

CIVIL AERONAUTICS MANUAL 8

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Civil Aeronautics Administration

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Subject: 8.10
Eligibility for Type Certificate

The purpose of this supplement is to provide holders of Civil Aeronautics Manual 8 with amended policy concerning airworthiness requirements for special purpose aircraft and with a copy of Appendix B to Manual 8, entitled "Airworthiness Criteria for Agricultural and Similar Special Purpose Aircraft."

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Appendix B

Office of Aviation Safety

E. S. HENSLEY, Director

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AIRCRAFT AIRWORTHINESS

RESTRICTED CATEGORY

§ 8.0 *Applicability of this part.* This part establishes standards for the issuance of type and airworthiness certificates for aircraft in the restricted category which are intended to be operated for agricultural, industrial, or other special purposes. This part also establishes operating limitations applicable to such aircraft.

§ 8.0-1 *Eligible special purposes (CAA interpretations which apply to § 8.0).*

(a) The operating limitations specified in §§ 8.32 and 8.33 limit the special purposes for which an aircraft may be certificated in the restricted category under Part 8. Section 8.32 prohibits the carriage of persons or cargo for hire in restricted category aircraft. Section 8.33 prohibits the carriage of persons other than the crew during special purpose operations. A flight operation involving the carriage of persons or cargo under the conditions prohibited by §§ 8.32 or 8.33 will therefore not be considered an eligible special purpose for certificating the aircraft under the provisions of Part 8.

(b) The following are examples of special purpose operations considered to be within the applicability of Part 8:

Agricultural—spraying, dusting, and seeding; livestock and predatory animal control. Forest and wildlife conservation.

Aerial surveying—photography, mapping; oil and mineral exploration.

Patrolling—pipelines, power lines, canals.

Weather control—cloud seeding.

Aerial advertising—skywriting, banner towing airborne signs and public address systems.

Appropriate combinations of such special purposes will also be eligible.

NOTE: A Certificate of Waiver or Authorization is required to conduct special purpose operations over certain areas (see §§ 8.31 and 8.31-1).

§ 8.0-2 *Applicability to aircraft previously certificated in the restricted category (CAA policies which apply to § 8.0).*

(a) Aircraft which were certificated in the restricted category prior to the effective

date of Part 8 (October 11, 1950) may at the option of the owner retain their existing certification status.

(b) Alternatively, aircraft previously certificated in the restricted category may be recertificated under Part 8 as follows:

(1) If the aircraft is not modified from its previously approved configuration, the applicant should apply for recertification in accordance with § 8.20-1 (a). The CAA representative, without further inspection of the aircraft, will issue a revised Operation Limitations Form ACA-309 (See § 8.30-1) indicating that the aircraft is certificated under Part 8. For agricultural aircraft the placard capacities of hoppers and tanks may be established and revised by the owner in accordance with § 8.10-4 (b). Repairs and alterations to such aircraft made after recertification under Part 8 will be handled in accordance with § 8.20-3.

(2) If the configuration of the aircraft is modified (i. e. a major alteration) from the previously approved configuration, the recertification procedure will be that specified in § 8.10-3.

(c) On or after October 11, 1950, an aircraft certificated for the first time in the restricted category must be certificated under Part 8, since previous restricted category requirements are rescinded on that date.

§ 8.0-3 *Applicability to aircraft certificated in a category other than restricted category (CAA policies which apply to § 8.0).* (a) Part 8 does not require an aircraft used for a special purpose to be certificated in the restricted category. An aircraft modified for a special purpose may therefore be certificated in a category other than the restricted category (e. g. normal, utility or acrobatic category), provided the modified aircraft fully complies with the airworthiness requirements for such category.

(b) An aircraft which has been previously modified and then certificated in a category other than restricted (as described in paragraph (a) of this section), may either retain its existing certification status or be recertificated in the restricted category under Part 8 in accordance with the procedure specified in § 8.0-2 (b). In the latter case, the CAA representative will issue both a revised Certificate of Airworthiness and revised Operation Limitations.

(c) An aircraft which has been previously type certificated in another category and then modified for a special purpose may be certificated in the restricted category in accordance with the procedure specified in § 8.10-3.

(d) An aircraft which has been certificated in the restricted category under Part 8 may be recertificated in another category when:

(1) The aircraft is restored to a configuration which is eligible for certification under an existing type certificate in such category, or

(2) Any changes from such configuration are shown to comply with the airworthiness requirements for the appropriate category.

