Civil Aeronautics Manual 7

Rotorcraft Airworthiness; Transport Categories



FEDERAL AVIATION AGENCY

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N. E. HALABY, Administrator

NOTE

This manual contains Civil Air Regulations Part 7, effective August 1, 1956, Amendments 7–1 through 7–5, and the editorial changes required by Special Regulation SR–430 effective December 31, 1958. As a convenience to the users of this manual, the changes made by Amendment 7–5, which was issued as a result of the First Federal Aviation Agency Airworthiness Review and which became effective May 3, 1962, are enclosed in black brackets.

As amendments and other pertinent materials pertaining to Part 7 are issued, they will be included in this manual.

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Rotorcraft Airworthiness; Transport Categories

Supplement No. 1, CAM 7 dated May 1962 **November 1, 1962**

SUBJECT: Display of Experimental Exterior Lighting Systems Approved for Use on Aircraft.

This supplement is issued to incorporate into CAM 7 Special Civil Air Regulation No. SR-392D, Display of Experimental Exterior Lighting Systems Approved for Use on Aircraft. This regulation was issued June 22, 1962, and became effective June 25, 1962.

Remove the following pages:	*Insert the following new pages:*
VII	VII
--	84-1 through 84-3

GEORGE C. PRILL, *Director,*
Flight Standards Service.

Attachments.

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Rotorcraft Airworthiness; Transport Categories

Subpart A—General

Applicability and Definitions

7.0 *Applicability of this part.* This part establishes standards with which compliance shall be demonstrated for the issuance of and changes to type certificates for Transport Category A and Transport Category B rotorcraft. This part, until superseded or rescinded, shall apply to all transport category rotorcraft for which applications for type certification in the transport categories are made after the effective date of this part (August 1, 1956).

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.1 *Definitions.* As used in this part terms are defined as follows:

(a) Administration.

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

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

(3) *Approved.* Approved, when used alone or as modifying terms such as means, devices, specifications, etc., means approved by the Administrator. (See sec. 7.18).

(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 (see NACA Technical Report 1235) defined as follows:

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

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

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

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

(v) The density ρ_0 at sea level under the above conditions is 0.002377 pound 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 sec. 7.451.)

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

(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) Deleted.

(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.

(d) *Weights.*

(1) *Maximum weight.* The maximum weight of the rotorcraft is that maximum at which compliance with the requirements of this part is demonstrated. (See sec. 7.101.)

(2) *Minimum weight.* The minimum weight of the rotorcraft is that minimum at which compliance with the requirements of this part is demonstrated. (See sec. 7.101.)

(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 sec. 7.104.)

(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 sec. 7.101.)

(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 sec. 7.101.)

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

(i) Gasoline 6 pounds per U.S. gallon. For other fuels, a design unit weight or range of weights appropriate to the type of fuel shall be established.

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

(iii) Crew and passengers 170 pounds per person.

(e) *Speeds.*

(1) *IAS.* Indicated airspeed is equal to the pitot static airspeed indicator reading as installed in the rotorcraft without correction for airspeed indicator system errors but including the sea level standard adiabatic compressible flow correction. (This latter correction is included in the calibration of the airspeed instrument dials.) (See secs. 7.612 and 7.732.)

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

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

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

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

(6) V_{NE}. The never-exceed speed. (See sec. 7.711.)

(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 sec. 7.200.)

(2) *Ultimate load.* An ultimate load is a limit load multiplied by the appropriate factor of safety. (See sec. 7.200.)

(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 opera-

tion and for uncertainties in design. (See sec. 7.200.)

(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 sec. 7.307(d).)

(g) *Powerplant installation.*[1]

[1] For engine airworthiness requirements see Part 13 of this subchapter.

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

(2) *Takeoff power or thrust.*

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

(ii) Takeoff power for turbine engines is the brake horsepower developed under static conditions at specified altitudes and atmospheric temperatures, under the maximum conditions of engine rotor shaft rotational speed and gas temperature approved for normal takeoff, and limited in use to a maximum continuous period as indicated in the approved engine specification.

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

(3) *Maximum continuous power or thrust.*

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

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

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

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

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

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

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

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

(h) *Propellers and rotors.*[2]

[2] For propeller airworthiness requirements see Part 14 of this subchapter.

(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]

[3] See NACA Technical Note No. 1604.

(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 rotor disc to the rotational tip speed of the rotor blades expressed as follows:

$$\mu=\frac{V\cos a}{\Omega R};$$

where:

V=airspeed of the rotorcraft along flight path (fps),

a=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), and

R=rotor radius (ft.).

(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.

(j) *Miscellaneous.*

(1) *Protective breathing equipment.* Protective breathing equipment is equipment designed to prevent the breathing of noxious gases which might be present as contaminants in the air within the rotorcraft in emergency situations (see sec. 7.646).

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-2, 23 F.R. 2592, Apr. 19, 1958, effective May 17, 1958; Amdt. 7-4, 24 F.R. 7074, Sept. 1, 1959, effective Oct. 1, 1959.)

Certification

7.10 *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 Adminis-

trator finds that the provision or provisions not complied with are compensated for by factors which provide an equivalent level of safety: *Provided,* That the Administrator finds no feature or characteristic of the rotorcraft which renders it unsafe.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.11 *Designation of applicable regulations.* The provisions of this section shall apply to all rotorcraft types certificated under this part irrespective of the date of application for type certificate.

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

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

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

(d) Except as otherwise provided by the Administrator pursuant to section 1.24 of this subchapter, a change to the type certificate (see sec. 7.13(b)) may be accomplished, at the option of the holder of the type certificate, either in accordance with the regulations incorporated by reference in the type certificate pursuant to section 7.13(c), or in accordance with subsequent amendments to such regulations in effect on the date of application for approval of the change, subject to the following provisions:

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

(2) When the change consists of a new design or a substantially complete redesign of a component, equipment installation, or system installation of the rotorcraft, and the Administrator finds that the regulations incorporated by reference in the type certificate pursuant to section 7.13(c) do not provide complete standards with respect to such change, he shall require compliance with such provisions of the regulations in effect on the date of application for approval of the change as he finds will provide a level of safety equal to that established by the regulations incorporated by reference at the time of issuance of the type certificate.

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

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

(1) A change in the number of engines or rotors;

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

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

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7–5, 27 F.R. 2999, Mar. 30, 1962, effective May 3, 1962.)

7.12 *Recording of applicable regulations.* The Administrator, upon the issuance of a type certificate, shall record the applicable regulations with which compliance was demonstrated. Thereafter, the Administrator shall record the applicable regulations for each change in the type certificate which is accomplished in accordance with regulations other than those recorded at the time of issuance of the type certificate. (See sec. 7.11.)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.13 *Type certificate.*

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

(b) The type certificate shall be deemed to include the type design (see sec. 7.14(b)), the operating limitations for the rotorcraft (see sec. 7.700), and any other conditions or limitations prescribed by the regulations in this subchapter.

(c) The applicable provisions of this part recorded by the Administrator in accordance with section 7.12 shall be considered as incorporated in the type certificate as though set forth in full.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.14 *Data required.*

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

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

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.15 *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 rotorcraft are constructed in accordance with the drawings in the type design,

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

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.16 *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 section 7.405.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.17 *Airworthiness, experimental, and production certificates.* (For requirements with regard to these certificates see Part 1 of this subchapter.)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.18 *Approval of materials, parts, processes, and appliances.*

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

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

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

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.19 *Changes in type design.* (For requirements with regard to changes in type design and the designation of applicable regulations therefor, see sec. 7.11 (d) and (e), and Part 1 of this subchapter.)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Rotorcraft Categories

7.20 *Rotorcraft categories.*

(a) For the purpose of certification under this part, rotorcraft are divided upon the basis of their size and complexity into the following categories:

(1) *Transport category A; suffix A.* Rotorcraft in this category shall be multiengined.

(2) *Transport category B; suffix B.* Rotorcraft in this category are limited to 20,000 pounds or less, and can be single- or multiengined.

(b) A multiengined rotorcraft may be certificated under the requirements of a particular category, or in both categories, if all of the requirements of each category are met. Sections of this part which apply to only one category are identified by the appropriate suffix added to the section number, as indicated in paragraph (a) of this section. All sections not identified by a suffix are applicable to both categories except as otherwise specified.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-2, 23 F.R. 2592, Apr. 19, 1958, effective May 17, 1958; Amdt. 7-4, 24 F.R. 7074, Sept. 1. 1959, effective Oct. 1, 1959.)

Subpart B—Flight

General

7.100 *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 authorized representative of the Administrator 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 authorized representative of the Administrator shall conduct any flight tests which he finds necessary to check the calibration and correction report.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.101 *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; or

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

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

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

(1) The minimum weight selected by the applicant;

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

(3) The minimum weight at which compliance with all of the applicable flight requirements has been demonstrated. (See sec. 7.741(c).)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.102 *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 section 7.101 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 section 7.101, with assumed weights for individual passengers and crewmembers 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 sec. 7.741(c).)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.103 *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 accommodate 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 secs. 7.713(b)(2) and 7.714 (b)). A means shall be provided to prevent rotational speeds substantially less than the approved minimum rotor rpm in any sustained flight condition with full throttle and with pitch control of the main rotor(s) in the high-pitch position, however, such means need not be provided if the Administrator finds that inherent characteristics of the rotorcraft render it unnecessary or that adequate means of warning the pilot of unsafe rotor speeds are provided. If a means to prevent low rotor speeds is provided, it shall be acceptable for such means to allow the use o higher pitch in an emergency, provided that the means incorporate provisions to prevent inadvertent transition from the normal operating range to the higher pitch angles.

(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 airspeeds and weights for which certification is sought (see secs. 7.713(a) and 7.713(b)(1)). A rotor blade low-pitch limiting device shall be positioned to provide sufficient rotational speed within the approved rotor speed range in any autorotative flight condition under the most adverse combinations of weight and airspeed with the rotor pitch control in the full low-pitch position. However, it shall be possible to prevent overspeeding of the rotor without requiring exceptional piloting skill.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-2, 23 F.R. 2592, Apr. 19, 1958, effective May 17, 1958; Amdt. 7-3, 23 F.R. 3514, May 22, 1958, effective May 17, 1958.)

7.104 *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, unusable fuel supply (see sec. 7.416), 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 sec. 7.740.)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.105 *Use of ballast.* Removable ballast may be used to enable the rotorcraft to comply with the flight requirements. (See secs. 7.391, 7.738, and 7.740.)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

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Performance

7.110 *General.*

(a) The performance prescribed in this subpart shall be determined using normal pilot skill and shall not require exceptionally favorable conditions. Compliance shall be shown for sea level standard conditions in still air and for the range of atmospheric variables as selected by the applicant. The performance as affected by engine power, instead of being based on dry air, shall be based on 80 percent relative humidity or 0.7″ Hg. vapor pressure whichever is less.

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

Note: The Administrator is authorized to establish appropriate margins to be applied to the performance data determined in accordance with this part for operating variables not covered in the performance determination; e.g., variations in pilot technique, engine power, rotor drag, rough air, etc.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.111 *Limiting height and speeds for safe landing following power failure.*

(a) *Category A.* If a range of heights exists at any speed, including zero, within which it is not possible to make a safe landing when the critical engine is suddenly made inoperative with takeoff power on the operating engine(s), the range of heights and its variation with forward speed shall be established (see secs. 7.715 and 7.741(f)).

