CIVIL AERONAUTICS BOARD
BUREAU OF SAFETY REGULATION
WASHINGTON, D. C.

September 25, 1950

CIVIL AIR REGULATIONS DRAFT RELEASE NO. 50-7

SUBJECT: First annual review and amendment of airworthiness regulations

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The Bureau of Safety Regulation has under consideration the attached amendments to the airworthiness parts of the Civil Air Regulation.

Also attached hereto is an "Explanatory Statement," setting forth the basis and purpose of the proposed rules and "Proposed Rules," setting forth the substance of the proposed amendments.

The proposal is being published in the Federal Register as a notice of proposed rule making.

The Bureau desires that all interested persons in the aviation industry who will be affected by the requirements of this proposal be fully informed as to the effect of the proposal upon their operations. To accomplish this objective the proposal is being circulated to the aviation industry in order to afford interested persons ample opportunity to submit to the Bureau such comments as they may desire. In order that such persons may have complete information readily available without the necessity of referring to other documents, we have attached an exact copy of the proposal as being published in the Federal Register.

Because of the large number of comments which we anticipate receiving in response to this draft release, we will be unable to acknowledge receipt of each reply. However, you may be assured that all comment will be given careful consideration. The proposed amendments when finally adopted by the Board may be changed in light of the comment received in response to this draft release and the notice of proposed rule making.

It should be noted that comments must be submitted in duplicate and in order to receive consideration should be received by the Bureau not later than October 31, 1950.

John M. Chamberlain
Director, Bureau of Safety Regulation

CIVIL AERONAUTICS BOARD

/14 CFR, Parts 1, 2, 3, 4b, 6, 15/

FIRST ANNUAL REVIEW AND AMENDMENT OF AIRWORTHINESS REGULATIONS

Pursuant to authority delegated by the Civil Aeronautics Board to the Bureau of Safety Regulation, notice is hereby given that the Bureau will propose to the Board amendments of airworthiness parts of the Civil Air Regulations in substance as hereinafter set forth.

Interested persons may participate in the making of the proposed rules by submitting such written data, views, or arguments as they may desire. Communications should be submitted in duplicate to the Civil Aeronautics Board, attention Bureau of Safety Regulation, Washington 25, D. C. All communications received by October 31, 1950, will be considered by the Board before taking further action on the proposed rules. Copies of such communications will be available after November 3, 1950, for perusal by interested persons at the Docket Section of the Board, Room 5412, Commerce Building, Washington, D. C.

In a policy statement dated October 6, 1949, the Civil Aeronautics Board announced a procedure for the annual review of airworthiness parts of the Civil Air Regulations. It was then indicated that after consideration of comments on, and suggestions for amendment of, the airworthiness requirements at the annual review meetings, which were to be held in the first two weeks of August 1950, that by October 1, 1950, there would be published a notice of proposed rule making indicating those specific amendments which, in the opinion of the Bureau of Safety Regulation, should be recommended for adoption by the Board.

Attached hereto are the amendments proposed under the caption, "Proposed Rules." Also attached is an "Explanatory Statement" setting forth the basis and purpose thereof.

It will be noted that due to circumstances resulting from the current military situation, it was impossible to consider at the annual review meetings any of the more complicated questions in transport category airworthiness requirements. Such matters will, therefore, be handled on an ad hoc basis outside of the scope of the annual review.

These amendments are proposed under the authority of Title VI of the Civil Aeronautics Act of 1938, as amended.

(Sec. 205 (a), 52 Stat. 984, 49 U.S.C. 425 (a). Interpret or apply secs. 601 - 610, 52 Stat. 1007 - 1012, 49 U.S.C. 551 - 560)

Dated September 20, 1950, at Washington, D. C.

By the Bureau of Safety Regulation:

John M. Chamberlain

(SEAL) John M. Chamberlain
Director

EXPLANATORY STATEMENT

The following statement sets forth the basis and purpose of the proposed amendments to the Civil Air Regulations under headings designed to facilitate reference thereto.

PART 1 - CERTIFICATION, IDENTIFICATION, AND MARKING OF AIRCRAFT AND RELATED PRODUCTS

Proposed Part 1 includes a revision of current Parts 1 and 2 and portions of Part 43. It is an attempt to synthesize and systematize the administrative rules for obtaining necessary aircraft and product certification. It also provides for the identification of products and aircraft in accordance with current requirements. In most significant respects, the part does not attempt to change current procedures or practices, but merely to reflect them accurately.

The most important changes from current requirements in the proposal are those affecting the duration of airworthiness certificates, and the provision in the proposal that airworthiness certificates shall be of one-year duration automatically renewable when maintained under a continuous maintenance system, or reissued upon satisfactory completion of the annual inspection does not depart radically from current practice. In addition, the part contains new requirements designed to permit more adequate supervision of products manufactured by a subsidiary manufacturer.

PART 3 - AIRPLANE AIRWORTHINESS - NORMAL, UTILITY, AND ACROBATIC CATEGORIES

The most extensive amendments resulting from the annual review cycle are those proposed for Part 3.

A considerable step towards simplifying type certification of small aircraft is proposed. For example, aircraft of 6,000 pounds or less maximum certificated take-off weight, will not be subject to the required service tests, and take-off, climb, landing, and trim requirements have been modified.

In addition, the current spin recovery requirements have been modified to permit demonstration of recovery with use of normal controls, and more realistic requirements for stall handling characteristics are set forth. It is further proposed, on the other hand, to provide a requirement for stall warning indication. Analysis of available safety statistics appears to establish that such modification of the regulations would contribute substantially to safety.

Amendments are also proposed to increase the crash load factor requirements for seat attachments and safety belt anchorages. The values proposed are designed to increase the chance of survival in crashes where the cabin structure remains relatively intact, and are consistent with the recently established crash load factor requirements for safety belts.

There are additional proposed amendments of a relatively minor nature, based upon experience with the requirements of the part, designed to increase safety or to facilitate administration of the part.

It should be noted that, as a result of discussions held during the annual review meetings, serious consideration is being given to limiting the applicability of Part 3 to airplanes having maximum certificated take-off weights of 12,500 pounds or less, and to establishing a separate cargo category.

POSITION LIGHT REQUIREMENTS

The requirements herein proposed for position lights are little different in substance from those currently in effect except for certain modifications of intensity requirements for transport category aircraft to bring such requirements into conformity with international standards. However, it is our understanding that United States air carrier position light systems already meet such modified requirements.

It is proposed that unnecessary material on position lights be eliminated from the applicable sections of Parts 3, 4b, 6, and 15. In addition, it is proposed that those sections be revised to provide a greater degree of clarity and uniformity.

PART 6 - ROTORCRAFT AIRWORTHINESS

Part 6, as adopted in 1945, was an initial attempt to establish standards for rotorcraft airworthiness. As of that date in view of the then extremely limited experience with rotorcraft, it was undesirable to specify too rigid standards which might have had the effect of restricting the development of rotorcraft. At the present time, in view of the rapid development of this category aircraft since 1945 and increased engineering and operational experience with it, it is possible to specify certain additional standards which must be met for type certification. However, we recognize the fact that rotorcraft are still in a developmental stage where the contribution to safety from a more rigid prescription of standards than proposed would probably be outweighed by the depressing effect of such prescription on new developments from manufacturers in the field and on applications for type certification from manufacturers not yet in the field.

The proposed revision of Part 6 prescribes: (a) conservative added powerplant requirements, (b) more comprehensive performance, flight, and structural requirements, (c) more detailed design and construction requirements, (d) new equipment and operating standards, and (e) the compilation of flight and maintenance manuals to be furnished to operators of rotorcraft. It is our opinion that this revision will substantially increase safety in the rotorcraft field without unduly depressing future development.

The Part also expressly provides that the airworthiness standards to be applicable to the type design shall be those standards in effect at the time of application for the type certificate, thus expressly including in the Part, the industry sponsored principle of non-retroactivity for airworthiness standards. The holder of the type certificate, however, is given the option of complying with such standards, or with those in effect at the later date for subsecuent amendments to the type design. Procedurally, it is provided that the Part, as amended, on the date of application for the type certificate shall be considered to be incorporated in the certificate. Such a provision shall be made applicable to current Part 6, thus making possible the promulgation of the proposal contained herein as revised Part 6, rather than Part 6b.

PART 15 - AIRCRAFT EQUIPMENT AIRWORTHINESS

In accordance with the program announced with the adoption of enabling amendments to the Civil Air Regulations authorizing the establishment of the T.S.O. system for approval of aircraft appliances, it is proposed to eliminate sections 15.21 and 15.31 from Part 15 providing for the type certification of landing flares and parachutes, since it is expected that technical standard orders for such equipment will be adopted and effective by January 1, 1951.

It is also proposed to eliminate sections 15.40, 15.50, and 15.51 providing for certification of control and structural units and particularized equipment for aircraft types since these provisions have not proven to be useful to the industry..

As previously mentioned, section 15.20 on position light systems is to be revised to provide a greater degree of clarity and uniformity and to modify certain of the intensity requirements for transport category aircraft to bring such requirements into conformity with international standards.

PROPOSED RULES - PART 1

It is proposed to rescind Part 2, Type and Production Certificates, and to revise Part 1, effective January 1, 1951, to read as follows:

CERTIFICATION, IDENTIFICATION, AND MARKING OF AIRCRAFT AND RELATED PRODUCTS

APPLICABILITY AND DEFINITIONS

TYPE CERTIFICATES

PRODUCTION CERTIFICATES

AIRCRAFT AND PRODUCT IDENTIFICATION

1.50 Identification.

AIRWORTHINESS CERTIFICATES

1.60 Application.
1.61 Aircraft categories for which airworthiness certificates are issued.
1.62 Amendment or modification.
1.63 Transferability.
1.64 Duration.
1.65 Display.
1.66 Airworthiness certificates for normal, utility, acrobatic, and transport categories.
1.67 Airworthiness certificate - requirement for issuance.
1.68 Airworthiness certificates for restricted category aircraft.
1.69 Airworthiness certificates for restricted category aircraft - requirements for issuance.
1.70 Multiple airworthiness certification.
1.71 Airworthiness certificate for limited category aircraft.
1.72 Airworthiness certificate for limited category aircraft - requirements for reissuance.
1.73 Experimental certificates.
1.74 Experimental certificates - requirements for issuance.
1.75 Special flight permits.
1.76 Special flight permits - requirements for issuance.

AIRCRAFT NATIONALITY AND REGISTRATION MARKS

1.80 General.
1.81 Display of identification marks.
1.82 Location of identification marks.
1.83 Measurements of identification marks.
1.84 Color.
1.85 Affixation.
1.86 Design.
1.87 Maintenance.
1.88 Identification marks for nonconventional aircraft.
1.89 Identification marks for export aircraft.

APPLICABILITY AND DEFINITIONS

1.0 Applicability of this part. This part establishes administrative requirements for the issuance of type, production, and airworthiness certificates and for the identification and marking of aircraft and related products.

1.1 Definitions.

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

(1) Administrator. The Administrator means the Administrator of Civil Aeronautics.

(2) Aircraft. An aircraft means any contrivance now known or hereafter invented, used, or designed for navigation of or flight in the air. 1/

(3) Aircraft engine. An aircraft engine means an engine used, or intended to be used, for propulsion of aircraft and includes all parts, appurtenances, and accessories thereof other than propellers. 1/

(4) Appliances. Appliances mean instruments, equipment, apparatus, parts, appurtenances, or accessories, of whatever description, which are used, or are capable of being or intended to be used, in the navigation, operation, or control of aircraft in flight (including parachutes and including communication equipment and any other mechanism or mechanisms installed in or attached to aircraft during flight), and which are not a part or parts of aircraft, aircraft engines, or propellers. 1/

(5) Authorized representative of the Administrator. An authorized representative of the Administrator means any employee of the Civil Aeronautics Administration or any private person, authorized by the Administrator to perform any of the duties delegated to the Administrator by the provisions of this part.

1/ As defined in Section 1 of the Civil Aeronautics Act of 1938, as amended.

(6) Person. Person means any individual, firm, copartnership, corporation, company, association, joint-stock association, or body politic; and includes any trustee, receiver, assignee, or other similar representative thereof. 1/

(7) Prime manufacturer. A prime manufacturer means the person who initiated the design and construction of the product and who applied for the type certificate, or any person to whom a current right to reproduce the product has been transferred.

(8) Product. The term product, as used in this part means:

(i) An aircraft,

(ii) An aircraft engine,

(iii) A propeller, or

(iv) Any appliance specified in the Civil Air Regulations as eligible for a type certificate.

(9) Propeller. A propeller includes all parts, appurtenances, and accessories thereof. 1/

(10) Subsidiary manufacturer. A subsidiary manufacturer means the person who contracted with the prime manufacturer to produce and to supply to the prime manufacturer major assemblies and components which are manufactured in conformity with the prime manufacturer's approved drawings and data for the fabrication of the product.

(11) United States. United States means the several States, the District of Columbia, and the several Territories and possessions of the United States, including the Territorial waters and the overlying air space thereof. 1/

1/ As defined in Section 1 of the Civil Aeronautics Act of 1938, as amended.

1.2 Type design. The type design shall consist of such test reports and computations as are necessary to demonstrate that the product complies with the pertinent airworthiness requirements, such drawings and specifications as are necessary to disclose the configuration of the product and all design features covered in the pertinent airworthiness requirements, sufficient information on materials and processes to define the strength of the structure, and sufficient other data to permit the airworthiness of subsequent products of the same type to be determined by comparison with the type design.

TYPE CERTIFICATES

1.10 Application. Any person, whether or not a citizen of the United States, may apply for the issuance of a type certificate. The application for a type certificate for a specified product shall be made upon a form prescribed and furnished by the Administrator.

1.11 Products for which issued. A type certificate may be issued for an aircraft, aircraft engine, propeller, or any appliance for which certification is provided elsewhere in the Civil Air Regulations.

1.12 Requirements for issuance. A type certificate for a product shall be issued when:

(a) The applicant has submitted such descriptive data, test reports, and other information required by the pertinent airworthiness regulations for the type design, and

(b) Upon examination of the type design and the completion of all tests and inspections, the Administrator finds that the type design meets the requirements of the applicable Civil Air Regulations.

1.13 Location of manufacturing facilities. No type certificate for a product shall be issued if the manufacturing facilities therefor are located outside the United States, unless where facilities are located outside the United States the Administrator finds that no undue burden on the Government is created in administering applicable requirements of the Act or regulations issued thereunder.

1.14 Type design changes. Changes in the type design shall be made in accordance with the rules established in the part of the Civil Air Regulations under which the type certificate was issued.

1.15 Transferability. A type certificate may be transferred or made available to third persons by licensing agreements: Provided, That the grantor shall immediately notify the Administrator in writing of any transfer, licensing agreement, or termination thereof: and provided further, That the provisions of § 1.13 are complied with.

1.16 Inspection. A representative of the Administrator shall be permitted to make such inspections as may be necessary to determine initial and continued compliance with the requirements of this part.

1.17 Duration. A type certificate shall remain in effect until surrendered, suspended, revoked, or a termination date is otherwise established by the Board.

1.18 Display. Type certificates shall be made available for examination by an authorized representative of the Board or of the Administrator.

1.19 Privileges. The holder of a type certificate or license may produce duplicates of any product for which a type certificate has been issued.

1.20 Statement of conformity. The holder of a type certificate only or of a current right to the benefits of a type certificate only under a licensing arrangement, upon the initial transfer by him of the ownership of any product manufactured under such type certificate or upon application for original issuance of an airworthiness certificate for an aircraft, shall furnish to an authorized representative of the Administrator a statement of conformity for such product on a form prescribed by the Administrator. For aircraft manufactured under a type certificate only, there shall be included a statement that the aircraft referred to has been flight checked. When a production certificate is held in addition to the type certificate, the provisions of § 1.35 shall apply. The Administrator may consider military acceptance in lieu of a statement of conformity for a product which has been manufactured for the military service.

PRODUCTION CERTIFICATES

1.30 Application. Any person, whether or not a citizen of the United States, may apply for the issuance of a production certificate. The application for a production certificate shall be made upon a form prescribed and furnished by the Administrator.

1.31 Product for which issued. A production certificate shall be issued only for products for which a type certificate is currently in effect. The applicant shall hold a currently effective type certificate for the product to be manufactured or shall hold a current right to the benefits of such certificate under a licensing agreement.

1.32 Requirements for issuance. A person shall be issued a production certificate when the Administrator finds, after examination of the supporting data and after inspection of the organization and production facilities, that the applicant complies with the requirements of §§ 1.33 through 1.37.

1.33 Location of manufacturing facilities. No production certificate for a product shall be issued if the manufacturing facilities therefor are located outside the United States, unless where facilities are located outside the United States the Administrator finds that no undue burden on the Government is created in administering applicable requirements of the Act or regulations issued thereunder.

1.34 Quality control. The applicant shall show that he is adequately prepared to manufacture and control the quality of any product for which he requests production certification, so that each article shall conform with the design provisions of the pertinent type certificate.

1.35 Statement of conformity. It shall not be necessary for the holder of a production certificate to furnish a separate statement of conformity for each of the products produced.

1.36 Data required - prime manufacturer. The applicant shall submit the following data:

(a) A description of the manufacturing layout and production flow,

(b) A listing and description of any special processes required by the product or products to be manufactured,

(c) A description of the established quality-control organization, its functions and responsibilities, including an organizational chart showing the lines of authority for quality control and inspection responsibility,

(d) If the application is for the manufacture of an aircraft, a description of the flight test procedures established by the manufacturer for the testing of production aircraft and a copy of the flight test check

list to be used, and for other products a description of such tests established by the manufacturer as may be appropriate for the product, and

(e) A list, by name and address, of any subsidiary manufacturers. (See § 1.37.)

1.37 Data required - subsidiary manufacturer. Where found necessary by the Administrator, a subsidiary manufacturer shall submit the data prescribed by paragraphs (a), (b), and (c) of § 1.36.

1.38 Modification of required data. The holder of a production certificate shall immediately notify the Administrator in writing of any changes effecting the data required by § 1.36 which may alter the conformity or quality control of the product being manufactured.

1.39 Multiple products. The Administrator may authorize more than one type certificated product to be manufactured under the terms of one production certificate provided that the products have similar production characteristics.

1.40 Production limitation record. A production limitation record shall be issued as part of a production certificate. The record shall list the type certificate of every product which the applicant is authorized to manufacture under the terms of a production certificate. Where different models of a basic type approved under the same type certificate number require different fabrication methods and processes, the Administrator may list the model designation of the product for which authorization is given, as well as the type certificate number, on the production limitation record.

1.41 Modification of the production limitation record. The holder of a production certificate desiring the addition of a type certificate and/or model to the production certificate shall submit an application therefor on

a form and in a manner prescribed by the Administrator. The applicant shall comply with the applicable requirements of §§ 1.32 through 1.36 and 1.38.

1.42 Transferability. A production certificate shall not be transferred.

1.43 Duration. A production certificate shall remain in effect until surrendered, suspended, revoked, or a termination date is otherwise established by the Board, or the location of the manufacturing facility is changed.

1.44 Display. A production certificate shall be prominently displayed in the main office of the factory.

AIRCRAFT AND PRODUCT IDENTIFICATION

1.50 Identification.

(a) Each product manufactured under the terms of a type or production certificate shall display permanently such data as may be required to show its identity. The data shall include such of the following items as the Administrator finds appropriate:

(1) Manufacturer's name,

(2) Model designation,

(3) Manufacturer's serial number (if article is numbered serially), otherwise the date of manufacture, except that articles subject to deterioration as a result of aging (parachutes, parachute flares, etc.) shall bear the date of manufacture in addition to the serial number, if any,

(4) Type certificate number,

(5) Production certificate number,

(6) Capacity or rating.

AIRWORTHINESS CERTIFICATES

1.60 Application. Any U. S. Citizen may apply for issuance of an airworthiness certificate for an aircraft provided he is the registered owner of the aircraft or his agent. The application for an airworthiness certificate shall be made upon a form prescribed and furnished by the Administrator.

1.61 Aircraft categories for which airworthiness certificates are issued. Airworthiness certificates are issued for aircraft whose type design has been certificated under the normal, utility, acrobatic, or transport categories, for aircraft of the restricted category, and for surplus military aircraft in the limited category. In addition, experimental certificates and special flight permits are issued.

1.62 Amendment or modification. An airworthiness certificate may be amended or modified only upon application to the Administrator.

