design minimum weight is the minimum weight of the airplane at which compliance is shown with the structural loading conditions. (See § 4b.210.)

(6) *Design take-off weight.* The design take-off weight is the maximum airplane weight used in structural design for taxying conditions, and for landing conditions at a reduced velocity of descent. (See § 4b.210.)

(7) *Design landing weight.* The design landing weight is the maximum airplane weight used in structural design for landing conditions at the maximum velocity of descent. (See § 4b.230 (b).)

(8) *Zero fuel weight.* The zero fuel weight is the design maximum weight of the airplane with no disposable fuel and oil.

(9) *Design unit weight.* The design unit weight is a representative weight used to show compliance with the structural design requirements.

(i) Gasoline 6 pounds per U. S. gallon.

(ii) Lubricating oil 7.5 pounds per U. S. gallon.

(iii) Crew and passengers 170 pounds per person.

(d) *Speeds*—(1) IAS: Indicated air speed is equal to the pitot static airspeed indicator reading as installed in the airplane without correction for airspeed indicator system errors but including the sea level standard adiabatic compressible flow correction. (This latter correction is included in the calibration of the air-speed instrument dials.) (See §§ 4b.612 (a) and 4b.710.)

(2) CAS: Calibrated air speed is equal to the air-speed indicator reading corrected for position and instrument error. (As a result of the sea level adiabatic compressible flow correction to the air-speed instrument dial, CAS is equal to the true air speed TAS in standard atmosphere at sea level.)

(3) EAS: Equivalent air speed is equal to the air-speed indicator reading corrected for position error, instrument error, and for adiabatic compressible flow for the particular altitude. (EAS is equal to CAS at sea level in standard atmosphere.)

(4) TAS: True air speed of the airplane relative to undisturbed air. (TAS=EAS $(\rho_0/\rho)^{1/2}$.)

(5) V_A: The design maneuvering speed. (See § 4b.210 (b) (2).)

(6) V_B: The design speed for maximum gust intensity. (See § 4b.210 (b) (3).)

(7) V_C: The design cruising speed. (See § 4b.210 (b) (4).)

(8) V_D: The design diving speed. (See § 4b.210 (b) (5).)

(9) V_{DF}/M_{DF}: The demonstrated flight diving speed at which compliance is shown with the applicable flight requirements. (See §§ 4b.190 and 4b.191(a).)

(10) V_F: The design flap speeds for flight loading conditions. (See § 4b.210 (b) (1).)

(11) V_{FE}: The flap extended speed is a maximum speed with wing flaps in a prescribed extended position. (See § 4b.714.)

(12) V_{LE}: The landing gear extended speed is the maximum speed at which the airplane can be flown safely with the landing gear extended. (See § 4b.716.)

(13) V_{LO}: The landing gear operating speed is a maximum speed at which the landing gear can be raised or lowered safely. (See § 4b.715.)

(14) V_{MC}: The minimum control speed with the critical engine inoperative. (See § 4b.133.)

(15) V_{FC}/M_{FC}: *The maximum speed for* stability characteristics. (See § 4b.191 (b).)

(16) V_{MO}/M_{MO}: The maximum operating limit speed. (See § 4b.711.)

(17) V_{s_0}: The stalling speed or the minimum steady flight speed with wing flaps in the landing position. (See §§ 4b.112 (a) and 4b.160.)

(18) V_{s_1}: The stalling speed or the minimum steady flight speed obtained in a specified configuration. (See § 4b.112 (b).)

(19) V_1: The critical-engine-failure speed. (See § 4b.114.)

(20) V_2: The take-off safety speed. (See § 4b.114 (b).)

(21) M : Mach number is the ratio of true airspeed to the speed of sound.

(e) *Structural*—(1) *Limit load.* A limit load is the maximum load anticipated in normal conditions of operation. (See § 4b.200.)

(2) *Ultimate load.* An ultimate load is a limit load multiplied by the appropriate factor of safety. (See § 4b.200.)

(3) *Factor of safety.* The factor of safety is a design factor used to provide for the possibility of loads greater than those anticipated in normal conditions of operation and for uncertainties in design. (See § 4b.200 (a).)

(4) *Load factor.* The load factor is the ratio of a specified load to the total weight of the airplane; the specified load may be expressed in terms of any of the following: aerodynamic forces, inertia forces, or ground or water reactions.

(5) *Limit load factor.* The limit load factor is the load factor corresponding with limit loads.

(6) *Ultimate load factor.* The ultimate load factor is the load factor corresponding with ultimate loads.

(7) *Checked pitching maneuver.* A checked pitching maneuver is one in which the pitching control is suddenly displaced in one direction and then suddenly moved in the opposite direction, the deflections and timing being such as to avoid exceeding the limit maneuvering load factor.

(8) *Design wing area.* The design wing area is the area enclosed by the wing outline (including wing flaps in the retracted position and ailerons, but excluding fillets or fairings) on a surface containing the wing chords. The outline is assumed to be extended through the nacelles and fuselage to the plane of symmetry in any reasonable manner.

(9) *Balancing tail load.* A balancing tail load is that load necessary to place the airplane in equilibrium with zero pitch acceleration.

(10) *Fitting.* A fitting is a part or terminal used to join one structural member to another. (See § 4b.307 (c).)

(f) *Powerplant installation*[1]—(1) *Brake horsepower.* Brake horsepower is the power delivered at the propeller shaft of the engine.

(2) *Take-off power or thrust.* (i) Take-off power for reciprocating engines is the brake horsepower developed under standard sea level conditions and under the maximum conditions of crankshaft rotational speed and engine manifold pressure approved for the normal take-off, and limited in use to a maximum continuous period as indicated in the approved engine specification.

(ii) Take-off power for turbine engines is the brake horsepower developed under static conditions at specified altitudes and atmospheric temperatures and under the maximum conditions of

[1] For engine airworthiness requirements see Part 13 of this subchapter; for propeller airworthiness requirements see Part 14 of this subchapter.

rotor shaft rotational speed and gas temperature approved for the normal take-off, and limited in use to a maximum continuous period as indicated in the approved engine specification.

(iii) Take-off thrust for turbine engines is the jet thrust developed under static conditions at specified altitudes and atmospheric temperatures and under the maximum conditions of rotor shaft rotational speed and gas temperature approved for the normal take-off, and limited in use to a maximum continuous period as indicated in the approved engine specification.

(3) *Maximum continuous power or thrust.* (i) Maximum continuous power for reciprocating engines is the brake horsepower developed in standard atmosphere at a specified altitude and under the maximum conditions of crankshaft rotational speed and engine manifold pressure, and approved for use during periods of unrestricted duration.

(ii) Maximum continuous power for turbine engines is the brake horsepower developed at specified altitudes, atmospheric temperatures, and flight speeds and under the maximum conditions of rotor shaft rotational speed and gas temperature, and approved for use during periods of unrestricted duration.

(iii) Maximum continuous thrust for turbine engines is the jet thrust developed at specified altitudes, atmospheric temperatures, and flight speeds and under the maximum conditions of rotor shaft rotational speed and gas temperature, and approved for use during periods of unrestricted duration.

(4) *Gas temperature.* Gas temperature for turbine engines is the temperature of the gas stream obtained as indicated in the approved engine specification.

(5) *Manifold pressure.* Manifold pressure is the absolute pressure measured at the appropriate point in the induction system, usually in inches of mercury.

(6) *Critical altitude.* The critical altitude is the maximum altitude at which in standard atmosphere it is possible to maintain, at a specified rotational speed, a specified power or a specified manifold pressure. Unless otherwise stated, the critical altitude is the maximum altitude at which it is possible to maintain, at the maximum continuous rotational speed, one of the following:

(i) The maximum continuous power, in the case of engines for which this power rating is the same at sea level and at the rated altitude,

(ii) The maximum continuous rated manifold pressure, in the case of engines the maximum continuous power of which is governed by a constant manifold pressure.

(7) *Pitch setting.* Pitch setting is the propeller blade setting determined by the blade angle measured in a manner, and at a radius, specified in the instruction manual for the propeller.

(8) *Feathered pitch.* Feathered pitch is the pitch setting which in flight, with the engines stopped, gives approximately the minimum drag and corresponds with a windmilling torque of approximately zero.

(9) *Reverse pitch.* Reverse pitch is the propeller pitch setting for any blade angle used beyond zero pitch (e. g., the negative angle used for reverse thrust).

(g) *Fire protection*—(1) *Fireproof.* Fireproof material means a material which will withstand heat at least as well as steel in dimensions appropriate for the purpose for which it is to be used. When applied to material and parts used to confine fires in designated fire zones, fireproof means that the material or part will perform this function under the most severe conditions of fire and duration likely to occur in such zones.

(2) *Fire-resistant.* When applied to sheet or structural members, fire-resistant material means a material which will withstand heat at least as well as aluminum alloy in dimensions appropriate for the purpose for which it is to be used. When applied to fluid-carrying lines, other flammable fluid system components, wiring, air ducts, fittings, and powerplant controls, this term refers to a line and fitting assembly, component, wiring or duct, or controls which will perform the intended functions under the heat and other conditions likely to occur at the particular location.

(3) *Flame-resistant.* Flame-resistant material means material which will not support combustion to the point of propagating, beyond safe limits, a flame after the removal of the ignition source.

(4) *Flash-resistant.* Flash-resistant material means material which will not burn violently when ignited.

(5) *Flammable.* Flammable pertains to those fluids or gases which will ignite readily or explode.

(h) *Miscellaneous*—(1) *Supplemental breathing equipment.* Supplemental breathing equipment is equipment designed to supply the supplementary oxygen required to protect against anoxia at altitudes where the partial pressure of oxygen in ambient air is reduced. (See § 4b.651.)

(2) *Protective breathing equipment.* Protective breathing equipment is equipment designed to prevent the breathing of noxious gases which might be present as contaminants in the air within the airplane in emergency situations. (See § 4b.651.)

[15 F. R. 3543, June 8, 1950, as amended by Amdt. 4b-6, 17 F. R. 1088, Feb. 5, 1952; Amdt. 4b-8, 18 F. R. 2214, Apr. 18, 1953; Amdt. 4b-2, 20 F.R. 5303, July 26, 1955; Amdt. 4b-6, 22 F.R. 5563, July 16, 1957; Amdt. 4b-8, 23 F.R. 2590, Apr. 19, 1958; Amdt. 4b-11, 24 F.R. 7068, Sept. 1, 1959; Amdt. 4b-12, 27 F.R. 2989, Mar. 30, 1962]

CERTIFICATION

§ 4b.10 Eligibility for type certificates.