(b) *Category B.* If a range of heights exists at any speed, including zero, within which it is not possible to make a safe landing following complete power failure, the range of heights and its variation with forward speed shall be established (see secs. 7.715 and 7.741(f)).

(c) *Category B; optional requirements for multiengined rotorcraft.* In lieu of compliance with paragraph (b) of this section, a multiengine rotorcraft that is certificated in accordance with Transport Category A powerplant installation requirements may, at the option of the applicant, comply with paragraph (a) of this section.

Note: (See sec. 7.384(b).) Category B. rotorcraft structure, controls, rotor mechanisms, and parts essential to a controlled landing are protected from powerplant fires for at least 5 minutes.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7–2, 23 F.R. 2592, Apr. 19, 1958, effective May 17, 1958.)

7.112 *Takeoff; general.*

(a) *Category A:* The takeoff performance shall be determined and scheduled in such a manner that, in the event of one engine becoming inoperative at any instant after the start of takeoff, it shall be possible for the rotorcraft either to return to and stop safely on the takeoff area, or to continue the takeoff, climbout, and attain a rotorcraft configuration and airspeed at which compliance with the climb requirement of section 7.115 (a)(2) is met.

(b) The takeoff data required by sections 7.113, 7.114, and 7.115 (a) (1) and (a) (2) shall be determined under the following conditions.

(1) At all weights, altitudes, and temperatures selected by the applicant, and

(2) With the operating engines not exceeding their approved limitations.

(c) All takeoff data, when corrected, shall assume a level takeoff surface, and shall be determined on a smooth, dry, hard surface, and in such a manner that reproduction of the performance does not require either exceptional skill or alertness on the part of the pilot or exceptionally favorable conditions. (For wind and runway gradient corrections see appropriate operating rules of the regulations in this subchapter.)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.113 *Category A; critical decision point.* The critical decision point shall be any combination of height and speed as selected by the applicant in demonstrating the takeoff as defined in section 7.114. The method used

to attain the critical decision point shall be such as to avoid flight within the critical areas of the limiting height-speed envelope as established in accordance with section 7.111(a).

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.114 *Takeoff.*

(a) *Category A.* The takeoff flight path and rejected takeoff path shall be established. It shall be permissible to initiate the takeoff in any manner provided the takeoff surface is defined and adequate safeguards are maintained to assure proper center of gravity position and control position.

(1) The rejected takeoff path shall be established with takeoff power on all engines from the start of takeoff to the critical decision point, at which point it shall be assumed that the critical engine becomes inoperative, and the rotorcraft is brought to a safe stop with the remaining engines operating within their approved limitations.

(2) The takeoff climbout path shall be established with takeoff power on all engines from the start of takeoff to the critical decision point, at which point it shall be assumed that the critical engine becomes inoperative. With the remaining engines operating within their approved limitations, the rotorcraft shall be accelerated such that the takeoff safety speed is reached by the end of the rejected takeoff distance and the climbout shall be accomplished at speeds not less than the takeoff safety speed used in meeting the rate of climb specified in section 7.115(a)(1), and in such a manner that the airspeed and configuration used in meeting the climb requirement specified in section 7.115(a)(2) are attained.

(3) The takeoff climbout and rejected takeoff shall be accomplished in such a manner as to provide a safe and smooth transition between all stages of the maneuver.

(b) *Category B.* The takeoff and climbout shall be established with the most unfavorable center of gravity position. It shall be permissible to initiate the takeoff in any manner provided the takeoff surface is defined and adequate safeguards are maintained to assure proper center of gravity position and control position and provided a landing can be made safely at any point along the flight path in the case of an engine failure (see sec. 7.111(b)).

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7–2, 23 F.R. 2592, Apr. 19, 1958, effective May 17, 1958.)

7.115 *Climb; one-engine-inoperative.*

(a) *Category A.* The following takeoff and en route climb requirements shall be met by all Category A rotorcraft:

(1) *Takeoff climb; gear extended.* The steady rate of climb without ground effect shall not be less than 100 fpm for each weight, altitude, and temperature condition for which takeoff data are to be scheduled with:

(i) The critical engine inoperative and the remaining engine(s) operating within their approved limitations,

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

(iii) Landing gear extended,

(iv) The takeoff safety speed as selected by the applicant (see sec. 7.114(a)(2)), and

(v) Cowl flaps or other means of controlling the engine-cooling air supply in the position which provides adequate cooling at the temperatures and altitudes for which certification is sought.

(2) *Climb at maximum continuous power.* The steady rate of climb without ground effect shall not be less than 150 fpm for each weight, altitude, and temperature condition for which takeoff data are to be scheduled with:

(i) The critical engine inoperative and the remaining engine(s) operating at maximum continuous power,

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

(iii) Landing gear retracted, if retractable,

(iv) The speed as selected by the applicant, and

(v) Cowl flaps or other means of controlling the engine-cooling air supply in the position which provides adequate cooling at the temperatures and altitudes for which certification is sought.

(3) *En route climb.* The steady rate of climb in feet per minute at any altitude at which the rotorcraft is expected to operate, and at any weight within the range of weights to be specified in the airworthiness certificate, shall be determined with:

(i) The critical engine inoperative, and the remaining engine(s) operating at the maximum continuous power available at such altitude,

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

(iii) The landing gear retracted, if retractable,

(iv) The speed as selected by the applicant, and

(v) Cowl flaps or other means of controlling the engine-cooling air supply in the position which provides adequate cooling at the temperatures and altitudes for which certification is sought.

(b) *Category B.* The following climb requirements shall be applicable to Category B rotorcraft:

(1) For all rotorcraft, the steady rate of climb at the best rate-of-climb speed with maximum continuous power on all engines and landing gear retracted, if retractable, shall be determined over the range of weights, altitudes, and temperatures for which certification is sought (see sec. 7.740). For all rotorcraft except helicopters this rate of climb shall provide a steady gradient of climb under standard sea level conditions of not less than 1: 6.

(2) For multiengine helicopters complying with the optional requirement of section 7.111(c), the steady rate of climb or descent shall be determined at the best rate-of-climb or rate-of-descent speed with one engine inoperative and the remaining engine(s) operating at a maximum continuous power.

(3) For all helicopters, the steady angle of glide shall be determined at the maximum and minimum rate-of-descent speed in autorotation at maximum weight at the optimum forward speed.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7–2, 23 F.R 2592, Apr. 19, 1958, effective May 17, 1958.)

7.116 *Hovering or minimum operating performance.*

(a) Category A: The hovering performance shall be determined over the range of weights, altitudes, and temperatures for which takeoff data are scheduled with not more than takeoff power on all engines, landing gear extended, and at a height above the ground consistent with the procedure used in the establishment of takeoff and accelerate-stop distance.

(b) Category B: Hovering performance for helicopters shall be determined over the range of weights, altitudes, and temperatures for which certification is sought with takeoff power on all engines, landing gear extended, and in the ground effect at a height above the ground consistent with normal takeoff procedures. At maximum weight, under standard atmospheric conditions and under the aforementioned conditions, 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 takeoff power and landing gear extended shall be determined over the range of weights, altitudes, and temperatures for which certification is sought.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.117 *Landing; general.*

(a) Category A: The landing performance shall be determined and scheduled in such a manner that, in the event of one engine becoming inoperative at any point in the approach path, it shall be possible for the rotorcraft to land and stop safely, and, further, it shall be possible from a point in

the approach path to climb out and attain a rotorcraft configuration and airspeed at which compliance with the climb requirement of section 7.115(a)(2) is met.

(b) The landing data required by section 7.118 shall be determined under the following conditions:

(1) At all weights, altitudes, and temperatures selected by the applicant, and

(2) With the operating engines not exceeding their approved limitations.

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

(d) During the landing there shall be no excessive vertical acceleration and no tendency to bounce, nose over, ground loop, porpoise, or water loop. All landing data, when corrected, shall assume a level landing surface, and shall be determined on a smooth, dry, hard surface. (For wind and runway gradient corrections see appropriate operating rules of the regulations in this subchapter.)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.118 *Landing.*

(a) *Category A; one engine inoperative.* The approach, balked landing, and landing paths shall be established. The approach and landing speeds shall be selected by the applicant and be appropriate to the type of rotorcraft being certificated. Such paths shall be established in the following manner:

(1) The approach and landing path shall be established such as to avoid flight within the critical areas of the limiting height–speed envelope as established in accordance with section 7.111(a) or, alternatively, at the option of the applicant, an envelope established in accordance with the landing condition with one engine inoperative.

(2) The balked-landing path shall be established such that, from a height and speed combination in the approach path as selected by the applicant, a safe climbout can be made and speeds attained corresponding to the speeds required in meeting the climb requirements of section 7.115 (a)(1) and (a)(2).

(3) The maneuvers specified in subparagraphs (1) and (2) of this paragraph shall be accomplished in such a manner as to provide safe and smooth transition between each stage.

(b) *Category A; complete failure of all power.* It shall be possible to make a safe landing on a prepared runway following complete failure of all power during normal cruising operating conditions (see sec. 7.743 (a)(2)). The maximum permissible descent speed in autorotation shall be determined.

(c) *Category B; autorotative 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 making this determination the following shall apply:

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

(2) The approach and landing shall be made with power off and shall be entered from steady autorotation.

(d) *Category B; Optional requirements for multiengined rotorcraft certificated in Transport Category B.* In lieu of compliance with the autorotative landing distance requirements specified in paragraph (c) of this section, a multiengined rotorcraft that complies with the powerplant installation requirements for Category A may, at the option of the applicant, comply with paragraphs (a) and (b) of this section, omitting the climbout requirement specified in paragraph (a)(2) of this section.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7–2, 23 F.R. 2592, Apr. 19, 1958, effective May 17, 1958; Amdt. 7–3, 23 F.R. 3514, May 22, 1958, effective May 17, 1958.)

Flight Characteristics

7.120 *General.*

(a) The rotorcraft shall comply with the requirements prescribed in sections 7.121 through 7.123 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 maintain a flight condition and 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 these conditions.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-2, 23 F.R. 2592, Apr. 19, 1958, effective May 17, 1958; Amdt. 7-4, 24 F.R. 7074, Sept. 1, 1959, effective Oct. 1, 1959.)

7.121 *Controllability.*

(a) The rotorcraft shall be safely controllable and maneuverable during steady flight and during the execution of any maneuver appropriate to the type of rotorcraft, including takeoff, 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 V_{NE} (see sec. 7.711), with:

(1) Maximum weight,

(2) Critical center of gravity,

(3) Power on and power off, and

(4) Critical rotor rpm.

(c) Compliance with paragraph (b) of this section shall include a demonstration with a power failure at V_H or V_{NE}, whichever is less.

(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 of rotorcraft; e.g., crosswind takeoffs, sideward or rearward flight. This wind velocity shall not be less than 20 mph.

(e) Controllability after power failure shall be demonstrated over the range of airspeeds and altitudes for which certification is sought, starting with maximum continuous power at critical weight. In taking corrective action, the time delay for all flight conditions shall be based on the normal pilot reaction time, except that for the cruise condition the time delay shall not be less than one second.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-4, 24 F.R. 7074, Sept. 1, 1959, effective Oct. 1, 1959.)