1.63 Transferability. An airworthiness certificate shall be transferred with the aircraft.

1.64 Duration. The duration of an airworthiness certificate shall be in accordance with the provisions of paragraphs (a) and (b) which follow:

(a) An airworthiness certificate shall remain in effect for one year from the date of issuance unless it is surrendered, suspended, revoked, or a termination date is otherwise established by the Board; or, in the case of an experimental airworthiness certificate, a lesser period is established by the Administrator.

(b) A currently valid airworthiness certificate may be automatically renewed when the aircraft is maintained under a continuous maintenance system approved by the Administrator, or reissued upon completion of the annual inspection elsewhere required in the Civil Air Regulations.

1.65 Display. An airworthiness certificate shall be carried in the aircraft at all times, and shall be displayed as prescribed by the Administrator.

1.66 Airworthiness certificates for normal, utility, acrobatic, and transport categories. Aircraft certificated in the normal, utility, acrobatic, and transport categories may be used for the carriage of persons and property for compensation or hire.

1.67 Airworthiness certificate - requirement for issuance. The requirements for the issuance of an airworthiness certificate are stated in paragraphs (a) and (b) which follow:

(a) Aircraft manufactured under a production certificate. An applicant for the original issuance of an airworthiness certificate for an aircraft, whose type design was certificated in categories other than the limited category, manufactured under the terms of a production certificate may be issued such certificate without further showing. The Administrator may inspect the aircraft to see if it conforms to the type design.

(b) Aircraft manufactured under type certificate only. An applicant for the original issuance of an airworthiness certificate for an aircraft, whose type design was certificated in categories other than the limited category, manufactured under the terms of a type certificate only shall be issued such certificate upon presentation of a statement of conformity for such aircraft issued by the manufacturer when, upon inspection of the aircraft, the Administrator finds that the aircraft conforms to the type design, and is in a condition for safe operation.

1.68 Airworthiness certificates for restricted category aircraft. Aircraft certificated in the restricted category may not be used for the

carriage of persons for compensation or hire. For purposes of this section, crop dusting, seeding, and other similar specialized operations are not considered as the carriage of persons or cargo for compensation or hire. Other special limitations for such aircraft are prescribed under the provisions of Part 8.

1.69 Airworthiness certificates for restricted category aircraft - requirements for issuance. The requirements for issuance of an airworthiness certificate for an aircraft in the restricted category are as stated in paragraphs (a) and (b) which follow:

(a) Aircraft manufactured under a production certificate or type certificate only. An applicant for the original issuance of an airworthiness certificate for an aircraft in the restricted category, type certificated under the provisions of § 8.10 (a) (1), shall comply with the appropriate provisions of § 1.67.

(b) Other aircraft. An applicant for the issuance of an airworthiness certificate for aircraft of the restricted category other than those referred to in paragrpah (a), such as surplus military aircraft and modified civil aircraft, may be issued such certificate when he demonstrates compliance with the following provisions:

(1) The aircraft has been type certificated under the provisions of § 8.10 (a) (2), or modified under the provisions of § 8.10 (b) of the Civil Air Regulations;

(2) The aircraft has been inspected by the Administrator and found by him to be in a good state of preservation and repair and in condition for safe operation; and

(3) The Administrator has prescribed operating limitations in accordance with Part 8.

1.70 Multiple airworthiness certification. Multiple airworthiness certification shall conform to the provisions of paragraphs (a) and (b) which follow.

(a) An aircraft shall be issued an airworthiness certificate in the restricted category and in any one or more of the other airworthiness categories prescribed by the Civil Air Regulations, if the applicant shows compliance with the requirements for each category when the aircraft is in the configuration for that category and if the aircraft can be converted from one category to another by removal or addition of equipment by simple mechanical means.

(b) Any aircraft certificated in the restricted and any other category shall be inspected and approved by an authorized representative of the Administrator, or by a certificated mechanic with an appropriate airframe rating, to determine airworthiness each time the aircraft is converted from the restricted category to another category for the carriage of passengers for compensation or hire, unless the Administrator finds this unnecessary for safety in a particular case.

1.71 Airworthiness certificate for limited category aircraft. Airworthiness certificates were issued for surplus military aircraft of the limited category prior to August 31, 1948, under the provisions of Part 9. Aircraft in the limited category may not be used for the carriage of persons or property for compensation or hire.

1.72 Airworthiness certificate for limited category aircraft, requirements for reissuance. An applicant for an airworthiness certificate for an aircraft in the limited category shall show that the aircraft has been previously issued a limited airworthiness certificate which had been surrendered or

has expired, and that the aircraft complies fully with the requirements of Part 9 of the Civil Air Regulations.

1.73 Experimental certificates. Experimental certificates are issued for amateur-built aircraft and for aircraft which are to be used for experiment, for exhibition, for air racing, and to show compliance with Civil Air Regulations for the issuance of type certificates and related purposes.

1.74 Experimental certificates - requirements for issuance. The requirements for the issuance of experimental certificates are as stated in paragraphs (a) and (b) which follow.

(a) In applying for an experimental certificate the applicant shall submit:

(1) A statement in a form and manner prescribed by the Administrator setting forth the purpose for which the aircraft is to be used,

(2) Sufficient data, such as photographs, to identify the aircraft, and,

(3) Upon inspection of the aircraft, any pertinent information found necessary by the Administrator to safeguard the general public.

(b) Appropriate operating restrictions for the use of such aircraft shall be prescribed by the Administrator.

(1) Experimental aircraft shall not be used for the carriage of persons or property for compensation or hire.

1.75 Special flight permits. A special flight permit may be issued for an aircraft which may not currently meet applicable airworthiness

requirements, but which is capable of safe flight, for the purpose of permitting the aircraft to be flown to a base where repairs or alterations are to be made or to permit the delivery or export of the aircraft.

1.76 Special flight permits - requirements for issuance. The requirements for the issuance of special flight permits are as stated in paragraphs (a) and (b) which follow.

(a) Where found necessary by the Administrator, an applicant for a special flight permit shall submit a statement in a form approved by the Administrator indicating the purpose of the flight, the proposed itinerary, the duration of authorization requested, the persons to be on board the aircraft, the particulars, if any, in which the aircraft does not comply fully with the applicable airworthiness requirements, and the restrictions, if any, deemed necessary for safe operation of the aircraft.

(b) The Administrator shall accomplish, or shall require the applicant to accomplish, such appropriate inspections or tests as the Administrator may deem necessary in the interest of safety.

(c) Nothing in the foregoing paragraphs shall prevent the issuance to an air carrier by the Administrator of a general authorization to conduct ferry flights for specified purposes as above provided, under such terms and conditions as may from time to time be prescribed by the Administrator.

AIRCRAFT NATIONALITY AND REGISTRATION MARKS

1.80 General. The identification of each aircraft shall be marked, and the markings shall be displayed as required in §§ 1.81 through 1.87. No design, mark, or symbol which modifies or confuses the identification

marks shall be placed on an aircraft, except with the approval of the Administrator.

1.81 Display of identification marks. Identification marks shall be displayed in accordance with the following provisions:

(a) Aircraft registered for the first time after December 31, 1948, shall display identification marks consisting of the Roman capital letter "N", denoting United States registration, followed by the registration number. Other aircraft which display identification marks containing an airworthiness symbol "C", "R", "X", or "L" and which are operated solely within the continental limits of the United States may display such identification marks until the first time such aircraft are recovered or refinished to an extent necessitating the reapplication of the identification mark. Thereafter, such aircraft, and after December 31, 1950, all aircraft of United States registry operated outside of the continental limits of the United States, shall display identification marks consisting of the Roman capital letter "N", denoting United States registration, followed by the registration number.

(b) When an identification mark including only the Roman capital letter "N" and the registration number is utilized, limited and restricted category aircraft and experimental aircraft shall display the words "limited," "restricted," or "experimental," respectively, near each entrance to the cabin or cockpit of the aircraft. These markings shall be in letters not less than 2 inches nor more than 6 inches in height.

1.82 Location of identification marks. Identification marks shall be located in accordance with paragraphs (a) through (e) of this section.

(a) Fixed-wing aircraft. The following shall be applicable to fixed-wing aircraft.

(1) Wing surfaces. Identification marks shall be displayed on the right half of the upper surface and the left half of the lower surface of the wing structure. As far as possible, the marks shall be located an equal distance from the leading and trailing edges of the wing. The top of the marks shall be toward the leading edge of the wing.

(2) Vertical tail surfaces. Identification marks shall be displayed on the upper half of the vertical tail surface. They shall be displayed on both sides of a single tail surface and on the outer sides of multitail surfaces. They may be placed either horizontally or vertically.

(3) Fuselage surfaces. Identification marks shall be displayed on the fuselage when the aircraft, as a result of design, does not have a vertical tail surface. The marks shall be located on each side of the top half of the fuselage, just forward of the leading edge of the horizontal tail surface. They may be placed either horizontally or vertically.

(b) Rotorcraft. The following requirements shall be applicable to rotorcraft.

(1) Bottom fuselage surfaces. Identification marks shall be displayed on the bottom surface of the fuselage or cabin. The top of the marks shall be toward the left side of the fuselage.

(2) Side fuselage surfaces. Identification marks shall be displayed below the window lines and as near the cockpit as possible.

(c) Airships. The following requirements shall be applicable to airships.

(1) Horizontal stabilizer surfaces. Identification marks shall be displayed on the upper surface of the right horizontal stabilizer and on the under surface of the left horizontal stabilizer. The top of the marks shall be toward the leading edge of the stabilizer. The marks shall be placed horizontally.

(2) Vertical stabilizer surfaces. Identification marks shall be displayed on each side of the bottom half of the vertical stabilizer. The marks shall be placed horizontally.

(d) Spherical balloons. Identification marks for spherical balloons shall be displayed on two places diametrically opposite, and shall be located near the maximum horizontal circumference of the balloon.

(e) Nonspherical balloons. Identification marks for nonspherical balloons shall be displayed on each side. They shall be located near the maximum cross section of the balloon, immediately above either the rigging band or the points of attachment of the basket or cabin suspension cables.

1.83 Measurements of identification marks. The measurements of identification marks shall conform to the provisions of paragraphs (a) through (d) of this section.

(a) Fixed-wing aircraft. The following requirements shall be applicable to fixed-wing aircraft.

(1) Wing surfaces. The height of the identification marks on the wings shall be at least 20 inches.

(2) Fuselage and vertical tail surfaces. Identification

marks shall be such as to leave at least a margin of 2 inches along each edge of the surface. Within these stipulations, the marks shall be as large as practicable, except that this rule shall not be interpreted as requiring the use of marks exceeding 6 inches in height or permitting the use of marks smaller than 2 inches in height. The letters and numbers of each separate group of identification marks shall be of equal height.

(b) Rotorcraft. The following requirements shall be applicable to rotorcraft.

(1) Fuselage or cabin bottom surfaces. Identification marks shall be at least 4/5 as high as the fuselage is wide, but need not be more than 20 inches high.

(2) Fuselage or cabin side surfaces. Identification marks shall conform to requirements stipulated in subparagraph (a) (2) of this section.

(c) Lighter-than-air aircraft. The following requirements shall be applicable to lighter-than-air aircraft.

(1) On each airship, spherical balloon, or nonspherical balloon identification marks shall be at least 20 inches high.

(d) All aircraft. The following requirements shall be applicable to all aircraft.

(1) Width. Identification marks shall be 2/3 as wide as they are high with the exception of number "1" which shall be 1/6 as wide as it is high.

(2) Thickness. Identification marks shall be formed by solid lines of a thickness equal to 1/6 of the character height.

(3) Spacing. The space between the identification numbers and letters shall be not less than 1/4 of the character width.

1.84 Color. On each aircraft, identification marks shall contrast in color with the background.

1.85 Affixation. On each aircraft, identification marks shall be painted or shall be affixed by any other means insuring a similar degree of permanence and legibility, except that aircraft intended for immediate delivery to a foreign purchaser may display identification marks of a readily removable material.

1.86 Design. On each aircraft, identification marks shall have no ornamentation.

1.87 Maintenance. On each aircraft, identification marks shall be kept clean and legible at all times.

1.88 Identification marks for nonconventional aircraft. The identification marking rules prescribed in §§ 1.81 through 1.87 are intended to apply to conventional aircraft as they are known today. When aircraft are developed which do not conform to the general configuration of present-day aircraft, a procedure for identification marking will be prescribed by the Administrator.

1.89 Identification marks for export aircraft. An aircraft manufactured in the United States for delivery outside the United States or its possessions may display such identification marks as are required by the State of registry of the aircraft. Such aircraft shall be operated only for the purpose of test and demonstration flights for a limited period of time or while in necessary trasnit to the purchaser.

PROPOSED RULES - PART 3

It is proposed to amend Part 3, effective January 1, 1951, as follows:

1. By amending the title thereof to read as follows: Part 3 - Airplane Airworthiness - Normal, Utility, and Acrobatic Categories.

2. By amending § 3.19 to read as follows:

3.19 Flight tests.

(a) After proof of compliance with the structural requirements contained in this part, and upon completion of all necessary inspection and testing on the ground, and proof of conformity of the airplane with the type design, and upon receipt from the applicant of a report of flight tests conducted by him, there shall be conducted such official flight tests as the Administrator finds necessary to determine compliance with §§ 3.61 through 3.780.

(b) After the conclusion of the flight tests prescribed in paragraph (a) of this section such additional flight tests shall be conducted, on airplanes having a maximum certificated take-off weight of more than 6,000 pounds, 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 model, its components, and ecuipment. If practicable, the flight tests performed for the purpose of ascertaining the reliability and proper functioning shall be conducted on the same airplane which was used in flight tests to show compliance with §§ 3.61 through 3.780.

3. By adding a new § 3.80 to read as follows:

3.80 Alternate performance requirements. As set forth in the following sections the provisions of §§ 3.84, 3.85, 3.86, and 3.112 (a)(2)(ii) shall not be applicable to airplanes having a maximum certificated take-off weight of 6,000 lbs or less. In lieu thereof, such airplanes shall comply with the provisions of §§ 3.84a, 3.85a, 3.87, and 3.112 (c).

4. By adding a new § 3.84a to read as follows:

3.84a Take-off requirements - aircraft of 6,000 lbs or less. Airplanes having a maximum certificated take-off weight of 6,000 lbs or less shall comply with the provisions of this section.

(a) Tail wheel type. The elevator control at 0.8 V_{S_1} shall be sufficient to maintain an airplane attitude which will permit holding the airplane on the runway until a safe take-off speed is attained.

(b) Nose wheel type. The elevator control shall be sufficient to raise the nose wheel clear of the take-off surface at a speed equal to 0.85 V_{S_1}.

(c) The characteristics prescribed in paragraphs (a) and (b) of this section shall be demonstrated with:

(1) Take-off power,

(2) Most unfavorable weight,

(3) Most unfavorable c.g. position.

(d) It shall be demonstrated that the airplane will take off safely without requiring an exceptional degree of piloting skill.

5. By adding a new § 3.85a to read as follows:

3.85a Climb requirements - aircraft of 6,000 lbs or less. Airplanes having a maximum certificated take-off weight of 6,000 lbs or less shall

comply with the requirements of this section.

(a) Climb - normal climb condition. The steady rate of climb at sea level shall not be less than 10 V_{S_1} or 300 feet per minute, whichever is the greater, with:

(1) Take-off power,

(2) Landing gear extended,

(3) Wing flaps in take-off position,

(4) Cowl flaps in the position used in cooling tests specified in §§ 3.581 through 3.596.

(b) Climb - balked landing conditions. The steady rate of climb at sea level shall not be less than 5 V_{S_0} or 200 feet per minute, whichever is the greater, with:

(1) Take-off power,

(2) Landing gear extended,

(3) Wing flaps in the landing position. If rapid retraction is possible with safety, without loss of altitude and without requiring sudden changes of angle of attack or exceptional skill on the part of the pilot, wing flaps may be retracted.

6. By adding a new § 3.87 to read as follows:

3.87 Landing requirements - aircraft of 6,000 lbs or less. For an airplane having a maximum certificated take-off weight of 6,000 lbs or less it shall be demonstrated that the airplane can be safely landed and brought to a stop without requiring an exceptional degree of piloting skill, and without excessive vertical acceleration, tendency to bounce, nose over, ground loop, porpoise, or water loop.

7. By adding a new § 3.112 (c) to read as follows:

3.112 Requirements. * * *

(c) For aircraft having a maximum certificated take-off weight of 6,000 lbs or less, the value specified in subdivision (a) (2) (ii) shall be 1.5 V_{S_1}.

8. By amending § 3.120 to read as follows:

3.120 Stalling demonstration.

(a) Stalls shall be demonstrated under two conditions:

(1) With power off, and

(2) With the power setting not less than that required to show compliance with the provisions of paragraph (a) of § 3.85 or with those of § 3.85a, whichever is appropriate.

(b) In either condition required by paragraph (a) it shall 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 show compliance with the applicable requirements of paragraphs (c) through (f).

(c) For airplanes having independently controlled rolling and directional controls, it shall be possible to produce and to correct roll by unreversed use of the rolling control and to produce and correct yaw by unreversed use of the directional control up until the time the airplane pitches in the maneuver prescribed in paragraph (g) of this section.

(d) For two-control airplanes having either interconnected lateral and directional controls or for airplanes having only one of these controls, it shall be possible to produce and to correct roll by unreversed use of the rolling control without producing excessive yaw up until the time the airplane pitches in the maneuver prescribed in paragraph (g) of this section.

(e) During the recovery portion of the stall maneuver the pitch shall not exceed a value of 30° below level, and the airplane shall not develop any uncontrollable rolling or yawing characteristics before the recovery is achieved. The altitude lost in the stall maneuver shall be entered in the airplane flight manual.

(f) A clear and distinctive stall warning shall precede the stalling of the airplane, with the flaps and landing gear in any position, both in straight and turning flight. The stall warning shall occur at a speed exceeding that of stalling by not less than 5 but not more than 10 miles per hour.

(g) In demonstrating the qualities required by paragraphs (c) through (f), the procedure set forth in subparagraphs (1) and (2) shall be followed:

(1) With trim controls adjusted for straight flight at a speed of approximately 1.4 V_{S_1}, 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 1 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 shall be allowed after such pitching motion has unmistakably developed.

9. By amending § 3.124 (a) to read as follows:

3.124 Spinning.

(a) Category N. All airplanes of 4,000 lbs or less maximum gross weight shall recover from a one-turn spin with the controls applied normally

for recovery in not more than $\frac{1}{2}$ additional turn and without exceeding either the limiting air speed or the limit positive maneuvering load factor for the airplane. In addition, there shall be no excessive back pressure either during the spin or in the recovery. It shall not be possible to obtain uncontrollable spins by means of any possible use of the controls. Compliance with the above shall be demonstrated at any permissible combination of weight and center of gravity positions obtainable with all or any part of the designed useful load. All airplanes in category N, regardless of weight, shall be placarded against spins or demonstrated to be "characteristically incapable of spinning" in which case they shall be so designated. (See paragraph (d) of this section.)

10. By rescinding paragraph (a) of § 3.318.

11. By rescinding §§ 3.319, "External bracing," and 3.320, "Covering."

12. By adding a new sentence at the end of paragraph (a) of § 3.390 to read as follows:

3.390 Seats and berths.

(a) Passenger seats and berths.

* * * The accelerations prescribed in § 3.386 shall be multiplied by a factor of 1.33 for determining the strength of the seat and berth attachments to the structure.

13. By adding a new sentance at the end of § 3.391 to read as follows:

3.391 Safety belt or harness provisions.

* * * The accelerations prescribed in § 3.386 shall be multiplied by a factor of 1.33 for determining the strength of the belt anchorages to the seat or to the structure.

14. By amending the first sentence of § 3.417 to read as follows:

3.417 Propeller vibrations. In the case of propellers with metal blades or other highly stressed metal components, the magnitude of the critical vibration stresses under all normal conditions of operation shall be determined by actual measurements or by comparison with similar installations for which such measurements have been made.

15. By amending § 3.431 to read as follows:

3.431 Multiengine fuel system arrangement. The fuel systems of multiengine airplanes which must comply with the provisions of § 3.85 (b) shall be arranged to permit operation in at least one configuration in such a manner that the failure of any one component will not result in the loss of power of more than one engine and will not require immediate action by the pilot to prevent the loss of power of more than one engine. Unless other provisions are made in order to comply with this requirement, the fuel system shall be arranged to permit supplying fuel to each engine through a system entirely independent of any portion of the system supplying fuel to the other engines. Other multiengine airplanes shall also comply with the requirement except that separate fuel tanks need not be provided for each engine.