An airplane shall be eligible for type certification under the provisions of this part if it complies with the airworthiness provisions established by this part or if the Administrator finds that the provision or provisions not complied with are compensated for by factors which provide an equivalent level of safety: *Provided,* That the Administrator finds no feature or characteristic of the airplane which renders it unsafe for the transport category.

[Amdt. 4b-6, 17 F. R. 1088, Feb. 5, 1952]

§ 4b.10-1 Approval of reverse thrust propellers (FAA policies which apply to § 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 § 4b.402-1, provided it has no feature or characteristic which renders its use unsafe in transport category airplanes.

[Supp. 25, 20 F. R. 2277, Apr. 8, 1955]

§ 4b.10-2 Approval of automatic propeller feathering installations (FAA policies which apply to § 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 § 4b.10 as providing an equivalent level of safety in showing compliance with §§ 4b.115, 4b.116, 4b.120 and 4b.133 if it complies with policies prescribed in §§ 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.

[Supp. 23, 19 F. R. 1817, Apr. 2, 1954]

§ 4b.10-3 Minimum quantity of anti-detonant fluid required (FAA policies which apply to § 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 § 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 §§ 4b.420-1 and 4b.718-1.

[Supp. 25, 20 F. R. 2277, Apr. 8, 1955]

§ 4b.11 Designation of applicable regulations.

The provisions of this section shall apply to all airplane types certificated under this part irrespective of the date of application for type certificate.

(a) Unless otherwise established by the Administrator, the airplane shall comply with the provisions of this part together with all amendments thereto effective on the date of application for type certificate, except that compliance with later amendments may be elected or required pursuant to paragraphs (c), (d), (e), and (f) of this section.

(b) If the interval between the date of application for type certificate and the issuance of the corresponding type certificate exceeds five years, a new application for type certificate shall be required, notwithstanding the applicant may have been issued a provisional type certificate, except that for applications pending on May 1, 1954, such five-year period shall commence on that date. At the option of the applicant, a new application may be filed prior to the expiration of the five-year period. In either instance the applicable regulations shall be those effective on the date of the new application in accordance with paragraph (a) of this section.

(c) During the interval between filing the application and the issuance of a type certificate, the applicant may elect to show compliance with any amendment of this part which becomes effective during that interval, in which case all other amendments found by the Administrator to be directly related shall be complied with.

(d) Except as otherwise provided by the Administrator pursuant to § 1.24 of this subchapter, a change to the type certificate (see § 4b.13 (b)) may be accomplished, at the option of the holder of the type certificate, either in accordance with the regulations incorporated by reference in the type certificate pursuant to § 4b.13 (c), or in accordance with subsequent amendments to such regulations in effect on the date of application for approval of the change, subject to the following provisions:

(1) When the applicant elects to show compliance with an amendment to the regulations in effect on the date of application for approval of a change, he shall show compliance with all amendments which the Administrator finds are directly related to the particular amendment selected by the applicant.

(2) When the change consists of a new design or a substantially complete redesign of a component, equipment installation, or system installation of the airplane, and the Administrator finds that the regulations incorporated by reference in the type certificate pursuant to § 4b.13 (c) do not provide complete standards with respect to such change, he shall require compliance with such provisions of the regulations in effect on the date of application for approval of the change as he finds will provide a level of safety equal to that established by the regulations incorporated by reference at the time of issuance of the type certificate.

NOTE: Examples of new or redesigned components and installations which might require compliance with regulations in effect on the date of application for approval, are: New powerplant installation which is likely to introduce additional fire or operational hazards unless additional protective measures are incorporated; the installation of an auto-pilot, a pressurization system, or a new electric power system.

(e) If changes listed in subparagraphs (1) through (3) of this paragraph are made, the airplane shall be considered as a new type, in which case a new application for type certificate shall be required and the regulations together with all amendments thereto effective on the date of the new application shall be made applicable in accordance with paragraphs (a), (b), (c), and (d) of this section

(1) A change in the number of engines;

(2) A change to engines employing different principles of propulsion;

(3) A change in design, configuration, power, or weight which the Administrator finds is so extensive as to require a substantially complete investigation of compliance with the regulations.

(f) Except as otherwise required by paragraph (e)(3) of this section compliance with the provisions of subparagraphs (1) and (2) of this paragraph is required for the type certification of a turbopropeller-powered airplane which was previously type certificated with the same number of reciprocating engines:

(1) The requirements of this part applicable to the airplane as type certificated with reciprocating engines and, in addition thereto or in lieu thereof as appropriate, the provisions of subdivisions (i) through (iv) of this subparagraph, effective on the date of application for type certification of the turbopropeller-powered airplane;

(i) The certification performance requirements prescribed in paragraph (2) of Special Civil Air Regulation No. SR-422B;

(ii) The powerplant requirements of this part applicable to the turboprop airplane;

(iii) The requirements of this part for the standardization of cockpit controls and instruments, except when a showing of compliance with a particular detailed requirement would be impractical and would not contribute materially to standardization; and

(iv) Such other requirements of this part applicable to the turboprop airplane which are found to be related to the changes in engines and which are necessary to insure a level of safety of the turboprop airplane equivalent to that established for the airplane certificated with reciprocating engines.

(2) If new limitations are established with respect to weight, speed, or altitude of operation, which are significantly altered from those approved for the airplane with reciprocating engines, compliance shall be shown with all of the requirements of this part, applicable to the specific limitations being changed, which are in effect on the date of application for type certification of the turbopropeller-powered airplane.

[Amdt. 4b-1, 19 F.R. 2249, Apr. 20, 1954, as amended at 19 F.R. 2532, May 1, 1954; Amdt. 4b-12, 27 F.R. 2989, Mar. 30, 1962; Amdt. 4b-13, 27 F.R. 12925, Dec. 29, 1962]

CROSS REFERENCE: For Special Civil Air Regulation with respect to type certification of transport category airplanes with turboprop replacements and applicable to § 4b.11 (e)(2), see SR-423, *supra*.

§ 4b.12 Recording of applicable regulations.

The Administrator, upon the issuance of a type certificate, shall record the applicable regulations with which compliance was demonstrated. Thereafter, the Administrator shall record the applicable regulations for each change in the type certificate which is accomplished in accordance with regulations other than those recorded at the time of issuance of the type certificate. (See § 4b.11.)

[Amdt. 4b-1, 19 F. R. 2249, Apr. 20, 1954]

§ 4b.13 Type certificate.

(a) An applicant shall be issued a type certificate when he demonstrates the eligibility of the airplane by complying with the requirements of this part in addition to the applicable requirements in Part 1 of this subchapter.

(b) The type certificate shall be deemed to include the type design (see § 4b.14 (b)), the operating limitations for the airplane (see § 4b.700), and any other conditions or limitations prescribed by the regulations in this subchapter.

(c) The applicable provisions of this part recorded by the Administrator in accordance with § 4b.12 shall be considered as incorporated in the type certificate as though set forth in full.

[Amdt. 4b-6, 17 F. R. 1088, Feb. 2, 1952, as amended by Amdt. 4b-1, 19 F. R. 2250, Apr. 20, 1954]

§ 4b.14 Data required.

(a) The applicant for a type certificate shall submit to the Administrator such descriptive data, test reports, and computations as are necessary to demonstrate that the airplane complies with the requirements of this part.

(b) The descriptive data required in paragraph (a) of this section shall be known as the type design and shall consist of such drawings and specifications as are necessary to disclose the configuration of the airplane and all the design features covered in the requirements of this part, such information on dimensions, materials, and processes as is necessary to define the structural strength of the airplane, and such other data as are necessary to permit by comparison the determination of the airworthiness of subsequent airplanes of the same type.

[Amdt. 4b-6, 17 F. R. 1088, Feb. 5, 1952]

§ 4b.15 Inspections and tests.

Inspections and tests shall include all those found necessary by the Administrator to insure that the airplane complies with the applicable airworthiness requirements and conforms to the following:

(a) All materials and products are in accordance with the specifications in the type design,

(b) All parts of the airplane are constructed in accordance with the drawings in the type design,

(c) All manufacturing processes, construction, and assembly are as specified in the type design.

[Amdt. 4b-6, 17 F. R. 1088, Feb. 5, 1952, as amended by Amdt. 4b-8, 18 F. R. 2214, Apr. 18, 1953]

§ 4b.16 Flight tests.

After proof of compliance with the structural requirements contained in this part, and upon completion of all necessary inspections and testing on the ground, and proof of the conformity of the airplane with the type design, and upon receipt from the applicant of a report of flight tests performed by him, the following shall be conducted:

(a) Such official flight tests as the Administrator finds necessary to determine compliance with the requirements of this part.

(b) After the conclusion of flight tests specified in paragraph (a) of this section, such additional flight tests as the Administrator finds necessary to ascertain whether there is reasonable assurance that the airplane, its components, and equipment are reliable and function properly. The extent of such additional flight tests shall depend upon the complexity of the airplane, the number and nature of new design features, and the record of previous tests and experience for the particular airplane type, its components, and equipment. If practicable, these flight tests shall be conducted on the same airplane used in the flight tests specified in paragraph (a) of this section.

[Amdt. 4b-6, 17 F. R. 1088, Feb. 5, 1952]

§ 4b.16-1 Applicant's flight test report (FAA policies which apply to § 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.

[Supp. 24, 19 F. R. 4446, July 20, 1954]

§ 4b.16-2 Pre-flight test planning (FAA policies which apply to § 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 FAA a proposed flight test program which will indicate at least the following:

(1) The area, defined by the several selections described in § 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[1] presents a list of most of the flight and operation tests generally required for the type certification program together with information relative to the airplane 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 FAA 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 FAA with the reasons for selecting the pertinent items. Appendix B[1] 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 proposes 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 FAA 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 C[1] shows a general arrangement that may be of assistance to those applicants who are not familiar with the FAA flight test procedures. Tests which

[1] Not submitted for publication in the FEDERAL REGISTER.

are particularly important in the early stages of the program are:

(1) *Air-speed calibration.* All tests involving air speed 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 take-off.* The take-off 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[1] 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 take-off and landing tests which usually require ground equipment to record horizontal distance, height, and time. Ground calibration of the air-speed indicating system can be accomplished at the same time. The FAA possesses certain instruments which may be used for obtaining test data, such as trailing air-speed bombs, sensitive altimeters, stop watches, carbon monoxide indicators, etc., as well as photographic equipment for measuring take-off and flight landing paths. It is therefore recommended that the matter of instrumentation be discussed with the FAA 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.[1]

(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 take-off data, fall in this category.

[Supp. 24, 19 F. R. 4446, July 20, 1954]

§ 4b.16-3 Additional flight tests (FAA policies which apply to § 4b.16(b)).