(e) An aircraft may, however, be certificated in the restricted and other categories in accordance with the multiple airworthiness certification provisions of § 8.21.

§ 8.1 Definitions. (a) As used in this part, terms shall be defined as follows:

(1) *Administrator*. The Administrator is the Administrator of Civil Aeronautics.

(2) *Applicant*. An applicant is a person or persons applying for approval of an aircraft 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.

(4) *Authorized representative of the Administrator*. An authorized representative of the Administrator shall mean any employee of the Civil Aeronautics Administration or any private person, authorized by the Administrator to perform any of the duties imposed upon him by the provisions of this part.

§ 8.1-1 *Authorized representative of the Administrator (CAA interpretations which apply to § 8.1 (a) (4))*. The term

'private person' mentioned in this section is interpreted to mean a Designated Aircraft Maintenance Inspector (DAMI), or a Designated Manufacturing Inspection Representative (DMIR). All such persons are issued a Certificate of Authority, Form ACA-1382, for the purpose of identification.

§ 8.10 *Eligibility for type certificate*. (a) Any aircraft of the following classifications shall be issued a type certificate in the restricted category, if the Administrator finds that no feature or characteristic of the aircraft renders it unsafe when operated in accordance with the limitations prescribed for its intended use:

(1) An aircraft type which has not previously been type certificated but which is shown by the applicant to comply with all of the airworthiness requirements of any other aircraft category prescribed in this subchapter, except those requirements which the Administrator finds inappropriate for the special purpose for which the aircraft is to be used; or

(2) An aircraft type which has been manufactured in accordance with the requirements of, and accepted for use by, a United States military service and subsequently modified for a special purpose, whether or not such aircraft has been issued a type certificate under the provisions of Part 9 of this chapter.

(b) A modification of a type certificate may be issued to an applicant for an aircraft which has been previously type certificated in another category and then modified for a special purpose when, upon inspection, the Administrator finds that the modifications conform to a good aeronautical practice and that no feature or characteristic of the aircraft renders it unsafe when operated in accordance with the limitations prescribed for its intended use.

§ 8.10-1 *Aircraft of a type not previously type certificated (CAA policies which apply to § 8.10 (a) (1))*. The following policies apply to the certification of new design restricted category aircraft which have not been type certificated or accepted for use by a U. S. military service.

(a) The applicant should submit an application for type certificate, Form ACA-312, in duplicate, to the appropriate CAA Regional Office, applying for a type certificate under this part. The CAA will issue a type certificate after the aircraft

has been shown to comply with appropriate airworthiness requirements.

(b) To establish the appropriate airworthiness requirements, the applicant may submit a proposal to the CAA Regional Office, Aircraft Division, in which he selects the airworthiness requirements of one of the standard categories (e. g. Normal or Utility in Part 3) as a basis, and indicates any requirements which he considers should be waived or modified for the special purpose involved. After examination of the applicant's proposal, the CAA will advise him of its acceptance as a basis for showing compliance, or specify the requirements which the CAA finds appropriate.

(c) In selecting and showing compliance with the appropriate airworthiness requirements the applicant may use as a guide, the information contained in Appendix B to this part, entitled "Airworthiness Criteria for Agricultural and Similar Special Purpose Aircraft."

§ 8.10-2 Military type aircraft (CAA policies which apply to § 8.10 (a) (2)). For certification in the restricted category, military aircraft are divided into three classes:

(a) *Military aircraft models previously type certificated in the limited category under part 9*

(1) For such aircraft, the certification procedure will be that specified in § 8.10-3.

(2) A list of military models that have been previously type certificated in the limited category is given in CAA Safety Regulation Release No. 277, "Status of Aircraft Certificated in the Limited Category."

(3) Compliance with the military technical orders listed on the CAA aircraft specifications will not be mandatory; however, the applicant should review the changes specified in these orders to determine if they are appropriate for the particular airplane and special purpose.

(b) *Military aircraft models previously type certificated under Part 4a.*

(1) Some military aircraft have been type certificated under Part 4a on the basis of required "conversion modifications" which are listed on the

pertinent CAA aircraft specification. Such modifications will not be mandatory for certification under Part 8; however, the applicant should review the conversion modifications listed on the aircraft specification to determine if they are appropriate to the particular aircraft and special purpose.