16. By amending § 3.434 to read as follows:

3.434 Fuel flow rate for gravity systems. The fuel flow rate for gravity systems (main and reserve supply) shall be 150 percent of the actual take-off fuel consumption of the engine.

17. By amending § 3.438 to read as follows:

3.438 Fuel system hot weather operation. Airplanes with suction lift fuel systems or other fuel system features conducive to vapor formation

shall be demonstrated to be free from vapor lock when using fuel at a temperature of 110°F. under critical operating conditions.

18. By amending § 3.442 (a) to read as follows:

3.442 Fuel tank installation.

(a) The method of supporting tanks shall not be such as to concentrate the loads resulting from the weight of the fuel in the tanks. Pads shall be provided to prevent chafing between the tank and its supports. Materials employed for padding shall be nonabsorbant or shall be treated to prevent the absorption of fuels. If flexible tank liners are employed, they shall be of an approved type, and they shall be so supported that the liner is not required to withstand fluid loads. Interior surfaces of compartments for such liners shall be smooth and free of projections which are apt to cause wear of the liner, unless provisions are made for the protection of the liner at such points or unless the construction of the liner itself provides such protection. A positive pressure shall be maintained within the vapor space of all bladder cells under all conditions of operation including the most critical condition of low air speed and rate of descent likely to be encountered in normal operation.

19. By amending paragraphs (a) and (b) of § 3.444 to read as follows:

3.444 Fuel tank sump.

(a) Each tank shall be provided with a drainable sump having a capacity of not less than 0.25 percent of the tank capacity or 1/16 gallon, whichever is the greater. The sump may be dispensed with if the fuel system is provided with a sediment bowl permitting ready ground inspection. The sediment bowl shall also be readily accessible for drainage. The capacity of the sediment

chamber shall not be less than 1 ounce per each 20 gallons of the fuel tank capacity.

(b) If a fuel tank sump is provided, the capacity specified in paragraph (a) shall be effective with the airplane in the normal ground attitude and the normal level flight attitude.

20. By amending § 3.449 (b) to read as follows:

3.449 Fuel pump and pump installation. * * *

(b) Emergency fuel pumps shall be provided to permit supplying all engines with fuel in case of the failure of any one engine-driven pump, except that if an engine fuel injection pump which has been certificated as an integral part of the engine is used, an emergency pump is not required. Emergency pumps shall be available for immediate use in case of the failure of any other pump. If both the normal pump and emergency pump operate continuously, means shall be provided to indicate to the crew when either pump is malfunctioning.

21. By amending § 3.553 to read as follows:

3.553 Fuel system drains. Drains shall be provided to permit safe drainage of the entire fuel system and shall incorporate means for locking in the closed position. The provisions for drainage shall be effective in the normal ground attitude.

22. By amending § 3.561 to read as follows:

3.561 Oil system. Each engine shall be provided with an independent oil system capable of supplying the engine with an ample quantity of oil at a temperature not exceeding the maximum which has been established as safe for continuous operation. The usable oil tank capacity shall not be less than the product of the endurance of the airplane under critical operating

conditions and the maximum oil consumption of the engine under the same conditions, plus a suitable margin to assure adequate system circulation and cooling. In lieu of a rational analysis of airplane range and oil consumption, a fuel-oil ratio of 30:1 by volume shall be considered acceptable.

23. By amending § 3.605 (b) to read as follows:

3.605 General. * * *

(b) Each engine shall be provided with at least two separate air intake sources, except that in the case of an engine equipped with a fuel injector only one air intake source need be provided, if the air intake, opening, or passage is unobstructed by a screen, filter, or other part on which ice might form and so restrict the air flow as to affect adversely engine operation. Primary air intakes may open within the cowling only if that portion of the cowling is isolated from the engine accessory section by means of a fire-resistant diaphragm or if provision is made to prevent the emergence of backfire flames. Alternate air intakes shall be located in a sheltered position and shall not open within the cowling unless they are so located that the emergence of backfire flames will not result in a hazard.

24. By adding a new paragraph (d) to § 3.606 to read as follows:

3.606 Induction system de-icing and anti-icing provisions. * * *

(d) Airplanes equipped with sea level engines employing carburetors which embody features tending to reduce the possibility of ice formation shall be provided with a sheltered source of air warmed at least to the extent that the cylinder cooling air is warmed.

25. By adding a new sentence at the end of paragraph (a) of § 3.624 to read as follows:

3.624 Fire wall construction.

(a) * * * However, fire-resistant material may be used in such applications on single-engine airplanes using unsupercharged wet sump engines, provided the opening that may result in case of fire will not involve a serious hazard from the standpoint of flame propagation to the sheltered side of the fire wall.

26. By amending § 3.637 to read as follows:

3.637 Powerplant fire protection. Suitable means shall be provided to shut off the flow in all lines carrying flammable fluids into the engine compartment on multiengine airplanes required to comply with the provisions of § 3.85 (b).

27. By amending § 3.672 to read as follows:

3.672 Fuel quantity indicator. Means shall be provided to indicate to the flight personnel the quantity of fuel in each tank during flight. Tanks, the outlets and air spaces of which are interconnected, may be considered as one tank and need not be provided with separate indicators. Exposed sight gauges shall be so installed and guarded as to preclude the possibility of breakage or damage. Sight gauges which form a trap in which water can collect and freeze shall be provided with means to permit drainage on the ground. Fuel quantity gauges shall be calibrated to read zero during level flight when the quantity of fuel remaining in the tank is equal to the unusable fuel supply as defined by § 3.437. Fuel gauges need not be provided for small auxiliary tanks which are used only to transfer fuel to other tanks, provided the relative size of the tanks, the rate of fuel transfer,

and the instructions pertaining to the use of the tanks are adequate to guard against overflow and to assume that the crew will receive prompt warning in case transfer is not being achieved as intended.

28. By amending § 3.700 to read as follows:

3.700 Position light system. If a position light system is installed, it shall be of a type certificated in accordance with Part 15 of the Civil Air Regulations, and shall comply with the pertinent provisions of that part.

29. By amending § 3.701 to read as follows:

3.701 Installation requirements. The following installation requirements apply to single circuit systems and shall be complied with if this type system is installed. 1/

(a) Forward and rear position lights. Single circuit systems shall consist of an aviation red light, an aviation green light, and an aviation white light. The red and the green lights shall be referred to as forward position lights and shall be so installed that, with the airplane in normal flying position, the red light is displayed on the left side and the green light on the right side, each showing unbroken light between two vertical planes the dihedral angle of which is 110° when measured to the left and right, respectively, of the airplane from dead ahead. These lights shall be spaced laterally as far apart as practicable. The white light shall be referred to as a rear position light and shall be mounted as far aft as practicable and so installed that unbroken light is directed symmetrically aft in such a manner that the axis of the maximum cone of illumination is parallel to the flight path. In addition, the

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1/ Installation recuirements for dual circuit position light systems are contained in Part 4b of the Civil Air Regulations.

intersection of the two planes forming dihedral angle A given in Part 15 of the Civil Air Regulations shall be vertical.

(b) Circuit. The forward position lights and the rear white position light shall constitute the single circuit.

(c) Position light flasher. If installed, a position light flasher shall be of a type acceptable to the Administrator.

30. By deleting §§ 3.702 and 3.703.

31. By combining §§ 3.704 and 3.705 into one section (3.704) to read as follows:

3.704 Riding light.

(a) When a riding (anchor) light is required for a seaplane, flying boat, or amphibian, it shall be capable of showing a white light for at least 2 miles at night under clear atmospheric conditions.

(b) The riding light shall be installed to show the maximum unbroken light practicable when the airplane is moored or drifting on the water. Externally hung lights shall be acceptable.

32. By amending § 3.715 to read as follows:

3.715 Safety belts. Safety belts shall be of an approved type.

33. By adding a new sentence at the end of § 3.759 to read as follows:

3.759 Powerplant instruments. * * * Ranges of engine speed which are restricted as a result of excessive engine or propeller vibration shall be marked with a red arc.

34. By amending § 3.780 (a) to read as follows:

3.780 Performance information.

(a) For airplanes with a maximum certificated take-off weight of more than 6,000 lbs, information relative to the items of performance set forth in subparagraphs (1) through (5) shall be included:

PROPOSED RULES - PART 4b

It is proposed to amend Part 4b, effective January 1, 1951, as follows:

1. By amending § 4b.632 to read as follows:

4b.632 Position light system. The position light system shall be of the dual circuit type, shall be certificated in accordance with Part 15 of the Civil Air Regulations, and shall comply with the provisions of § 15.20 (b) of that part.

2. By renumbering § 4b.633 as § 4b.636 and by adding a new § 4b.633 to read as follows:

4b.633 Installation requirements. The installation requirements of paragraphs (a) through (e) apply to dual circuit systems.

(a) Forward position lights. Forward position lights shall consist of a red and green light spaced laterally as far apart as practicable and installed forward on an airplane in such a location that, with the airplane in normal flying position, the red light is displayed on the left side and the green light is displayed on the right side, each showing unbroken light between two vertical planes the dihedral angle of which is 110° when measured respectively to the left and to the right of the airplane from dead ahead.

(b) Rear position lights. Rear position lights shall consist of a red and a white light mounted as far aft as practicable, located in close proximity to each other, and installed so that unbroken light is directed symmetrically aft from each light with the axis of the maximum cone of illumination parallel to the flight path. In addition, the intersection of the two planes forming the dihedral angle A prescribed in Part 15 of the Civil Air Regulations shall be vertical.

(c) Fuselage lights. Fuselage lights shall consist of two white lights installed approximately in line with the forward position lights. One of these lights shall be mounted on the top of the fuselage, the other on the bottom. In the case of seaplanes, the location of the bottom fuselage light shall be subject to specific approval on each individual type airplane. The top and bottom fuselage lights shall show through approximately a hemisphere.

(d) Circuits. The forward position lights and the rear white position light shall be on one of the circuits, while the fuselage lights and the rear red position light shall be on the other.

(e) Position light flasher. An approved flasher for dual circuit systems shall be installed. The flasher shall actuate the system automatically so that the two circuits are energized alternately at an approved frequency. A switch shall be provided to disconnect the flasher from the circuit so that continuous light can be supplied by the forward position lights and the rear white position light, while the fuselage lights and the rear red position light are not illuminated.

PROPOSED RULES - PART 6

It is proposed to revise Part 6, effective January 1, 1951, to read as follows:

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SUBPART A - GENERAL

APPLICABILITY AND DEFINITIONS

6.0 Applicability of this part. This part establishes standards with which compliance shall be demonstrated for the issuance of type certificates for rotorcraft. This part, until superseded or rescinded, shall apply to all rotorcraft for which applications for type certification are made after the effective date of this part.

6.1 Definitions. Unless otherwise noted, terms used in this part of the regulations are defined as follows.

(a) Administration.

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

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

(b) Rotorcraft types.

(1) Rotorcraft. A rotorcraft is any aircraft deriving its principal lift from one or more rotors.

(2) Helicopter. A helicopter is a rotorcraft which depends principally for its support and motion in the air upon the lift generated by one or more power driven rotors, rotating on substantially vertical axes.

(3) Gyroplane. A gyroplane is a rotorcraft which depends principally for its support upon the lift generated by one or more rotors which are not power driven, except for initial starting, and which are

caused to rotate by the action of the air when the rotorcraft is in motion. The propulsion is independent of the rotor system and usually consists of conventional propellers.

(4) Gyrodyne. A gyrodyne is a rotorcraft which depends principally for its support upon the lift generated by one or more rotors which are partially power driven, rotating on substantially vertical axes. The propulsion is independent of the rotor system and usually consists of conventional propellers.

(c) General design.

(1) Standard atmosphere. The standard atmosphere is an atmosphere 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 -67° F is -0.003566° F/ft and zero thereabove,

(v) The density ρ_0 at sea level under the above conditions is 0.002378 lbs sec^2/ft^4.

(2) Maximum anticipated air temperature. The maximum anticipated air temperature is a temperature specified for the purpose of compliance with the powerplant cooling standards. (See § 6.451.)

(3) Aerodynamic coefficients. Aerodynamic coefficients are nondimensional coefficients for forces and moments. They correspond with those adopted by the U. S. National Advisory Committee for Aeronautics.

(4) Autorotation. Autorotation is a rotorcraft flight condition in which the lifting rotor is driven entirely by the action of the air when the rotorcraft is in motion.

(5) Autorotative landing. An autorotative landing is any landing of a rotorcraft in which the entire maneuver is accomplished without the application of power to the rotor.

(6) Autorotative landing distance. Autorotative landing distance is the horizontal distance required to make an autorotative landing and come to a complete stop (to a speed of approximately 3 mph for seaplanes or floatplanes) from a height of 50 feet above the landing surface.

(7) Ground resonance. Ground resonance is the mechanical instability encountered when the rotorcraft is in contact with the ground.

(8) Mechanical instability. Mechanical instability is an unstable resonant condition due to the interaction between the rotor blades and the rotorcraft structure, while the rotorcraft is on the ground or airborne.

(i) Weights.

(1) Maximum weight. The maximum weight of the rotorcraft is that maximum at which compliance with the requirements of this part of the Civil Air Regulations is demonstrated. (See § 6.101.)

(2) Minimum weight. The minimum weight of the rotorcraft is that minimum at which compliance with the requirements of this part of the Civil Air Regulations is demonstrated. (See § 6.101.)

(3) Empty weight. The empty weight of the rotorcraft is a readily reproducible weight which is used in the determination of the operating weights. (See § 6.104.)

(4) Design maximum weight. The design maximum weight is the maximum weight of the rotorcraft at which compliance is shown with the structural loading conditions. (See § 6.101.)

(5) Design minimum weight. The design minimum weight is the minimum weight of the rotorcraft at which compliance is shown with the structural loading conditions. (See § 6.101.)

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

(i) Gasoline 6 lbs per U. S. gallon,

(ii) Lubricating oil 7.5 lbs per U. S. gallon,

(iii) Crew and passengers 170 lbs per person.

(e) Speeds.

(1) IAS - indicated air speed is equal to the pitot static air-speed indicator reading as installed in the rotorcraft without correction for air-speed 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 §§ 6.612 and 6.732.)

(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) T.A.S - true air speed of the rotorcraft relative to undisturbed air. ($T.A.S = E.A.S\ (\rho_0/\rho)^{\frac{1}{2}}$)

(5) V_H - the maximum speed obtainable in level flight with rated rpm and power.

(6) V_{NE} - the never-exceed speed. (See § 6.711.)

(7) V_X - the speed for best angle of climb.

(8) V_Y - the speed for best rate of climb.

(f) Structural.

(1) Limit load. A limit load is the maximum load anticipated in normal conditions of operation. (See § 6.200.)

(2) Ultimate load. An ultimate load is a limit load multiplied by the appropriate factor of safety. (See § 6.200.)

(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 § 6.200.)

(4) Load factor. The load factor is the ratio of a specified load to the total weight of the rotorcraft; 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) Fitting. A fitting is a part or terminal used to join one structural member to another. (See § 6.307 (d).)

(g) Power installation. 1/

(1) Brake horsepower. Brake horsepower is the power delivered at the propeller shaft of the engine.

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

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

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

(5) 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 or at the rated altitude,

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1/ For engine airworthiness requirements see Part 13.

(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.

(h) Propellers and rotors. 2/

(1) Rotor. Rotor is a system of rotating airfoils.

(2) Main rotor. The main rotor is the main system of rotating airfoils providing sustentation for the rotorcraft.

(3) Auxiliary rotor. An auxiliary rotor is one which serves either to counteract the effect of the main rotor torque on the rotorcraft, or to maneuver the rotorcraft about one or more of its three principal axes.

(4) Axis of no feathering. The axis of no feathering is the axis about which there is no first harmonic feathering or cyclic pitch variation. 3/

(5) Plane of rotor disc. The plane of rotor disc is a reference plane at right angles to the axis of no feathering.

(6) Tip speed ratio. The tip speed ratio is the ratio of the rotorplane flight velocity component in the plane of the rotor disc to the rotational tip speed of the rotor blades expressed as follows:

$$\mu = \frac{V \cos \alpha}{\Omega R}$$ where:

V = air speed of the rotorcraft along flight path (feet per second),

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2/ For propeller airworthiness requirements see Part 14.

3/ See N.A.C.A. Technical Note No. 1604.

α = angle between projection in plane of symmetry of axis of no feathering and a line perpendicular to the flight path (radians, positive when axis is pointing aft),

Ω = angular velocity of rotor (radians per second),

R = rotor radius (feet),

(i) 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.

CERTIFICATION

6.10 Eligibility for type certificates. A rotorcraft shall be eligible for type certification under the provisions of this part if it complies with the airworthiness provisions hereinafter established, or if the Administrator finds that the provision or provisions not complied with are compensated for by other design features which provide an equivalent level of safety, provided that the Administrator finds no feature or characteristic of the rotorcraft which renders it unsafe.

6.11 Incorporation of Part 6 in the type certificate.

(a) The provisions of this part, together with all amendments effective on the date of application for type certification, shall be considered as incorporated in the type certificate.

(b) The type certificate shall bear the legend set forth in subparagraph (1).

(1) "The provisions of Part 6 of the Civil Air Regulations, together with all amendments thereto effective on the date of application for this certificate, are hereby incorporated herein and made a part hereof as though set forth in full, and, except as otherwise provided by the Board, or pursuant to § 6.24 of this Part by the Administrator, any amendment of the type design may, at the option of the holder of the type certificate, be accomplished in accordance with either the standards set forth in such regulations or with the standards in effect at the time the application for amendment is filed."

6.12 Amendment. Unless otherwise specified, an amendment of this part shall be effective with respect to rotorcraft for which applications for type certificates are filed after the effective date of the amendment.

6.13 Type certificate. An applicant shall be issued a type certificate when he demonstrates the eligibility of the rotorcraft by complying with the requirements of §§ 6.14 through 6.16 in addition to those contained in Part 1 of the Civil Air Regulations.

6.14 Data required. 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 rotorcraft complies with the airworthiness requirements. The descriptive data shall be known as the type design and shall consist of drawings and specifications disclosing the configuration of the rotorcraft and all design features covered in the airworthiness requirements as well as sufficient information on dimensions, materials, and processes to define the strength of the structure. The type design shall describe the rotorcraft in sufficient detail to permit the airworthiness of subsequent rotorcraft of the same type to be determined by comparison with the type design.

6.15 Inspections and tests. Inspections and tests shall include all those found necessary by the Administrator to insure that the rotorcraft 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 such that the design strength and safety contemplated by the type design will be realized in service.

6.16 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 rotorcraft 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 rotorcraft, its components, and equipment are reliable and function properly. The extent of such additional flight tests shall depend upon the complexity of the rotorcraft, the number and nature of new design features, and the record of previous tests and experience for the particular rotorcraft type, its components, and equipment. If practicable, these flight tests shall be conducted on the same rotorcraft used in the flight tests specified in paragraph (a) of this section and in the rotor drive endurance tests specified in §§ 6.412.

6.17 Airworthiness, experimental, and production certificates. (For requirements with regard to these certificates see Part 1.)

6.18 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 Civil Air Regulations. 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.

(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.

CHANGES

6.20 General. When the type design is changed, the applicant or holder of the type certificate shall demonstrate that the rotorcraft complies with the applicable airworthiness requirements.

6.21 Classification of changes. Changes shall be classified as minor and major. A minor change shall be one which has no appreciable effect on the weight, balance, structural strength, powerplant operation, flight characteristics, or other characteristic affecting the airworthiness of the rotorcraft. A major change shall be one not classified as a minor change.

6.22 Approval of minor changes. Minor changes to type designs may be approved by an authorized representative of the Administrator prior to the submittal to the Administrator of any revised drawings.

6.23 Approval of major changes. Major changes to type designs shall be approved only after receipt by the Administrator of substantiating data and necessary descriptive data for inclusion in the type design.

6.24 Service experience changes.

(a) Where the Administrator finds as a result of service experience that an unsafe condition exists with respect to a design feature, part, or characteristic of any rotorcraft certificated under this part, he shall furnish notice [4/] thereof to all operators of rotorcraft of that type, and the rotorcraft shall not thereafter be operated until the unsafe condition has been corrected, unless otherwise authorized by the Administrator under specified conditions and limitations.