(a) *General.* (1) At the option of the applicant, the flight tests specified in Civil Aeronautics Manual 1.76-4 (§ 1.76-4) of this subchapter for the ferry flight of a four-engine airplane with one engine inoperative may be conducted during the flight tests for type certification. Routine CAR tests as prescribed in §§ 4b.100 through 4b.743 will be conducted (in accordance with existing procedures) to determine performance, flying qualities, power plant characteristics, etc.

(2) The official functional and reliability tests will be that portion of the tests conducted under the immediate supervision of the Type Certification Board[2] as prescribed in paragraphs (c) through (h) of this section to show compliance with §§ 4b.100 through 4b.743.

(3) 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.

(4) *Simulated tests consisting of tests* on the ground or in an airplane of (like) components and equipment under conditions simulating those likely to be obtained in service will also be taken into consideration in establishing the extent of the official portion of the tests.

(b) *Functional and reliability tests.* In order to satisfactorily accomplish the objectives of § 4b.16 (b) concerning additional flight tests and the extent thereof, the Administrator deems it necessary that:

(1) A comprehensive and systematic check be made in flight of the operation of all components to determine whether they "function properly," i. e., perform their intended function without introducing safety hazards.

(2) Sufficient testing and supplementary experience under actual, or a combination of simulated and actual experience, be obtained and evaluated to give reasonable assurance that the airplane is "reliable," i. e., should continue to function properly in service. (In or-

[1] Not submitted for publication in the FEDERAL REGISTER.

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

der to obtain wider experience, manufacturers are encouraged to cooperate with airlines or other responsible operators in operating experimental airplanes of the same type under service conditions.)

(3) Appropriate corrective action be taken when the need therefor is determined under subparagraphs (1) and (2) of this paragraph. (The FAA is concerned only to the extent that the airplane can be operated safely under suitable inspection and maintenance procedures, but is not concerned with maintenance costs.)

(c) *Test program.* The Type Certification Board for each project will decide upon a proposed official test program at the time of the pre-flight meeting of the Board (prior to the routine CAR flight tests) and coordinate this with the airplane manufacturer. At the conclusion of the routine type tests, the T. C. Board will meet again to review the experience gained in those tests, changes made in the design, and any additional supplementary experience, and to revise the proposed test program accordingly.

(d) *Planning and execution of test program.* The following points should be considered:

(1) The test program should be sufficiently well planned to enable its execution in an efficient manner without overlooking important items. It is not intended that the "paper work" be overemphasized to the detriment of the practical results, and it should be reduced to a minimum for small simple airplanes. The T. C. Board will review the design features and equipment with respect to the general objectives, and prepare a list showing:

(i) Components and systems to be checked in subparagraph (4) of this paragraph,

(ii) A brief description of the operations to be performed, where these are not obvious (referencing any necessary operating instructions),

(iii) Special checks or likely critical conditions,

(iv) Estimated flight time required.

(2) Allowance may be made for the functional tests already required by the routine type tests. Allowance may also be made for simulated testing of new features and equipment; however, the flight test program should be planned to determine the adequacy of the simulated tests (e. g., to determine whether the actual environmental conditions of temperature,[3] vibration, etc., are covered by the simulated tests) when these may be critical, and to determine whether the installation and connected systems are satisfactory. The T. C. Board will then make a consolidated estimate of the total flight time required, allowing for overlapping, and adjust this in accordance with the "Test time" outlined in paragraph (e) of this section.

(3) The program will be arranged to permit the Flight Test Agent in charge to become thoroughly familiar with the flying qualities of the airplane, particularly those not specifically covered in the routine type tests.

(4) All components of the airplane should be intensively operated and studied under all operating conditions expected in service and obtainable within the time and geographic limitations of the tests. Intensive operation means repeated operation of components in various sequences and combinations likely to occur in service. Particular attention should be given to potential sources of crew error, overtaxing of crew ability and the emergency procedures that would be required in the event of malfunction of any component. This intensive type of testing should be conducted in all cases, but the length of time for which it is continued will depend upon the simulated and supplementary experience available for the particular type, as outlined in "Test time" in paragraph (e) of this section.

(5) Ground inspections should be made at appropriate intervals during the test program to determine whether there are any failures or incipient failures in any of the components which might be a hazard to safe flight.

(6) When design changes are made during the course of the test, or when the official test airplane differs from those on which supplementary experience is obtained, or from modified versions of the same basic airplane type, the revised or modified items should be rechecked in accordance with the above procedure, but every effort should be

[3] This does not imply that flight tests must be conducted under the most severe outside air temperatures likely to be encountered in service. It should normally be possible to determine the effects of extreme outside temperatures on local temperatures by extrapolation or by suitable correction factors.

made to include such items in the program in such a way as to avoid unduly extending the overall test time. To this end, the Administrator may accept, in lieu of additional flight tests:

(i) Special tests of the original and revised components in which the conditions causing failure are intensified and

(ii) Simulated tests of differing components.

(e) *Test time.* It is highly desirable that functioning and reliability test programs be administered uniformly so that the program and flight time for a given project would be approximately the same regardless of which T. C. Board administered the project. This is difficult to achieve without establishing fixed arbitrary test times which would obviously be contrary to the intent of § 4b.16 (b). The following procedure which permits considerable flexibility is, therefore, established for the guidance of T. C. Boards.

(1) When supplementary experience is not taken into account and the airplane is conventional in regard to complexity and design features, the functioning and reliability test programs should be 150 hours. This time may be reduced to allow for simulated testing (see paragraph (d) (2) of this section), and for supplementary experience (see subparagraph (2) of this paragraph). However, it may be necessary to increase the 150 hours, if difficulties are encountered in earlier flights, or for radically new design features or in extreme cases of complexity. An example of extreme complexity would be an airplane intended for operation at 40,000 ft. altitude, with automatic dive recovery flaps, turbos, variable jet exhaust, two speed cooling fans, retractable wind screens, automatic control of engine cooling, turbos, intercoolers, jet exhausts, etc. The test program for such an airplane might require as much as 300 hours if no supplementary experience were available.

(2) When satisfactory supplementary experience is available and taken into account, the following allowances should be used as a guide and applied with judgment in reducing the official flight test time. However, in any case, the official program should provide sufficient time to accomplish the objective of paragraph (b) (1) of this section in accordance with the items listed in paragraph (d) (3) and (4) of this section.

(i) *For intensive experience.* When the allowance is based on the total time of any one airplane in airline crew training and similar intensive operations, two hours of such operation may be considered equivalent to one hour of official testing.

(ii) *For miscellaneous experience.* When the allowance is based on the total time of any one airplane, five hours of such experience may be considered equivalent to one hour of official testing.

(iii) *Reduction for supplementary experience.* Whenever a reduction of official test time is desired on the basis of supplementary experience, such experience should be adequately recorded and submitted to the T. C. Board as described in paragraph (f) of this section.

(f) *Reports and records.* (1) A log should be kept of all flight tests, and accurate and complete records kept of the inspections made and of all defects, difficulties, and unusual characteristics and sources of crew error discovered during the tests, and of the recommendations made and action taken. Items for which design changes may be required will be reported to the manufacturer and the appropriate FAA engineering division.

(2) If supplementary experience is to be taken into account, similar records of such experience should be kept and submitted to the T. C. Board, together with a list of the differences between the airplane on which the experience was obtained and the official test airplane. When supplementary experience is obtained on a large fleet of airplanes (for example, military operations) of the same or a comparable type (see paragraph (d) (6) of this section), these records may consist of statistical summaries in lieu of complete records for each individual airplane.

(3) At the conclusion of the official tests, a summary report should be prepared by the T. C. Board and forwarded to Washington for inclusion in the Type Inspection Report.

(g) *Administration.* The FAA Flight Test Agent in charge will act as coordinator of all flight activities of the T. C. Board during the official program and the agent or an alternate designated by him will participate in all flights. He will collaborate with the manufacturers' pilots in all these activities, particularly in regard to flight plans and procedures. The manufacturers' pilot should be in command of all flights, but FAA pilots will fly the airplane at least sufficiently to accomplish item listed in paragraph (d) (3) of this section.

(1) Other FAA personnel (e.g., representatives of other divisions and specialists) will participate in the flight tests when deemed necessary by the T. C. Board to accomplish the purposes of the tests.

(2) When supplementary experience is obtained in airline operations, a FAA Aviation Safety Agent will be assigned to follow the operations, review the operator's records, and supplement these by reports to the T. C. Board.

(h) *Test airplane.* To facilitate completion of the type certification procedure one airplane may be used for the official functioning and reliability tests while another airplane (or airplanes) is used for the routine type tests. In this case the test time on at least one airplane should be sufficient to accomplish the objective of paragraph (b) (2) of this section.

(i) *Modified types.* The procedure outlined in paragraph (h) of this section applies to new type designs. When a design employs components identical to those used in previous designs, credit may be given for the supplementary experience available for such components. When a design is modified (for example, several versions of the same basic type with different engines, propellers, etc.), the modified features and components should be treated in accordance with paragraph (d) (6) of this section.

[Supp. 24, 19 F. R. 4447, July 20, 1954, as amended by Supp. 26, 20 F. R. 6677, Sept. 10, 1955]

§ 4b.16–4 Flight tests (FAA policies which apply to § 4b.16).

The policies outlined in § 4b.402–1(c) and (1)(3) will apply.

[Supp. 25, 20 F.R. 2277, Apr. 8, 1955]

§ 4b.17 Airworthiness, experimental, and production certificates.

(For requirements with regard to these certificates see Part 1 of this subchapter.)

[Amdt. 4b–6, 17 F. R. 1088, Feb. 5, 1952]

§ 4b.18 Approval of materials, parts, processes, and appliances.

(a) Materials, parts, processes, and appliances shall be approved upon a basis and in a manner found necessary by the Administrator to implement the pertinent provisions of the regulations in this subchapter. The Administrator may adopt and publish such specifications as he finds necessary to administer this regulation, and shall incorporate therein such portions of the aviation industry, Federal, and military specifications respecting such materials, parts, processes, and appliances as he finds appropriate.

NOTE: The provisions of this paragraph are intended to allow approval of materials, parts, processes, and appliances under the system of Technical Standard Orders, or in conjunction with type certification procedures for an airplane, or by any other form of approval by the Administrator.

(b) Any material, part, process, or appliance shall be deemed to have met the requirements for approval when it meets the pertinent specifications adopted by the Administrator, and the manufacturer so certifies in a manner prescribed by the Administrator.

[Amdt. 4b–6, 17 F. R. 1088, Feb. 5, 1952]

§ 4b.18–1 Approval of aircraft materials, parts, processes and appliances (FAA rules which apply to § 4b.18).

Aircraft materials, parts, processes and appliances made the subject of Technical Standard Orders shall be approved upon the basis and in the manner prescribed in Part 514,[3] "Technical Standard Orders—C Series—Aircraft Components", of this title.