(2) For such aircraft the certification procedure will be that specified in § 8.10-3.

(3) A listing of these military aircraft models is given in the CAA "Alphabetical List of Aircraft Specifications" which is included in the files of CAA Regional and District Offices, Aviation Safety Agents and Designated Aircraft Maintenance Inspectors.

(c) *Military aircraft models not previously type certificated in any category.* For military aircraft not covered by paragraphs (a) and (b) of this section, the certification procedure will be that specified in § 8.10-3 upon completing the following initial steps:

(1) The applicant should first submit a letter to the CAA, Aircraft Division, Washington 25, D. C., identifying the military model and the proposed special purpose, and requesting certification under Part 8.

(2) The CAA will check the military record of the aircraft type. If the record discloses unsafe characteristics, the CAA will inform the applicant of these, and the aircraft will not be eligible for certification unless they are corrected or can be compensated by operating restrictions. If the military record is considered satisfactory, the applicant will be so informed, and a type certificate issued for the basic type.

The certification procedure will then continue as specified in § 8.10-3.

§ 8.10-3 Aircraft modified from a previously approved type (CAA policies which apply to § 8.10 (b)). Under the provisions of §§ 8.10 (b) and 8.20 (a), a modification to the type certificate must be issued for an aircraft which has been previously type certificated in another category and then modified for a special purpose, in order to make the aircraft eligible for an airworthiness certificate in the restricted category. A

modification of the type certificate will be issued by means of Repair and Alteration Form ACA-337 upon completion of the procedure specified in paragraphs (a) through (f) of this section.

The term "another category", as used in § 8.10 (b), includes normal, utility, acrobatic, transport or limited categories, under Parts 3, 4a, 4b, 6, or 9 but does not include experimental. For aircraft previously certificated in the restricted category, see § 8.0-2.

(a) *Classes of modifications.* Since modifications may vary in scope from minor alterations to complete redesign of major components, the basis for determining the airworthiness of a modified aircraft will depend upon the nature and extent of the modification. For this purpose, modifications are divided into two classes:

(1) *Visual basis modifications.* Modifications in this class are those for which airworthiness can be determined by visual examination, using as guides the original design of the aircraft and available information on modification practices. (See § 8.10-4.)

The procedure for this class is given in paragraphs (b) through (f) of this section. The submittal of technical data, such as drawings and stress analysis, is not required; however, for some modifications of this class it may be desirable to obtain engineering advice.

Examples of this class are:

(i) The removal of a diagonal from a lower fuselage bay and substitution of equivalent bracing, installation of a hopper, and increase of engine weight and power, using information referenced in § 8.10-4 as a guide.

(ii) Reduction in span of a strut braced monoplane. In this case engineering advice should be obtained, since the loads in the wing spars may or may not be seriously changed, depending on the relative location of the strut attachment point in the original and modified designs. In such cases, the CAA will furnish technical assistance upon request by the applicant.

(2) *Design requirement modifications.* Some modifications may be so extensive that the original design of the aircraft and available information on modifica-

tion practices no longer furnish a suitable basis for determining airworthiness.

An example is the conversion of a monoplane to a biplane, in which case the original design does not furnish an adequate basis of comparison for judging the structural strength of the new lift truss.

The airworthiness of this class of modifications should be determined in accordance with the applicable parts of the airworthiness requirements for new design aircraft, as specified in § 8.10-1 (b) or (c). Technical data or other proof of compliance should be submitted in accordance with those requirements.

(b) *Application.* The applicant should apply to a CAA Aviation Safety District Office, CAA Aviation Safety Agent, or a Designated Aircraft Maintenance Inspector (DAMI) who has been specifically authorized to perform restricted category certification, and request certification of the modified aircraft in the restricted category. The following documents should be submitted by the applicant:

(1) Duplicate copies of Repair and Alteration Form ACA-337. (See paragraph (d) of this section.) These forms are prepared by the agency performing the modification.

(2) Application for Airworthiness Certificate and/or Annual Inspection of an Aircraft Form ACA-305. (See § 8.20-1 (a).)

These forms are obtainable from all CAA Regional and District Offices and DAMI's. The applicant may consult with CAA or proceed with the modification prior to making formal application.