(1) When the Administrator finds that design changes are necessary to correct the unsafe condition of the rotorcraft, the holder of the type certificate, upon request of the Administrator, shall submit appropriate design modifications for the approval of the Administrator.

(2) Upon approval, such changes shall be made a part of the type design of the type certificate, and descriptive data covering the changes shall be made available by the holder of the type certificate to all operators of rotorcraft previously certificated under such type certificate.

4/ Operators of rotorcraft are notified of any unsafe condition, of the required corrective action, and of compliance dates through the medium of airworthiness directives issued by the Administrator.

(3) All rotorcraft of the same type shall be modified in accordance with such amended type certificate.

(b) Where no current unsafe condition exists but the Administrator or the holder of the type certificate finds through service experience that changes in type design will contribute to the safety of the rotorcraft, the holder of the type certificate may submit appropriate design modifications for the approval of the Administrator. Upon approval of such modifications, the type design of the type certificate shall be amended accordingly, and all rotorcraft manufactured thereafter shall be modified in accordance with such amended type certificate. The manufacturer shall make available to all operators of the same type of rotorcraft information on the design modifications.

SUBPART B - FLIGHT

GENERAL

6.100 Proof of compliance.

(a) Compliance with the requirements prescribed in this subpart shall be established by flight or other tests conducted upon a rotorcraft 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 rotorcraft 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, and trim of the rotorcraft 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 rotorcraft 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.

6.101 Weight limitations. The maximum and minimum weights at which the rotorcraft 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) The maximum weight shall not be less than the sum of the weights of the following:

(1) The empty weight in accordance with § 6.104,

(2) 1 gallon of usable fuel for every 7 maximum continuous horsepower for which the rotorcraft is certificated,

(3) The full oil capacity,

(4) 170 lbs in all seats. Where in actual operation weights other than 170 lbs may affect adversely the balance and controllability of the rotorcraft, such weights shall be used in lieu of the 170 lbs. (See § 6.738 (a).)

(c) The minimum weight 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.

(d) The minimum weight shall not exceed the sum of the weights of the following:

(1) The empty weight in accordance with § 6.104,

(2) The minimum crew necessary to operate the rotorcraft assuming for each crew member the lowest of the following:

(i) 170 lbs,

(ii) Weight selected by the applicant,

(iii) Weight included in the loading instructions (see §§ 6.102 (b) and 6.738 (a)),

(3) 1 gallon of oil for each 100 maximum continuous horsepower for which the rotorcraft is certificated.

6.102 Center of gravity limitations.

(a) Center of gravity limits shall be established as the most forward position permissible for each weight established in accordance with § 6.101 and the most aft position permissible for each of such weights.

Such limits of the center of gravity range shall not exceed any of the following:

(1) The extremes selected by the applicant,

(2) The extremes for which the structure has been proven,

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

(b) Loading instructions shall be provided if the center of gravity position under any possible loading condition between the maximum and minimum weights as specified in § 6.101, with assumed weights for individual passengers and crew members variable over the anticipated range of such weights, lies beyond:

(1) The extremes selected by the applicant,

(2) The extremes for which the structure has been proven,

(3) The extremes for which compliance with all of the applicable flight requirements has been demonstrated. (See paragraph 6.741 (c).)

6.103 Rotor limitations and pitch settings.

(a) Power-on. A range of power-on operating speeds for the main rotor(s) shall be established which will provide adequate margin to accomodate the variation of rotor rpm attendant to all maneuvers appropriate to the rotorcraft type and consistent with the type of synchronizer or governor used, if any (see §§ 6.713 (b) (2) and 6.714 (b)). A rotor blade high-pitch limiting device shall be provided and shall be positioned to prevent rotational speeds substantially less than the approved minimum rotor rpm in any flight condition with full throttle and with the pitch control of the main rotor(s) in the full high-pitch position.

(b) Power-off. A range of power-off operating rotor speeds shall be established which will permit execution of all autorotative flight maneuvers appropriate to the rotorcraft type throughout the range of air speeds and weights for which certification is sought (see §§ 6.713 (a) and 6.713 (b) (1)). A rotor blade low-pitch limiting device shall be positioned to provide rotational speeds within the approved rotor speed range in any autorotative flight condition under the most adverse combinations of weight and air speed with the rotor pitch control in the full low-pitch position.

6.104 Empty weight.

(a) The empty weight, and the corresponding center of gravity position, shall be determined by weighing the rotorcraft. This weight shall exclude the weight of the crew and payload, but shall include the weight of all fixed ballast, the unusable fuel supply (see § 6.421), undrainable oil, total quantity of engine coolant, and total quantity of hydraulic fluid.

(b) The condition of the rotorcraft at the time of weighing shall be one which can be easily repeated and easily defined, particularly as regards the contents of the fuel, oil, and coolant tanks, and the items of equipment installed. (See § 6.740.)

6.105 Use of ballast. Removable ballast may be used to enable the rotorcraft to comply with the flight requirements. (See §§ 6.391, 6.738, and 6.740.)

PERFORMANCE

6.110 General. The performance information prescribed in §§ 6.111 through 6.114 shall be determined, and the rotorcraft shall comply with the

corresponding requirement in the standard atmosphere in still air.

6.111 Take-off.

(a) The distance required to take off and climb over a 50-foot obstacle shall be determined under the following conditions:

(1) Most unfavorable combination of weight and center of gravity location,

(2) Engines operating within the approved limitations.

(b) The take-off shall be made in a manner such that a landing can be made safely at any point along the flight path in case of an engine failure and shall not require an exceptional degree of skill on the part of the pilot or exceptionally favorable conditions.

(c) The take-off distance obtained, the type of surface from which the take-off was made, the effect of temperature and altitude variations, and all other pertinent information shall be established. (See § 6.740.)

6.112 Climb.

(a) For all rotorcraft, the steady rate of climb at the best rate-of-climb speed with maximum continuous power and landing gear retracted shall be determined over the range of weights, altitudes, and temperatures for which certification is sought (see § 6.740). This rate of climb shall provide a steady angle of climb under standard sea level conditions of not less than 1:6.

(b) For multiengine helicopters, the steady angle of climb at maximum weight, with one engine inoperative and the remaining engine(s) operating at maximum continuous power, shall not be less than 1:20 under standard sea level conditions.

6.113 Minimum operating speed performance.

(a) Hovering ceilings for helicopters shall be determined under the following conditions over the range of weights, altitudes, and temperatures for which certification is sought:

(1) With take-off power and landing gear extended in the ground effect at a height above the ground consistent with normal take-off procedures,

(2) With maximum continuous power and landing gear extended out of the ground effect.

(b) At maximum weight, under standard atmospheric conditions, and under conditions prescribed in subparagraph (a) (1) of this section, the hovering ceiling for helicopters shall not be less than 4,000 feet.

(c) For rotorcraft other than helicopters, the steady rate of climb at the minimum operating speed appropriate to the type with take-off power and landing gear extended shall be determined over the range of weights, altitudes, and temperatures for which certification is sought.

6.114 Landing. The horizontal distance required to land and come to a complete stop (to a speed of approximately 3 mph for seaplanes or float planes) from a point at a height of 50 feet above the landing surface shall be determined in accordance with the following:

(a) The approach speed or speeds in the glide shall be appropriate to the type of rotorcraft and shall be chosen by the applicant.

(b) The approach and landing shall be entered from steady autorotation and shall be made in such a manner that its reproduction would not require an exceptional degree of skill on the part of the pilot or exceptionally favorable conditions.

(c) During the landing there shall be no excessive vertical acceleration and no tendency to bounce, nose over, ground loop, porpoise, or water loop.

(d) There shall be established for the landing the type of surface on which the landing was made, the effect of temperature and altitude variations, and all other pertinent information (see also § 6.743 (c)).

FLIGHT CHARACTERISTICS

6.120 General.

(a) The rotorcraft shall meet the requirements prescribed in §§ 6.120 to 6.123 at all normally expected operating altitudes, under all critical loading conditions within the range of weight and center of gravity, and for all speeds, power, and rotor rpm conditions for which certification is sought.

(b) It shall be possible to make a smooth transition from one flight condition to another 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, including those conditions normally encountered in the event of sudden powerplant failure.

(c) For night or instrument certification the rotorcraft shall have such additional flight characteristics as the Administrator finds are required for safe operation under those conditions.

6.121 Controllability.

(a) The rotorcraft shall be safely controllable and maneuverable during steady flight and during the execution of any maneuver appropriate

to the type rotorcraft, including take-off, climb, level flight, turn, glide, and power-on or power-off landings.

(b) The margin of longitudinal and lateral cyclic control shall allow satisfactory pitching and rolling control at the maximum permissible forward speed with:

(1) Maximum weight,

(2) Critical center of gravity,

(3) Power on and power off,

(4) Critical rotor rpm.

(c) Compliance with paragraph (b) of this section shall include a demonstration with a power failure at V_H.

(d) There shall be established a wind velocity in which the rotorcraft can be operated without loss of control on or near the ground at the critical center of gravity and the critical rotor rpm in any maneuver appropriate to the type rotorcraft (e.g. cross-wind take-offs, sideward or rearward flight). This wind velocity shall not be less than 20 mph.

6.122 Trim. It shall be possible in steady level flight at any speed appropriate to the type rotorcraft to trim the steady longitudinal and lateral control forces to zero. The trim device shall not introduce any undesirable discontinuities in the force gradients.

6.123 Stability.

(a) General. It shall be possible to fly the rotorcraft in normal maneuvers, including a minimum of three take-offs and landings, for a continuous period of time appropriate to the operational use of the particular type rotorcraft without the pilot experiencing undue fatigue or strain. In addition, the rotorcraft shall comply with the requirements of paragraph (b).

(b) Static longitudinal stability. In the following configurations the characteristics of the longitudinal cyclic control shall be such that, with constant throttle and collective pitch settings, a rearward displacement of longitudinal control shall be necessary to obtain and maintain speeds below the specified trim speed, and a forward displacement shall be necessary to obtain and maintain speeds above the specified trim speed for the ranges of altitude and rotor rpm for which certification is sought.

(1) Climb. The stick position curve shall have a stable slope from an increment of speed 15 percent of V_H below the best rate-of-climb speed to an increment of speed 20 percent of V_H above the best rate-of-climb speed, with:

(i) Critical weight and center of gravity,

(ii) Maximum continuous power,

(iii) Landing gear retracted,

(iv) Trim at the best rate-of-climb speed.

(2) Cruise. The stick position curve shall have a stable slope from 0.7 V_H to 1.1 V_H, with:

(i) Critical weight and center of gravity,

(ii) Power for level flight at 0.9 V_H,

(iii) Landing gear retracted,

(iv) Trim at 0.9 V_H.

(3) Autorotation. The stick position curve shall have a stable slope throughout the speed range for which certification is sought, with:

(i) Critical weight and center of gravity,

(ii) Power off,

(iii) Landing gear both retracted and extended,

(iv) Trim at the speed for minimum rate of descent.

(4) Hovering. In the case of helicopters the stick position curve shall have a stable slope between the maximum approved rearward speed and a forward speed of 20 mph with:

(i) Critical weight and center of gravity,

(ii) Power required for hovering in still air,

(iii) Landing gear retracted,

(iv) Trim for hovering.

GROUND AND WATER HANDLING CHARACTERISTICS

6.130 General. The rotorcraft shall demonstrate satisfactory ground and water handling characteristics. There shall be no uncontrollable tendencies in any operating condition reasonably expected for the type.

6.131 Ground resonance. There shall be no uncontrollable tendency for the rotorcraft to oscillate when the rotor is turning and the rotorcraft is on the ground.

6.132 Spray characteristics. For rotorcraft equipped with floats, the spray characteristics during taxying, take-off, and landing shall be such as not to obscure the vision of the pilot nor produce damage to the rotors, propellers, or other parts of the rotorcraft.

MISCELLANEOUS FLIGHT REQUIREMENTS

6.140 Flutter and vibration. All parts of the rotorcraft shall be demonstrated to be free from flutter and excessive vibration under all speed and power conditions appropriate to the operation of the type rotorcraft. (See also §§ 6.203 (f) and 6.711.)

SUBPART C - STRUCTURE

GENERAL

6.200 Loads.

(a) Strength requirements of this subpart are specified in terms of limit and ultimate loads. Unless otherwise stated, the specified loads shall be considered as limit loads. In determining compliance with these requirements the specifications set forth in paragraphs (b) through (e) shall be used.

(b) The factor of safety shall be 1.5 unless otherwise specified. The factor of safety shall apply to the external and inertia loads, unless its application to the resulting internal stresses is more conservative.

(c) Unless otherwise provided, the specified air, ground, and water loads shall be placed in equilibrium with inertia forces, considering all items of mass in the rotorcraft.

(d) All loads shall be distributed in a manner closely approximating or conservatively representing actual conditions.

(e) If deflections under load significantly change the distribution of external or internal loads, the redistribution shall be taken into account.

6.201 Strength and deformation.

(a) The structure shall be capable of supporting limit loads without suffering detrimental permanent deformations.

(b) At all loads up to limit loads the deformation shall be such as not to interfere with safe operation of the rotorcraft.

(c) The structure shall be capable of supporting ultimate loads

without failure. It shall support the load for at least 3 seconds, unless proof of strength is demonstrated by dynamic tests simulating actual conditions of load application.

6.202 Proof of structure.

(a) Proof of compliance of the structure with the strength and deformation requirements of § 6.201 shall be made for all critical loading conditions.

(b) Proof of compliance by means of structural analysis shall be acceptable only when the structure conforms to types for which experience has shown such methods to be reliable. In all other cases substantiating tests shall be required.

(c) In all cases certain portions of the structure shall be tested as specified in § 6.300.

6.203 Structural and dynamic tests. At least the following structural tests shall be conducted to show compliance with the strength criteria:

(a) Dynamic and endurance tests of rotors and rotor drives, including controls (see § 6.412),

(b) Control surface and system limit load tests (see § 6.323),

(c) Control system operation tests (see § 6.324),

(d) Vibration surveys (see §§ 6.221 and 6.250),

(e) Landing gear drop tests (see § 6.237),

(f) Ground vibration tests to determine the natural frequencies of the blades and major structural components of the rotorcraft,

(g) Such additional tests as may be found necessary by the Administrator to substantiate new and unusual features of the design.

6.204 Design limitations. The following values shall be established by the applicant for purposes of showing compliance with the structural requirements specified in this subpart:

(a) Maximum design weight,

(b) Power-on and power-off main rotor rpm ranges (see §§ 6.103 and 6.713 through 6.714 (b)),

(c) Maximum forward speeds for the power-on and power-off rotor rpm ranges established in accordance with paragraph (b) of this section (see § 6.711),

(d) Maximum rearward and sideward flight speeds,

(e) Extreme positions of rotorcraft center of gravity to be used in conjunction with the limitations of paragraphs (b), (c), and (d) of this section,

(f) Rotational speed ratios between the powerplant and all connected rotating components,

(g) Positive and negative limit maneuvering load factors.

FLIGHT LOADS

6.210 General. Flight load requirements shall be complied with at all weights from the design minimum weight to the design maximum weight, with any practicable distribution of disposable load within prescribed operating limitations stated in the Rotorcraft Flight Manual (see § 6.741).

6.211 Flight load factors. The flight load factors shall represent rotor load factors. The net load factor acting at the center of gravity of the rotorcraft shall be obtained by proper consideration of balancing loads acting in the specific flight conditions.

6.212 Maneuvering conditions. The rotorcraft structure shall be designed for a positive maneuvering limit load factor of 3.5 and for a negative maneuvering limit load factor of 1.0, except that lesser values shall be allowed if the manufacturer shows by analytical study and flight demonstrations that the probability of exceeding the values selected is extremely remote. In no case shall the limit load factors be less than 2.5 positive and 0.5 negative. The resultant loads shall be assumed to be applied at the center(s) of the rotor hub(s) and to act in such directions as necessary to represent all critical maneuvering motions of the rotorcraft applicable to the particular type, including flight at the maximum design rotor tip speed ratio under power-on and power-off conditions.

6.213 Gust conditions. The rotorcraft structure shall be designed to withstand the loading due to a vertical gust of 30 feet per second in velocity in conjunction with the critical rotorplane air speeds, including hovering.

CONTROL SURFACE AND SYSTEM LOADS

6.220 General. The structure of all auxiliary rotors (antitorque and control), fixed or movable stabilizing and control surfaces, and all systems operating any flight controls shall be able to comply with the provisions of §§ 6.221 through 6.225.

6.221 Auxiliary rotor assemblies. Auxiliary rotor assemblies shall be tested in accordance with the provisions of § 6.412 for rotor drives. In addition, auxiliary rotor assemblies with detachable blades shall be substantiated for centrifugal loads of twice those resulting when the rotor is driven by the engine at its maximum continuous speed. In the case of auxiliary rotors with highly stressed metal components, the vibration

stresses shall be determined in flight, and it shall be demonstrated that these stresses do not exceed safe values for continuous operation.

6.222 Auxiliary rotor attachment structure. The attachment structure for the auxiliary rotors shall be able to withstand a limit load equal to the maximum loads in the structure occurring under the flight and landing conditions.

6.223 Tail rotor guard. When a tail rotor is provided on a rotorcraft it shall not be possible for the tail rotor to contact the landing medium during a normal landing. If a tail rotor guard is provided which will contact the landing medium during landings and thus prevent tail rotor contact, suitable design loads for the guard shall be established, and the guard and its supporting structure shall be able to withstand the established loads.

6.224 Stabilizing and control surfaces. Stabilizing and control surfaces shall be designed to withstand the critical loading from maneuvers or from combined maneuver and gust. In no case shall the limit load be less than 15 lbs per square foot or a load due to $C_N = 0.55$ at the maximum design speed. The load distribution shall simulate closely the actual pressure distribution conditions.

6.225 Primary control systems. Manual control systems shall comply with the following.

(a) From the pilot compartment to the stops which limit the range of motion of the pilots' controls, the controls shall be designed to withstand the limit pilot applied forces as set forth in subparagraphs (1) through (3), unless it is shown that the pilot is unable to apply such loads to the system. In the latter event the system shall be designed for the

maximum loads which the pilot is able to apply, except that in any case values less than 0.60 of those specified shall not be employed.

(1) Foot type controls – 130 lbs,

(2) Stick type controls – fore and aft 100 lbs,

– laterally 67 lbs,

(3) Wheel type controls – fore and aft 100 lbs,

– laterally 53 lb couple applied

on opposite sides of the control wheel.

(b) From the stops to the attachment of the control system to the rotor blades (or control areas) the control system shall be designed to withstand the maximum loads which can be obtained in normal operation of the rotorcraft, except that where jamming, ground gusts, control inertia, or friction can cause loads exceeding operational loads, the system shall support without yielding 0.60 of the loads specified in subparagraphs (1), (2), and (3) of paragraph (a) of this section.

LANDING LOADS

6.230 Landing loads.

(a) General. The limit loads obtained in the landing conditions shall be considered as external forces which would occur in a rotorcraft structure if it were acting as a rigid body. In each of the conditions the external loads shall be placed in equilibrium with the linear and angular inertia forces in a rational or conservative manner. In applying the specified conditions the provisions of paragraphs (b) through (e) shall be complied with.

(b) Center of gravity positions. The critical center of gravity positions within the certification limits shall be selected so that the

maximum design loads in each of the landing gear elements are obtained.

(c) Design weight. The design weight used in the landing conditions shall not be less than the maximum weight of the rotorcraft less the weight of the rotor blades.

(d) Load factor. The structure shall be designed for a limit load factor not less than two-thirds of the value developed in the energy absorption tests specified in § 6.237, except in conditions in which other values of load factor are prescribed.

(e) Landing gear position. For landing gear arrangements where two wheels are located aft and one or more wheels are located forward of the center of gravity, the tires shall be assumed to be in their static position, and the shock absorbers shall be assumed to be in the most critical position unless otherwise prescribed.

6.231 Level landing conditions.

(a) Under loading conditions prescribed in paragraph (b) of this section, the rotorcraft shall be assumed to be in the following two level landing attitudes:

(1) All wheels contacting the ground simultaneously,

(2) The aft wheels contacting the ground while the forward wheel(s) being just clear of the ground.