7.122 *Trim.* It shall be possible in steady level flight at any speed appropriate to the type of 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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.123 *Stability.*

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

(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 speeds below the specified trim speed, and a forward displacement shall be necessary to obtain speeds above the specified trim speed for the ranges of altitude and rotor rpm for which certification is sought:

(1) *Climb.* At all speeds from $0.85V_Y$ to $1.2V_Y$, with:

(i) Critical weight and center of gravity,

(ii) Maximum continuous power,

(iii) Landing gear retracted, and

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

(2) *Cruise.* At all speeds from $0.7V_H$ or $0.7V_{NE}$, whichever is less, to $1.1V_H$ *or* $1.1V_{NE}$, whichever is less, with:

(i) Critical weight and center of gravity,

(ii) Power for level flight at 0.9 V_H or 0.9 V_{NE}, whichever is less,

(iii) Landing gear retracted, and

(iv) Trimmed at 0.9 V_H, or 0.9 V_{NE}, whichever is less.

(3) *Autorotation.* 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, if retractable, and extended, and

(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, except for Category A helicopters the weight shall be that determined for hovering. (See sec. 7.116(a).)

(ii) Power required for hovering in still air,

(iii) Landing gear retracted, and

(iv) Trim for hovering.

Note: It is considered acceptable for the stick position versus speed curve to have a negative slope within the speed range specified for each of the conditions in subparagraphs (1) through (3) of this paragraph, provided the negative stick displacement required is not greater than 10 percent of the total stick travel.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-2, 23 F.R. 2592, Apr. 19, 1958, effective May 17, 1958; Amdt. 7-4, 24 F.R. 7074, Sept. 1, 1959, effective Oct. 1, 1959.)

Ground and Water Handling Characteristics

7.130 *General.* The rotorcraft shall be demonstrated to have satisfactory ground and water handling characteristics. There shall be no uncontrollable tendencies in any operating condition reasonably expected for the type.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.131 *Ground resonance.* There shall be no tendency for the rotorcraft to oscillate when the rotor is turning and the rotorcraft is on the ground unless the Administrator finds that such tendencies are not dangerous.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-2, 23 F.R. 2592, Apr. 19, 1958, effective May 17, 1958.)

7.132 *Spray characteristics.* For rotorcraft equipped with floats, the spray characteristics during taxiing, takeoff, 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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Miscellaneous Flight Requirements

7.140 *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 of rotorcraft. (See also secs. 7.203(f) and 7.711.)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Subpart C—Structure

General

7.200 *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 provisions set forth in paragraphs (b) through (e) of this section shall apply.

(b) The factor of safety shall be 1.5 unless otherwise specified, and 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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.201 *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 not be such as 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 during a static test for at least 3 seconds, unless proof of strength is demonstrated by dynamic tests simulating actual conditions of load application.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.202 *Proof of structure.*

(a) Proof of compliance of the structure with the strength and deformation requirements of section 7.201 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 section 7.203.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.203 *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 sec. 7.405).

(b) Control surface and system limit load tests (see sec. 7.323).

(c) Control system operation tests (see sec. 7.324).

(d) Flight stress measurements (see secs. 7.221, 7.250, and 7.251).

(e) Landing gear shock absorption tests (see sec. 7.332).

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

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7–4, 24 F.R. 7074, Sept. 1, 1959, effective Oct. 1, 1959.)

7.204 *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 and minimum design weights.

(b) Power-on and power-off main rotor rpm ranges (see secs. 7.103 and 7.713 through 7.714(b)),

(c) Maximum forward speeds for the power-on and power-off main rotor rpm

ranges established in accordance with paragraph (b) of this section (see sec. 7.713),

(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, and

(g) Positive and negative limit maneuvering load factors.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Flight Loads

7.210 *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 sec. 7.741).

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.211 *Flight load factor.* The flight load factor shall be assumed to act normal to the longitudinal axis of the rotorcraft, and shall be equal in magnitude and shall be opposite in direction to the rotorcraft inertia load factor at the center of gravity.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.212 *Maneuvering conditions.* The rotorcraft structure shall be designed for a positive maneuvering limit load factor of 3.5 and a negative maneuvering limit load factor of 1.0, except that lesser values shall be allowed if the applicant shows by analytical study and flight demonstrations that the probability of exceeding the values selected is extremely remote. Where such lesser values of maneuvering load factor are selected, the values selected shall be appropriate to each design weight condition between design minimum and design maximum values. In no case shall the limit load factors be less than 2.0 positive and 0.5 negative. Air loads shall be assumed to be applied at the center(s) of the rotor hub(s) and at any auxiliary lifting surface(s) and to act in such directions with distributions of load among the rotor(s) and auxiliary lifting surface(s) 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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.213 *Gust conditions.* The rotorcraft structure shall be designed to withstand the loading due to vertical and horizontal gusts of 30 fps in velocity in conjunction with the critical rotorcraft airspeeds, including hovering.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.214 *Yawing conditions.* The rotorcraft shall be designed for loads resulting from conditions specified in this section. Unbalanced aerodynamic moments about the center of gravity shall be reacted in a rational or a conservative manner considering the principal masses furnishing the reacting inertia forces. With the maximum main rotor speed and at a forward speed up to V_{NE} or V_H, whichever is less, the following maneuver shall be considered:

(a) With the rotorcraft in unaccelerated flight at zero yaw, it shall be assumed that the cockpit directional control is suddenly displaced to the maximum deflection as limited by the control stops or by maximum pilot effort.

(b) With the directional control deflected as in paragraph (a) of this section, it shall be assumed that the rotorcraft yaws to a resulting sideslip angle.

(c) With the rotorcraft yawned to the static sideslip angle corresponding with the directional control deflection specified in paragraph (a) of this section, it shall be as-

sumed that the directional control is suddenly returned to neutral.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Control Surface and System Loads

7.220 *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 designed to comply with the provisions of sections 7.221 through 7.226.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.221 *Auxiliary rotor assemblies.* Auxiliary rotor assemblies shall be tested in accordance with the provisions of section 7.405 for rotor drives. In addition, auxiliary rotor assemblies with detachable blades shall be substantiated for centrifugal loads resulting from the maximum design rotor rpm. 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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

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

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.223 *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 designed to withstand the established loads.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.224 *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 pounds 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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.225 *Primary control systems; general.* Longitudinal, lateral, vertical (collective pitch), and directional control systems shall be designed to the minimum requirements set forth in paragraphs (a) and (b) of this section.

(a) [All] control systems, including their supporting structure, shall be designed to withstand the loads resulting from the limit pilot-applied forces as set forth in subparagraphs (1) through (3) of this paragraph, or the maximum loads which can be obtained in normal operation of the rotorcraft, including any single power boost system failure (see sec. 7.328), whichever is greater. Where it can be shown that the system design or the normal operating loads are such that a portion of the system cannot react the specified pilot-applied forces of subparagraphs (1) through (3) of this paragraph, that portion of the system shall be designed to withstand the maximum loads which can be obtained in normal operation of the rotorcraft. The minimum design loads shall in any case be sufficient to provide a rugged system for service use, including consideration of fatigue, jamming, ground gusts, control inertia, and friction loads. In the absence of a rational analysis, the design loads resulting from 0.60 of the specified pilot-applied forces shall be considered as acceptable minimum design loads.

(1) Foot-type controls—130 pounds.

(2) Stick-type controls—100 pounds fore and aft—67 pounds laterally.

(3) Wheel-type controls—100 pounds fore and aft—53*D* inch-pounds couple at the rim of the control wheel (where *D* is wheel diameter, inches).

(b) The reaction to the applied loads shall be provided as follows:

(1) By the control stops only,

(2) By the control locks only,

(3) By the irreversible mechanism only (with the irreversible mechanism locked and with the control surface in all critical positions for the affected portions of the system within its limit of motion),

(4) By the attachment of the control system to the rotor blade pitch control horn only (with the control in all critical positions for the affected portions of the system within the limits of its motion), and

(5) By the attachment of the control system to the control surface horn (with the control in all critical positions for the affected portions of the system within the limits of its motion).

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-4, 24 F.R. 7074, Sept. 1, 1959, effective Oct. 1, 1959; Amdt. 7-5, 27 F.R. 2999, Mar. 30, 1962, effective May 3, 1962.)

[7.226 *Dual primary flight control systems.* If a dual primary flight control system is provided, the system shall be designed for conditions when the pilots operate the controls in opposition and in conjunction. Individual pilot loads equal to 75 percent of those obtained in accordance with section 7.225 shall be applicable.]

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-5, 27 F.R. 2999, Mar. 30, 1962, effective May 3, 1962.)

Landing Loads

7.230 *General.*

(a) *Loads and equilibrium.* The limit loads obtained in the landing conditions shall be considered as external loads 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 loads in a rational or conservative manner. In applying the specified conditions the provisions of paragraphs (b) through (e) of this section 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. It shall be acceptable to assume a rotor lift, equal to two-thirds the design maximum weight, to exist throughout the landing impact and to act through the center of gravity of the rotorcraft. Higher values of rotor lift shall be acceptable if substantiated by tests and/or data which are applicable to the particular rotorcraft.

(d) *Load factor.* The structure shall be designed for a limit load factor selected by the applicant, of not less than the value of the limit inertia load factor substantiated in accordance with the provisions of section 7.332, except in conditions in which other values of load factors are prescribed.

(e) *Landing gear position.* 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.

(f) *Landing gear arrangement.* The provisions of sections 7.231 through 7.236 shall be applicable to landing gear arrangements where two wheels are located aft and one or more wheels are located forward of the center of gravity.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.231 *Level landing conditions.*

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

(1) All wheels contacting the ground simultaneously, and

(2) The aft wheels contacting the ground with 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 section 7.230.

(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. For the attitude prescribed in paragraph (a)(1) of this section the resulting pitching moment shall be assumed resisted by the forward gear, while for the attitude prescribed in paragraph (a)(2) of this section the resulting pitching moment shall be assumed resisted by angular inertia forces.

(c) Drag components simulating the forces required to accelerate the wheel rolling assembly up to the specified ground speed shall be combined with the vertical reactions existing at the instant of peak drag loads. The ground speed for determination of the spin-up loads shall be assumed equal to 75 percent of the optimum forward flight speed for minimum rate of descent in autorotative flight. The vertical loads under this loading condition shall be in accordance with the provisions of section 7.230(d). It shall be acceptable to apply this condition only to the landing gear and the attaching structure.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.232 *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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.233 *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 section 7.231(b)(1). The unbalanced external loads shall be reacted by the inertia of the rotorcraft.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.234 *Lateral-drift landing condition.*

(a) The rotorcraft shall be assumed in the level landing attitude. Side loads shall be combined with one-half the maximum ground reactions obtained in the level landing conditions of section 7.231(b)(1). These loads shall be applied at the ground contact point, unless the landing gear is of the full-swiveling type in which case the loads shall be applied at the center of the axle. The conditions set forth in paragraphs (b) and (c) of this section shall be considered.

(b) Only the wheels aft of the center of gravity shall be assumed to contact the ground. Side loads equal to 0.8 of the vertical reaction acting inward (on one side) and 0.6 of the vertical reaction acting outward (on the other side) shall be combined with the vertical loads specified in paragraph (a) of this section.