(c) *Performance of modification.* The modification to the aircraft should be performed by or under the supervision of an authorized agency (i. e., a certificated mechanic, or approved repair station having the proper ratings, or the manufacturer of the aircraft) as specified by § 18.10. Information for guidance in performing modifications is referenced in §§ 8.10-4 and 8.10-5.

(d) *Form ACA-337.* Two copies of Repair and Alteration Form ACA-337 should be prepared by the agency performing the modification, in accordance with the following:

APPENDIX B

AIRWORTHINESS CRITERIA FOR AGRICULTURAL AND SIMILAR SPECIAL PURPOSE AIRCRAFT

November 15, 1951

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APPENDIX B

Airworthiness Criteria for Agricultural and Similar Special Purpose Aircraft

.0 BASIS AND PURPOSE

These airworthiness criteria are issued by the Administrator as a guide whereby the applicant for a type certificate may select the appropriate airworthiness requirements for agricultural and similar special purpose aircraft in accordance with CAM 8.10-1. In accordance with CAR 8.10 (a) (1), these airworthiness criteria have been derived from Part 3 of the Civil Air Regulations, "Airplane Airworthiness—Normal, Utility, and Acrobatic Categories," as amended to July 1, 1951. Certain requirements of CAR 3 have been waived, modified, or presented in a different form, to provide criteria appropriate to the types of airplanes and operations provided in section .00 of this Appendix, and to simplify methods and procedures for showing compliance, in accordance with the objectives of CAR 8, as stated by the Civil Aeronautics Board in the preamble to that Part. (The Preamble is quoted in CAM 8.)

.00 Scope and Applicability. These criteria may be used as the basis for the issuance or modification of type certificates in the restricted purpose category of an aircraft intended to be operated for agricultural and similar special purpose operations. The criteria provided herein are applicable to single-engine airplanes intended for low speed dusting, spraying, and similar types of operations.

.01 Safety Recommendations. Several safety recommendations for consideration in the basic design of the aircraft are also included with these criteria. Additional suggestions and examples dealing with the safety aspects of agricultural aircraft and the dispensing installations are published in Appendix A to Civil Aeronautics Manual 8, entitled, "Restricted Category Aircraft Modifications."

.02 Type Certificate. An applicant will be issued a type certificate after the aircraft has been shown to comply with these airworthiness criteria together with procedural requirements described in Part 1 of the Civil Air Regulations. The procedure is further explained in CAM 8.10-1 and CAM 8.10-3 (a) (2) of Civil Aeronautics Manual 8.

.03 Airworthiness Certificate. An airworthiness certificate will be issued for aircraft type certificated in the restricted category under Civil Air Regulations 8.10 (a) (1) and subsequently manufactured under this type certificate when upon inspection of the airplane the Administrator determines that it conforms to the type design and is in condition for safe

operation, and has prescribed operating limitations in accordance with CAR 8.30 and CAM 8.30-1. The procedures for issuance of an airworthiness certificate are described in Parts 1 and 8 of the Civil Air Regulations and further explained in CAM 8.20-2 of Civil Aeronautics Manual 8.

.04 Procedure for Showing Compliance

(a) To expedite approval of the type design at least the following information should be forwarded to the CAA in the early stages of the project:

(1) A general description of the airplane and any unusual or unconventional features therein, together with a three-view dimensional drawing.

(2) A statement of loading conditions to be used for major components. Where loading conditions differ from those specified in these criteria a complete description of the loadings used and their source are required.

(3) A statement outlining the method of analysis and tests to be conducted in substantiation of structural and powerplant items. This statement may be combined with the statement of (2) above if desired.

(b) Prior to certification, the applicant for a type certificate should either forward to or make available for review by the Administrator such other descriptive data, test reports, and computations as are necessary to demonstrate that the aircraft complies with these criteria. This technical information should be forwarded within three months after certification.

.05 Inspections and Tests. Representatives of the Administrator should have access to the airplane and may witness or conduct such inspections and tests as are necessary in complying with these criteria.

.06 Individual Certification. When an applicant requests certification of aircraft on an individual basis, he should show that the actual aircraft conforms to, or is conservative with respect to, the materials, dimensions, and other data used in the analytic or test reports.