[Supp. 20, 17 F. R. 10101, Nov. 7, 1952]

§ 4b.18–2 Application of Technical Standard Orders—C Series (FAA policies which apply to § 4b.18).

(a) *Purpose of Technical Standard Orders.* Technical Standard Orders are a means by which the Administrator adopts and publishes the specifications for which authority is provided in § 4b.18(a).

(b) *Applicability of Technical Standard Order requirements.* (1) The applicability of and effective dates for TSO'd items are set forth in each TSO.

(2) Each Technical Standard Order sets forth the conditions under which materials, parts, processes and appliances approved by the Administrator prior to establishment of an applicable TSO, may continue to be used in aircraft.

(3) The establishment of Technical Standard Order for any product does not preclude the possibility of establishing the acceptability of a similar product as part of an aircraft, engine or propeller, under the type certification or modification procedures, if there is established a level of safety equivalent to that provided in the Civil Air Regulations as implemented by the appropriate Technical Standard Order and the product is identified as a part of the airplane, engine or propeller.

(c) *Administration of the Technical Standard Order (TSO) system.* The principles which apply in administering the Technical Standard Order system are as follows:

(1) Technical Standard Orders will reference performance provisions of recognized government specifications, or established industry specifications which have been found acceptable by the FAA. If no satisfactory specification exists, the orders will include criteria prepared by the Administrator. In preparing criteria of this type, the Administrator will give consideration to recommendations made by the industry.

(2) Minimum performance requirements established by the Federal Aviation Agency and published in Technical Standard Orders will serve as a means by which materials, parts, processes, and appliances intended for use in certificated aircraft will be accepted.

(3) TSO's set forth the minimum requirements for safety. Every effort will be made by the FAA to keep the requirements at the minimum levels of safety, and TSO's will not be used to set forth "desirable" standards.

(4) It will be the responsibility of the person submitting a statement of conformance to the FAA, certifying that his product meets the requirements of the TSO, to conduct the necessary tests demonstrating compliance therewith. This person will be held responsible for maintaining quality control adequate to assure that products which he guarantees to meet the requirements of a TSO do, in fact, meet these standards. The FAA will not formally approve such products as meeting the requirements of TSO's nor exercise direct inspection control over them. The statement of conformance with the provisions of a Technical Standard Order normally will be accepted by the FAA as sufficient indication that the applicable requirements have been fulfilled. Any TSO'd item which is modified must continue to comply with the requirements of the TSO, and the person authorizing the modification will be responsible for such compliance.

(d) *Numbering of Technical Standard Orders.* Each Technical Standard Order will be assigned a designation consisting of the letters "TSO," a series code letter "C", indicating aircraft materials, parts, processes or appliances and a serial number to be assigned in sequence for each of the TSO's issued in the "C" series, e. g., TSO–C–1, "Smoke Detectors." Revisions are indicated by the addition of letters a, b, c, etc., after the number.

[Supp. 20, 17 F. R. 10101, Nov. 7, 1952]

§ 4b.18–3 Manufacturer (FAA interpretation which applies to § 4b.18(b)).

(a) For the purpose of accepting a statement of conformance for a Technical Standard Order product, the word "manufacturer" is interpreted to mean a person who fabricates, or both fabricates and assembles, a product by cutting, drilling, bolting, riveting, gluing, soldering, sewing, or other fabrication and assembly techniques.

(b) A person is not regarded as the manufacturer solely by his engaging in the following activities:

(1) Distributing a completed product fabricated or fabricated and assembled by another person.

(2) Cleaning and reassembling products, repairing products, or replacing components or parts in products.

[Supp. 41, 23 F. R. 10325, Dec. 25, 1958]

§ 4b.18–4 Approval of products under the type certificate or modification procedures (FAA policies which apply to § 4b.18(b)).

A material, part, process, or appliance (hereinafter called "product") may be approved as a part of the airplane type design under a type certificate or a supplemental type certificate in accordance with the procedures provided in this section.

EXPLANATORY NOTE: Products previously approved by the FAA by means of letters of approval, Repair and Alteration Form

[3] Copies of individual TSO's in Part 514 of this title are available upon application to the Aviation Information Staff, Federal Aviation Agency, Department of Commerce Washington 25, D.C.

ACA-337, or listing on FAA Product and Process Specifications will continue to be eligible for installation in aircraft unless the eligibility is restricted by applicable regulations or airworthiness directives issued under § 1.24 of this subchapter.

(a) *Policies controlling where there is an applicable Technical Standard Order.* If a Technical Standard Order covering the product is in effect, the applicant for approval should submit type design data showing that the product meets the performance standards of the Technical Standard Order. Deviations from such performance standards may be allowed to the extent that the applicant for the type certificate or the supplemental type certificate substantiates that certain provisions of the Technical Standard Order are not required for the product as installed in the airplane.

(b) *Policies controlling in the absence of an applicable Standard Technical Order.* Where no TSO covering the product exists, the applicant for approval should submit type design data showing compliance with all the requirements of this part which are applicable to the product. Any deviation from standards prescribed in this part may be allowed only in accordance with § 4b.10.

(c) *Methods of identifying products approved under this section.* (1) Products approved as a part of the airplane type design under a type certificate should be identified by an airplane part number on the approved drawing list.

(2) Products approved as a part of the airplane type design under a supplemental type certificate should be identified by a part or drawing number on such certificate.

(3) Each TSO product that is approved as a part of the airplane should have the TSO identification removed and be identified as set forth in subparagraph (1) or (2) of this paragraph, whichever is applicable.

[Supp. 41, 23 F. R. 10325, Dec. 25, 1958]

§ 4b.19 Changes in type design.

(For requirements with regard to changes in type design and the designation of applicable regulations therefor, see § 4b.11 (d) and (e), and Part 1 of this subchapter.)

[Amdt. 4b-1, 19 F. R. 2250, Apr. 20, 1954]

Subpart B—Flight

General

§ 4b.100 Proof of compliance.

(a) Compliance with the requirements prescribed in this subpart shall be established by flight or other tests conducted upon an airplane of the type for which a certificate of airworthiness is sought or by calculations based on such tests, provided that the results obtained by calculations are equivalent in accuracy to the results of direct testing.

(b) Compliance with each requirement shall be established at all appropriate combinations of airplane weight and center of gravity position within the range of loading conditions for which certification is sought by systematic investigation of all these combinations, except where compliance can be inferred reasonably from those combinations which are investigated.

(c) The controllability, stability, trim, and stalling characteristics of the airplane shall be established at all altitudes up to the maximum anticipated operating altitude.

(d) The applicant shall provide a person holding an appropriate pilot certificate to make the flight tests, but a designated representative of the Administrator shall pilot the airplane when it is found necessary for the determination of compliance with the airworthiness requirements.

(e) Official type tests shall be discontinued until corrective measures have been taken by the applicant when either:

(1) The applicant's test pilot is unable or unwilling to conduct any of the required flight tests, or

(2) It is found that requirements which have not been met are so substantial as to render additional test data meaningless or are of such a nature as to make further testing unduly hazardous.

(f) Adequate provision shall be made for emergency egress and for the use of parachutes by members of the crew during the flight tests.

(g) The applicant shall submit to the Administrator's representative a report covering all computations and tests required in connection with calibration of instruments used for test purposes and correction of test results to standard atmospheric conditions. The Administrator's representative shall conduct any flight tests which he finds necessary to check the calibration and correction report.

§ 4b.100-1 Procedure for demonstrating compliance with the flight requirements (FAA policies which apply to § 4b.100(a)).

(a) *Responsibility.* The burden of showing or implementing compliance with the requirements for an airworthiness or a type certificate rests with the applicant. The applicant should at his own expense and risk, conduct such official flight tests as determined by the FAA to demonstrate compliance with the minimum requirements. During the type inspection the applicant should make available the airplane for that purpose as well as all of the personnel and equipment necessary to obtain the required data.

(b) *Tolerances permitted for flight tests*—(1) *General.* The tolerances in (b) (2) of this section are the allowable deviation from specified flight conditions for a particular test. They are not allowable tolerances on specific requirements, nor are they to be considered as allowable inaccuracy of measurement or of the method of determination. As an example, when demonstrating stability with specified trim speed of 1.4 V_{s_1}, the trim speed may be 1.4 V_{s_1}±3 mph or 3 percent; however, no positive tolerance is permitted when demonstrating the minimum prescribed trim speed of 1.4 V_{s_1}.

(i) Where the variation in the parameter on which a tolerance is allowed will have an appreciable effect on the test, the results should be corrected to the standard value of the parameter; otherwise, no correction is necessary. The applicant may adhere to closer tolerances if he so desires.

(ii) The following list indicates the cases in which correction for tolerances should be made:

Test	Weight	C. G.	Air speed	Power	Wind
Air speed calibration	—	—	—	—	—
Stall speeds	X	—	—	—	—
All climbs	X	—	—	X	—
Landings	X	—	X	—	X
Take-off	X	—	X	X	X
Accelerate	X	—	X	X	X
Decelerate	X	—	X	—	X
Stability and control	—	—	—	—	—
Minimum control speed	—	—	—	X	—

(2) *Individual tolerances.* The following are general tolerances from specified values permitted during FAA testing. These tolerances apply unless, for a particular test, other tolerances are set forth in the testing procedure. These tolerances are plus or minus variations unless otherwise noted in the particular test:

Item:	*Tolerance*
Weight	+5 percent, −10 percent.
Critical items affected by weight	+5 percent, −1 percent.
C. G.	7 percent total travel.
Air speed	3 m. p. h. or ±3 percent whichever is greater.
Power	5 percent.
Wind (take-off and landing tests)	As low as possible but not to exceed approximately 12 percent V_{s_1} or 12 m. p. h., whichever is lower, along the runway—measured at a height of 6 feet above the runway surface.

(c) *Type Inspection Report.* (1) All information and data obtained as a result of the type inspection investigation and tests should be reported in Form ACA 283-4b, Type Inspection Report.

(2) Upon completion of the type inspection, the applicant should prepare the information necessary to show compliance with the requirements. This material together with the Airplane Flight Manual required by § 4b.740 should be completed as promptly as possible and forwarded to the FAA.

[Supp. 24, 19 F. R. 4448, July 20, 1954]

§ 4b.100-2 Selection of weight, altitudes, speeds and wing flap positions (FAA policies which apply to § 4b.100(b)).

Before starting official flight tests, certain data should be obtained by the applicant in order that the options prescribed in paragraphs (a) through (e) of this section can be executed.