(c) The forward and aft wheels shall be assumed to contact the ground simultaneously. Side loads on the wheels aft of the center of gravity shall be applied in accordance with paragraph (b) of this section. A side load at the forward gear equal to 0.8 of the vertical reaction shall be combined with the vertical load specified in paragraph (a) of this section.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.235 *Brake roll conditions.* The rotorcraft attitudes shall be assumed to be the

same as those prescribed for the level landing conditions in section 7.231(a), with the shock absorbers deflected to their static position. The limit vertical load shall be based upon a load factor of 1.33 when the rotorcraft attitude is as specified in section 7.231(a)(1); the limit vertical load factor may be reduced to 1.0 when the attitude is as specified in section 7.231(a)(2). 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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-4, 24 F.R. 7074, Sept. 1, 1959, effective Oct. 1, 1959.)

7.236 *Taxiing 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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.240 *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) of this section:

(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 section 7.230 (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 bearing. (For P and n see paragraph (a)(1) of this section.)

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

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.245 *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) of this section:

(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 section 7.230(d) or shall be assumed to be the same as the load factor determined for the ground type landing gear.

(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 in this condition equal to 0.75 the vertical load prescribed in paragraph (a) (1) of this section, divided equally between the floats, shall be applied together with a side component. The total side component shall be equal to 0.25 the total vertical load in this condition and shall be applied to one float only.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.246 *Tailwheel type landing gear ground loading conditions.* The structure of a rotorcraft equipped with landing gears arranged such that two wheels are located forward and one wheel is located aft of the center of gravity shall be assumed to be subjected to the loading conditions in accordance with paragraphs (a) through (h) of this section:

(a) *Level landing on forward gear only.* The rotorcraft shall be assumed to be in the level landing attitude with only the forward wheels contacting the ground.

(1) Vertical loads shall be applied in accordance with provisions of sec. 7.230.

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

(3) In the conditions of subparagraphs (1) and (2) of this paragraph, unbalanced pitching moments shall be assumed resisted by angular inertia forces.

(b) *Level landings; all wheels contacting simultaneously.* The rotorcraft shall be assumed to be in the level landing attitude with all wheels contacting the ground simultaneously.

(1) Vertical loads shall be applied in accordance with the provisions of sec. 7.230.

(2) The vertical loads specified in subparagraph (1) of this paragraph shall be combined with a drag load at each wheel axle of not less than 25 percent of the respective vertical load. Unbalanced pitching moments shall be assumed resisted by angular inertia forces.

(c) *Nose-up landing condition.* The rotorcraft shall be assumed to contact the ground on the rear wheel only at the maximum nose-up attitude to be expected under all operational landing conditions including landings in autorotation. The conditions of this paragraph need not be applied if it can be demonstrated that the probability of landing with initial contact on the rear wheel is extremely remote. In determining the applicable ground loads, it shall be acceptable to use a rational method to account for the distance between the direction of the rear wheel ground reactions and the rotorcraft c.g.

(1) Vertical loads shall be applied in accordance with the provisions of section 7.230.

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

(d) *One-wheel landing condition.* The rotorcraft shall be assumed in the level attitude to contact the ground on one of the wheels located forward of the c.g. The vertical load shall be the same as that obtained on the one side in the condition specified in paragraph (a)(1) of this section. Unbalanced moments shall be assumed resisted by angular inertia forces.

(e) *Side load landing condition.* The rotorcraft shall be assumed in the landing attitudes of paragraphs (a) and (b) of this section. Side loads in combination with one-half the maximum vertical ground reactions obtained in the landing conditions of paragraphs (a)(1) and (b)(1) of this section shall be applied at each wheel. The magnitude of the side loads on the forward wheels in each case shall be 0.8 of the vertical reaction (on one side) acting inward and 0.6 of the vertical reaction (on the other side) acting outward. The magnitude of the side load on the rear wheel shall be equal to 0.8 of the vertical reaction. These loads shall be applied at the ground contact point, unless the landing gear is of the full-swiveling type in which case the loads shall be applied at the center of the axle. When a lock, steering device, or shimmy damper is provided, the swiveled wheel shall also be assumed to be in the trailing position with the side load acting at the ground contact point.

(f) *Braked roll condition.* The rotorcraft attitudes shall be assumed to be the same as those prescribed in paragraphs (a) and (b) of this section with the shock absorbers deflected to their static position. The limit vertical load shall be based upon a load factor of 1.33 when the rotorcraft attitude is as specified in paragraph (b) of this section; the limit load factor may be reduced to 1.0 when the attitude is as specified in paragraph (a) of this section. 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.

(g) *Rear wheel turning condition.* The rotorcraft shall be asssumed to be in the static ground attitude with the shock absorbers and tires deflected to their static position. A vertical ground reaction equal to the static load on the rear wheel in combination with a side component of equal magnitude shall be assumed. When a swivel is provided, the rear wheel shall be assumed to be swiveled 90 degrees to the rotorcraft longitudinal axis with the resultant load passing through the axle. When a lock, steering device, or shimmy damper is provided, the rear wheel shall be assumed to be in the trailing position with the side load acting at the ground contact point.

(h) *Taxiing 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.

(Added by Amdt. 7-4, 24 F.R. 7074, Sept. 1, 1959, effective Oct. 1, 1959.)

Main Component Requirements

7.250 *Main rotor structure.* The requirements of paragraphs (a) through (g) of this section 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 the repeated loading conditions likely to occur within the established service life for such parts. The stresses of critical parts shall be determined in flight in all attitudes appropriate to the type of rotorcraft throughout the ranges of limitations prescribed in section 7.204. The service life of such parts shall be established by the applicant on the basis of fatigue tests or other methods found acceptable to the Administrator.

(b) The main rotor structure shall be designed to withstand the critical flight loads prescribed in sections 7.210 through 7.214.

(c) The main rotor structure shall be designed to withstand the limit loads prescribed in sections 7.210 through 7.214 under conditions of autorotation necessary for normal operation.

(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 by the rotor drive 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 section 7.251(c). The design torque shall be distributed to the rotor blades in a rational manner.

(g) The rotor assembly shall be designed to withstand the maximum torque likely to be transmitted thereto from sudden applications of the rotor brake if provided. The design torque shall be equally distributed among the rotor blades.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.251 *Fuselage and rotor pylon structure.* The requirements of paragraphs (a) through (e) of this section shall apply to the fuselage and rotor pylon structure.

(a) The structure shall be designed to withstand the critical loads prescribed in sections 7.210 through 7.214. The balancing air loads and inertia loads occurring under the accelerated flight conditions as well as the thrust from auxiliary rotors and the torque reaction of the rotor drive systems shall be considered.

(b) The structure shall be designed to withstand the applicable ground loads prescribed in sections 7.230 through 7.245.

(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 as defined by the power conditions in sections 7.1(g)(3) by a factor of 1.33. For 4-, 3-, and 2-cylinder engines, the factors shall be 2, 3, and 4, respectively. When a gas turbine powerplant is used, the limit torque shall be obtained by multiplying the mean torque for maximum continuous power by a factor of 1.25.

(d) The structure shall be designed to withstand the loads prescribed in sections 7.250 (d) and (g).

(e) Those parts of the basic structure which are directly subjected to alternating stresses and the sudden failure of which would threaten the structural integrity of the rotorcraft shall be designed to withstand the repeated loading conditions likely to occur within the established service life for such parts. The stresses of critical parts shall be determined in flight in all attitudes appropriate to the type of rotorcraft throughout the ranges of limitations prescribed in section 7.204. The service life of such parts shall be established by the applicant on the basis of fatigue tests or other methods found acceptable to the Administrator.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.252 *Auxiliary lifting surfaces.* The requirements of paragraphs (a) through (c) of this section shall apply to the auxiliary lifting surfaces.

(a) The structure shall be designed to withstand the critical flight loads prescribed in sections 7.210 through 7.214.

(b) The structure shall be designed to withstand the applicable ground loads of sections 7.230 through 7.245.

(c) The structure shall be designed to withstand loadings simulating other critical conditions which might be encountered in normal operations.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Emergency Landing Conditions

7.260 *General.* The requirements of paragraphs (a) through (c) of this section deal with emergency conditions of landing on land or water in which the safety of the occupants is 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 sec. 7.355), 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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.261 *Fuel tank protection.* When fuel tanks are located within the fuselage and be-

low the passenger floor level in an area where there is a likelihood of tank rupture from ground impact in the emergency landing condition (see sec. 7.260), the fuselage structure in the area of such fuel tanks shall be designed to resist the crash impact and protect the fuel tanks from rupture.

Note: Fuselage keels whose design and structural strength are such as to resist crash impacts associated with the emergency landing conditions of section 7.260 without extreme distortion which might tend to rupture the fuel tank may be considered to comply with the requirements of this section.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Subpart D—Design and Construction

General

7.300 *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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

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

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.302 *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 requires close control to attain this objective, the process shall be performed in accordance with the approved process specification.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.303 *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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.304 *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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.305 *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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.306 *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

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understrength because of material variations is extremely remote.

[(c) Values contained in MIL–HDBK–5, MIL–HDBK–17 Part I, ANC–17 Part II, ANC–18, MIL–HDBK–23 Part I, and ANC–23 Part II shall be used unless shown to be inapplicable in a particular case.

[*Note:* MIL–HDBK–5, "Strength of Metal Aircraft Elements"; MIL–HDBK–17, "Plastics for Flight Vehicles, Part I—Reinforced Plastics"; ANC–17, "Plastics for Aircraft, Part II—Transparent Glazing Materials"; ANC–18, "Design of Wood Aircraft Structures", MIL–HDBK–23, "Composite Construction for Flight Vehicles, Part I—Fabrication Inspection Durability and Repair"; and ANC–23, "Sandwich Construction for Aircraft, Part II—Material Properties and Design Criteria", are published by the Department of Defense and the Federal Aviation Agency and may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D.C.]

(d) The strength, detail design, and fabrication of the structure shall be such as to minimize the probability of disastrous fatigue failure.

Note: Points of stress concentration are one of the main sources of fatigue failure.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7–5, 27 F.R. 2999, Mar. 30, 1962, effective May 3, 1962.)

7.307 *Special factors.*

(a) *General.* Where there is uncertainty concerning the actual strength of a particular part of the structure, or where the strength is likely to 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 section 7.200 (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) of this section shall be acceptable for this purpose.

[(b) *Casting factors.* For structural castings, the factor of safety prescribed in section 7.200 shall be multiplied by the casting factors specified in subparagraphs (1) and (2) of this paragraph. The prescribed tests and inspections shall be in addition to those necessary to establish foundry quality control. Castings shall be inspected in accordance with approved specifications.

[(1) Each casting, the failure of which would preclude continued safe flight and landing of the rotorcraft or which would result in serious injury to occupants, shall have a casting factor of at least 1.25 and shall receive 100 percent inspection by visual, radiographic, and magnetic particle or penetrant inspection methods or approved equivalent nondestructive inspection methods. Where such castings have a casting factor less than 1.50, 3 sample castings shall be static tested. The test castings shall comply with the strength requirements of section 7.201 at an ultimate load corresponding with a casting factor of 1.25 and shall comply with the deformation requirements at a load equal to 1.15 times limit load.