.07 Certification of Series Aircraft. When the holder of a type certificate requests airworthiness certification of a series of aircraft by comparison with the basic type, he should have available sufficient drawings, jigs, templates, or sample parts to show that the series aircraft are equivalent to or better than the one originally type certificated, in respect to compliance with these criteria.

.08 Changes. Changes of the type design previously approved by the CAA are divided into the following classes:

.080 MINOR CHANGES. Minor changes which obviously do not impair the airworthiness of the aircraft need not be approved by the CAA.

.081 VISUAL BASIS CHANGES. Changes in this class are those for which the airworthiness may be determined by visual inspection by a representative of the Administrator and need not be substantiated by the submittal of technical data. However, a brief description of such modifications should be forwarded to the CAA for their reference file.

.082 DESIGN REQUIREMENT CHANGES. When changes other than those described in sections .080 and .081 are made, the altered aircraft should be shown to comply with the applicable airworthiness requirements.

.083 SERVICE EXPERIENCE CHANGES. When experience shows that any particular part or characteristic of the aircraft causes an unsafe condition, the Administrator may require appropriate changes to correct such condition.

.09 Definitions.

.090 GENERAL.

.0900 *Standard Atmosphere*. The standard atmosphere should be based upon the following assumptions:

- (a) The air is a dry perfect gas.
- (b) The temperature at sea level is 59°F.
- (c) The pressure at sea level is 29.92 inches Hg.
- (d) The temperature gradient from sea level to the altitude at which the temperature becomes -67°F. is -0.003566°F. per foot and zero thereabove.
- (e) The density ρ_0 at sea level under the above conditions is 0.002378 lbs. sec.²/ft.⁴.

.0901 *Airplane Configuration*. This term refers to the position of the various elements affecting the aerodynamic characteristics of the airplane, such as landing gear and flaps.

.091 WEIGHTS.

.0910 *Empty weight*. (See section .111.)

.0911 *Maximum weight*. (See section .112.)

.0912 *Minimum weight*. (See section .113.)

.092 POWER. Take-off and maximum continuous power ratings are those established in accordance with CAR 13.

.093 SPEEDS.

.0930 V_t — True air speed of the airplane relative to the undisturbed air.

*Reference
Sections*

In the following symbols having subscripts, V denotes:

- (a) "Equivalent" air speed for structural design purposes equal to $V_t \sqrt{\rho/\rho_0}$.
- (b) "True indicated" or "calibrated" air speed for performance and operating purposes equal to indicator reading corrected for position and instrument errors.

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.0934 V_M —design maneuvering speed..... .2100

.0935 V_d —design dive speed..... .2100

.0936 V_{ne} —never exceed speed..... .6100

.094 STRUCTURAL TERMS.

.0940 *Structure.* Those portions of the airplane the failure of which would seriously endanger the safety of the airplane.

.0941 *Design Wing Area, S.* The area enclosed by the wing outlined (including ailerons and flaps in the retracted position, but ignoring fillets and fairings) on a surface containing the wing chords. The outline is assumed to extend through the nacelles and fuselage to the centerline of symmetry.

.0942 *Design Wing Loading, W/S.* The maximum weight of the airplane divided by the design wing area.

.0943 *Limit Load.* The maximum load anticipated in service.

.0944 *Ultimate Load.* The maximum load which a part of structure should be capable of supporting.

.0945 *Factor of Safety.* The factor by which the limit load should be multiplied to establish the ultimate load.

.0946 *Load Factor or Acceleration Factor, n* . The ratio of the force acting on a mass to the weight of the mass. When the force in question represents the net external load acting on the airplane in a given direction, n represents the acceleration in that direction in terms of the gravitational constant.

.0947 *Limit Load Factor*. The load factor corresponding to limit load.

.0948 *Ultimate Load Factor*. The load factor corresponding to ultimate load.

.095 FIRE PROTECTION.

.0950 *Fireproof*. "Fireproof" material means a material which will withstand heat equally well or better than 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.

.0951 *Fire-Resistant*. When applied to sheet or structural members, "fire-resistant" material means a material which will withstand heat equally well or better than aluminum alloy in dimensions appropriate for the purpose for which it is to be used. When applied to fluid-carrying lines, this term refers to a line-and-fitting assembly which will perform its intended protective functions under the heat and other conditions likely to occur at the particular location.

.0952 *Flame-Resistant*. "Flame-resistant" material means material which will not support combustion to the point of propagating, beyond safe limits, a flame after removal of the ignition source.