(b) The following two level landing loading conditions shall be considered. Where the forward portion of the landing gear has two wheels, the total load applied to the forward wheels shall be divided between the two wheels in a 40:60 proportion.

(1) Vertical loads shall be applied in accordance with the provisions of § 6.230.

(2) The vertical loads specified in subparagraph (1) of this paragraph shall be combined with a drag load at each wheel. The drag loads shall not be less than 25 percent of the respective vertical loads.

6.232 Nose-up landing condition. The rotorcraft shall be assumed in the maximum nose-up attitude permitting clearance of the ground by all parts of the rotorcraft. The ground loads shall be applied perpendicularly to the ground.

6.233 One-wheel landing condition. The rotorcraft shall be assumed in the level attitude to contact the ground on one of the wheels located aft of the center of gravity. The vertical load shall be the same as that obtained on the one side in the condition specified in § 6.231 (b) (1). The unbalanced external loads shall be reacted by the inertia of the rotorcraft.

6.234 Side load landing conditions.

(a) The rotorcraft shall be assumed in the level landing attitude. The limit vertical and side loads loads shall be based upon load factors of 1.33 and 0.56 respectively. These loads shall be applied at the ground contact point, unless the landing gear is of the full-swivelling type in which case the loads shall be applied at the center of the axle. The conditions set forth in paragraphs (b) and (c) shall be considered.

(b) Only the wheels aft of the c.g. shall be assumed to contact the ground. The vertical load shall be divided equally between the wheels. The side load shall be divided between the two wheels so that 60 percent of this load acts inboard on one wheel and 40 percent acts outboard on the other wheel.

(c) The forward and aft wheels shall be assumed to contact the ground simultaneously. The vertical and side loads on the aft wheels shall be divided in accordance with paragraph (a) of this section. Where the forward portion of the landing gear has two wheels, the loads applied to the forward wheels shall be divided between the two wheels in a 40:60 proportion.

6.235 Brake roll conditions. The rotorcraft attitudes shall be assumed to be the same as those prescribed for the level landing conditions in § 6.231 (a), with the shock absorbers deflected to their static position. The limit vertical load shall be based upon a load factor of 1.33. A drag load equal to the vertical load multiplied by a coefficient of friction of 0.8 shall be applied at the ground contact point of each wheel equipped with brakes, except that the drag load need not exceed the maximum value based on limiting brake torque.

6.236 Taxying condition. The rotorcraft and its landing gear shall be designed for loads which occur when the rotorcraft is taxied over the roughest ground which it is reasonable to expect in normal operation.

6.237 Energy absorption for landing conditions. The landing gear shall be capable of absorbing the energy of a free drop from a height of 20 inches measured from the bottom of the tires to the ground, except that a lesser height shall be acceptable if the value chosen is shown to exceed by at least $\sqrt{1.5}$ the value corresponding with the greatest probable sinking speed of the rotorcraft at ground contact in power-off landings likely to be made by pilots of average skill. In no case shall the drop height be less than 12 inches. It shall be acceptable to neglect the weight of the rotor blades in the drop test. The maximum drop test acceleration developed at the c.g. of the rotorcraft shall be determined in this test.

6.240 Ski landing conditions. The structure of a rotorcraft equipped with skis shall be designed in compliance with the loading conditions set forth in paragraphs (a) through (c).

(a) Up load conditions.

(1) A vertical load of Pn and a horizontal load of Pn/4 shall be applied simultaneously at the pedestal bearings, P being the maximum static weight on each ski when the rotorcraft is loaded to the maximum design weight. The limit load factor n shall be determined in accordance with § 6.230 (d).

(2) A vertical load equal to 1.33 P shall be applied at the pedestal bearings. (For P see subparagraph (1) of this paragraph.)

(b) Side load condition. A side load of 0.35 Pn shall be applied in a horizontal plane perpendicular to the center line of the rotorcraft at the pedestal bearings. (For P see subparagraph (a) (1) of this section.)

(c) Torque load condition. A torque load equal to 1.33 P (ft lbs) shall be applied to the ski about the vertical axis through the center line of the pedestal bearings. (For P see subparagraph (a) (1) of this section.)

6.245 Float landing conditions. The structure of a rotorcraft equipped with floats shall be designed in compliance with the loading conditions set forth in paragraphs (a) and (b).

(a) Up load conditions.

(1) With the rotorcraft assumed in the static level attitude a load shall be applied so that the resultant water reaction passes vertically through the center of gravity of the rotorcraft. The limit load factor shall be determined in accordance with § 6.230 (d).

(2) The vertical load prescribed in subparagraph (1) of this paragraph shall be applied together with an aft component equal to 0.25 the vertical component.

(b) Side load condition. The vertical load prescribed in subparagraph (a) (1) of this section, divided equally between the floats, shall be applied together with a side component equal to 0.25 the total vertical load. The total side component shall be applied to one float only.

MAIN COMPONENT REQUIREMENTS

6.250 Main rotor structure. The requirements of paragraphs (a) through (f) shall apply to the main rotor assemblies including hubs and blades.

(a) The hubs, blades, blade attachments, and blade controls which are subject to alternating stresses shall be designed to withstand repeated loading conditions. The stresses of critical parts shall be determined in flight in all attitudes appropriate to the type rotorcraft throughout the ranges of limitations prescribed in § 6.204. The service life of such parts shall be determined by fatigue tests or by other methods found acceptable by the Administrator.

(b) The main rotor structure shall be designed to withstand the critical flight loads prescribed in §§ 6.210 through 6.213.

(c) The main rotor structure shall be designed to withstand the limit loads prescribed in §§ 6.210 through 6.213 under conditions of autorotation necessary for normal operation. The rotor rpm used shall be such as to include the effects of altitude.

(d) The rotor blades, hubs, and flapping hinges shall be designed to withstand a loading condition simulating the force of the blade impact against its stop during operation on the ground.

(e) The rotor assembly shall be designed to withstand loadings simulating other critical conditions which might be encountered in normal operation.

(f) The rotor assembly shall be designed to withstand, at all rotational speeds including zero, the maximum torque likely to be transmitted thereto in both directions. If a torque limiting device is provided in the transmission system the design limit torque need not be greater than the torque defined by the limiting device, except that in no case shall the design limit torque be less than the limit torque specified in § 6.251 (c). The design torque shall be distributed to the rotor blades in a rational manner.

6.251 Fuselage, landing gear, and rotor pylon structure. The requirements of paragraphs (a) through (c) shall apply to the fuselage, landing gear, and rotor pylon structure.

(a) The structure shall be designed to withstand the critical loads prescribed in §§ 6.210 through 6.213. It shall be permissible to represent the resultant rotor force as a single force applied at the hub attachment point. The balancing and inertia loads occurring under the accelerated flight conditions as well as the thrust from auxiliary rotors shall be considered.

(b) The structure shall be designed to withstand the applicable ground loads prescribed in §§ 6.230 through 6.245.

(c) The engine mount and adjacent fuselage structure shall be designed to withstand loads occurring in the rotorcraft under the accelerated flight and landing conditions, including the effects of engine torque loads. In the case of engines having 5 or more cylinders, the limit torque shall be obtained by multiplying the mean torque by a factor of 1.5. For

4,3, and 2-cylinder engines the factors shall be 2,3, and 4, respectively.

(d) The structure shall be designed to withstand the loads prescribed in § 6.250 (d) and (f).

EMERGENCY LANDING CONDITIONS

6.260 General. The requirements of paragraphs (a) through (c) deal with emergency conditions of landing on land or water in which the safety of the occupants shall be considered, although it is accepted that parts of the rotorcraft may be damaged.

(a) The structure shall be designed to give every reasonable probability that all of the occupants, if they make proper use of the seats, belts, and other provisions made in the design (see § 6.355), will escape serious injury in the event of a minor crash landing (with wheels up if the rotorcraft is equipped with retractable landing gear) in which the occupants experience the following ultimate inertia forces relative to the surrounding structure.

(1) Upward 1.5g (Downward 4.0g)

(2) Forward 4.0g

(3) Sideward 2.0g

(b) The use of a lesser value of the downward inertia force specified in paragraph (a) of this section shall be acceptable if it is shown that the rotorcraft structure can absorb the landing loads corresponding with the design maximum weight and an ultimate descent velocity of 5 fps without exceeding the value chosen.

(c) The inertia forces specified in paragraph (a) of this section shall be applied to all items of mass which would be apt to injure the passengers or crew if such items became loose in the event of a minor crash landing, and the supporting structure shall be designed to restrain these items.

SUBPART D - DESIGN AND CONSTRUCTION

GENERAL

6.300 Scope. The rotorcraft shall not incorporate design features or details which experience has shown to be hazardous or unreliable. The suitability of all questionable design details or parts shall be established by tests.

6.301 Materials. The suitability and durability of all materials used in the rotorcraft structure shall be established on the basis of experience or tests. All materials used in the rotorcraft structure shall conform to approved specifications which will insure their having the strength and other properties assumed in the design data.

6.302 Fabrication methods. The methods of fabrication employed in constructing the rotorcraft structure shall be such as to produce a consistently sound structure. When a fabrication process such as gluing, spot welding, or heat treating recuires close control to attain this objective, the process shall be performed in accordance with an approved process specification.

6.303 Standard fastenings. All bolts, pins, screws, and rivets used in the structure shall be of an approved type. The use of an approved locking device or method is required for all such bolts, pins, and screws. Self-locking nuts shall not be used on bolts which are subject to rotation in operation.

6.304 Protection.

(a) All members of the structure shall be suitably protected against deterioration or loss of strength in service due to weathering, corrosion, abrasion, or other causes.

(b) Provision for ventilation and drainage of all parts of the structure shall be made where necessary for protection.

(c) In rotorcraft equipped with floats, special precautions shall be taken against corrosion from salt water, particularly where parts made from different metals are in close proximity.

6.305 Inspection provisions. Means shall be provided to permit the close examination of those parts of the rotorcraft which require periodic inspection, adjustment for proper alignment and functioning, and lubrication of moving parts.

6.306 Material strength properties and design values.

(a) Material strength properties shall be based on a sufficient number of tests of material conforming to specifications to establish design values on a statistical basis.

(b) The design values shall be so chosen that the probability of any structure being understrength because of material variations is extremely remote.

(c) ANC-5a and ANC-18 values shall be used unless shown to be inapplicable in a particular case. 5/

(d) The structure shall be designed in so far as practicable to avoid points of stress concentration where variable stresses above the fatigue limit are likely to occur in normal service.

6.307 Special factors.

General.

(a) Where there is uncertainty concerning the actual strength of a particular part of the structure, or where the strength is likely to

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5/ ANC-5a, "Strength of Metal Aircraft Elements," and ANC-18, "Design of Wood Aircraft Structures," are published by the Army-Navy-Civil Committee on Aircraft Design Criteria and may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

deteriorate in service prior to normal replacement of the part, or where the strength is subject to appreciable variability due to uncertainties in manufacturing processes and inspection methods, the factor of safety prescribed in § 6.200 (b) shall be multiplied by a special factor of a value such as to make the probability of the part being understrength from these causes extremely remote. The special factors set forth in paragraphs (b) through (d) shall be used for this purpose.

(b) Casting factors.

(1) Where only visual inspection of a casting is to be employed, the casting factor shall be 2.0, except that it need not exceed 1.25 with respect to bearing stresses.

(2) It shall be acceptable to reduce the factor of 2.0 specified in subparagraph (1) of this paragraph to a value of 1.25 if such a reduction is substantiated by testing at least three sample castings and if the sample castings as well as all production castings are visually and radiographically inspected in accordance with an approved inspection specification. During these tests the samples shall withstand the ultimate load multiplied by the factor of 1.25 and in addition shall comply with the corresponding limit load multiplied by a factor of 1.15.

(3) Casting factors other than those contained in subparagraphs (1) and (2) of this paragraph shall be acceptable if they are found to be appropriately related to tests and to inspection procedures.

(4) A casting factor need not be employed with respect to the bearing surface of a part if the bearing factor used (see paragraph (c) of this section) is of greater magnitude than the casting factor.

(c) Bearing factors.

(1) Bearing factors shall be used of sufficient magnitude

to provide for the effects of normal relative motion between parts and in joints with clearance (free fit) which are subject to pounding or vibration.

(2) A bearing factor need not be employed on a part if another special factor prescribed in this section is of greater magnitude than the bearing factor.

(d) Fitting factors.

(1) A fitting factor of at least 1.15 shall be used on all fittings the strength of which is not proven by limit and ultimate load tests in which the actual stress conditions are simulated in the fitting and the surrounding structure. This factor shall apply to all portions of the fitting, the means of attachment, and the bearing on the members joined.

(2) In the case of integral fittings the part shall be treated as a fitting up to the point where the section properties become typical of the member.

(3) The fitting factor need not be employed where a type of joint made in accordance with approved practices is based on comprehensive test data, e.g. continuous joints in metal plating, welded joints, and scarf joints in wood.

(4) A fitting factor need not be employed with respect to the bearing surface of a part if the bearing factor used (see paragraph (c) of this section) is of greater magnitude than the fitting factor.

MAIN ROTOR

6.310 Main rotor blades - pressure venting and drainage. Internal pressure venting of the main rotor blades shall be provided. Drain holes shall be provided and, in addition, the blades shall be designed to preclude the possibility of water becoming trapped in any section of the blade.

6.311 Stops. The rotor blades shall be provided with stops, as required for the particular design, to limit the travel of the blades about their various hinges. Provision shall be made to keep the blades from hitting the droop stops except during the starting and stopping of the rotor.

6.312 Rotor and blade balance. Rotors and blades shall be mass balanced to the degree necessary to prevent excessive vibrations and to safeguard against flutter at all speeds up to the maximum forward speed.

CONTROL SYSTEMS

6.320 General. All controls and control systems shall operate with ease, smoothness, and positiveness appropriate to their function. (See also §§ 6.350 and 6.353.)

6.321 Control system stops.

(a) All control systems shall be provided with stops which positively limit the range of motion of the pilot's controls.

(b) Control system stops shall be so located in the system that wear, slackness, or take-up adjustments will not appreciably affect the range of travel.

(c) Control system stops shall be capable of withstanding the loads corresponding with the design conditions for the control system.

6.322 Control system locks. If a device is provided for locking the control system while the rotorcraft is on the ground or water, the provisions of paragraphs (a) and (b) shall apply.

(a) A means shall be provided to give unmistakable warning to the pilot when the locking device is engaged.

(b) Means shall be provided to preclude the possibility of the lock becoming engaged during flight.

6.323 Static tests. Tests shall be conducted on control systems to show compliance with limit load requirements in accordance with the provisions of paragraphs (a) through (c).

(a) The direction of the test loads shall be such as to produce the most severe loading in the control system.

(b) The tests shall include all fittings, pulleys, and brackets used in attaching the control system to the main structure.

(c) Analyses or individual load tests shall be conducted to demonstrate compliance with the special factor requirements for control system joints subjected to angular motion. (See §§ 6.307 and 6.325.)

6.324 Operation tests. An operation test shall be conducted for each control system by operating the controls from the pilot compartment with the entire system loaded to correspond with loads specified for the control system. In this test there shall be no jamming, excessive friction, or excessive deflection.

6.325 Control system details. All details of control systems shall be designed and installed to prevent jamming, chafing, and interference [redacted] and loose objects. Precautionary means shall be

6.327 Autorotation control mechanism. The main rotor blade pitch control mechanism shall be arranged to permit rapid entry into autorotative flight in the event of power failure.

LANDING GEAR

6.335 Wheels. Landing gear wheels shall be of an approved type and shall have limit load ratings equal to or greater than the limit loads determined in accordance with §§ 6.230 through 6.237.

6.336 Brakes. A braking device shall be installed, controllable by the pilot and usable during power-off landings, which is adequate to insure:

(a) Counteraction of any normal unbalanced torque when starting or stopping the rotor,

(b) Holding the rotorcraft parked on a 10° slope on a dry, smooth pavement.

6.337 Tires. Landing wheel tires shall be of an approved type. The maximum static load rating of the tire shall not be less than the static ground reaction obtained at the wheel, assuming the maximum design weight concentrated at the most unfavorable center of gravity position.

6.338 Skis. Skis shall be of an approved type. The approved rating of the skis shall not be less than the maximum weight of the rotorcraft on which they are installed.

6.339 Ski installation.

(a) When used, a ski installation shall include a trimming gear and a restraining gear.

(b) The trimming gear shall be designed to maintain the ski in an appropriate position during flight. It shall have sufficient strength to withstand the maximum aerodynamic and inertia loads to which the ski is subjected.

(c) The restraining gear and the structure to which it is attached shall be designed to withstand a vertical load equal to 0.8 times the static vertical load on the ski, applied first at the forward end of the flat portion of the ski and secondly at the aft end of the flat portion. The restraining gear shall limit the angular travel of the ski, with the shock absorber both in the extended and the fully compressed positions, to such values as will accommodate the position assumed by the ski in the conditions set forth in subparagraphs (1) and (2).

(1) When the rotorcraft encounters an uphill slope of 7.5° max. in a level attitude,

(2) When the rotorcraft encounters a downhill slope of 7.5° max. in a tail-down position.

FLOATS

6.340 Buoyancy (main floats).

(a) Main floats shall have a buoyancy in excess of that required to support the maximum weight of the rotorcraft in fresh water as follows:

(1) 50 percent in the case of single floats,

(2) 60 percent in the case of double floats.

(b) Main floats for use on rotorcraft of 2,500 lbs or more maximum weight shall contain at least 5 watertight compartments of approximately equal volume. Main floats for use on rotorcraft of less than 2,500 lbs maximum weight shall contain at least four such compartments.

6.341 Float strength. Floats shall be designed for the conditions set forth in paragraphs (a) and (b).

(a) Bag type floats. Bag type floats shall withstand the

maximum pressure differential which might be developed at the maximum altitude for which the rotorcraft is designed. In addition, the float shall withstand the maximum expected vertical load distributed along the length of the bag over three-quarters of the projected bag area.

(b) Rigid floats. Rigid type floats shall withstand the maximum expected vertical, horizontal, and side loads. An appropriate load distribution under critical conditions shall be used.

PERSONNEL AND CARGO ACCOMMODATIONS

6.350 Pilot compartment - general.

(a) The arrangement of the pilot compartment and its appurtenances shall provide safety and assurance that the pilot will be able to perform all of his duties and operate the controls in the correct manner without unreasonable concentration and fatigue.

(b) When provision is made for a second pilot, the rotorcraft shall be controllable with equal safety from both seats.

(c) The pilot compartment shall be constructed to prevent leakage likely to be distracting to the crew or harmful to the structure when flying in rain or snow.

(d) Vibration and noise characteristics of cockpit appurtenances shall not interfere with the safe operation of the rotorcraft.

6.351 Pilot compartment vision. The pilot compartment shall be arranged to afford the pilot a sufficiently extensive, clear, and undistorted view for the safe operation of the rotorcraft. During flight in a moderate rain condition the pilot shall have an adequate view of the flight path in normal flight and landing, and have sufficient protection from the elements so that his vision is not unduly impaired. The pilot compartment shall be free of glare and reflections which would interfere with the

pilot's vision. For rotorcraft intended for night operation, the demonstration of these qualities shall include night flight tests.

6.352 Pilot windshield and windows. All glass panes shall be of a nonsplintering safety type.

6.353 Controls.

(a) All cockpit controls shall be located to provide convenience in operation and in a manner tending to prevent confusion and inadvertent operation. (See also § 6.737.)

(b) The controls shall be so located and arranged with respect to the pilots' seats that there exists full and unrestricted movement of each control without interference from either the cockpit structure or the pilots' clothing when seated. This shall be demonstrated for individuals ranging from 5'2" to 6'0" in height.

6.354 Doors. Closed cabins shall be provided with at least one adequate and easily accessible external door. No passenger door shall be so located with respect to the rotor discs as to endanger persons using the door.

6.355 Seats and berths. On rotorcraft manufactured on or after the effective date of this part all seats and berths, including their supporting structure shall be designed for the loads resulting from all specified flight and landing conditions, including the emergency landing conditions of § 6.260. Reactions from safety belts and harnesses shall be taken into account.

6.356 Cargo and baggage compartments. (See also § 6.382.)

(a) Each cargo and baggage compartment shall be designed for the placarded maximum weight of contents and the critical load distributions at

the appropriate maximum load factors corresponding with all specified flight and ground load conditions, excluding the emergency landing conditions of § 6.260.