[*Note:* Examples of castings to which this subparagraph applies are: structural attachment fittings; parts of flight control systems; control surface hinges and balance weight attachments; seat, berth, safety belt, and fuel and oil tank supports and attachments; cabin pressure valves.

[(2) For structural castings other than those specified in subparagraph (1) of this paragraph, the casting factors and inspections shall be in accordance with the following table except that it shall be acceptable to reduce the percentage of castings inspected by nonvisual methods when an approved quality control procedure is established. For castings procured to a specification which guarantees the mechanical properties of the material in the castings and provides for demonstration of these properties by test of coupons cut from castings on a sampling basis, it shall be acceptable to use a casting factor of 1.0. The inspection requirements for such castings shall be in accordance with those specified in the following table for casting factors of 1.25 to 1.50, and the testing requirements shall be in accordance with subparagraph (1) of this paragraph.

Casting factor	Inspections
2.0 or greater	100 percent visual.
Less than 2.0 greater than 1.5.	100 percent visual, and magnetic particle or penetrant or equivalent nondestructive inspection methods.
1.25 to 1.50	100 percent visual, magnetic particle or penetrant, and radiographic, or approved equivalent nondestructive inspection methods.

[(3) Castings which are pressure tested as parts of a hydraulic or other fluid system shall not be required to comply with the provisions of this section unless such castings support rotorcraft structural loads.

[(4) The casting factor need not exceed 1.25 with regard to bearing stresses regardless of the method of inspection employed. 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 greater than the casting factor.]

(c) *Bearing factors.*

(1) Bearing factors of sufficient magnitude shall be used 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 searf 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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-5, 27 F.R. 2999, Mar. 30, 1962, effective May 3, 1962.)

Main Rotor

7.310 *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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.311 *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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.312 *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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.313 *Rotor blade clearance.* Clearance shall be provided between the main rotor and all other parts of the rotorcraft to prevent the blades from striking any part of the rotorcraft during any operating condition.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Control Systems

7.320 *General.* All controls and control systems shall operate with ease, smoothness, and positiveness appropriate to their function. The elements of the flight control sys-

tem shall be designed or shall be distinctively and permanently marked to minimize the possibility of incorrect assembly which could result in the malfunctioning of the control system. (See also secs. 7.350 and 7.353.)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7–4, 24 F.R. 7074, Sept. 1, 1959, effective Oct. 1, 1959.)

7.321 *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 affect appreciably the range of travel.

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

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.322 *Control 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) of this section shall apply.

(a) The device shall either automatically disengage when the pilot operates the controls in a normal manner, or it shall limit the operation of the rotorcraft in such a manner that the pilot receives unmistakable warning while on the ground prior to takeoff.

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

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.323 *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) of this section.

(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 secs. 7.307 and 7.325.)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.324 *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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.325 *Control system details; general.* All details of control systems shall be designed and installed to prevent jamming, chafing, and interference from cargo, passengers, and loose objects. Precautionary means shall be provided in the cockpit to prevent the entry of foreign objects into places where they would jam the control systems. Provisions shall be made to prevent the slapping of cables or tubes against other parts of the rotorcraft. The following detailed requirements shall be applicable with respect to cable systems and joints:

(a) *Cable systems.*

(1) Cables, cable fittings, turnbuckles, splices, and pulleys shall be of an acceptable type.

(2) The design of cable systems shall preclude any hazardous change in cable tension throughout the range of travel under operating conditions and temperature variations.

(3) Cables smaller than ⅛ inch diameter shall not be used in the primary control system.

(4) Pulley types and sizes shall correspond to the cables with which they are used. The pulley-cable combinations and strength values specified in [MIL–HDBK–5] shall be used unless shown to be inapplicable for a particular installation.

(5) All pulleys shall be provided with closely fitted guards to prevent the cables being displaced or fouled.

(6) Pulleys shall lie in the plane passing through the cable within such limits that the cable does not rub against the pulley flange.

(7) Fairleads shall be so installed that they do not cause a change in cable direction of more than 3°.

(8) Clevis pins (excluding those not subject to load or motion) retained only by cotter pins shall not be used in the control system.

(9) Turnbuckles attached to parts having angular motion shall be installed to prevent positively any binding throughout the range of travel.

(10) Provision for visual inspection shall be made at all fairleads, pulleys, terminals, and turnbuckles.

(b) *Joints.*

(1) Control system joints subjected to angular motion in push-pull systems, excepting ball and roller bearing systems, shall incorporate a special factor of not less than 3.33 with respect to the ultimate bearing strength of the softest material used as a bearing.

(2) It shall be acceptable to reduce the factor specified in subparagraph (1) of this paragraph to a value of 2.0 for joints in cable control systems.

(3) The manufacturer's static, non-Brinell rating of ball and roller bearings shall not be exceeded.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7–5, 27 F.R. 2999, Mar. 30, 1962, effective May 3, 1962.)

7.326 *Spring devices.* The reliability of any spring device used in the control system shall be established by tests simulating service conditions, unless it is demonstrated that failure of the spring will not cause flutter or unsafe flight characteristics.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.327 *Autorotative 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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.328 *Power boost and power-operated control systems.* When a power boost or power-operated control system is used, an alternate system shall be immediately available, such that the rotorcraft can be flown and landed safely in the event of any single failure in the power portion of the system or in the event of failure of all engines. Such alternate system may be a duplicate power portion or a manually operated mechanical system. The power portion shall include the power source (e.g., hydraulic pumps), and such items as valves, lines, and actuators. The failure of mechanical parts (such as piston rods and links), and the jamming of power cylinders need not be considered if failure or jamming is considered to be extremely remote.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7–4, 24 F.R. 7074, Sept. 1, 1959, effective Oct. 1, 1959.)

Landing Gear

7.330 *General.* The requirements of sections 7.331 through 7.338 shall apply to the complete landing gear.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.331 *Shock absorbers.*

(a) The shock absorbing elements for the main, nose, and rear wheel units shall be substantiated by the tests specified in section 7.332.

(b) The shock absorbing ability of the landing gear in taxiing shall be demonstrated by taxiing tests (see sec. 7.236).

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.332 *Shock absorption tests.* Drop tests shall be conducted in accordance with paragraphs (a) and (b) of this section to substantiate the landing limit inertia load factor (see sec. 7.230(d) and to demonstrate the reserve energy absorption capacity of the landing gear. The drop tests shall be conducted with the complete rotorcraft or on units consisting of wheel, tire, and shock absorber in their proper relation.

(a) *Limit drop test.* The drop height in the limit drop test shall be 13 inches measured from the lowest point of the landing gear to the ground. A lesser drop height shall be permissible if it results in a drop test contact velocity found by the Administrator to be equal to the greatest probable sinking speed of the rotorcraft at ground contact in power-off landings likely to be made in normal operation of the rotorcraft. In no case shall the drop height be less than 8 inches. If rotor lift is considered (see sec. 7.230(c)), it shall be introduced in the drop test by the use of appropriate energy absorbing devices or by the use of an effective mass. The attitude in which the landing gear unit is tested shall be such as to simulate the landing condition which is critical from the standpoint of energy to be absorbed by the particular unit.

Note: In lieu of more rational computations, the following may be employed when use is made of an effective mass:

$$W_e = W\left(\frac{h+(1-L)d}{h+d}\right)$$

where:

W_e=the effective weight to be used in the drop test (pounds).

$W=W_M$ for main gear units (pounds), equal to the static reaction on the particular unit with the rotorcraft in the most critical attitude; a rational method may be used in computing the main gear static reaction, taking into consideration the distance between the direction of the main wheel reaction and the aircraft center of gravity.

$W=W_N$ for nose wheel units (pounds), equal to the vertical component of the ground reaction which would exist at the nose wheel, assuming the mass of the rotorcraft acting at the center of gravity and exerting a force of $1.0g$ downward and $0.25g$ forward.

[$W=W_T$ for tailwheel units (pounds) equal to whichever of the following is critical:

[(1) The static weight on the tailwheel with the rotorcraft resting on all wheels, or

[(2) The vertical component of the ground reaction which would occur at the tailwheel assuming the mass of the rotorcraft acting at the center of gravity and exerting a force of 1g downward with the rotorcraft in the maximum nose-up attitude considered in the nose-up landing conditions. (See sec. 7.246 (b) and (c).)]

h=specified free drop height (inches).

L=ratio of assumed rotor lift to the rotorcraft weight.

d=deflection under impact of the tire (at the approved inflation pressure) plus the vertical component of the axle travel relative to the drop mass (inches).

(b) *Reserve energy absorption drop test.* The reserve energy absorption capacity shall be demonstrated by a drop test in which the drop height is equal to 1.5 times the drop height prescribed in paragraph (a) of this section, and the rotor lift is assumed to be not greater than 1.5 times the rotor lift used in the limit drop tests, except that the resultant inertia load factor need not exceed 1.5 times the limit inertia load factor determined in accordance with paragraph (a) of this section. In this test the landing gear shall not collapse.

Note: The effect of rotor lift may be considered in a manner similar to that prescribed in paragraph (a) of this section.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-4, 24 F.R. 7074, Sept. 1, 1959, effective Oct. 1, 1959; 7-5, 27 F.R. 2999, Mar. 30, 1962, effective May 3, 1962.)

7.333 *Limit load factor determination.* In determining the rotorcraft inertia load factor "n" from the free drop tests specified in section 7.332, the following formula shall be used:

$$n = n_j\frac{W_e}{W} + L;$$

where:

n_j=load factor during impact developed on the mass used in the drop tests (i.e., the acceleration

dv/dt in g's recorded in the drop tests, plus 1.0). (See sec. 7.332(a) for explanation of W_o, W, and L.)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.334 *Retracting mechanism.*

(a) *General.*

(1) The landing gear retracting mechanism, wheel well doors, and supporting structure shall be designed for the loads occurring in the flight maneuvering conditions when the gear is in the retracted position, and for the combination of friction, inertia, and air loads occurring during retraction and extension at any airspeed up to the design maximum landing gear extended speed.

(2) The landing gear, the retracting mechanism, and the rotorcraft structure including wheel well doors shall be designed to withstand flight loads, including those in yawed flight, occurring with the landing gear in the extended position at any airspeed up to the design maximum landing gear extended speed.

(b) *Landing gear lock.* A positive means shall be provided for the purpose of maintaining the landing gear in the extended position.

(c) *Emergency operation.* When other than manual power for the operation of the landing gear is employed, emergency means for extending the landing gear shall be provided, so that the landing gear can be extended in the event of any reasonably probable failure in the normal retraction system. When an emergency system is installed, it shall provide for the failure of any single source of hydraulic, electric, or equivalent energy supply.

(d) *Operation test.* Proper functioning of the landing gear retracting mechanism shall be demonstrated by operation tests.

(e) *Position indicator.* When a retractable landing gear is used, means shall be provided for indicating to the pilot when the gear is secured in the extended and in the retracted positions.

(f) *Control.* The location and operation of the landing gear retraction control shall be according to the provisions of section 7.353.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-4, 24 F.R. 7074, Sept. 1, 1959, effective Oct. 1, 1959.)