.0953 *Flash-Resistant*. "Flash-resistant" material means material which will not burn violently when ignited.

.0954 *Inflammable*. "Inflammable" fluids or gases mean those which will ignite readily or explode.

.096 APPROVED. Approved, when used alone or as a modifying term, (such as approved methods, devices, specifications, materials, etc.) means approved by the Administrator.

.1 FLIGHT

.10 Procedure. Flight tests should be made to demonstrate the existence of satisfactory flight and ground handling characteristics. As a minimum measure of airworthiness, compliance with the standards specified in this section should be shown at the critical combination of weight and center of gravity within the range of either for which certification is desired.

.11 Weight and Balance. There should be established, as part of the type inspection, ranges of weight and center of gravity within which the airplane can be safely operated. Where comparatively large vertical movement of the center of gravity is allowed, consideration should be given to determining the effect on the flight characteristics.

.110 EMPTY WEIGHT. The empty weight and corresponding center of gravity location should include all fixed ballast, undrainable oil, full engine coolant, and hydraulic fluid.

.111 MAXIMUM WEIGHT. The maximum weight should not exceed any of the following:

- (a) the weight selected by the applicant,
- (b) the design weight for which the structure has been proven,
- (c) the maximum weight at which compliance with the flight standards is demonstrated.

.112 MINIMUM WEIGHT. The minimum weight should not exceed the sum of the following:

- (a) the empty weight
- (b) the minimum cargo (170# in each seat)
- (c) 1 gallon of fuel for every 12 maximum continuous horsepower for which the airplane is certificated,
- (d) either 1 gallon of oil for each 25 gallons of fuel specified in (c) or 1 gallon of oil for each 75 maximum continuous horsepower for which the airplane is certificated, whichever is greater.

.12 Performance

.120 STALLING SPEEDS. The following should be determined using the procedure outlined in .1330(e):

- (a) V_{S_0} —the stalling speed or the minimum steady flight speed with:
 - (1) engine idling, throttle closed (or not more than sufficient power for zero thrust),
 - (2) propeller in 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 allowable landing range,
- (7) maximum weight.

(b) V_{s1} —the stalling, or the minimum steady flight speed with:

- (1) engine idling, throttle closed (or not more than sufficient power for zero thrust),
- (2) propeller in position normally used for take-off, the airplane in all other respects (flaps, landing gear, etc.), in the particular condition existing in that particular test in connection with which V_{s1} is being used,
- (3) Maximum weight.

.121 STALLING SPEED LIMIT. The stalling speed at maximum weight in the configuration used during normal operations should not exceed 70 mph.

Recommendation.—Studies of forced landings show that, all other things being equal, the fatality rate is proportional to the stall speed, i.e., as the stall speed increases, the number of fatalities per accident increases. The record indicates that fatality rate increases rapidly above approximately 55 mph. Therefore, it is strongly recommended that the stall speed not exceed 55 mph in the landing configuration at maximum weight.

.122 NORMAL CLIMB. The steady rate of climb under sea level standard conditions should be at least 8 V_{s1} or 300 feet per minute, whichever is greater, with:

- (a) maximum weight,
- (b) not more than maximum continuous power,
- (c) landing gear fully retracted,
- (d) wing flaps in the position selected by the applicant for the intended operation.

.13 Flight Characteristics

.130 CONTROLLABILITY

.1300 *General.* The airplane should be satisfactorily controllable and maneuverable during maneuvers appropriate to the intended operation including take-off, climb, level flight, dive, and landing, with or without power. It should be possible to make a smooth transition from one flight condition to another, including turns and slips, without requiring an exceptional degree of skill, alertness, or strength on the part of the pilot, and without danger of exceeding the limit load factor under all conditions of operation probable for the type.

Recommendation.—In cases where the control forces are considered marginally high the following limits are recommended:

	Type	Pitch	Roll	Yaw
(a) For temporary application.....	Stick	60	30	150
	Wheel	75	60	150
(b) For prolonged application.....		10	5	20

.1301 *Longitudinal Control.* (a) It should be possible at all speeds below $1.3 V_{s1}$ to pitch the nose downward so that the rate of increase in air speed is satisfactory for prompt acceleration to $1.3 V_{s1}$ with:

- (1) maximum continuous power, the airplane trimmed at $1.3 V_{s1}$,
- (2) power off, the airplane trimmed at $1.4 V_{s1}$,
- (3) wing flaps and landing gear both extended and retracted.