(b) Provisions shall be made to prevent the contents in the compartments from becoming a hazard by shifting under the loads specified in paragraph (a) of this section.

(c) Provisions shall be made to protect the passengers and crew from injury by the contents of any compartment when the ultimate inertia force acting forward is 4g.

6.357 Emergency exits.

(a) Closed cabins on rotorcraft carrying more than 5 persons shall be provided with an emergency exit. An additional exit or exits shall be provided where the total seating capacity is more than 15. Emergency exits shall comply with the provisions of subparagraphs (1) through (6). (See also § 6.738 (c).)

(1) An emergency exit shall consist of a movable window or panel or of an additional external door which provides a clear and unobstructed opening, the minimum dimensions of which shall be such that a 19 in. by 26 in. ellipse may be completely inscribed therein.

(2) An exit shall be readily accessible, shall not require exceptional agility of a person using it, and shall be so located as to facilitate egress without crowding in all probable attitudes resulting from a crash.

(3) The method of opening an emergency exit shall be simple and obvious, and the exit shall be so arranged and marked as to be readily located and operated even in darkness.

(4) Reasonable provisions shall be made against the jamming of emergency exits as a result of fuselage deformation.

(5) The emergency exit, or second door, shall be on the opposite side of the cabin from the main door.

(6) The proper functioning of emergency exits shall be demonstrated by tests.

6.358 Ventilation. The ventilating system for the pilot and passenger compartments shall be so designed as to preclude the presence of excessive quantities of fuel fumes and carbon monoxide. The concentration of carbon monoxide shall not exceed 1 part in 20,000 parts of air under conditions of forward flight or hovering in zero wind. For other conditions of operation, if the carbon monoxide concentration exceed this value, suitable operating restrictions shall be provided.

FIRE PREVENTION

6.380 General. The fire prevention requirements of this subpart apply to personnel and cargo compartments. Additional fire prevention requirements are prescribed in Supart E, Powerplant Installation, and Subpart F, Equipment.

6.381 Cabin interiors. All compartments occupied or used by the crew or passengers shall comply with the provisions of paragraphs (a) through (c).

(a) The materials in no case shall be less than flash-resistant.

(b) The wall and ceiling linings, the covering of all upholstering, floors, and furnishings shall be flame-resistant.

(c) Compartments where smoking is to be permitted shall be equipped with ash trays of the self-contained type which are completely removable. All other compartments shall be placarded against smoking.

6.382 Cargo and baggage compartments. Cargo and baggage compartments which are remote from the pilot compartment shall be completely lined with fire resistant material, except that additional lining of flame-resistant material may be employed.

6.383 Heating systems.

(a) General. Heating systems involving the passage of cabin air over or in close proximity to the exhaust manifold shall not be used unless adequate precautions are incorporated in the design to prevent the introduction of carbon monoxide into the cabin or pilot compartment.

(b) Heat exchangers. Heat exchangers shall be constructed of suitable materials, shall be cooled adequately under all conditions, and shall be capable of easy disassembly for inspection.

(c) Combustion heaters. Gasoline-operated combustion heaters shall be of an approved type and shall be installed so as to comply with the applicable sections of the powerplant installation requirements covering fire hazards and precautions. All applicable requirements concerning fuel tanks, lines, and exhaust systems shall be considered. (See §§ 6.422 through 6.428 and 6.463.)

6.384 Fire protection of flight controls. All primary flight controls passing through the engine compartment shall be constructed of fireproof material or shall be enclosed in a suitably ventilated and drained enclosure of 0.012-inch nominally thick stainless steel or material of equivalent fireproof qualities.

MISCELLANEOUS

6.390 Leveling marks. Reference marks shall be provided for use in leveling the rotorcraft to facilitate weight and balance determinations on the ground.

6.391 Ballast provisions. Ballast provisions shall be so designed and constructed as to prevent the inadvertant shifting of the ballast in flight. (See also §§ 6.105, 6.738, and 6.741 (c).)

SUBPART E - POWERPLANT INSTALLATION

GENERAL

6.400 Scope. (a) General. The powerplant installation shall be considered to include all components of the rotorcraft which are necessary for its propulsion with the exception of the structure of the main and auxiliary rotors. It shall also be considered to include all components which affect the control of the major propulsive units or which affect their safety of operation between normal inspections or overhaul periods. (See §§ 6.604 and 6.613 for instrument installation and marking.) The requirements of paragraphs (b) through (d) shall be applicable to all powerplants.

(b) All components of the powerplant installation shall be constructed, arranged, and installed in a manner which will assure their continued safe operation between normal inspections or overhaul periods.

(c) Accessibility shall be provided to permit such inspection and maintenance as is necessary to assure continued airworthiness.

(d) Electrical interconnections shall be provided to prevent the existance of differences of potential between major components of the powerplant installation and other portions of the rotorcraft.

6.401 Engine type certification. All engines shall be type certificated in accordance with the provisions of Part 13 of the Civil Air Regulations.

6.402 Engine vibration. The engine shall be installed to preclude harmful vibration of any of the engine parts or of any of the components of the rotorcraft. It shall be demonstrated by means of a vibration investigation that the addition of the rotor and the rotor drive system to the engine does not result in modification of engine vibration characteristics to the extent that the principal rotating portions of the

engine are subjected to excessive vibratory stresses. It shall also be demonstrated that no portion of the rotor drive system is subjected to excessive vibratory stresses.

ROTOR DRIVE SYSTEM

6.410 Rotor drive mechanism. The rotor drive mechanism shall incorporate a unit which will automatically disengage the rotor drive and engine from the main and auxiliary rotors in the event of power failure. The rotor drive mechanism shall be so arranged that all rotors necessary for control of the rotorcraft in autorotative flight will continue to be driven by the main rotor(s) after disengagement of the engine and rotor drive from the main and auxiliary rotors. If a torque limiting device is employed in the rotor drive system (see § 6.250 (f)), such device shall be located to permit continued control of the rotorcraft after it becomes operative.

6.411 Rotor brakes. If a means is provided to control the rotation of the rotor drive system independent of the engine, the limitations on the use of such means shall be specified, and the control for this means shall be guarded to prevent inadvertent operation.

6.412 Rotor drive and control mechanism endurance tests. (a) The rotor drive and control mechanism shall be tested for not less than 100 hours. The test shall be conducted on the rotorcraft, and the power shall be absorbed by the actual rotors to be installed, except that the use of other ground or flight test facilities with any other appropriate method of power absorption shall be acceptable provided that all conditions of support and vibration closely simulate the conditions which would exist during a test on the actual rotorcraft. The endurance tests shall include the tests required by paragraphs (b) through (g).

(b) A 50-hour portion of the endurance test shall be run at not less than the maximum continuous engine speed in conjunction with maximum continuous engine power. In this test the main rotor shall be set in the position which will give maximum longitudinal cyclic pitch change to simulate forward flight. The auxiliary rotor controls shall be in the position for normal operation under the conditions of the test.

(c) A 50-hour portion of the endurance test shall be run at not less than 90 percent of maximum continuous engine speed and 75 percent of maximum continuous engine power. The main and auxiliary rotor controls during this test shall be in the same position as prescribed in paragraph (b) of this section.

(d) A 10-hour portion of the endurance test shall be run at not less than take-off engine power and speed. The main and auxiliary rotor controls shall be in the normal position for vertical ascent during this test.

(e) The portions of the endurance test prescribed in paragraphs (b) and (c) of this section shall be conducted in intervals of not less than 30 minutes and may be accomplished either on the ground or in flight. The portion of the endurance test prescribed in paragraph (d) of this section may be conducted in intervals of 5 minutes or more.

(f) At intervals of not more than every 5 hours during the endurance tests prescribed in paragraphs (b), (c), and (d) of this section the engine shall be stopped rapidly enough to allow the engine and rotor drive to be automatically disengaged from the rotors.

(g) There shall be accomplished under the operating conditions specified in paragraph (b) of this section 500 complete cycles of lateral control and 500 complete cycles of longitudinal control of the main rotors,

and 500 complete cycles of control of all auxiliary rotors. A complete control cycle shall be considered to involve movement of the controls from the neutral position, through both extreme positions, and back to the neutral position. The control cycling may be accomplished during the testing prescribed in paragraph (b) of this section or may be accomplished separately.

6.413 Additional tests. Such additional dynamic, endurance, and operational tests or vibratory investigations shall be conducted as are found necessary by the Administrator to substantiate the airworthiness of the rotor drive mechanism.

6.414 Shafting critical speeds. An investigation shall be made to determine that the critical speeds of all shafting lie outside the range of permissible engine speeds under idling, power-on, and autorotative conditions. It shall be demonstrated by actual operation that this condition is satisfied with the mechanism installed in the rotorcraft.

6.415 Shafting joints. All universal joints, slip joints, and other shafting joints shall have provision for lubrication, unless it is demonstrated that lack of lubrication will have no adverse effect on the operation of the rotorcraft.

FUEL SYSTEM

6.420 Capacity and feed. The usable fuel capacity shall not be less than 0.15 gallon per maximum continuous horsepower for which the rotorcraft is to be certificated. Gravity feed or mechanical pumping of fuel shall be employed. Air-pressure fuel systems shall not be allowed. The fuel supply system shall be arranged so that, in so far as practicable, the entire fuel supply can be utilized in the maximum inclinations of the fuselage for any sustained conditions of flight, and so that the feed ports will not be uncovered during normal maneuvers

involving moderate rolling or sideslipping. The system shall also feed fuel promptly after one tank has run dry and another tank is turned on.

6.421 Unusable fuel supply. The unusable fuel supply in each tank shall be that quantity at which the first evidence of malfunctioning occurs in any sustained flight condition at the most critical weight and center of gravity position within the approved limitations. The unusable fuel supply shall be determined for each tank used in normal operation. (See also §§ 6.104, 6.736, and 6.741 (e).)

6.422 Fuel tank construction and installation. Fuel tanks shall be designed and installed in accordance with the provisions of paragraphs (a) through (e).

(a) Fuel tanks shall be capable of withstanding without failure all vibration, inertia, fluid, and structural loads to which they may be subjected in operation.

(b) Fuel tanks shall be capable of withstanding, without failure or leakage, an internal pressure equal to the pressure developed during the maximum limit acceleration with full tanks, except that in no case shall the minimum internal pressure be less than 3.5 lbs/sq. in. for conventional type tanks or less than 2.0 lbs/sq. in. for bladder type tanks.

(c) Fuel tanks of 10 gallons or greater capacity shall incorporate internal baffles unless external support is provided to resist surging.

(d) Fuel tanks shall be separated from the engine compartment by a fire wall. At least one-half inch clear air space shall be provided between the tank and fire wall.

(e) Spaces adjacent to the surfaces of fuel tanks shall be ventilated so that fumes cannot accumulate in the tank compartment in case

of leakage. If two or more tanks have their outlets interconnected, they shall be considered as one tank. The air spaces in such tanks shall be interconnected to prevent the flow of fuel from one tank to another as a result of a difference in pressure in the respective tank air spaces.

6.423 Fuel tank details.

(a) Expansion space. Fuel tanks shall be provided with an expansion space of not less than 2 percent of the tank capacity. It shall not be possible to fill the fuel tank expansion space inadvertently when the rotorcraft is in the normal ground attitude.

(b) Sump. Each fuel tank shall incorporate a sump and drain located at the point in the tank which is the lowest when the rotorcraft is in the normal ground attitude. The main fuel supply shall not be drawn from the bottom of the sump.

(c) Filler connection. The design of fuel tank filler connections shall be such as to prevent the entrance of fuel into the fuel tank compartment or to any other portion of the rotorcraft other than the tank itself. (See also § 6.738 (b) (1).)

(d) Vents. Fuel tanks shall be vented from the top portion of the expansion space in such a manner that venting of the tank is effective under all normal flight conditions. The air vents shall be arranged to minimize the possibility of stoppage by dirt or ice formation.

(e) Outlet. Fuel tank outlets shall be provided with large-mesh finger strainers.

6.424 Fuel pumps. If a mechanical pump is employed, an emergency pump shall also be installed to be available for immediate use in case of failure of the mechanical pump. Pumps of appropriate capacity may also be used for pumping fuel from an auxiliary tank to a main fuel tank.

Mechanical pump systems shall be so arranged that they cannot feed from more than one tank at a time.

6.425 Fuel system lines and fittings.

(a) Fuel lines shall be installed and supported to prevent excessive vibration and to withstand loads due to fuel pressure and due to accelerated flight conditions.

(b) Fuel lines which are connected to components of the rotorcraft between which relative motion could exist shall incorporate provisions for flexibility.

(c) Flexible hose shall be of an approved type.

(d) All fuel lines and fittings shall be of sufficient size so that the fuel flow, with the fuel being supplied to the carburetor at the minimum pressure for proper carburetor operation, is not less than the following:

(1) For gravity feed systems: double the normal flow required to operate the engine at take-off power;

(2) For pump systems: 1.5 times the normal flow required to operate the engine at take-off power.

(e) A test for proof of compliance with the applicable flow requirements shall be conducted.

6.426 Valves. A positive and quick-acting valve which will shut off all fuel to each engine individually shall be provided. The control for this valve shall be within easy reach of appropriate flight personnel. In the case of rotorcraft employing more than one source of fuel supply, provision shall be made for independent feeding from each source. The shutoff valve shall not be located closer to the engine than the remote side of the fire wall.

6.427 Strainers. A strainer incorporating a sediment trap and drain shall be provided in the fuel system between the fuel tanks and the engine and shall be installed in an accessible position. The screen shall be easily removable for cleaning. If an engine-driven fuel pump is provided, the strainer shall be located between the fuel tank and the pump.

6.428 Drains. One or more accessible drains shall be provided at the lowest point in the fuel system to drain completely all parts of the system when the rotorcraft is in its normal position on level ground. Such drains shall discharge clear of all parts of the rotorcraft and shall be equipped with safety locks to prevent accidental opening.

6.429 Fuel quantity indicator. The fuel quantity indicator (see § 6.613 (b)) shall be installed to indicate clearly to the flight crew the quantity of fuel in each tank while in flight. When two or more tanks are closely interconnected by a gravity feed system and vented, and when it is impossible to feed from each tank separately, only one fuel quantity indicator need be installed. If exposed sight gauges are employed they shall be installed and guarded to preclude the possibility of breakage or damage.

OIL SYSTEM

6.440 General.

(a) Each engine shall be provided with an independent oil system capable of supplying the engine with an appropriate quantity of oil at a temperature not exceeding the maximum which has been established as safe for continuous operation. (For oil system instruments see §§ 6.604 and 6.735.)

(b) The usable oil capacity shall not be less than the product of the endurance of the rotorcraft under critical operating conditions and

the maximum oil consumption of the engine under the same conditions, to which product a suitable margin shall be added to assure adequate circulation and cooling of the oil system. In lieu of a rational analysis of rotorcraft endurance and oil consumption, the total oil capacity of 1 gallon for each 30 gallons of fuel capacity shall be considered acceptable.

(c) The ability of the oil cooling provisions to maintain the oil inlet temperature to the engine at or below the maximum established value shall be demonstrated by flight tests.

6.441 Oil tank construction and installation. Oil tanks shall be designed and installed in accordance with the provisions of paragraphs (a) through (e).

(a) Oil tanks shall be capable of withstanding without failure all vibration, inertia, fluid, and structural loads to which they may be subjected in operation.

(b) Oil tanks shall be capable of withstanding without failure or leakage an internal pressure of 5 lbs/sq.in.

(c) Oil tanks shall be provided with an expansion space of not less than 10 percent of the tank capacity, nor less than one-half gallon.

(d) Oil tanks shall be vented.

(e) Provision shall be made in the filler opening to prevent oil overflow from entering the compartment in which the oil tank is located. (See also § 6.738 (b) (2).)

6.442 Oil lines and fittings.

(a) Oil lines shall be supported to prevent excessive vibration.

(b) Oil lines which are connected to components of the rotorcraft between which relative motion could exist shall incorporate provisions for flexibility.

(c) Flexible hose shall be of an approved type.

(d) Oil lines shall have an inside diameter not less than the inside diameter of the engine inlet or outlet, and shall have no splices between connections.

6.443 Oil drains. One or more accessible drains shall be provided at the lowest point in the oil system to drain completely all parts of the system when the rotorcraft is in its normal position on level ground. Such drains shall discharge clear of all parts of the rotorcraft and shall be equipped with safety locks to prevent accidental opening.

6.444 Oil quantity gauge. An oil quantity indicator (see § 6.735) shall be installed to indicate during the filling operation the amount of oil in the oil tank.

6.445 Oil temperature indication. A means shall be provided for measuring during flight the oil temperature at the engine inlet. If a separate oil system is provided for the main rotor drive, a means shall also be provided to give a warning in flight when the oil temperature has exceeded a safe value. (See § 6.604.)

6.446 Oil pressure indication. If the main rotor drive incorporates an independent oil pressure system, a means shall be provided to give a warning in flight when the oil pressure has fallen below a safe value.

COOLING SYSTEM

6.450 General. The cooling system shall be capable of maintaining engine temperatures within safe operating limits under all conditions of flight during a period at least equal to that established by the fuel capacity of the rotorcraft, assuming normal engine power and speeds.

6.451 Cooling tests. Compliance with the provisions of § 6.450 shall be demonstrated in flight tests in which engine temperature measurements are obtained under critical flight conditions. Such tests

shall be conducted in air at temperatures corresponding with the maximum anticipated air temperatures as specified in paragraph (a) of this section. If the tests are conducted under conditions which deviate from the maximum anticipated air temperature, the recorded powerplant temperatures shall be corrected in accordance with the provisions of paragraphs (b) and (c) of this section. The corrected temperatures determined in this manner shall not exceed the maximum established safe values. The fuel used during the cooling tests shall be of the minimum octane number approved for the engines involved, and the mixture settings shall be those used in normal operation.

(a) Maximum anticipated air temperature. The maximum anticipated air temperature (hot day condition) shall be 100° F at sea level, decreasing from this value at the rate of 3.6° F per thousand feet of altitude above sea level until a temperature of -67° F is reached above which altitude the temperature shall be constant at -67° F.

(b) Correction factor for cylinder head and oil inlet temperatures. The cylinder head and oil inlet temperatures shall be corrected by adding the difference between the maximum anticipated air temperature and the temperature of the ambient air at the time of the first occurrence of maximum cylinder head or oil inlet temperature recorded during the cooling test, unless a more rational correction is shown to be applicable.

(c) Correction factor for cylinder barrel temperatures. Cylinder barrel temperatures shall be corrected by adding 0.7 of the difference between the maximum anticipated air temperature and the temperature of the ambient air at the time of the first occurrence of the maximum cylinder barrel temperature recorded during the cooling test, unless a more rational correction is shown to be applicable.

6.452 Coolant system. The coolant system for liquid-cooled engines shall be designed and installed in accordance with the provisions of paragraphs (a) through (d).

(a) Filler openings. Provision shall be made in coolant tank filler openings to prevent coolant overflow from entering the compartment in which the tank is located. (See also § 6.738 (b) (3).)

(b) Lines. Lines and connections shall conform to accepted standards and by their presence shall not induce vibration to the radiator or to the structure of the rotorcraft.

(c) Radiators. Radiators shall be so mounted as not to induce vibrations and strains causing distortion.

(d) Drains. One or more accessible drains shall be provided at the lowest point in any liquid coolant system to drain completely all parts of the system when the rotorcraft is in its normal position on level ground. Such drains shall discharge clear of all parts of the rotorcraft and shall be equipped with safety locks to prevent accidental opening.

INDUCTION AND EXHAUST SYSTEMS

6.460 General. The induction and exhaust systems shall be designed in accordance with accepted practice.

6.461 Air induction.

(a) The engine air induction system shall be designed to supply the proper quantity of air to the engine under all conditions of operation.

(b) Cold air intakes shall open completely outside the cowling unless the emergence of backfire flames is positively prevented.

(c) Carburetor air intakes shall be provided with drains. The drains shall not discharge fuel in the possible path of exhaust flames.

6.462 Induction system de-icing and anti-icing provisions.

(a) The engine air induction system shall incorporate means for the prevention and elimination of ice accumulations. Unless it is demonstrated that this can be accomplished by other means, compliance with the following heat rise provisions shall be demonstrated in air free of visible moisture at a temperature of 30° F. when the engine is operating at 75 percent of its maximum continuous power.