7.335 *Wheels.* Landing gear wheels shall be of an approved type. The maximum static load rating of each wheel shall not be less than the corresponding static ground reaction under the maximum weight of the rotorcraft and the critical center of gravity position. The maximum limit load rating of each wheel shall not be less than the maximum radial limit load determined in accordance with the applicable ground load requirements of this part.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.336 *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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.337 *Tires.*

(a) Landing gear tires shall be of a proper fit on the rim of the wheel, and their approved rating shall be such that it is not exceeded under the following conditions:

(1) Rotorcraft weight equal to the maximum design weight.

(2) Load on each main wheel tire equal to the corresponding static ground reaction when considering the critical center of gravity position.

(3) Load on nose wheel tires (to be compared with the dynamic rating established for such tires) equal to the reaction obtained at the nose wheel assuming the mass of the rotorcraft concentrated at the most critical center of gravity and exerting a force of

1.0g downward and 0.25g forward, the reactions being distributed to the nose and main wheels by the principles of statics with the drag reaction at the ground applied only at those wheels which have brakes.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.338 *Skis.*

(a) Landing gear skis shall have load ratings appropriate to the limit loads determined in accordance with the applicable ground load requirements of this part (see sec. 7.240).

(b) A stabilizing means shall be provided to maintain the ski in an appropriate position during flight and shall have sufficient strength to withstand the maximum aerodynamic and inertia loads to which the ski is subjected.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

[Hulls and Floats]

7.340 *Buoyancy.*

(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 multiple floats.

(b) Main floats shall contain at least 5 watertight compartments of approximately equal volume.

[(c) If a rotorcraft, constructed with a hull and auxiliary floats, is to be approved for both taking off from and alighting on water, the hull and auxiliary floats shall be divided into watertight compartments so that, with any single compartment flooded, the buoyancy of the hull and auxiliary floats (and wheel tires if used) will provide a sufficient margin of positive stability to minimize capsizing. (See sec. 7.741(e).)]

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-5, 27 F.R. 2999, Mar. 30, 1962, effective May 3, 1962.)

7.341 *Float strength.* Floats shall be designed for the conditions set forth in paragraphs (a) and (b) of this section:

(a) *Bag type floats.* Bag type floats shall withstand the maximum pressure differential which might be developed at the maximum altitude for which certification with floats is sought. In addition, the floats shall withstand the vertical loads prescribed by section 7.245(a) distributed along the length of the bag over three-quarters of the projected bag area.

(b) *Rigid floats.* Rigid type floats shall withstand the vertical, horizontal, and side loads prescribed in section 7.245. An appropriate load distribution under critical conditions shall be used.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Personnel and Cargo Accommodations

7.350 *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.

(e) A passageway between the pilot compartment and the passenger compartment shall be provided. Suitable means shall be provided to prevent passengers from entering the pilot compartment without permission.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.351 *Pilot compartment vision.*

(a) *Nonprecipitation conditions.*

(1) The pilot compartment shall be arranged to afford the pilot(s) a sufficiently extensive, clear, and undistorted view for the safe operation of the rotorcraft.

(2) It shall be demonstrated during the day and, where appropriate, during the night by flight tests that the pilot compartment is free of glare and reflection which would tend to interfere with the pilots' vision.

(b) *Precipitation conditions.*

(1) Means shall be provided so that the pilot(s) is afforded a sufficiently extensive view to permit safe operation under the following conditions:

(i) In heavy rain at forward speeds up to V_H and

(ii) In the most severe icing condition in which operation of the rotorcraft is approved.

(2) In addition to the means provided in subparagraph (1) of this paragraph, the pilot shall be provided with a window which is openable under the conditions prescribed in subparagraph (1) of this paragraph and which provides the view prescribed in that subparagraph.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

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

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.353 *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 sec. 7.737.)

(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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.354 *Doors.*

(a) Closed cabins shall be provided with at least one adequate and easily accessible external door.

(b) No passenger door shall be so located with respect to the rotor discs as to endanger persons using the door when appropriate operating instructions are employed.

(c) Means shall be provided for locking crew and external passenger doors and for safeguarding against their opening in flight either inadvertently by persons or as a result of mechanical failure. It shall be possible to open external doors from either the inside or the outside of the cabin while the rotorcraft is on the ground. The means of opening shall be simple and obvious and shall be so arranged and marked that it can be readily located and operated.

(d) Reasonable provisions shall be made to prevent the jamming of any external door as a result of fuselage deformation in a minor crash.

(e) Means shall be provided for a direct visual inspection of the locking mechanism by crewmembers to ascertain whether all external doors, including passenger, crew, service, and cargo doors are fully locked. In addition, visual means shall be provided to signal to appropriate crewmembers that all normally used external doors are closed and in the fully locked position.

(f) For outwardly opening external doors usable by persons for entrance or egress, an auxiliary safety latching device shall be provided which will prevent the door from coming open in the event of difficulties with the primary latching mechanism. If the door will not meet the requirements of paragraph (c) of this section with the auxiliary safety latching device in place, then suitable operating procedures shall be established to insure

that the device shall not be in place during takeoff or landing.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.355 *Seats and safety belts.*

(a) *General.* At all stations designated as occupiable during takeoff and landing, the seats, belts, harnesses (if used) and adjacent parts of the rotorcraft shall be such that a person making proper use of these facilities will not suffer serious injury in the emergency landing conditions as a result of inertia forces specified in section 7.260. Seats shall be of an approved type (see also sec. 7.643 concerning safety belts).

(b) *Arrangement.*

(1) Passengers and crew shall be afforded protection from head injuries by one of the following means:

(i) Safety belt and shoulder harness which will prevent the head from contacting any injurious object;

(ii) Safety belt and elimination of all injurious objects within striking radius of the head; or

(iii) Safety belt and a cushioned rest which will support the arms, shoulders, head, and spine.

(2) For arrangements which do not provide a firm handhold on seat backs, hand grips or rails shall be provided along aisles to enable passengers or crewmembers to steady themselves while using the aisles in moderately rough air.

(3) All projecting objects which would cause injury to persons seated or moving about the rotorcraft in normal flight shall be padded.

(c) *Strength.* All seats and their supporting structure shall be designed for an occupant weight of 170 pounds with due account taken of the maximum load factors, inertia forces, and reactions between occupant, seat, and safety belt or harness corresponding with all relevant flight and ground load conditions, including the emergency landing conditions prescribed in section 7.260. In addition, the following shall apply:

(1) Pilot seats shall be designed for the reactions resulting from the application of pilot forces to the flight controls as prescribed in section 7.225.

(2) In determining the strength of the seat attachments to the structure and the safety belt or shoulder harness (if installed) attachments to the seat or structure, the inertia forces specified in section 7.260(a) shall be multiplied by a factor of 1.33.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.356 *Cargo and baggage compartments.* (See also sec. 7.382.)

(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 section 7.260.

(b) Provision 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) Provision 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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.357. *Emergency evacuation.* Crew and passenger areas shall be provided with emergency evacuation means to permit rapid egress in the event of crash landings, whether with the landing gear extended or retracted, taking into account the possibility of the rotorcraft being on fire. Passenger entrance, crew, and service doors shall be considered as emergency exits if they meet the applicable requirements of this section.

(a) *Flight crew emergency exits.* Flight crew emergency exits shall be located in the flight crew area on both sides of the rotorcraft or as a top hatch to provide for rapid evacuation. Such exits shall not be required on small rotorcraft where the Administrator finds that the proximity of passenger emer-

gency exits to the flight crew area renders them convenient and readily accessible to the flight crew.

(b) *Passenger emergency exits; type and location.* The types of exits and their location shall be as follows:

(1) *Type I.* A rectangular opening of not less than 24 inches wide by 48 inches high, with corner radii not greater than 4 inches, located in the passenger area in the side of the fuselage at floor level and as far away as practicable from areas which might become potential fire hazards after a crash.

(2) *Type II.* Same as Type I (subparagraph (1) of this paragraph) except that the opening is not less than 20 inches wide by 44 inches high.

(3) *Type III.* A rectangular opening of not less than 20 inches wide by 36 inches high, with corner radii not greater than 4 inches, located in the passenger area in the side of the fuselage and as far away as practicable from areas which might become potential fire hazards after a crash.

(4) *Type IV.* A rectangular opening of not less than 19 inches wide by 26 inches high, with corner radii not greater than 4 inches, located in the side of the fuselage with a step-up inside the rotorcraft of not more than 29 inches.

Note: Larger openings than those specified in paragraph (b) of this section will be acceptable, whether or not of rectangular shape, provided the specified rectangular openings can be inscribed therein, and further provided that the base of the opening affords a flat surface not less than the width specified.

(c) *Passenger emergency exits; number required.* Emergency exits of the type and located as prescribed in paragraph (b) of this section shall be accessible to the passengers, and shall be provided in accordance with the following table:

Passenger seating capacity	Emergency exits required on each side of fuselage			
	Type I	Type II	Type III	Type IV
1 to 19 inclusive			1	
20 to 39 inclusive		1		1
40 to 69 inclusive	1			1

In addition to the number of exits required for the side of the fuselage, openings shall be provided in other parts of the fuselage (top, bottom, or ends) so that, in the event of a crash landing in which the fuselage comes to rest on its side, emergency exits shall be available for egress. When it can be satisfactorily demonstrated that the configuration of the rotorcraft is such that the probability of the rotorcraft rolling over and coming to rest on the side of the fuselage after a crash landing is extremely remote, it shall be acceptable to provide emergency exits in the side of the fuselage only.

(d) *Emergency exit arrangement.*

(1) Emergency exits shall consist of movable doors or hatches in the external walls of the fuselage and shall provide an unobstructed opening to the outside.

(2) All emergency exits shall be openable from the inside and from the outside.

(3) The means of opening emergency exits shall be simple and obvious and shall not require exceptional effort of a person opening them.

(4) Means shall be provided for locking each emergency exit and for safeguarding against opening in flight either inadvertently by persons or as a result of mechanical failure.

(5) Provision shall be made to minimize the possibility of jamming of emergency exits as a result of fuselage deformation in a minor crash landing.

(6) For all emergency exits other than Type IV located above a wing (see paragraph (b) of this section) which are more than 6 feet from the ground with the rotorcraft on the ground and the landing gear extended, acceptable means shall be provided to assist the occupants in descending to the ground.

(7) The proper functioning of emergency exit installations shall be demonstrated by test.

(e) *Emergency exit marking.*

(1) All emergency exits, their means of access, and their means of opening shall be marked conspicuously. The identity and

location of emergency exits shall be recognizable from a distance equal to the width of the cabin. The location of the emergency exit operating handle and the instructions for opening shall be marked on or adjacent to the emergency exit and shall be readable from a distance of 30 inches.

(2) A source or sources of light, with an energy supply independent of the main lighting system, shall be installed to illuminate all emergency exit markings. Such lights shall be designed to function automatically in a crash landing and shall also be operable manually.

(3) All emergency exits and their means of opening shall be marked on the outside of the rotorcraft for guidance of rescue personnel.

(f) *Emergency exit access.* Passageways between individual compartments of the passenger area and passageways leading to Type I and Type II emergency exits (see paragraph (b) of this section) shall be unobstructed and shall be not less than 20 inches wide. Adjacent to emergency exits where assisting means are required by paragraph (d)(6) of this section, there shall be sufficient additional space to allow a crewmember to assist in the evacuation of passengers without reduction in the unobstructed width of the passageway to such exit.