(b) Demonstrations should be made to show that all reasonable changes in flap position and power can be made suddenly at any appropriate airspeed without requiring a change in trim control setting or the exertion of more control force than can be applied readily with one hand for a short period of time.

.131 TRIM. The means used for trimming the airplane should be such that, after being trimmed, and without further pressure upon or movement of either the primary control or its corresponding trim control by the pilot, the airplane will maintain:

(a) lateral and directional trim in level flight at the normal operating speed with the landing gear and flaps retracted,

(b) longitudinal trim during level flight at any speed from $1.3 V_{s1}$ to $1.8 V_{s1}$, with landing gear retracted and with wing flaps in the position selected by the applicant for the intended operation.

.132 STABILITY. The airplane should be longitudinally, directionally, and laterally stable in accordance with the following sections. Suitable stability and control "feel" (static stability) should be required in other conditions normally encountered in service, if flight tests show such stability to be necessary for safe operation.

.1320 *Static Longitudinal Stability in the Climb.*

(a) From $1.2 V_{s1}$ to $1.6 V_{s1}$ the slope of the stick force curve should be stable and such that any substantial change in speed is clearly perceptible to the pilot through a resulting change in stick force with:

- (1) wing flaps retracted,
- (2) landing gear retracted,
- (3) maximum weight,
- (4) maximum continuous power,
- (5) the airplane trimmed at $1.4 V_{s1}$.

(b) The friction within the control system should be such that the airspeed will return to within 10 percent of the original trim speed when the control force is slowly released from any speed from $1.2 V_{S_1}$ to $1.6 V_{S_1}$.

.1321 *Static Directional and Lateral Stability*

(a) The static directional stability, as shown by the tendency to recover from a skid with rudder free, should be positive for all flap positions and power conditions, and for all speeds from $1.2 V_{S_1}$ up to the maximum permissible speed,

(b) The static lateral stability as shown by the tendency to raise the low wing in a side-slip, for all flap positions and power conditions, should:

- (1) be positive at the maximum permissible speed,
- (2) not be negative at a speed equal to $1.2 V_{S_1}$.

(c) In straight steady sideslips, the aileron and rudder control movements and forces should increase steadily, but not necessarily in constant proportion, with increase in angle of sideslip. Rudder pedal forces should not reverse at any obtainable combination of sideslip and rudder angle.

(d) Sufficient bank should accompany sideslipping to indicate adequately any departure from steady unyawed flight.

.1322 *Dynamic Stability*. Any short period oscillation about any of the three primary axes occurring between stalling speed and maximum permissible speed should be heavily damped with the primary controls (a) free, and (b) in a fixed position.

.133 STALLING

.1330 *Level Flight Stalls*. (a) Stalls should be demonstrated under two conditions:

- (1) with power off,
- (2) with maximum continuous power.

(b) In either condition it should be possible, with flaps and landing gear in any position, with center of gravity in the position least favorable for recovery, and with appropriate airplane weights, to produce and to correct roll by unreversed use of the rolling control and to produce and to correct yaw by unreversed use of the directional control, during the maneuver described in (e), up to the time when the airplane pitches.

(c) A clear and distinctive stall warning should be unmistakably apparent to the pilot at a speed of 5 mph but not more than 10 mph above the stalling speed with flaps and landing gear in any position, both in straight and turning flight.

(d) During the recovery portion of the maneuver it should be possible to prevent more than 15 degrees roll or yaw by the normal use of the controls, and any loss of altitude in excess of 100 feet or any pitch in

excess of 30 degrees below level should be indicated on a placard in the cockpit and in clear view of the pilot.

(e) In demonstrating these qualities, the order of events should be:

(1) with trim controls adjusted for straight flight at a speed of approximately $1.4 V_{S1}$, reduce speed by means of the elevator control until the speed is steady at slightly above stalling speed, then

(2) pull elevator control back at a rate such that the airplane speed reduction does not exceed one mile per hour per second until a stall is produced as evidenced by an uncontrollable downward pitching motion of the airplane, or until the control reaches the stop. Normal use of the elevator control for recovery may be made after such pitching motion is unmistakably developed.