(b) Rotorcraft equipped with sea level engines employing conventional venturi carburetors shall have a preheater capable of providing a heat rise of 90° F.

(c) Rotorcraft equipped with sea level engines employing carburetors which embody features tending to reduce the possibility of ice formation shall have a preheater capable of providing a heat rise of 70° F.

(d) Rotorcraft equipped with altitude engines employing conventional venturi carburetors shall have a preheater capable of providing a heat rise of 120° F.

(e) Rotorcraft equipped with altitude engines employing carburetors which embody features tending to reduce the possibility of ice formation shall have a preheater capable of providing a heat rise of 100° F., except that if a fluid de-icing system is used the heat rise need not be greater than 40° F.

6.463 Exhaust manifolds.

(a) Exhaust manifolds shall be designed to provide for expansion, and shall be arranged and cooled so that local hot points cannot form.

(b) Exhaust manifolds shall be installed in accordance with the requirements of subparagraphs (1) through (3).

(1) Exhaust manifolding shall be such that exhaust gases are discharged clear of cowling, rotorcraft structure, carburetor air intake, and fuel system parts or drains.

(2) Exhaust manifolding shall not be located immediately adjacent to or under the carburetor or fuel system parts unless such parts are protected against leakage.

(3) Exhaust manifolding shall be such that exhaust gases do not discharge in a manner which would impair pilot vision at night due to glare.

POWERPLANT CONTROLS AND ACCESSORIES

6.470 Powerplant controls - general. The provisions of § 6.353 shall be applicable to all powerplant controls with respect to location and arrangement, and the provisions of § 6.737 shall be applicable to all powerplant controls with respect to marking. All flexible powerplant controls shall be of an approved type.

6.471 Throttle controls.

(a) A separate throttle control shall be provided for each engine. Throttle controls shall be grouped and arranged to permit separate control of each engine and also simultaneous control of all engines.

(b) Throttle controls shall afford a positive and immediately responsive means of controlling the engines.

6.472 Ignition switches.

(a) Means shall be provided for quickly shutting off all ignition by the grouping of switches or by providing a master ignition control.

(b) If a master ignition control is provided, a guard shall be incorporated to prevent inadvertent operation of the control.

6.473 Mixture controls. If mixture controls are provided, a separate control shall be provided for each engine. The mixture controls shall be grouped and arranged to permit separate control of each engine and also simultaneous control of all engines.

6.474 Powerplant accessories. Engine mounted accessories shall be of a type approved for installation on the engine involved, and shall utilize the provisions made on the engine for mounting.

POWERPLANT FIRE PROTECTION

6.480 General. The powerplant installation shall be protected against fire in accordance with §§ 6.481 through 6.484. Additional fire prevention requirements are prescribed in Subpart D, Design and Construction, and Subpart F, Equipment.

6.481 Ventilation. Compartments which include powerplant installation shall have provision for ventilation.

6.482 Shut-off means. Means shall be provided to shut off the flow in all lines carrying flammable fluids into the engine compartment, except that a shut-off means need not be provided in lines forming an integral part of an engine. Provision shall be made to guard against inadvertent operation of the shut-off means, and to make it possible for the crew to reopen the shut-off means in flight after it has once been closed.

6.483 Fire wall.

(a) All engines, auxiliary power units, fuel-burning heaters,

and other combustion equipment which are intended for operation in flight shall be isolated from the remainder of the rotorcraft by means of fire walls, shrouds, or other equivalent means.

(b) Fire walls and shrouds shall be constructed in such a manner that no hazardous quantity of air, fluids, or flame can pass from the engine compartment to other portions of the rotorcraft.

(c) All openings in the fire wall or shroud shall be sealed with close fitting fireproof grommets, bushings, or fire-wall fittings.

(d) Fire walls and shrouds shall be constructed of fireproof material and shall be protected against corrosion.

6.484 Engine cowling and engine compartment covering.

(a) Cowling or engine compartment covering shall be constructed and supported so as to make it capable of resisting all vibration, inertia, and air loads to which it would be subjected in operation.

(b) Provision shall be made to permit rapid and complete drainage of all portions of the cowling or engine compartment in all normal ground and flight attitudes. Drains shall not discharge in locations which might cause a fire hazard.

(c) Cowling or engine compartment covering shall be constructed of fire-resistant material.

(d) Those portions of the cowling or engine compartment covering which would be subjected to high temperatures due to their proximity to exhaust system parts or exhaust gas impingement shall be constructed of fireproof material.

SUBPART F- EQUIPMENT

GENERAL

6.600 Scope. The required basic equipment as prescribed in this subpart is the minimum which shall be installed in the rotorcraft for certification. Such additional equipment as is necessary for a specific type of operation is prescribed in the operating rules of the Civil Air Regulations.

6.601 Functional and installational requirements. Each item of equipment installed in a rotorcraft shall be:

(a) Of a type and design appropriate to perform its intended function,

(b) Labeled as to its identification, function, or operational limitations, or any combination of these, whichever is applicable,

(c) Installed in accordance with specified limitations of the equipment,

(d) Demonstrated to function properly in the rotorcraft.

6.602 Required basic equipment. The equipment listed in §§ 6.603 through 6.605 shall be the required basic equipment. (See § 6.600.)

6.603 Flight and navigational instruments. (See § 6.612 for installation requirements.)

(a) Air-speed indicator (see § 6.612 (a)),

(b) Altimeter,

(c) Magnetic direction indicator (see § 6.612 (c)).

6.604 Powerplant instruments. (See § 6.613 for installation requirements.)

(a) For each engine or tank there shall be installed:

(1) A fuel quantity indicator (see § 6.613 (b)),

(2) An oil pressure indicator,

(3) An oil temperature indicator (see § 6.613 (g)),

(4) A carburetor air temperature indicator (see § 6.613 (f)),

(5) A tachometer to indicate engine rpm and rotor rpm for the main rotor, or for each main rotor the speed of which can vary appreciably with respect to another main rotor.

(b) For each engine or tank (if required in reference section) there shall be installed:

(1) A coolant temperature indicator, if liquid-cooled engines are used (see § 6.613 (h)),

(2) A cylinder head temperature indicator (see § 6.613 (e)),

(3) A fuel pressure indicator (if pump-fed engines are used),

(4) A manifold pressure indicator (if altitude engines are used),

(5) An oil quantity indicator (see § 6.613 (d)).

6.605 Miscellaneous equipment.

(a) Approved seats for all occupants (see § 6.355),

(b) Approved safety belts for all occupants (see § 6.643),

(c) Master switch arrangement (see §§ 6.623 and 6.624),

(d) Source(s) of electrical energy (see §§ 6.620 through 6.622), where such electrical energy is necessary for operation of the rotorcraft,

(e) Electrical protective devices (see § 6.625).

INSTRUMENTS - INSTALLATION

6.610 General. The provisions of §§ 6.611 through 6.613 shall apply to the installation of instruments in rotorcraft.

6.611 Arrangement and visibility of instrument installations.

(a) Flight, navigation, and powerplant instruments for use by each pilot shall be easily visible to him.

(b) On multiengine rotorcraft, identical powerplant instruments for the several engines shall be so located as to prevent any confusion as to the engines to which they relate.

(c) The vibration characteristics of the instrument panel shall be such as not to impair seriously the readability or the accuracy of the instruments or to damage them.

6.612 Flight and navigational instruments.

(a) Air-speed indicating system. The air-speed indicating system shall be so installed that the air-speed indicator shall indicate true air speed at sea level under standard conditions to within an allowable installational error of not more than plus or minus 3 percent of the calibrated air speed or 5 mph, whichever is greater. The calibration shall be made in flight at all forward speeds of 10 mph or over. The allowable installation error shall not be exceeded at any forward speed of 20 mph and over. (See § 6.732.)

(b) Static air-vent system. All instruments provided with static air case connections shall be so vented that the influence of rotorcraft speed, the opening and closing of windows, air-flow variation, moisture, or other foreign matter will not seriously affect their accuracy.

(c) Magnetic direction indicator. The magnetic direction indicator shall be so installed that its accuracy shall not be excessively

affected by the airplane's vibration or magnetic fields. After the direction indicator has been compensated, the installation shall be such that the deviation in level flight does not exceed 10° on any heading. A suitable calibration placard shall be provided as specified in § 6.733.

6.513 Powerplant instruments.

(a) Instrument lines. Instrument lines shall comply with the provisions of § 6.425. In addition, instrument lines carrying flammable fluids or gases under pressure shall be provided with restricted orifices or equivalent safety devices at the source of the pressure to prevent the escape of excessive fluid or gas in case of line failure.

(b) Fuel quantity indicator. Fuel quantity indicators shall be calibrated to read zero during level flight when the quantity of fuel remaining in the tank is equal to the unusable fuel supply as defined by § 6.421. (See also § 6.736.)

(c) Fuel flowmeter system. When a flowmeter system is installed, the metering component shall include a means for by-passing the fuel supply in the event that malfunctioning of the metering component results in a severe restriction to fuel flow.

(d) Oil quantity indicator.

(1) A stick gauge or other equivalent means shall be provided to indicate the quantity of oil in each tank. (See § 6.735.)

(2) If an oil transfer system or a reserve oil supply system is installed, means shall be provided to indicate to the crew during flight the quantity of oil in each tank.

(e) Cylinder head temperature indicator. A cylinder head temperature indicator shall be provided for each engine or rotorcraft equipped with cooling shutters. In the case of rotorcraft which do not have cooling shutters, an indicator shall be provided if compliance with

the provisions of § 6.451 is demonstrated in a condition other than the most critical cooling flight condition.

(f) Carburetor air temperature indicating system. A carburetor air temperature indicating system shall be provided for each engine equipped with a preheater which is capable of providing a heat rise in excess of 60° F.

(g) Oil temperature indicator. Means shall be provided to indicate to the appropriate members of the flight crew, during flight, the oil inlet temperature of each engine.

(h) Coolant temperature indicator. Means shall be provided to indicate to the appropriate members of the flight crew, during flight, the coolant outlet temperature of each liquid-cooled engine.

ELECTRICAL SYSTEMS AND EQUIPMENT

6.620 Installation.

(a) Electrical systems and equipment shall be free from hazards in themselves, in their method of operation, and in their effects on other parts of the rotorcraft. They shall be protected from fuel, oil, water, other detrimental substances, and from mechanical damage.

(b) The design of all components of the electrical system shall be appropriate for the intended use, and the components shall be capable of satisfactory operation over the entire range of environmental conditions encountered in the operation of the rotorcraft.

(c) Electrical sources of power shall have sufficient capacity during all normal flight operating conditions to supply maximum peaks and short-time and continuous electrical load requirements. For emergency operating conditions the capacity of electrical power sources shall be sufficient for all electrical loads necessary to permit a safe landing.

6.621 Batteries. A battery or batteries shall be provided consistent with the needs of the electrical system in meeting the requirements of electrical power capacity. The installation shall provide adequate ventilation and drainage for the battery under all operating conditions, and means shall be provided to prevent corrosive battery substance from coming in contact with other parts of the rotorcraft during servicing or in flight.

6.622 Generator system.

(a) Generator. Sources of electrical power (including the battery) shall act coordinately, and shall also be capable of independent operation. The generator(s) shall be capable of delivering sufficient power to keep the batteries charged, and in addition shall provide for the normal electrical power requirements of the rotorcraft.

(b) Generator controls. Generator voltage control equipment shall be capable of regulating the generator output within rated limits.

(c) Reverse current cut-off. A generator reverse current cut-off shall disconnect the generator from the battery and from other generators when the generator is developing a voltage of such value that current sufficient to cause malfunctioning can flow into the generator.

6.623 Master switch. A master switch arrangement shall be provided which will disconnect all sources of electrical power from the main distribution system at a point adjacent to the power sources.

6.624 Master switch installation. The master switch or its controls shall be so installed that it is easily discernible and accessible to a member of the crew in flight.

6.625 Protective devices. Protective devices (fuses or circuit breakers) shall be installed in the circuits to all electrical equipment,

except that such items need not be installed in the main circuits of starter motors or in other circuits where no hazard is presented by their omission. If fuses are used, one spare of each rating or 50 percent spare fuses of each rating, whichever is the greater, shall be provided.

6.626 Protective devices installation. Protective devices in circuits used in flight shall be conveniently located and properly identified to facilitate replacement of fuses or resetting of circuit breakers in flight.

6.627 Electric cables. The electric cables used shall be in accordance with approved standards for aircraft electric cable of a slow-burning type. They shall have current-carrying capacity sufficient to deliver the necessary power to the items of equipment to which they are connected.

6.628 Switches. Switches shall be capable of carrying their rated current. They shall be accessible to the crew and shall be labeled as to operation and the circuit controlled.

LIGHTS

6.630 Instrument lights.

(a) Instrument lights shall provide sufficient illumination to make all instruments, switches, etc., easily readable.

(b) Instrument lights shall be so installed that their direct rays are shielded from the pilot's eyes and so that no objectionable reflections are visible to him.

6.631 Landing lights.

(a) Landing and hovering lights shall be of an approved type.

(b) Landing lights shall be installed so that there is no objectionable glare visible to the pilot and so that the pilot is not adversely affected by halation.

6.621 Batteries. A battery or batteries shall be provided consistent with the needs of the electrical system in meeting the requirements of electrical power capacity. The installation shall provide adequate ventilation and drainage for the battery under all operating conditions, and means shall be provided to prevent corrosive battery substance from coming in contact with other parts of the rotorcraft during servicing or in flight.

6.622 Generator system.

(a) Generator. Sources of electrical power (including the battery) shall act coordinately, and shall also be capable of independent operation. The generator(s) shall be capable of delivering sufficient power to keep the batteries charged, and in addition shall provide for the normal electrical power requirements of the rotorcraft.

(b) Generator controls. Generator voltage control equipment shall be capable of regulating the generator output within rated limits.

(c) Reverse current cut-off. A generator reverse current cut-off shall disconnect the generator from the battery and from other generators when the generator is developing a voltage of such value that current sufficient to cause malfunctioning can flow into the generator.

6.623 Master switch. A master switch arrangement shall be provided which will disconnect all sources of electrical power from the main distribution system at a point adjacent to the power sources.

6.624 Master switch installation. The master switch or its controls shall be so installed that it is easily discernible and accessible to a member of the crew in flight.

6.625 Protective devices. Protective devices (fuses or circuit breakers) shall be installed in the circuits to all electrical equipment,

except that such items need not be installed in the main circuits of starter motors or in other circuits where no hazard is presented by their omission. If fuses are used, one spare of each rating or 50 percent spare fuses of each rating, whichever is the greater, shall be provided.

6.625 Protective devices installation. Protective devices in circuits used in flight shall be conveniently located and properly identified to facilitate replacement of fuses or resetting of circuit breakers in flight.

6.627 Electric cables. The electric cables used shall be in accordance with approved standards for aircraft electric cable of a slow-burning type. They shall have current-carrying capacity sufficient to deliver the necessary power to the items of equipment to which they are connected.

6.628 Switches. Switches shall be capable of carrying their rated current. They shall be accessible to the crew and shall be labeled as to operation and the circuit controlled.

LIGHTS

6.630 Instrument lights.

(a) Instrument lights shall provide sufficient illumination to make all instruments, switches, etc., easily readable.

(b) Instrument lights shall be so installed that their direct rays are shielded from the pilot's eyes and so that no objectionable reflections are visible to him.

6.631 Landing lights.

(a) Landing and hovering lights shall be of an approved type.

(b) Landing lights shall be installed so that there is no objectionable glare visible to the pilot and so that the pilot is not adversely affected by halation.

(c) Landing lights shall be installed in a location where they provide the necessary illumination for night operation including hovering and landing.

(d) A switch for each light shall be provided, except that where multiple lights are installed at one location a single switch for the multiple lights shall be acceptable.

6.632 Position light system. If a position light system is installed, it shall be of a type certificated in accordance with Part 15 of the Civil Air Regulations, and shall comply with the pertinent provisions of that part.

6.633 Installation requirements. The installation requirements of paragraphs (a) through (c) apply to single circuit systems and shall be complied with if this type system is installed.6/

(a) Forward and rear position lights. Single circuit systems shall consist of an aviation red light, an aviation green light, and an aviation white light. The red and the green lights shall be referred to as forward position lights and shall be so installed that, with the rotorcraft in normal flying position, the red light is displayed on the left side and the green light on the right side, each showing unbroken light between two vertical planes the dihedral angle of which is 110° when measured to the left and right, respectively, of the rotorcraft from dead ahead. These lights shall be spaced laterally as far apart as practicable. The white light shall be referred to as a rear position light, and shall be mounted as far aft as practicable and so installed

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6/ Installation requirements for dual circuit position light systems are contained in Part 4b of the Civil Air Regulations.

that unbroken light is directed symmetrically aft in such a manner that the axis of the maximum cone of illumination is parrelled to the forward flight path. In addition, the intersection of the two planes forming dihedral angle A given in Part 15 of the Civil Air Regulations shall be vertical.

(b) Circuit. The forward position lights and the rear white position light shall constitute the single circuit.

(c) Position light flasher. If installed, a position light flasher shall be of a type acceptable to the Administrator.

6.636 Riding light.

(a) When a riding (anchor) light is required for a rotorcraft operated from water, it shall be capable of showing a white light for at least 2 miles at night under clear atmospheric conditions.

(b) Riding lights shall be installed so that they will show a maximum practicable unbroken light when the rotorcraft is moored or drifting on the water. Externally hung lights shall be permitted.

SAFETY EQUIPMENT

6.640 General. Required safety equipment which the crew is expected to operate at a time of emergency, such as flares and automatic life-raft releases, shall be readily accessible. (See also § 6.738 (c).)

6.641 Flares. When parachute flares are required, they shall be of an approved type.

6.642 Flare installation.

(a) Parachute flares shall be releasable from the pilot compartment and installed to minimize the danger of accidental discharge.

(b) It shall be demonstrated in flight that the flare installation is such that ejection can be accomplished without hazard to the rotorcraft and its occupants.

(c) If recoil loads are involved in the ejection of the flares, the structure of the rotorcraft shall withstand such loads.

6.643 Safety belts. Rotorcraft manufactured on or after the effective date of this part shall be equipped with safety belts approved in accordance with § 6.19. In no case shall the rated strength of the safety belt be less than that corresponding with the ultimate load factors specified, taking due account of the dimensional characteristics of the safety belt installation for the specific seat or berth arrangement. Safety belts shall be attached so that no part of the anchorage will fail at a load lower than that corresponding with the ultimate load factors specified. (See § 6.260.)

6.644 Emergency flotation and signaling equipment. When emergency flotation and signaling equipment is required by the operating rules of the Civil Air Regulations, such equipment shall comply with the provisions of paragraphs (a) through (c).

(a) Rafts and life preservers shall be installed so as to be readily available to the crew and passengers.

(b) Rafts released automatically or released by the pilot shall be attached to the rotorcraft by means of a line to keep them alongside the rotorcraft.

(c) Signaling devices shall be free from hazard in their operation and shall be installed in an accessible location.

MISCELLANEOUS EQUIPMENT

6.650 Hydraulic systems.

(a) Design. Hydraulic systems and elements shall withstand, without exceeding the yield point, all structural loads which are expected to be imposed in addition to the hydraulic loads.

(b) Tests. Hydraulic systems shall be substantiated by proof pressure tests. When proof tested, no part of a hydraulic system shall fail, malfunction, or experience a permanent set. The proof load of any system shall be 1.5 times the maximum operating pressure of that system.

(c) Accumulators. Hydraulic accumulators or pressurized reservoirs shall not be installed on the engine side of the fire wall, except when they form an integral part of the engine.

SUBPART G - OPERATING LIMITATIONS AND INFORMATION

GENERAL

6.700 Scope.

(a) The operating limitations in §§ 6.710 through 6.718 shall be established as prescribed in this part.

(b) The operating limitations, together with any other information concerning the rotorcraft found necessary for safety during operation, shall be included in the Rotorcraft Flight Manual (§ 6.740), shall be expressed as markings and placards (§ 6.730), and shall be made available by such other means as will convey the information to the crew members.

OPERATING LIMITATIONS

6.710 Air-speed limitations - general. When air-speed limitations are a function of weight, weight distribution, altitude, or other factors, the values corresponding with all critical combinations of these values shall be established.