(a) *The selection of the range of weight and altitude to be covered by the flight testing required for certification.* This selection should be based upon the extent to which the applicant for certification is concerned with the operating limitations which will be imposed upon the airplane. If the applicant is not concerned with this point, he may elect to conduct only the flight tests required to demonstrate compliance with the minimum performance requirements contained in § 4b.110 together with those quired to demonstrate compliance with the flying qualities and other requirements specified in §§ 4b.130 through 4b.-190. If it is practicable to limit the operation of the airplane by a scheduled air carrier to sea level airports containing runways of ample length and to terrain altitude not in excess of 4,000 feet, this procedure appears satisfactory. It should be noted that this case could apply to a seaplane in scheduled operation. If the applicant wishes to provide for the greatest possible flexibility in the matter of compliance with the operating limitations contained in § 40.70 of this subchapter, considerably more performance tests will be necessary. It may be entirely practicable, for example, for operation over routes involving appreciable differences in the altitude of airports, to take advantage of the improvement in performance which is possible by means of reducing the weight at which the airplane is operated. It may also be desirable to alter the various flap settings in order to improve the climbing performance at a given weight. In cases such as these, it will be necessary to determine by flight testing and calculation, the effect of weight, altitude, and flap setting, throughout the range of each for which it is desired to provide, upon the take-off, landing, and climbing performance and to include this information in the FAA Approved Airplane Flight Manual. This selection will be left to the applicant since, even though he may find it difficult to anticipate the uses to which the airplane may subsequently be put, he is nevertheless in better position to forecast this than anyone else.

(b) *The selection of the weight range to be covered by the terms of the certification.* This selection is closely related to paragraph (a) of this section and should be based upon essentially the same considerations. The simplest possible selection of weights is a single maximum weight to be used both for take-off and landing and as a basis for the operating limitations. The next simplest choice would appear to be a maximum take-off weight and a maximum landing weight differing from take-off weight. This choice requires the installation of fuel jettisoning equipment (when the take-off weight exceeds the landing weight by more than 5 percent) of sufficient capacity to reduce the weight of the airplane from the maximum take-off weight to the maximum landing weight in compliance with § 4b.437. The operating limitations may then be based upon the assumption that these two weights exist throughout each flight. The most flexible possible arrangement in the matter of weights is provided by selecting a range of weights for take-off and a range for landing, and determining the performance as functions of these weights so that, in showing compliance with the operating limitations, any weight within these ranges may be selected to fit the requirements of a particular route. This selection should be left with the applicant.

(c) *The selection of the range of altitude to be covered by the terms of the certification.* This selection is also closely related to paragraph (a) of this section and is analogous in its nature to paragraph (b) of this section. The simplest possible selection is that indicated by the minimum performance requirements contained in § 4b.110, namely, sea level for the purposes of the determination of the take-off and landing distances and certain of the rates of climb at 5,000 feet for the purpose of determining the en route rates of climb. The selection providing the greatest possible flexibility is the one in which these items of performance are determined for a range of altitude great enough to cover all anticipated routes over which the airplane may be operated.

(d) *The selection of the wing flap positions desired for certification.* Policies outlined in § 4b.111-1 will apply to this selection.

(e) *The selection of the critical speed*[4] *to be used in the determination of the take-off distance.* Policies outlined in § 4b.113-2 will apply to this selection.

[Supp. 24, 19 F. R. 4449, July 20, 1954]

§ 4b.100-3 Flying qualities (FAA policies which apply to § 4b.100(c)).

(a) It should be possible to operate the airplane safely at all anticipated altitudes without requiring exceptional attention and skill by the pilot or appropriate crew members.

(b) If there is less than two mph difference in the forward and rearward C. G. stalling speeds, all flying qualities may be based upon the forward C. G. stalling speeds. Otherwise, the stalling speed appropriate to the C. G. position should be used.

(c) If there is reason to believe that any of the flying qualities would be affected by altitude, they should be investigated for the most adverse altitude condition expected in normal operation.

[Supp. 24, 19 F. R. 4449, July 20, 1954]

§ 4b.101 Weight limitations.

The maximum and minimum weights at which the airplane will be suitable for operation shall be established as follows:

(a) Maximum weights shall not exceed any of the following:

(1) The weight selected by the applicant;

(2) The design weight for which the structure has been proven;

(3) The maximum weight at which compliance with all of the applicable flight requirements has been demonstrated.

(b) It shall be acceptable to establish maximum weights for each altitude and for each practicably separable operating condition (e. g., take-off, en route, landing).

(c) Minimum weights shall not be less than any of the following:

(1) The minimum weight selected by the applicant;

(2) The design minimum weight for which the structure has been proven;

(3) The minimum weight at which compliance with all of the applicable flight requirements has been demonstrated.

[4] The practical effect of the selection of this speed is that it permits the applicant to define in the type certificate the limits of airplane weight and airport altitude within which the airplane may be operated by a scheduled air carrier in compliance with Part 40 of this subchapter.

§ 4b.102 Center of gravity limitations.

Center of gravity limits shall be established as the most forward position permissible and the most aft position permissible for each practicably separable operating condition in accordance with § 4b.101 (b). Limits of the center of gravity range shall not exceed any of the following:

(a) The extremes selected by the applicant;

(b) The extremes for which the structure has been proven;

(c) The extremes at which compliance with all of the applicable flight requirements has been demonstrated.

[15 F. R. 3543, June 8, 1950, as amended by Amdt. 4b-6, 17 F. R. 1088, Feb. 5, 1952]

§ 4b.103 Additional limitations on weight distribution.

If a weight and center of gravity combination is permissible only within certain load distribution limits (e.g., spanwise) which could be exceeded inadvertently, such limits shall be established together with the corresponding weight and center of gravity combinations, and shall not exceed any of the following:

(a) The limits selected by the applicant;

(b) The limits for which the structure has been proven;

(c) The limits for which compliance with all the applicable flight requirements has been demonstrated.

§ 4b.104 Empty weight.

(a) The empty weight and the corresponding center of gravity position shall be determined by weighing the airplane. This weight shall exclude the weight of the crew and payload, but shall include the weight of all fixed ballast, unusable fuel supply (see § 4b.416), undrainable oil, and total quantity of hydraulic fluid.

(b) The condition of the airplane at the time of weighing shall be one which can be easily repeated and easily defined, particularly as regards the contents of the fuel and oil tanks and the items of equipment installed.

[15 F. R. 3543, June 8, 1950, as amended by Amdt. 4b-3, 21 F. R. 990, Feb. 11, 1956]

§ 4b.105 Use of ballast.

It shall be acceptable to use removable ballast to enable the airplane to comply with the flight requirements. (See §§ 4b.738 and 4b.741(c).)

§ 4b.105–1 Use of ballast during flight tests (FAA policies which apply to § 4b.105).

Ballast should be carried during the flight tests whenever it is necessary to simulate pay load. Consideration should be given to the vertical as well as horizontal location of the ballast in cases where it may have an appreciable effect on the performance or flying qualities of the airplane. The strength of the supporting structures should be adequate to preclude their failure as a result of the flight loads that may be imposed during the tests.

[Supp. 24, 19 F. R. 4449, July 20, 1954]

PERFORMANCE

CROSS REFERENCE: For Special Civil Air Regulations applicable to turbine-powered transport category airplanes of current design, in lieu of the requirements contained in §§ 4b.110 through 4b.125, see SR–422, SR–422A, and SR–422B, *supra*.

§ 4b.110 General.

(a) With respect to all airplanes type certificated on or after February 12, 1951, the performance prescribed in this subpart shall be determined, and compliance shall be shown, for standard atmospheric conditions and still air, except that the performance as affected by engine power, instead of being based on dry air, shall be based on 80 percent relative humidity.

(b) Each set of performance data required for a particular flight condition shall be determined with the powerplant accessories absorbing the normal amount of power appropriate to that flight condition. (See also § 4b.117.)

[Amdt. 4b–3, 16 F. R. 314, Jan. 12, 1951, as amended by Amdt. 4b–6, 17 F. R. 1089, Feb. 5, 1952]

§ 4b.110–1 Engine power corrections (FAA policies which apply to § 4b.110).

(a) *Engine power corrections for vapor pressure.* The following standard vapor pressures, specific humidities, and densities versus altitude have been established for the purpose of correcting airplane performance data in accordance with § 4b.110.

Altitude H (Ft.)	Vapor pressure e (In. Hg.)	Specific humidity w (lb. moisture per lb. dry air)	Density ratio $\sigma = \frac{\rho}{.0023769}$
0	0.403	0.00849	0.99508
1,000	.354	.00773	.96672
2,000	.311	.00703	.93895
3,000	.272	.00638	.91178
4,000	.238	.00578	.88514
5,000	.207	.00523	.85910
6,000	.1805	.00472	.83361
7,000	.1566	.00425	.80870
8,000	.1356	.00382	.78434
9,000	.1172	.00343	.76053
10,000	.1010	.00307	.73722
15,000	.0463	.001710	.62868
20,000	.01978	.000896	.53263
25,000	.00778	.000436	.44806

(b) *Engine power corrections for cylinder head temperatures.* Official flight tests should be discontinued whenever engine limitations are exceeded. This procedure automatically makes corrections of this type unnecessary.

(c) *Engine power corrections for fuel flow.* Official flight tests should not be conducted when the metering characteristics of the carburetor are outside the range of acceptable tolerances. This procedure automatically makes corrections for fuel-air mixture ratio in performance evaluation unnecessary.

[Supp. 23, 19 F.R. 1817, Apr. 2, 1954, as amended by Supp. 39, 23 F.R. 7482, Sept. 26, 1958]

§ 4b.110–2 Engine power calibration (FAA policies which apply to § 4b.110).

The performance of an airplane established in accordance with the requirements of §§ 4b.110 through 4b.125 and shown in the performance section of the Airplane Flight Manual should be reproducible by any airplane of a similar model having engines that deliver no more than 100 percent certificated rated power. This means that the power used to drive all accessories, other than those necessary to the functioning of the engine, should be deducted from the certificated rated or installed engine power, whichever is less. To assist in meeting these objectives, the engine power of all new type airplanes as defined by § 4b.11 (e) should be calibrated in accordance with paragraphs (a) through (c) of this section.

(a) *Corrections to the calibrated power for engines producing power above the certificated ratings.* (1) The applicant should provide engine power

output data obtained from dynamometer tests, or the equivalent thereof for all engines that are installed in the airplane which will be used in the power calibration flight tests. The data should be sufficiently complete to allow a direct comparison with the approved certificated ratings of the engines.