[(g) *Width of main aisle.* The main passenger aisle width at any point between seats shall not be less than the values in the following table:

Passenger seating capacity	Minimum main passenger aisle width	
	Less than 25 inches from floor	25 inches and more from floor
	Inches	*Inches*
10 or less	12	18
11 to 19	12	20
20 or more	15	20]

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-5, 27 F.R. 2999, Mar. 30, 1962, effective May 3, 1962.)

7.358 *Ventilation.*

(a) All passenger and crew compartments shall be ventilated and crew compartments shall be provided with a sufficient amount of fresh air to enable crewmembers to perform their duties without undue discomfort or fatigue.

Note: A fresh air supply of 10 cubic feet per minute is considered a minimum for each crewmember.

(b) Crew and passenger compartment air shall be free from harmful or hazardous concentrations of gases or vapors. The concentration of carbon monoxide shall not exceed 1 part in 20,000 parts of air under conditions of forward flight. For other configurations of operation, suitable operating restrictions shall be provided if the carbon monoxide concentration exceeds this value.

(c) Provisions shall be made to insure the conditions prescribed in paragraph (b) of this section in the event of reasonably probable failures of the ventilating, heating, or other systems and equipment.

Note: Examples of acceptable provisions include secondary isolation, integral protective devices, and crew warning and shutoff provisions for equipment the malfunctioning of which could introduce harmful or hazardous quantities of smoke or gases.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.359 *Heaters.* Combustion heaters shall be of an approved type and shall comply with the fire protection requirements of section 7.383. Engine exhaust heaters shall comply with the provisions of section 7.467 (c) and (d).

New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Fire Prevention

7.380 *General.* Compliance shall be shown with the fire prevention requirements of sections 7.381 through 7.385. Additional fire prevention requirements are prescribed in Subpart E, Powerplant Installation, and Subpart F, Equipment.

(a) *Hand fire extinguishers.* Hand fire extinguishers shall be of an approved type.

The types and quantities of extinguishing agents shall be appropriate for the type of fires likely to occur in the compartments where the extinguishers are intended for use. Extinguishers intended for use in personnel compartments shall be such as to minimize the hazard of toxic gas concentrations.

(b) *Built-in fire extinguishers.* Where a built-in fire extinguishing system is required, its capacity in relation to the compartment volume and ventilation rate shall be sufficient to combat any fire likely to occur in the compartment. All built-in fire extinguishing systems shall be so installed that any extinguishing agent likely to enter personnel compartments will not be hazardous to the occupants and that any discharge of the extinguisher cannot result in structural damage.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.381 *Cabin interiors.* All compartments occupied or used by the crew or passengers shall comply with the provisions of paragraphs (a) through (f) of this section.

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

(b) The wall and ceiling linings, the covering of all upholstery, 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.

(d) All receptacles for used towels, paper, and waste shall be of fire-resistant materials and shall incorporate covers or other provisions for containing possible fires.

(e) At least one hand fire extinguisher shall be provided for use by the flight crew.

(f) In addition to the requirements of paragraph (e) of this section, at least the following number of hand fire extinguishers conveniently located for use in passenger compartments shall be provided according to the passenger capacity of the rotorcraft:

Passenger capacity	Minimum number of hand fire extinguishers
6 or less	0
7 through 30	1
31 through 60	2

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.382 *Cargo and baggage compartments.* (a) Cargo and baggage compartments shall be constructed of or completely lined with fire-resistant material. Compartments shall include no controls, wiring, lines, equipment, or accessories, the damage or failure of which would affect the safe operation of the rotorcraft, unless such items are shielded, isolated, or otherwise protected so that they cannot be damaged by movement of cargo in the compartment, and so that any breakage or failure of such items will not create a fire hazard. Design of inaccessible compartments and sealing of these compartments shall be such as to contain cargo compartment fires for a period of time sufficient to permit landing and safe evacuation of the occupants.

Note: For compartments having a volume not in excess of 500 cubic feet, an airflow of not more than 1,500 cubic feet per hour is considered acceptable. For larger compartments lesser airflow may be applicable.

(b) Cargo and baggage compartments shall be designed or provided with detection devices to insure detection of fires by a crewmember while at his proper station, and to preclude the entrance of harmful quantities of smoke, flame, etc., into crew or passenger compartments.

(c) If compartments are intended to be accessible in flight, protective breathing equipment shall be available for the use of the appropriate crewmember (see sec. 7.646).

(d) Compliance with the provisions of this section which refer to fire detection and the entry of hazardous quantities of smoke, extinguishing agents, or other noxious gases into the crew and passenger compartments shall be demonstrated in flight.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.383 *Combustion heater fire protection.*

(a) *Combustion heater fire zones.* The following shall be considered as combustion heater fire zones and shall be protected against fire in accordance with the applicable provisions of sections 7.480 through 7.486 and section 7.489:

(1) Region surrounding the heater, if such region contains any flammable fluid system components including the heater fuel system which might be damaged by heater malfunctioning or which, in case of leakage or failure, might permit flammable fluids or vapors to reach the heaters.

(2) That portion of the ventilating air passage which surrounds the combustion chamber, except that this area need not be provided with an extinguishing system if the passage is so constructed that it will contain and withstand any fire which may occur within the passage without damage to other rotorcraft components.

(b) *Ventilating air ducts.*

(1) Ventilating air ducts which pass through fire zones shall be of fireproof construction.

(2) Unless isolation is provided by the use of fireproof valves or other equivalently effective means, the ventilating air duct downstream of the heater shall be of fireproof construction for a sufficient distance to assure that any fire originating from within the heater can be contained within the duct.

(3) Portions of ventilating ducts passing through regions in the rotorcraft where flammable fluid systems are located shall be so constructed or isolated from such systems that failure or malfunctioning of the flammable fluid system components cannot introduce flammable fluids or vapors into the ventilating airstream.

(c) *Combustion air ducts.*

(1) Combustion air ducts shall be of fireproof construction for a distance sufficient to prevent damage from backfiring or reverse flames propagation.

(2) Combustion air ducts shall not communicate with the ventilating airstream unless it is demonstrated that flames from backfires or reverse burning cannot enter the ventilating airstream under any conditions of ground or flight operation including conditions of reverse flow or malfunctioning of the heater or its associated components.

(3) Combustion air ducts shall not restrict prompt relief of backfires which can cause heater failure due to pressures generated within the heater.

(d) *Heater controls; general.* Provisions shall be made to prevent hazardous accumulations of water or ice on or within any heater control components, control system tubing, or safety controls.

(e) *Heater safety controls.*

(1) In addition to the components provided for normal continuous control of air temperature, airflow, and fuel flow, means independent of such components shall be provided with respect to each heater to shut off automatically that heater's ignition and fuel supply at a point remote from the heater when the heat exchanger temperature or ventilating air temperature exceeds safe limits or when either the combustion airflow or the ventilating airflow becomes inadequate for safe operation. The means provided for this purpose for any individual heater shall be independent of all components serving other heaters, the heat output of which is essential to the safe operation of the rotorcraft. The means shall also be such that the heater will remain off until restarted by the crew.

(2) Warning means shall be provided to indicate to the crew when a heater, the heat output of which is essential to the safe operation of the rotorcraft, has been shut off by the operation of the automatic means prescribed in subparagraph (1) of this paragraph.

(f) *Air intakes.* Combustion and ventilating air intakes shall be so located that no

flammable fluids or vapors can enter the heater system under any conditions of ground or flight operation either during normal operation or as a result of malfunctioning, failure, or improper operation of other rotorcraft components.

(g) *Heater exhaust.* Heater exhaust systems shall comply with the provisions of section 7.467 (a) and (b). In addition, the following shall apply:

(1) Exhaust shrouds shall be sealed so that flammable fluids and hazardous quantities of vapors cannot reach the exhaust systems through joints.

(2) Exhaust systems shall not restrict the prompt relief of backfires which can cause heater failure due to pressures generated within the heater.

(h) *Heater fuel systems.* Heater fuel systems shall comply with all portions of the powerplant fuel system requirements which affect safe heater operation. In addition, heater fuel system components within the ventilating airstream shall be protected by shrouds so that leakage from such components cannot enter the ventilating airstream.

(i) *Drains.* Means shall be provided for safe drainage of fuel accumulations which might occur within the combustion chamber or the heat exchanger. Portions of such drains which operate at high temperatures shall be protected in the same manner as heater exhausts (see paragraph (g) of this section). Drains shall be protected against hazardous ice accumulations in flight and during ground operation.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.384 *Fire protection of structure, controls, and other parts.*

(a) *Category A.* All structure, controls, rotor mechanism, and other parts essential to controlled flight and landing of the rotorcraft which would be affected by powerplant fires shall be of fireproof construction.

(b) *Category B.* All structure, controls, rotor mechanism, and other parts essential to a controlled landing of the rotorcraft which would be affected by powerplant fires either shall be of fireproof construction or shall be otherwise protected, so that they can perform their essential functions for at least 5 minutes under all foreseeable powerplant fire conditions. (See also secs. 7.480 and 7.483(a).)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.385 *Flammable fluid fire protection.* In areas of the rotorcraft where flammable fluids or vapors might be liberated by leakage or failure in fluid systems, design precautions shall be taken to safeguard against the ignition of such fluids or vapors due to the operation of other equipment or to control any fire resulting from such ignition.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Miscellaneous

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

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.391 *Ballast provisions.* Ballast provisions shall be so designed and constructed as to prevent the inadvertent shifting of the ballast in flight. (See also secs. 7.105, 7.738 (a), and 7.741(c).)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.392 *Ice protection.* If certification for flight in icing conditions is desired, the rotorcraft shall be capable of operating safely in the range of conditions applicable to the operating limitations of the design.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Subpart E—Powerplant Installation

General

7.400 *Scope and general design.* 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 secs. 7.604 and 7.613 for instrument installation and marking.) The general provisions of paragraphs (a) through (d) of this section shall be applicable.

(a) Reciprocating engine installations shall comply with the provisions of this subpart. Turbine engine installations shall comply with such of the provisions of this subpart as are found applicable to the specific type of installation and such other requirements as may be deemed necessary by the Administrator.

(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 existence of differences of potential between major components of the powerplant installation and other portions of the rotorcraft.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.401 *Engines.*

(a) *Type certification.* All engines shall be type certificated in accordance with the provisions of Part 13 of this subchapter.

(b) *Category A; engine isolation.* The powerplants shall be arranged and isolated each from the other to permit operation in at least one configuration in such a manner that the failure or malfunctioning of any engine, or the failure of any system of the rotorcraft which can affect an engine, will not prevent the continued safe operation of the remaining engine(s) or require immediate action by crewmembers for their continued safe operation.

(c) *Category A; control of engine rotation.* Means shall be provided for stopping and restarting the rotation of any engine individually in flight. All components provided for this purpose which are located on the engine side of the firewall and which might be exposed to fire shall be of fire-resistant construction unless more than one means is available for this purpose and provided further that the duplicate controls are so located that all are not likely to be damaged at the same time in case of fire.

(d) *Category A; engine cooling fan blade protection.* If an engine cooling fan is installed, means shall be provided to insure that the occurrence of a fan blade failure will not affect the operation of the remaining engine(s) nor jeopardize the continued safe operation of the rotorcraft.