6.711 Never-exceed speed V_{NE}.

(a) The never-exceed speed shall be established. It shall not be less than the maximum level flight speed with all engines operating at maximum continuous rpm and 90 percent of maximum continuous power, nor greater than either of the following:

(1) 0.9V established in accordance with § 6.204,

(2) 0.9 times the maximum speed demonstrated in accordance with § 6.140.

(b) It shall be permissible to vary the never-exceed speed with altitude and rotor rpm, provided that the ranges of these variables are sufficiently large to allow an operationally practical and safe variation of the never-exceed speeds.

6.712 Operating speed range. An operating speed range shall be established for each rotorcraft.

6.713 Rotor speed. Rotor rpm limitations shall be established as set forth in paragraphs (a) and (b).

(a) Maximum power off (autorotation). Not to exceed 95 percent of the maximum design rpm determined under § 6.204 (b) or 95 percent of the maximum rpm demonstrated during the type tests (see § 6.103 (b)), whichever is lower.

(b) Minimum.

(1) Power off. Not less than 105 percent of the higher of the following:

(i) The minimum demonstrated during the type tests (see § 6.103 (b)),

(ii) The minimum determined by design substantiation.

(2) Power on. Not less than the higher of the following:

(i) The minimum demonstrated during the type tests (see § 6.103 (a)),

(ii) The minimum determined by design substantiation and not higher than a value determined in compliance with § 6.103 (a).

6.714 Powerplant limitations. The powerplant limitations set forth in paragraphs (a) through (c) shall be established for the rotorcraft. They shall not exceed the corresponding limits established as a part of the type certification of the engine installed on the rotorcraft.

(a) Take-off operation. The take-off operation shall be limited by:

(1) The maximum rotational speed, which shall not be greater than the maximum value determined by the rotor design, nor greater than the maximum value demonstrated during type tests,

(2) The maximum permissible manifold pressure,

(3) The time limit upon the use of the corresponding power,

(4) The maximum allowable cylinder head, coolant outlet, or oil temperatures, if applicable when the time limit of subparagraph (3) of this paragraph exceeds two minutes.

(b) Continuous operation. The continuous operation shall be limited by:

(1) The maximum rotational speed, which shall not be greater than the maximum value determined by the rotor design, nor greater than the maximum value demonstrated during type tests,

(2) The minimum rotational speed demonstrated in compliance with the rotor speed requirements as prescribed in § 6.713 (b) (2).

(c) Fuel octane rating. The minimum octane rating of fuel shall be established for satisfactory operation of the powerplant within the limitations prescribed in paragraphs (a) and (b) of this section.

6.715 Limiting height for autorotative landing. If a range of heights exists at any speed, including zero, within which it is not possible to make a safe landing following power failure, the range of heights and its variation with forward speed shall be established together with any other pertinent information, such as type of landing surface. (See § 6.741 (f).)

6.716 Rotorcraft weight and center of gravity limitations. The rotorcraft weight and c.g. limitations to be established are those required to be determined by §§ 6.101 and 6.102.

6.717 Minimum flight crew. The minimum flight crew shall be established by the Administrator as that number of persons which he finds necessary for safety in the operations authorized under § 6.718. This finding shall be based upon the work load imposed upon individual crew

members with due consideration given to the accessibility and the ease of operation of all necessary controls by the appropriate crew members.

6.718 Types of operation. The type of operation to which a rotorcraft is limited shall be established on the basis of flight characteristics and the equipment installed. (See the operating parts of the Civil Air Regulations.)

6.719 Maintenance manual. The applicant shall furnish with each rotorcraft a maintenance manual to contain information which he considers essential for the proper maintenance of the rotorcraft. The maintenance manual shall include recommended limits on service life or retirement periods for major components of the rotorcraft.

MARKINGS AND PLACARDS

6.730 General.

(a) The markings and placards specified in §§ 6.731 through 6.738 are required for all rotorcraft.

(b) Markings and placards shall be displayed in conspicuous places and shall be such that they cannot be easily erased, disfigured, or obscured.

(c) Additional information, placards, and instrument markings having a direct and important bearing on safe operation of the rotorcraft shall be required when unusual design, operating, or handling characteristics so warrant.

6.731 Instrument markings - general.

(a) When markings are placed on the cover glass of the instrument, provision shall be made to maintain the correct alignment of the glass cover with the face of the dial.

(b) All arcs and lines shall be of sufficient width and so located that they are clearly visible to the pilot.

6.732 Air-speed indicator. Instrument indications shall be in terms of indicated air speed. The markings set forth in paragraphs (a) through (c) shall be used to indicate to the pilot the maximum and minimum permissible speeds and the normal precautionary operating ranges. (See § 6.612 (a).)

(a) A red radial line shall be used to indicate the limit beyond which operation is dangerous.

(b) A yellow arc shall be used to indicate the precautionary operating range.

(c) A green arc shall be used to indicate the safe operating range.

6.733 Magnetic direction indicator. A placard shall be installed on or in close proximity to the magnetic direction indicator which shall comply with the requirements of paragraphs (a) through (c). (See § 6.612 (c).)

(a) The placard shall contain the calibration of the instrument in a level flight attitude with engine(s) operating.

(b) The placard shall state whether the calibration was made with radio receiver(s) on or off.

(c) The calibration readings shall be in terms of magnetic headings in not greater than 45° increments.

6.734 Powerplant instruments - general. All required powerplant instruments shall be marked as required in paragraphs (a) through (c). (See § 6.613.)

(a) The maximum and the minimum (if applicable) safe operation limits shall be marked with red radial lines.

(b) The normal operating ranges shall be marked with a green arc not extending beyond the maximum and minimum safe operating limits.

(c) The take-off and precautionary ranges shall be marked with a yellow arc.

6.735 Oil quantity indicators. Oil quantity indicators shall be marked in sufficient increments to indicate readily and accurately the quantity of oil. (See § 6.613 (d).)

6.736 Fuel quantity indicator. When the unusable fuel supply for any tank exceeds 1 gallon or 5 percent of the tank capacity, whichever is the greater, a red arc shall be marked on the indicator extending from the calibrated zero reading to the lowest reading obtainable in the level flight attitude. (See §§ 6.421 and 6.613 (b).) A notation in the Rotorcraft Flight Manual shall be made to indicate that the fuel remaining in the tank when the quantity indicator reaches zero is not usable in flight. (See § 6.741 (g).)

6.737 Control markings - general.

(a) All cockpit controls including those referred to in paragraphs (b) and (c) shall be plainly marked as to their function and method of operation. (See § 6.353.)

(b) Powerplant fuel controls. The powerplant fuel controls shall be marked as required by subparagraphs (1) through (4).

(1) Controls for fuel tank selector valves shall be marked to indicate the position corresponding with each tank with all existing cross-feed positions.

(2) When more than one fuel tank is provided, and if safe operation depends upon the use of tanks in a specific sequence, the fuel tank selector controls shall be marked adjacent to or on the control to indicate to the flight personnel the order in which the tanks must be used.

(3) On multiengine rotorcraft, controls for engine valves shall be marked to indicate the position corresponding with each engine.

(4) The capacity of each tank shall be indicated adjacent to or on the fuel tank selector control.

(c) Accessory and auxiliary controls. Accessory and auxiliary controls shall be marked as required by subparagraphs (1) and (2).

(1) Where visual indicators are essential to the operation of the rotorcraft (such as a rotor pitch or retractable landing gear indicator), they shall be marked in such a manner that the crew members at all times can determine the position of the unit.

(2) Emergency controls shall be colored red and shall be marked to indicate their method of operation.

6.738 Miscellaneous markings and placards.

(a) Baggage compartments and ballast location. Each baggage and cargo compartment as well as the ballast location shall bear a placard stating the maximum allowable weight of contents and, if applicable, any other limitation on contents found necessary due to loading requirements. When the maximum permissible weight to be carried in a seat is less than 170 pounds (see 6.101 (b) (4)), a placard shall be permanently attached to the seat structure stating the maximum allowable weight of the occupant to be carried.

(b) Fuel, oil, and coolant filler openings. The information required by subparagraphs (1) through (3) shall be marked on or adjacent to the appropriate filler cover.

(1) The word "fuel", the minimum permissible fuel octane number for the engines installed, and the usable fuel tank capacity (see § 6.423 (c)),

(2) The word "oil" and the oil tank capacity (see § 6.441 (e)),

(3) The name of the proper coolant fluid and the capacity of the coolant system (see § 6.452 (a)).

(c) Emergency exit placards. Emergency exit placards and operating controls shall be colored red. A placard shall be located adjacent to the controls which clearly indicates the location of the exit and the method of operation. (See § 6.357.)

(d) Operating limitation placard. A placard shall be provided in clear view of the pilot stating: "This (helicopter, gyrodyne, etc.) must be operated in compliance with the operating limitations specified in the CAA approved Rotorcraft Flight Manual."

(e) Safety equipment.

(1) Safety equipment controls which the crew is expected to operate in time of emergency, such as flares, automatic life raft releases, etc., shall be plainly marked as to their method of operation.

(2) When fire extinguishers and signaling and other life-saving equipment are carried in lockers, compartments, etc., these locations shall be marked accordingly.

ROTORCRAFT FLIGHT MANUAL

6.740 General.

(a) A Rotorcraft Flight Manual shall be furnished with each rotorcraft.

(b) The portions of the manual listed in §§ 6.741 through 6.744 as are appropriate to the rotorcraft shall be verified and approved and shall be segregated, identified, and clearly distinguished from portions not so approved.

(c) Additional items of information having a direct and important bearing on safe operation shall be required when unusual design, operating, or handling characteristics so warrant.

6.714 Operating limitations. The operating limitations set forth in paragraphs (a) through (g) shall be furnished with each rotorcraft.

(a) Air-speed and rotor limitations. Sufficient information shall include the information necessary for the marking of the limitations on or adjacent to the indicators as required. (See § 6.732.) In addition, the significance of the limitations and of the color coding used shall be explained.

(b) Powerplant limitations. Information shall be included to outline and to explain all powerplant limitations (see § 6.714) and to permit marking the instruments as required by §§ 6.734 through 6.736.

(c) Weight and loading distribution. The rotorcraft weights and center of gravity limits required by §§ 6.101 and 6.102 shall be included, together with the items of equipment on which the empty weight is based. Where the variety of possible loading conditions warrants, instructions shall be included to facilitate observance of the limitations.

(d) Flight crew. When a flight crew of more than one is required, the number and functions of the minimum flight crew determined in accordance with § 6.717 shall be described.

(e) Type of operation. The type(s) of operation(s) shall be listed for which the rotorcraft and its equipment installations have been approved. (See § 6.718.)

(f) Limiting heights. Sufficient information shall be included to outline the limiting heights and corresponding speeds for safe landing after power failure. (See § 6.715.)

(g) Unusable fuel. If the unusable fuel supply in any tank exceeds one gallon or 5 percent of the tank capacity, whichever is the greater, warning shall be provided to indicate to the flight personnel that the fuel remaining in the tank when the quantity indicator reads zero cannot be used safely in flight. (See § 6.421.)

6.742 Operating procedures. The section of the manual devoted to operating procedures shall contain information concerning normal and emergency procedures and other pertinent information peculiar to the rotorcraft's operating characteristics which are necessary for safe operation.

6.743 Performance information. Information relative to the items of performance set forth in paragraphs (a) through (d) shall be included.

(a) The take-off distance and the air speed at the 50-foot height together with any pertinent information defining the flight path with respect to the required autorotative landing in the event of an engine failure, including the calculated effect of altitude and temperature, (See § 6.111 (c).)

(b) The steady rates of climb and hovering ceilings together with the corresponding air speeds and other pertinent information, including the calculated effect of altitude and temperature. (See §§ 6.112 and 6.113.)

(c) The autorotative landing distance and the type of landing surface together with any other pertinent information which might affect this distance, including the calculated effect of altitude and temperature, (See § 6.114.)

(d) Maximum wind allowable for safe operation near the ground. (See § 6.121 (d).)

6.744 Marking and placard information. (See § 6.730.)

ROTORCRAFT IDENTIFICATION DATA

6.750 Identification plate. A fireproof identification plate shall be securely attached to the structure in an accessible location where it will not likely be defaced during normal service. The identification plate shall not be placed in a location where it might be expected to be destroyed or lost in the event of an accident. The identification plate shall contain the identification data required by § 1.50 of the Civil Air Regulations.

6.751 Identification marks. The nationality and registration marks shall be permanently affixed in accordance with the operating rules of the Civil Air Regulations.

PROPOSED RULES - PART 15

It is proposed to amend Part 15, effective January 1, 1951, as follows:

1. By amending § 15.20 to read as follows:

15.20 Position light systems. The position light systems for aircraft shall be one of the following types. The type to be used in a particular case shall be in accordance with requirements contained in the aircraft airworthiness or operational parts of the Civil Air Regulations.

(a) Single circuit systems. Single circuit systems shall conform to the rules set forth in subparagraphs (1) through (6) and may or may not incorporate a position light flasher.

(1) General. Single circuit systems shall consist of an aviation red light, an aviation green light, and an aviation white light. The red and green lights shall be spaced laterally as far apart as practicable and installed forward on an aircraft in such a location that, with the craft in normal flying position, the red light is displayed on the left side and the green light is displayed on the right side. These lights shall be referred to as forward position lights. The white light shall be mounted as far aft as practicable and shall be referred to as a rear position light.

(2) Dihedral angles. The forward and rear position lights shall show unbroken light within dihedral angles specified as follows:

(i) Dihedral angle L (left) shall be formed by two intersecting vertical planes, one parallel to the longitudinal axis of the aircraft, and the other at 110° to the left of the first, when looking forward along the longitudinal axis.

(ii) Dihedral angle R (right) shall be formed by two intersecting vertical planes, one parallel to the longitudinal axis of the aircraft, and the other at 110° to the right of the first, when looking forward along the longitudinal axis.

(iii) Dihedral angle A (aft) shall be formed by two intersecting vertical planes making angles of 70° to the right and 70° to the left, respectively, looking aft along the longitudinal axis, to a vertical plane passing through the longitudinal axis.

(3) Position light flashers. If installed, a position light flasher for a single circuit system shall be of a type acceptable to the Administrator.

(4) Color specifications. The colors of the position lights shall have the following International Commission on Illumination chromaticity coordinates:

(i) Aviation red.

y is not greater than 0.335,

z is not greater than 0.002;

(ii) Aviation green.

x is not greater than $0.440 - 0.320y$,

x is not greater than $y - 0.170$,

y is not less than $0.390 - 0.170$;

(iii) Aviation white.

x is not less than 0.350,

x is not greater than 0.540,

$y - y_o$ is not numerically greater than 0.01,

y_o being the y coordinate of the Plankian radiator for which $x_o = x$.

(5) Light distribution and intensities. The intensities prescribed in this section are those to be provided by new equipment with all filters and covers in place. Intensities shall be determined with the light source operating at a steady value equal to the average luminous output of the light source at the normal operating voltage of the aircraft. The light distribution and intensities of the position lights shall comply with the following requirements.

(i) Forward position lights. Each forward position light shall have an intensity of not less than three candles in all directions in dihedral angle L for the left light and in dihedral angle R for the right light. Within these dihedral angles the minimum permissible intensities in any plane through the longitudinal axis of the unit shall not be less than the following values within the angular limits noted:

Angles from longitudinal axis of unit	Intensity
60 degrees	4 candles
30 degrees	8 candles

In all directions in dihedral angle L for the right light and in dihedral angle R for the left light, a tolerance of 10° shall be permissible in which the intensity of these lights shall be reduced to two candles or less. In these same directions an additional 10° shall be permissible in which the intensity shall be reduced to 0.5 candle or less. In all directions in dihedral angle A a tolerance of 10° shall be permissible in which the intensity of these lights shall be reduced to 0.5 candle or less. In all directions outside the specified dihedral angle and the permissible tolerance angles for each unit, the stray light intensity shall not exceed 0.5 candle.

(iii) Rear position lights. Each rear position light shall have an intensity of not less than 8 candles in all directions within dihedral angle A. In all directions in dihedral angles L and R, a tolerance of 20° shall be permissible in which the intensity of this light shall be reduced to 1 candle or less. In all directions outside the specified dihedral angle and the permissible tolerance angles, the stray light intensity shall not exceed 1 candle.

(6) Light covers. The lamps and reflectors shall be protected by a cover which shall be of a noncombustible material, shall be so constructed that it will not change color or shape, and will not cloud or suffer any considerable loss of transmission in normal use. The coloring of those portions which are intended to transmit light shall be completely diffused through the material.

(b) Dual circuit systems. Dual circuit systems shall conform to the rules set forth in subparagraphs (1) through (6) and shall incorporate a position light flasher.

(1) General. Dual circuit systems shall include, in addition to the lights specified for the single circuit system, two aviation white lights and one aviation red light. These lights will constitute the second circuit. The two white lights shall be installed approximately in line with the forward position lights. One of these lights shall be mounted on the top of the fuselage, the other on the bottom with both showing unbroken light through approximately a hemisphere. These lights shall be referred to as fuselage lights. In the case of seaplanes, the location of the bottom fuselage light shall be subject to specific approval on each individual type airplane. The red light shall be mounted

as far aft as practicable and in close proximity to the white rear position light. It shall also be referred to as a rear position light.

(2) Dihedral angles. The dihedral angles for dual circuit systems are identical to those prescribed for the single circuit system in subparagraph (a) (2) of this section

(3) Position light flashers. Dual circuit position light flashers shall be of a type approved by the Administrator.

(4) Color specifications. The colors of the position lights for dual circuit systems shall be the same as those prescribed for single circuit systems in subparagraph (a) (4) of this section.

(5) Light distribution and intensities. The intensities prescribed in this section are those to be provided by new equipment with all filters and covers in place. Intensities shall be determined with the light source operating at a steady value equal to the average luminous output of the light source at the normal operating voltage of the aircraft. The light distribution and intensities of the position lights shall comply with the following requirements.

(i) Forward and rear position lights.

(a) Intensities in horizontal plane. The intensity in any direction in the horizontal plane shall not be less than the values given in Figure 15-2. (The horizontal plane is the plane containing the longitudinal axis and is perpendicular to the plane of symmetry of the airplane.)

(b) Intensities above and below horizontal. The intensity in any direction in any vertical plane shall not be less than the

appropriate value given in Figure 15-3, where I is the minimum intensity prescribed in Figure 15-2 for the direction in the horizontal plane determined by the intersection of the horizontal plane and the vertical plane for which the distribution is prescribed. (Vertical planes are planes perpendicular to the horizontal plane.)

(c) Overlaps between adjacent signals. The intensities in overlaps between adjacent signals shall not exceed the values given in Figure 15-4.

Dihedral angle	Angle from right or left of longitudinal axis, measured from dead ahead	Intensity
L and R	0° to 10°	40 candles
	10° to 20°	30 candles
	20° to 110°	20 candles
A	110° to 180°	20 candles

Figure 15-2

MINIMUM INTENSITIES IN THE HORIZONTAL PLANE

Angle above or below horizontal	Intensity
0°	1.00 I
0° to 5°	0.90 I
5° to 10°	0.80 I
10° to 15°	0.70 I
15° to 20°	0.50 I
20° to 30°	0.30 I
30° to 40°	0.10 I
40° to 90°	at least 2 candles

Figure 15-3

MINIMUM INTENSITIES IN ANY VERTICAL PLANE

Overlaps	Maximum intensity	
	Area A 1/	Area B 2/
Green in dihedral angle L	10 candles	1 candle
Red in dihedral angle R	10 candles	1 candle
Green in dihedral angle A	5 candles	1 candle
Red in dihedral angle A	5 candles	1 candle
Rear white or rear red in dihedral angle L	5 candles	1 candle
Rear white or rear red in dihedral angle R	5 candles	1 candle

Figure 15-4

MAXIMUM INTENSITIES IN OVERLAPPING BEAMS OF FORWARD AND REAR POSITION LIGHTS

(ii) Fuselage lights. The top and bottom fuselage lights shall each furnish illumination of an intensity equivalent to a 32-candlepower lamp installed in a reflector of high reflective properties and shall have a clear cover glass. These lights shall show through approximately a hemisphere.

(6) Light covers. The light covers for dual circuit systems are identical to those prescribed for the single circuit system in subparagraph (a) (6) of this section.

1/ Area A represents the overlap in any plane bounded by two straight lines forming angles of 10° cos θ and 20° cos θ to the common boundary of the dihedral angles considered.

2/ Area B represents the overlap in any plane beyond 20° cos θ. θ is the angle of the plane to the horizontal plane.