(2) If the dynamometer calibration data for any engine selected for the inflight power calibration in accordance with the provisions of paragraph (b) of this section indicate that the power (based on standard atmospheric conditions for the engine) is higher than the certificated rating for the engine model, the calibrated power curve established as a result of flight tests in paragraphs (b) and (c) of this section should be corrected by applying the following power reduction: 100 percent of the power increment between the dynamometer calibration and the certificated engine rating at sea level, and 47 percent of the sea level power increment applied at an altitude of 20,000 feet with a lineal variation between these two points throughout the operating altitude range of the airplane. If the calibrated power curve established as a result of the flight tests represents an average power for more than one engine, it should be corrected by applying a power reduction equivalent to the average power difference between the dynamometer and the rated power for all engines used in the flight calibration tests. The application of other correction methods and values that will adjust the power data on the basis of the certificated rating of the engine throughout the operating altitude range of the airplane are acceptable if they can be substantiated.

(b) *Selection of engines for power calibration in flight.* With the exception of the critical inoperative engine, the number of engines which will be used as a basis for power calibration is left to the option of the applicant. However, the procedure specified in this paragraph should be followed to determine which engine(s) should be selected for establishing the basic calibrated power curve.

(1) The installed power of all engines should be compared in flight by means of calibrated torquemeters or other equivalent methods. If a calibrated power curve is to be established on the basis that all engine driven accessories will be in operation during flight, the comparison should be made under full accessory load conditions. If a separate calibrated power curve is to be established for application to those test configurations where certain accessories will not be in operation, the power of all engines may be compared when these accessories are in the appropriate idling or off position. In this case it will be necessary to provide data, indicating accessory load requirements for those flight configurations and the particular engine(s) from which the power is obtained.

(2) For two-engine aircraft it is only necessary to calibrate the engine which produces the lesser power determined by comparing the results of the torquemeter indications in accordance with subparagraph (1) of this paragraph for the most critical accessory load condition and taking into consideration the appropriate power reduction when the engine dynamometer test output is above the rated power for the engine. All performance data scheduled in the Airplane Flight Manual should be based on the calibrated power curve established for this engine. If the applicant desires to calibrate the power of both engines, only the all engine operating performance data should be based on a curve representing the average power for the two engines.

(3) When the applicant desires to calibrate the power of one engine for aircraft having more than two engines, the engine selected should be that which delivers the lowest power, determined by comparing the results similarly as in the case of the two-engine aircraft in subparagraph (2) of this paragraph. All performance data scheduled in the Airplane Flight Manual should be based on the calibrated power curve established for this engine. If the applicant desires to calibrate the power of two engines, the calibrated power curve should be based on values representing an average of the two engines delivering the lowest power.

(4) The procedure in subparagraph (3) of this paragraph should be followed if the applicant desires to calibrate the power of more than two engines, however, the Airplane Flight Manual performance data should be based upon an average calibrated power curve which has been derived from not more than the actual number of engines in operation corresponding to the test configuration for which performance is established. This procedure is not necessary, for ex-

ample, in the case where the average power curve for two and three engines is substantially equal. However, the third engine may be calibrated to obtain additional data which will permit a more accurate fairing of the calibrated power curve.

(5) If the results of the flight tests indicate that the power of any engine selected in accordance with the provisions of this paragraph exceeds rated power after the application of the dynamometer correction specified in paragraph (a) of this section, the calibrated power curve for application to performance testing should be based upon not more than certificated rated power of the engine with the power to drive the accessories deducted.

(c) *Flight test procedure for calibrating engine power.* The engine calibration flight tests should be conducted in accordance with the provisions specified in this paragraph.

(1) The critical altitudes of the engine should be established for takeoff power and maximum continuous power providing these critical altitudes lie below the highest operating altitude desired for certification. Critical altitudes need not be determined above the maximum operating altitude of the airplane.

(2) For engine installations specifically designed to indicate power by means of torquemeters, the engine power calibration tests as well as all performance tests which are affected by power should be obtained with calibrated torquemeters.

(3) All engine adjustments such as ignition timing, valve clearances, air-fuel ratios, fuel flow rates, antidetonant injection flow rates, etc., should be maintained within approved limits for the engine. If any permanent changes are made to the engine or powerplant installation during the type certification tests, and such changes result in an engine power output less than that established in the calibrated power data, then all performance data should be corrected to this lower power.

(4) The engine power calibration tests should be conducted in an atmosphere which is free of any visible moisture.

(5) The engine power calibration tests should be conducted in the configurations that follow:

(i) *Takeoff power.*

Weight—maximum takeoff.
C. G. position—optional.
Wing flaps—takeoff position.
Landing gear—retracted.
Operating engine(s)—takeoff r. p. m. and manifold pressure or full throttle, mixture setting at normal position for takeoff power, carburetor air heat control at cold and cowl flaps in takeoff position (see § 4b.118-1 (d) (1)).
Critical inoperative engine—throttle closed on highest powered engine, propeller windmilling in takeoff pitch (may be feathered if automatic feathering device is installed), mixture setting at idle cut-off and cowl flaps in takeoff position (see § 4b.118-1 (d) (1)).

(ii) *Maximum continuous power.*

Weight—maximum takeoff.
C. G. position—optional.
Wing flaps—en route position.
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 at FAA hot day cooling position.
Critical inoperative engine—throttle closed on highest powered engine, propeller feathered and cowl flaps in minimum drag position.

(6) *Test procedure and required data:* The engine power calibration tests should be conducted in a climbing attitude at the takeoff safety speed, V_2, with the use of takeoff power and at the en route climb speed with the use of maximum continuous power. The climbs should be started at the lowest practicable altitude and cover the altitude range desired for certification. During these tests the engine(s) should be operated within the approved limits for r. p. m., manifold pressures, temperatures, etc. The following data should be recorded at reasonable time intervals for each power condition:

Pressure altitude.
Ambient air temperature.
Humidity.
Indicated airspeed.
Engine(s), r. p. m. and manifold pressure.
Torque pressure.
Cylinder head temperatures.
Carburetor air temperature.
Fuel flow rate.
Antidetonant injection flow rate.

In addition, a record should be made of the following items:

Fuel grade.
Wing flap position.
Landing gear position.
Cowl flap position.
Mixture setting.
Blower setting.
Accessory power loads and distribution.

(d) *Engine power checks.* A suitable means should be established by which engine power may be compared after overhauls with the original calibrated power data obtained as a result of the type certification tests.

[Supp. 31, 21 F.R. 8417, Nov. 3, 1956]

§ 4b.111 Wing flap positions.

(a) The wing flap positions denoted respectively as the take-off, en route, approach, and landing positions shall be selected by the applicant. (See also § 4b.323.)

(b) It shall be acceptable to make the flap positions variable with weight and altitude.

§ 4b.111-1 Selection of the wing flap positions (FAA policies which apply to § 4b.111).

(a) In the selection of the wing flap positions desired for certification, the flap position indicator should show flap up, take-off, en route, approach, and landing positions. Various items of performance are required to be determined at each of these flap positions. Section 4b.120(d) requires that the stalling speed with the flap in the "approach" position should not exceed 110 percent of the stalling speed with the flap in the "landing" position. No plans for flight testing should be made until these positions are selected unless the applicant wishes to investigate systematically the effect of flap positions upon each or several of the items of performance which should be determined at the nominal position to be selected.

(b) The selection of multiple sets of wing flap positions is permitted in order to obtain optimum performance at various airports. However, it is recommended that the approval of multiple flap position settings for any one airplane be limited to two or at the most three.[4]

(c) A reasonable number of take-off flap settings in excess of three may be approved for operation under Civil Air Regulations, Parts 40, 41, 42, and 43 of this chapter if a dispatch procedure is established to provide pertinent operating limitations for the particular take-off involved.

[Supp. 24, 19 F. R. 4449, July 20, 1954]

§ 4b.112 Stalling speeds.

(a) The speed, V_{s_0}, shall denote the calibrated stalling speed, or the minimum steady flight speed at which the airplane is controllable, in miles per hour, with:

(1) Engines idling, throttles closed (or not more than sufficient power for zero thrust at a speed not greater than 110 percent of the stalling speed);
(2) Propeller pitch controls in the position normally used for take-off;
(3) Landing gear extended;
(4) Wing flaps in the landing position;
(5) Cowl flaps closed;
(6) Center of gravity in the most unfavorable position within the allowable landing range;
(7) The weight of the airplane equal to the weight in connection with which V_{s_0} is being used as a factor to determine a required performance.

(b) The speed, V_{s_1}, shall denote the calibrated stalling speed, or the minimum steady flight speed at which the airplane is controllable, in miles per hour, with:

(1) *Engines idling, throttles closed* (or not more than sufficient power for zero thrust at a speed not greater than 110 percent of the stalling speed);
(2) Propeller pitch controls in the position normally used for take-off, the airplane in all other respects (flaps, landing gear, etc.) in the particular condition existing in the particular test in connection with which V_{s_1} is being used;
(3) The weight of the airplane equal to the weight in connection with which V_{s_1} is being used as a factor to determine a required performance.

(c) The stall speeds defined in this section shall be the minimum speeds obtained in flight tests conducted in accordance with the procedure of subparagraphs (1) and (2) of this paragraph.

(1) From a speed sufficiently above the stalling speed to assure steady conditions, the elevator control shall be applied at a rate such that the airplane speed reduction does not exceed one mile per

[4] The reason for recommending a limited number of flap settings is due to the increasing complexity of T-category operation with the increasing number of variables such as power ratings, take-off flap settings and associated climb speeds, temperature accountability, etc., which are contained in the Airplane Flight Manual. Each additional set of flap positions approved increases the complexity with which the performance information in the Airplane Flight Manual can be evaluated to provide the proper level of safety, particularly in the take-off flight stage.

hour per second. This maneuver shall be performed with the airplane trimmed at a speed of $1.4V_{s_1}$, except that airplanes utilizing adjustable stabilizers may be trimmed at a speed selected by the applicant but not less than $1.2V_{s_1}$, nor greater than $1.4V_{s_1}$.

(2) During the test prescribed in subparagraph (1) of this paragraph, the flight characteristics provisions of § 4b.160 shall be complied with.

[15 F. R. 3543, June 8, 1950; 15 F. R. 4171, June 29, 1950, as amended by Amdt. 4b–3, 21 F.R. 990, Feb. 11, 1956; Amdt. 4b–11, 24 F.R. 7068, Sept. 1, 1959]

§ 4b.112–1 Procedure for determining stalling speeds (FAA policies which apply to § 4b.112(c)).