.1331 Turning Flight Stalls. When stalled during a coordinated 30° banked turn with 75 percent maximum continuous power, flaps and landing gear retracted, it should be possible to recover to normal level flight without encountering excessive loss of altitude, uncontrollable rolling characteristics, or uncontrollable spinning tendencies. These qualities should be demonstrated by performing the following maneuvers:

With the airplane in a coordinated 30° banked turn in level flight, the airspeed should be decreased by steadily and progressively tightening the turn with the elevator control until the airplane is stalled or until the elevator has reached its stop. When the stall has fully developed, recovery to level flight should be made with normal use of the controls.

Recommendation.—For aircraft designed for low speed flight, such as dusting, it is strongly recommended that the airplane be made as stall proof and spin proof as practicable.

.14 Ground Characteristics

.140 LONGITUDINAL STABILITY AND CONTROL. There should be no uncontrollable tendency to nose over in any operating condition reasonably expected for the type, or when rebound occurs during landing or take-off. Wheel brakes should operate smoothly and should exhibit no undue tendency to induce nosing over.

.141 DIRECTIONAL STABILITY AND CONTROL. (a) There should be no uncontrollable looping tendency in 90° crosswinds up to a velocity equal to $0.2 V_{S0}$ at any speed at which the aircraft may be expected to be operated upon the ground.

(b) The airplane should be demonstrated to be satisfactorily controllable without exceptional degree of skill or alertness on the part of the pilot in power-off landings at normal landing speed and during which brakes or engine power are not used to maintain a straight path.

(c) Means should be provided for adequate directional control during taxiing.

.142 SHOCK ABSORPTION. The shock absorbing mechanism should not produce damage to the structure when the airplane is taxied on the roughest ground which it is reasonable to expect the airplane to encounter in normal operation.

.15 Flutter and Vibration. All parts of the airplane should be demonstrated to be free from flutter and excessive vibration under all speed and power conditions appropriate to the operation of the airplane up to at least the minimum value permitted for V_d flight in .2100. There should also be no buffeting condition in any normal flight condition severe enough to interfere with the satisfactory control of the airplane, or result in structural damage. However, buffeting as stall warning, is considered desirable and discouragement of this type of buffeting is not intended.

.2 STRENGTH CRITERIA

.20 General

.200 LOADS. The strength criteria of the following sections are specified in terms of limit and ultimate loads. Limit loads are the maximum loads anticipated in service. Ultimate loads are equal to the limit loads multiplied by the factor of safety.

.2000 *Applicability of Loads.* The air and ground loads specified in sections .21 and .22 are considered to be adequate for design of a conventional type aircraft suitable for agricultural and similar special purposes and may be used without further substantiation. For unconventional type aircraft for which little experience is available or for which it is evident that the loadings specified in the following sections are either unconservative or inapplicable, the applicant should propose suitable loading criteria for approval or comment by CAA. The term unconventional as used above refers to the basic design and Aerodynamic characteristics of the airplane as a whole and/or its major components and for which considerable experience and reliable test data are already available.

.201 FACTOR OF SAFETY. The factor of safety should be 1.5 unless otherwise specified.

.202 STRENGTH AND DEFORMATIONS. The structure should be capable of supporting limit loads without suffering detrimental permanent deformations. At all loads up to limit loads the deformation should be such as not to interfere with the safe operation of the airplane. The structure should be capable of supporting ultimate loads without failure for at least three seconds, except that when proof of strength is demonstrated by dynamic tests simulating actual conditions of load application, the three-second limit does not apply.

.203 PROOF OF STRUCTURE. Structural analysis may be used for proof of compliance with these criteria provided the structure conforms to types for which experience has shown such methods to be reliable. Structural static tests or dynamic tests, including flight tests, may also be used to demonstrate compliance with these criteria. If desired, combinations of structural tests, flight tests, and analyses may be employed. If static tests are used for proof of compliance, these tests should be carried to ultimate load unless supplemented by analyses. No material correction factor need be applied in cases of tests of structural components. If dynamic tests, including flight tests, are used for demonstration of compliance, they need only be carried to 1.15 times limit load and need not be supplemented by analyses. In the event that dynamic tests, including flight tests are employed, the aircraft used for the tests should be instrumented sufficiently to show that the design conditions have been met. In all cases certain portions of the structure should be subjected to tests as described in section .216.