(a) Since all performance requirements are based upon some function of the stalling speeds, accurate measuring methods and careful piloting technique should be employed during the tests required for determination of these speeds. The essential items to be considered when conducting tests to determine the stalling speeds are as follows:

(1) The airspeed system should have the same characteristics as outlined in § 4b.611–1(a)(2). Preferably, an independent test airspeed system should be employed in measuring the stalling speeds such as a shielded or swivel impact pressure sensing head used in conjunction with a trailing static bomb. The airspeed system lag should be a minimum with the impact and static systems dynamically balanced to minimize the error associated with changing ambient pressure. With the above described airspeed system, the applicant may elect to use the minimum airspeed obtained during the maneuver, or may determine and apply the lag correction associated with changing airspeed (deceleration) to the minimum values obtained above. If the latter option is elected, the applicant should determine the correct lag factors to be applied under varying dV/dt conditions. If the airspeed system is not dynamically balanced, adequate corrections should be made.

(2) A satisfactory method of determining the correct lag associated with changing airspeed to be applied for balanced systems only in subparagraph (1) of this paragraph is to simulate the airspeed variations associated with stall tests, utilizing the airspeed system installed in the aircraft. For this purpose an additional airspeed instrument having a known calibration should be inserted in the airspeed system adjacent to the pressure source, and a velocity-time history of instantaneous values for true and lagging total pressures be obtained by photo-recorder. It is necessary that a steady deceleration rate appropriate to that used during actual flight tests be maintained sufficiently long to allow the system lag to stabilize. The simulated velocity-time history should be appropriately corrected to the conditions existing in the actual stall flight tests.

(3) If the stalling speed tests are to be conducted with the propellers delivering zero thrust, some dependable method such as a propeller slipstream rake by means of which zero thrust condition can be ascertained should be available in flight. The general practice of establishing zero thrust r. p. m. by calculation is also acceptable. For the turbo-propeller and turbo-jet powered aircraft of conventional design, the stall speed can be determined with flight idle power, in lieu of zero thrust, if it can be shown that this power does not materially affect the stall speed. If the stall speed is materially affected by the above power, corrections should be made to zero thrust conditions. Analytical corrections will be acceptable if satisfactory accounting is made for the effects of propeller efficiency, slipstream, altitude, and other pertinent variables. The stall speed should be determined below an altitude of 10,000 feet, where practicable, to minimize the altitude effect on flight idle power.

(4) An accurate method for determining the fuel load should be established for the purpose of ascertaining the airplane's gross weight and c. g. position at the time of each stall.

(5) Test instrumentation should consist of the usual sensitive indicators, especially sensitive tachometers, in order to be able to maintain r. p. m. which results in zero thrust. The time history during the stall should be recorded photographically, and should include those data indicated in paragraph (c) (4) of this section.

(b) The test methods required in the options that follow (see also figure 1)

are for the purpose of determining accurately the stalling speed used to calculate the pertinent performance climb requirements. The airplane loading during these tests will depend upon the c. g. weight range desired for approval, and whether the climb requirements are based on stalling speeds obtained with a fixed, or variable, c. g. position as indicated in subparagraphs (1) and (2) of this paragraph. In any case, the stalling speeds should be based on tests conducted for the most critical c. g.-weight combination, within the allowable tolerance specified in § 4b.100–1.

(1) *Climb requirement based on stalling speed at the most forward c. g. position desired for certification.* (i) Under this option, the applicant should measure stalling speeds at the maximum forward c. g. position for certification and at the maximum landing weight. However, in some cases where the forward c. g. limit is variable with weight, this would require that stalling speed tests be conducted at a weight and c. g. position outside of the approved structural limit. In lieu of this, and if the applicant so desires, he may measure the stalling speeds at the maximum forward c. g. position for maximum landing weight and also at the maximum forward c. g. position desired for certification and its associated weight.

(ii) It is only necessary to conduct stall speed tests for one or two loading conditions, as indicated above, if the weight range from maximum takeoff to minimum landing weight, and the variations in c. g. positions are within the allowable tolerances specified in § 4b.100–1 (b) (2) with respect to both maximum takeoff and minimum landing weights. (See figure 1, option 1, case A.) In cases where a large variation of weight exists, it may be necessary to make an additional check of the stalling speed at the most forward c. g. position corresponding to maximum takeoff weight. (See figure 1, option 1, case B.)

(2) *Climb requirement based on stalling speed varying with c. g. position.* If this option is elected, the applicant should conduct a sufficient number of tests to adequately establish the variation of stalling speed with center of gravity position. In any case, the stalling speed should be measured at the maximum forward c. g. position desired for certification and at the most rearward c. g. position desired for the purpose of varying the climb requirement with c. g. position. In the event that the above configurations do not encompass the maximum takeoff weight considering the allowable tolerances, stalling speed test should also be conducted at the maximum takeoff weight and its appropriate c. g.

(c) The deceleration rate actually utilized in each test may be obtained from the velocity-time history provided by photo-recorder data. For the purpose of determining the above deceleration rate, dV/dt should be based on the average slope of the velocity-time history, from a speed 10 percent above the minimum speed obtained with the test airspeed system, down to the minimum speed. (This method should not be used in calculating the appropriate lag corrections indicated in paragraph (a) (1) and (2) of this section.)

(d) Configurations: The stalling speed should be demonstrated in the configuration shown in subparagraphs (1) and (2) of this paragraph.

(1) *Configurations for demonstrating stalling speed V_{s_0}, § 4b.112 (a).*

Weight—maximum landing or maximum weight at required c. g. position.

C. g. position—as required in paragraph (b) of this section.

Wing flaps—landing position.

Landing gear—extended.

Engines—idling or not more than sufficient power for zero thrust at a speed not greater than 110 percent of the stall speed.

Propeller controls—normal takeoff pitch.

Cowl flaps—closed.

Trim speed—as prescribed in § 4b.112 (c)(1).

(2) *Configuration for demonstrating stalling speeds V_{s_1}, § 4b.112 (b).*

Weight—maximum landing or maximum weight at required c. g. position.

C. g. position—as required in paragraph (b) of this section.

Wing flaps—en route, takeoff and approach positions.

Landing gear—retracted.

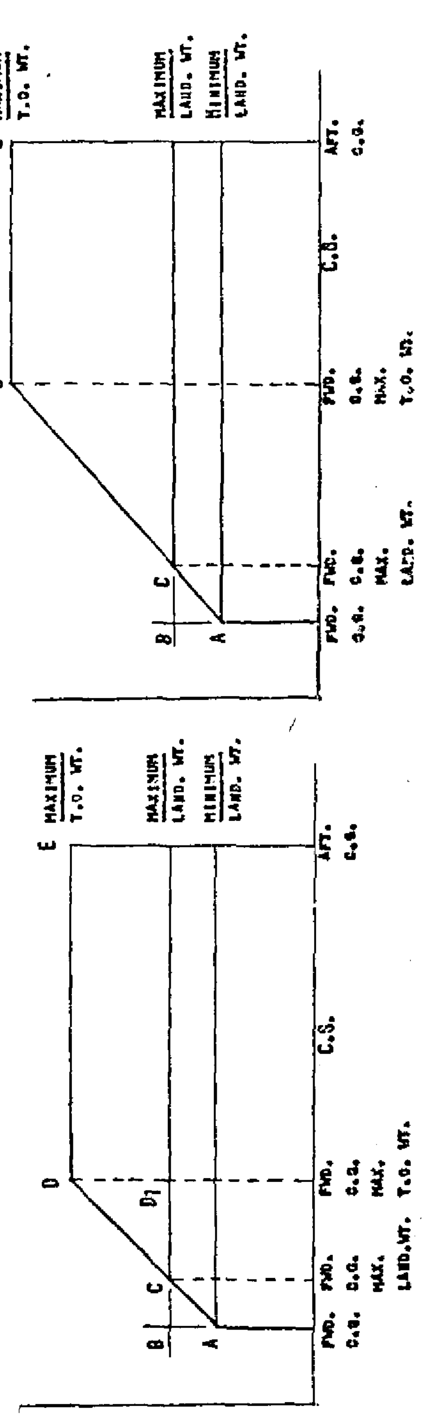
Engines—idling or not more than sufficient power for zero thrust at a speed not greater than 110 percent of the stall speed.

Propeller controls—normal takeoff pitch.

Cowl flaps—closed.

Trim speed—as prescribed in § 4b.112 (1.4 V_{s_1})

FIGURE 1—Weight-C. G. Position.



Case A. This case may be used when it is possible to conduct stalling speed tests at the c. g.-weight combinations in options (1) or (2) below provided the test weights are within the tolerance limits of 4b.100-1 (b) (2) for both maximum takeoff and minimum landing weights. *In this case, stalling speeds for all* flap positions may be calculated for the performance weight range from the stall test data at these weights.

Option (1)—For climb requirements based on stalling speed at most forward c. g. position.

(A) Tests may be conducted at c. g.-weight combination only, that is, point "*B*".

(B) *In lieu of (A) tests should be conducted* at c. g.-weight combination points "*A*" and "*C*".

Option (2)—For climb requirements based on stalling speed varying with c. g. position.

(A) Tests should be conducted at c. g.-weight combination points "*A*", "*C*", and "D_1" in order to adequately establish the variation of stalling speed with c. g. position.

Case B. This case should be used when the test weights shown in Case A do not fall within the tolerance limits of § 4b.100-1 (b) (2) for both maximum takeoff and minimum landing weights. *In this case stalling speeds* for the retracted, en route, and takeoff flap should be calculated for the entire performance weight range from the stall test data of the highest weight tested, and stalling speeds for the approach flap should be calculated for the entire performance weight range from stall test data at the lower weights tested. Stalling speeds for the landing flap should be calculated for the entire performance weight range from stall test data at both weights.

NOTE: Both weights are necessary in this latter case since the en route climb requirement is based on stall speed for the landing flap setting and appropriate weight.

Option (1)—For climb requirements based on stalling speed at most forward c. g. position.

(A) Tests may be conducted at two c. g.-weight combinations, that is, points "*B*" and "*D*".

(B) In lieu of (A) tests should be conducted at c. g-weight combination points "*A*", "*C*", and "*D*".

Option (2)—For climb requirements based on stalling speed varying with c. g. position.

(A) *Tests should be conducted at three or more equally spaced* c. g.-weight combinations between points "*A*" and "*D*" in order to adequately establish the variation of stalling speed with c. g. position.

(e) Test procedure and required data: (1) A *sufficient number of representative* stalls should be conducted for each airplane configuration and for each c. g. location as required in paragraphs (b) and (d) of this section in order to provide for accurate determination of the stall speeds at a *dV/dt* equals 1 m. p. h./sec. The minimum number of stalls required will depend on the range of flap angles and other variable factors (such as variable c. g. position in determining the minimum climb requirement) which are proposed by the applicant. *In cases where the* flap positions have not been predetermined, it is permissible to conduct tests using four or more equally spaced flap angles. Based upon four equally spaced flap settings, an acceptable minimum number of representative stalls for each flap angle should be four. The minimum number of stalls at each flap angle should be increased if a lesser number of flap settings is proposed. *For other configurations* and variables a lesser number of stalls should be acceptable once a basic stall *speed versus* flap angle curve has been determined. Not more than zero propeller thrust should be used, as determined in paragraph (a) (3) of this section.

(2) The stalling speed tests should be conducted in accordance with the procedure outlined in § 4b.112 (c).

(3) Since the trim speed 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 photographically for each stall:

Vertical acceleration.
Angle of attack.
Elevator angle.
Air speed.
Altimeter.
R. p. m.

(5) In addition to the photorecorder record, the following data should be recorded for each stall:

Torque pressure.
C. g. position.
R. p. m. for zero thrust at 1.1 V_s.
Time.
Weight.
Ambient air temperature.
Wing flap position.
Landing gear position.
IAS at stall warning.
Nature of stall warning.

(6) In subparagraph (4) of this paragraph, the following data may be omitted if the exception clause of § 4b.160 (c) (2) is applicable, or if during the demonstration of stall charactertistics no marginal conditions existed and the elevator control was utilized to the full extent of its rearward (up elevator) travel. Under these circumstances the procedure used for stalling the aircraft to determine stall speeds, and recovery there*from, should duplicate* that used during the stall characteristics demonstration.

Elevator angle.
Angle of attack.
Vertical acceleration.

[Supp. 32, 22 F.R. 5791, July 20, 1957, as amended by Supp. 42, 24 F.R. 7072, Sept. 1, 1959]

§ 4b.113 Take-off; general.

(a) The take-off data in §§ 4b.114 to 4b.116, inclusive, shall be determined under the following conditions:

(1) *At all weights and altitudes* selected by the applicant;

(2) With a constant take-off flap posi*tion for the particular weight and alti*tude;

(3) With the operating engines not *exceeding their approved limitations* at the particular altitude.

(b) All take-off data, when corrected, *shall assume a level take-off surface, and* shall be determined on a smooth, dry, hard-surfaced runway, in such a manner that reproduction of the performance does not require exceptional skill or alertness on the part of the pilot. (For temperature accountability data see § 4b.117. For wind and runway gradient corrections see appropriate operating rules of this subchapter.)

§ 4b.113-1 Downwind take-off (FAA policies which apply to § 4b.113).

Downwind take-off 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 take-off in downwind the data should be substantiated by actual flight tests. The general methods and procedures would be comparable to those for substantiating take-off distances in no wind. The flight tests should be conducted in tailwind com*ponents up to 150 percent of the maxi*mum 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 "take-off" 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 subparagraph (3) of this paragraph.)

(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 take-off distances for the Airplane Flight Manual performance data, 150 percent of the effect of the reported tailwind component should be taken into account. (See § 4b.740-1 (d) (2) (x).) This may in some cases, permit calculating the required distances without further tests providing sufficiently high speed take-offs and decelerations were made in the original type tests. However, except in the circumstances outlined in paragraph (d) of this section, actual take-offs should be made under the conditions outlined in paragraph (b) of this section to check the flight and ground handling characteristics.

(b) *Controllability.* Take-offs 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[4] 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-foot 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.

(d) *Tolerances.* (1) With regard to performance tests outlined in paragraph (a) of this section, approval may be given for calculated take-off distances for reported tailwind velocities up to 10 mph. 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 paragraph (b) of this section, approval may be given for reported downwind velocities up to 10 mph. measured at 50′ height without additional flight tests.

[Supp. 23, 19 F. R. 1817, Apr. 2, 1954, as amended by Supp. 25, 20 F. R. 2277, Apr. 8, 1955]

§ 4b.113-2 Determination of the take-off field length (FAA policies which apply to § 4b.113).

(a) The dimensions of a take-off flight path should be such that, if the take-off 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 §§ 4b.113 through 4b.116 generally one set of data at one altitude should be sufficient to determine take-off distances for altitudes from sea level to 8,000 feet. If a greater range of airport altitudes is desired, the tests should be conducted at two or more altitudes.

[Supp. 24, 19 F. R. 4451, July 20, 1954]

§ 4b.114 Take-off speeds.

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

(b) The minimum take-off safety speed V_2, in terms of calibrated air speed, shall be selected by the applicant so as to permit the rate of climb required in § 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 § 4b.133.

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

[15 F. R. 3543, June 8, 1950, as amended by Amdt. 4b-2, 20 F. R. 5304, July 26, 1955]

§ 4b.114-1 Selection of the take-off speeds (FAA policies which apply to § 4b.114).

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

(c) The minimum take-off 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 take-off conditions in flight. (See § 4b.133.)

[Supp. 24, 19 F. R. 4451, July 20, 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.

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

(a) *Establish representative dimension.* 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 take-off 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 take-off 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 take-off, additional tests should be conducted to cover the flap range. (See § 4b.118-1 (d) (2).)

[6] See § 4b.115-2 for policies covering automatic feathering propellers.

(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 take-off gross weight with the airplane at this maximum take-off weight. The true ground speed at the start of the deceler-

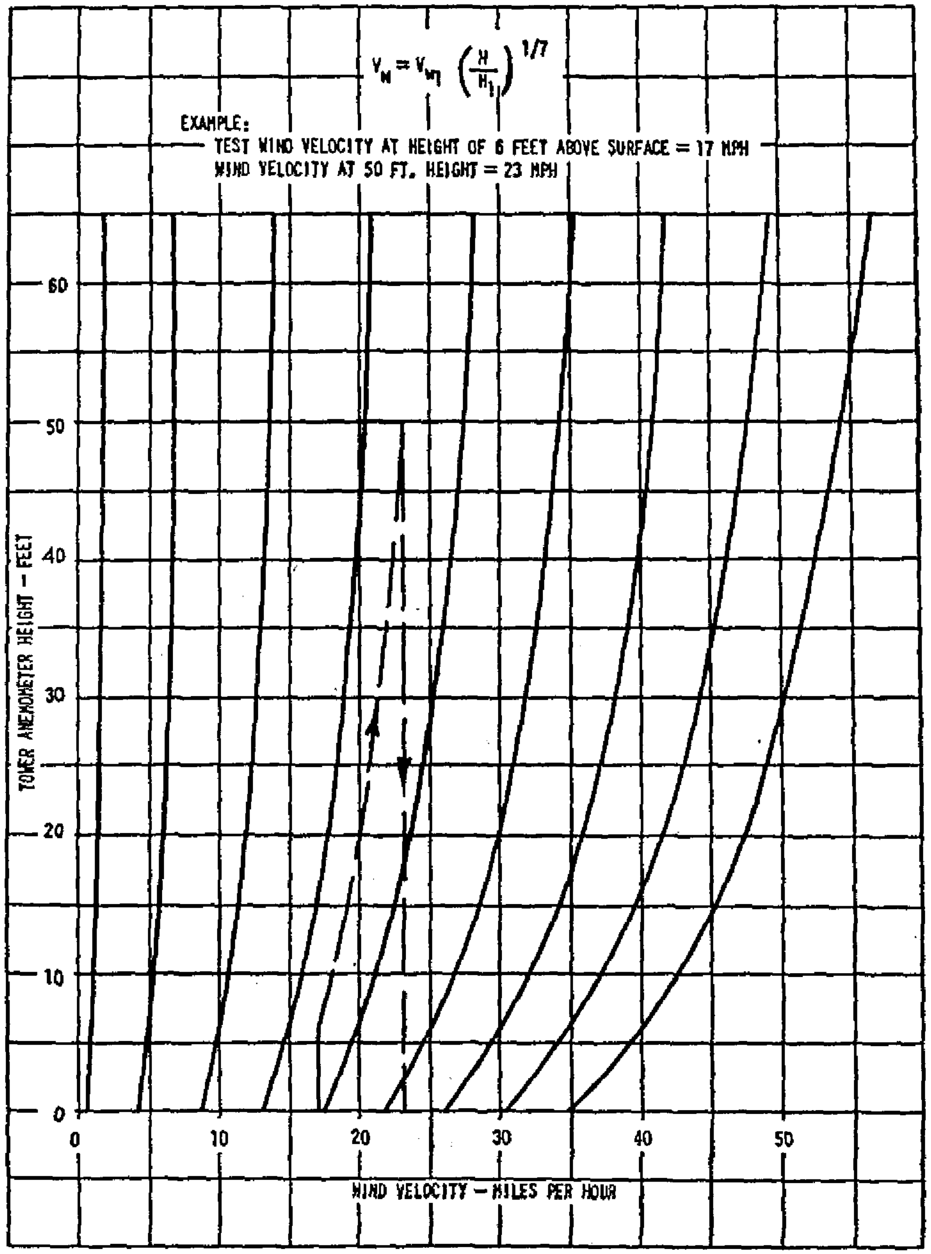


FIGURE 2—Wind Velocity Gradient.

ation 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 take-offs and the decelerations during landings at the take-off configuration providing a minimum of one acceleration and stop run is conducted at the maximum take-off 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 rpm, *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 § 4b.740–1 (d) (2) (x)), the manual data should be based 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 take-off 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 take-off and one lower.
C. G. position—Most forward. (Most aft for reverse thrust decelerations.)
Wing flaps—Take-off position.
Landing gear—Extended.
Operating engines—During acceleration, all engines operating at full take-off power and rpm; cowl flaps set in take-off position (see § 4b.118–1 (d) (1)).
Inoperative engines—During deceleration, throttles closed; propellers windmilling in take-off pitch (except for failed engine with automatic feathering see § 4b.115–2); cowl flaps set in take-off position (see § 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.
Rpm (obtained during acceleration and deceleration).
Manifold pressure.
Torque pressure.
Carburetor air temperature.
Mixture setting.
Cowl flap position.
Wing flap position.
Time, distance and air speed 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.

[Supp. 24, 19 F. R. 4451, July 20, 1954]

§ 4b.115–2 Approval of automatic propeller feathering installations for use in establishing accelerate-stop distance (FAA policies which apply to § 4b.115).

The accelerate-stop distance 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 §§ 4b.10–2, 4b.401–1, 4b.700–1, and Civil Air Regulations Part 4b Interpretation No. 1, § 4b.133 note.)

[Supp. 23, 19 F.R. 1818, Apr. 2, 1954]

§ 4b.115–3 Reverse thrust used in accelerate-stop distance (FAA policies which apply to § 4b.115).

The policies outlined in § 4b.402–1(k) will apply.

[Supp. 25, 20 F.R. 2277, Apr. 8, 1955]

§ 4b.115–4 Accelerate-stop distance with an antiskid device installed (FAA policies which apply to § 4b.115).

The policies outlined in § 4b.337–4 will apply.

[Supp. 26, 21 F.R. 2558, Apr. 19, 1956]