(e) *Category B; engine cooling fan blade protection.* If an engine cooling fan is installed, means shall be provided to protect the rotorcraft and to permit a safe landing in the event of a fan blade failure. Compliance shall be shown with any one of the provisions of subparagraphs (1) through (3) of this paragraph.

(1) It shall be demonstrated that the fan blades will be contained in the event of failure;

(2) The fan is so located that a fan blade failure will not jeopardize the safety of the rotorcraft or its occupants; or

(3) It shall be demonstrated that the fan blade can withstand an ultimate load of 1.5 times the centrifugal force resulting from engine rpm limited by either:

(i) The engine terminal rpm which can occur under uncontrolled conditions, or

(ii) An overspeed limiting device.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-2, 23 F.R. 2592, Apr. 19, 1958, effective May 17, 1958.)

7.402 *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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Rotor Drive System

7.403 *Rotor drive system.*

(a) *General.* The rotor drive system shall be considered to include all parts necessary to transmit power between the engine(s) and the main and/or auxiliary rotor hubs. This includes gear boxes, shafting, universal joints, couplings, rotor brake assembly, overrunning and other clutches, supporting bearings for shafting, and any attendant accessory pads or drives. Cooling fans which are not certificated as part of the engine shall also be considered a part of the rotor drive system.

(b) *Arrangement.*

(1) The rotor drive system of a multiengine rotorcraft shall be so arranged that all rotors necessary for operation and control of the rotorcraft will continue to be driven by the remaining engine(s) in the event of failure of any of the engines.

(2) Category B: On single-engine rotorcraft the rotor drive system 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 from the main and auxiliary rotors.

(3) The rotor drive system shall incorporate a unit for each engine which will automatically disengage the engine from the drive system in the event of a power failure of the engine.

(4) If a torque limiting device is employed in the rotor drive system (see 7.250 (f)), such device shall be located to permit continued control of the rotorcraft after the device becomes operative.

(5) On rotorcraft employing rotors which must be phased for intermeshing purposes, the rotor drive system shall provide constant and positive phase relationship under all operating conditions. If a rotor dephasing device is incorporated, means shall be provided to insure that the rotors are locked in proper phase prior to operation.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.404 *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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.405 *Rotor drive system and control mechanism tests.*

(a) *Endurance tests.*

(1) *General.* The rotor drive system and rotor control mechanism shall be tested for not less than 200 hours. The test shall be conducted on the rotorcraft and the power shall be absorbed by the actual rotors to be installed. The endurance tests shall be conducted in 10-hour test cycles composed of the tests prescribed in subparagraphs (2) through (10) of this paragraph. Compliance with the endurance tests prescribed in this paragraph will be accepted for helicopter engine certification in lieu of the endurance testing specified in Part 13 of this subchapter. (The other phases of helicopter engine certification such as vibration, calibration, detonation, operation, and engine inspection will of course require compliance in accordance with Part 13 of this subchapter.)

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(2) *Takeoff power run.* The takeoff power run shall consist of 1 hour of alternate runs of 5 minutes at takeoff power and speed, and 5 minutes at as low an engine idle speed as practicable. The engine shall be declutched from the rotor drive system and the rotor brake, if furnished and so intended, shall be applied during the first minute of the idle run. During the remaining 4 minutes of the idle run, the clutch shall be engaged so that the engine drives the rotors at the minimum practical r.p.m. Acceleration of the engine and the rotor drive system shall be accomplished at the maximum rate. When declutching the engine, it shall be decelerated at a rate sufficiently rapid to permit the operation of the overrunning clutch. In the absence of a takeoff rating, maximum continuous power and speed shall be substituted for takeoff power and speed.

(3) *Maximum continuous run.* Three hours of continuous operation at maximum continuous power and speed as follows:

(i) During the run, the main rotor controls shall be operated at a minimum of 15 times each hour through the main rotor pitch positions of full vertical thrust, maximum forward thrust component, maximum aft thrust component, maximum left thrust component, and maximum right thrust component, except that the control movements need not produce loads or blade flapping motion exceeding the maximum loads or motions encountered in flight.

(ii) The directional controls shall be operated at a minimum of 15 times each hour through the control extremes of maximum right turning torque, neutral torque as required by the power applied to the main rotor, and maximum left turning torque.

(iii) Each control position shall be held at maximum for at least 10 seconds and the rate of change of control position shall be at least as rapid as for normal operation.

(4) *90 percent maximum continuous run.* One hour of continuous operation at 90 percent maximum continuous power at maximum continuous speed.

(5) *80 percent maximum continuous run.* One hour of continuous operation at 80 percent maximum continuous power and speed.

(6) *60 percent maximum continuous run.* Two hours of continuous operation at 60 percent maximum continuous power at minimum desired cruising speed or at 90 percent maximum continuous speed, whichever speed is lower.

(7) *Engine malfunctioning run.* It shall be determined whether malfunctioning of such components as the engine fuel or ignition systems or unequal power output from the various engines can result in dynamic conditions which might be detrimental to the drive system. If so, a suitable number of hours of operation shall be accomplished under such conditions, one hour of which shall be included in each cycle, and the remaining hours accomplished at the conclusion of the 20 cycles. If no detrimental condition results, an additional hour of operation as prescribed in subparagraph (2) of this paragraph shall be substituted.

(8) *Overspeed run.* One hour of continuous operation at 110 percent maximum continuous speed at maximum continuous power. In the event that the engine(s) installed are limited by the manufacturer to an overspeed of less than 110 percent of maximum continuous speed for the periods required, the speed employed shall be the highest speed permissible with the engine(s) involved.

(9) *Rotor control positions.* Whenever the rotor controls are not being cycled during the tie-down tests, the rotor shall be operated to produce each of the maximum thrust positions for the percentages of test time as follows, except that the control positions need not produce loads or blade flapping motion exceeding the maximum loads or motions encountered in flight, using the procedures of subparagraph (3) of this paragraph:

(i) Full vertical thrust, 20 percent.

(ii) Forward thrust component, 50 percent.

(iii) Right thrust component, 10 percent.

(iv) Left thrust component, 10 percent.

(v) Aft thrust component, 10 percent.

(10) *Clutch and brake engagements.* A total of at least 400 clutch and brake engagements including the engagements of paragraph (a)(2) of this section shall be made during the takeoff power runs and, as necessary, at each change of power and speed throughout the test. In each clutch engagement, the shaft on the driven side of the clutch shall be accelerated from rest. The clutch engagements shall be accomplished at the speed and by the method prescribed in the operations manual. During deceleration after each clutch engagement, the engine(s) shall be stopped rapidly enough to allow the engine(s) to be automatically disengaged from the rotor(s) and/or rotordrive(s). If a rotor brake is installed for the purpose of stopping the rotor, the clutch, during brake engagements, shall be disengaged above 40 percent maximum continuous rotor speed and the rotor(s) allowed to decelerate to 40 percent maximum continuous rotor speed at which time the rotor brake shall be applied. If the clutch design does not permit stopping the rotor(s) with the engine running, or if no clutch is provided, the engine shall be stopped before each application of the rotor brake, and then immediately restarted after the rotors have stopped.

(b) *Overspeed test.* After completion of the 200-hour tie-down test and without intervening major disassembly, the rotor drive system shall be subjected to 50 overspeed runs, each 30±3 seconds in duration at 120 percent maximum continuous speed. Overspeed runs shall be alternated with stabilizing runs of 1 to 5 minutes duration each at from 60 to 80 percent maximum continuous speed. Acceleration and deceleration shall be accomplished in a period not longer than 10 seconds, and the time for changing speeds shall not be deducted from the specified time for the overspeed runs. Overspeed runs should be made with the rotor(s) in the flattest pitch at which smooth operation can be obtained. In the event that the engine(s) installed is limited by the engine manufacturer to an overspeed of less than 120 percent of maximum continuous speed for the periods required, the speed employed shall be the highest speed permissible with the engine(s) involved.

(c) *Critical component reliability tests.* Components within the rotor drive system, the failure of which will result in an uncontrolled landing, components essential to the phasing of the rotors on multirotor rotorcraft, or as a driving link for essential control of rotors in autorotation, and components common to more than one engine on multiengine rotorcraft, shall be designed to have a level of safety equivalent to the main rotors. Components which are affected by flight maneuvering and gust loads shall be additionally investigated for the same flight conditions as the main rotor(s). The service life of such parts shall be determined by fatigue tests or by other methods found acceptable by the Administrator.

(d) *Special tests.* Rotor drive systems designed to operate at two or more gear ratios shall be subjected to special testing and durations found necessary by the Administrator to substantiate the airworthiness of the rotor drive system.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-5, 27 F.R. 2999, Mar. 30, 1962, effective May 3, 1962.)

7.406 *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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.407 *Critical shafting 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. If critical vibration conditions (persistent or momentary) are found in the entire range of operations from and including clutch engagement to maximum overspeed, either during acceleration or deceleration, it shall be demonstrated in the rotorcraft that such vibration is within safe limits. Such demonstration may be made during the endurance testing (see sec. 7.405(a)), in which case the test schedule may be altered to include the critical vibratory conditions in lieu of equivalent time in appropriate portions of the endurance test procedure.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.408 *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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Fuel System Operation and Arrangement

7.410 *General.*

(a) The fuel system shall be constructed and arranged in such a manner as to assure a flow of fuel to each engine at a rate and pressure which have been established for proper engine functioning under all normal conditions, including all maneuvers for which the rotorcraft is intended. (For fuel system instruments see sec. 7.604.)

(b) The fuel system shall be so arranged that no one engine or fuel pump can draw fuel from more than one tank at a time unless means are provided to prevent introducing air into the system.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.411 *Fuel system independence.*

(a) *Category A.* The design of the fuel system shall comply with the requirements of section 7.401(b). Unless other provisions are made in compliance with this requirement, the fuel system shall be arranged to permit the supply of fuel to each engine through a system independent of any portion of a system supplying fuel to any other engine.

(b) *Category B.* The design of the fuel system for multiengine rotorcraft shall be arranged to permit supplying fuel to each engine through a system independent of all portions of systems supplying fuel to the other engines, except that separate fuel tanks need not be provided for each engine.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

[7.413 *Fuel flow.*

[(a) The fuel system shall provide not less than 100 percent of the fuel flow required by the engines when the rotorcraft is operated under all intended operating conditions and maneuvers.

[(b) In determining compliance with the provisions of paragraph (a) of this section, the provisions of subparagraphs (1) through (4) of this paragraph shall apply.

[(1) Fuel shall be delivered to the engine at a pressure within the limits specified in the engine type certificate.

[(2) The quantity of fuel in the tank being considered shall not exceed the sum of the amount established as the unusable fuel supply for that tank, as determined in accordance with the provisions of section 7.416, and whatever minimum quantity of fuel it may be necessary to add for the purpose of determining compliance.

[(3) Such main pumps shall be used as are necessary for each operating condition and airplane attitude for which compliance is determined and, in addition, for each main pump so used, the appropriate emergency pump shall be substituted. (See sec. 7.430 (b).)

[(4) If a fuel flowmeter is provided, operation of the meter shall be blocked in determining compliance with this section and the fuel shall flow through the meter or its bypass.

[(c) If an engine can be supplied with fuel from more than one tank, the fuel system shall feed promptly when the fuel supply becomes low in one tank and another tank is turned on.]

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-5, 27 F.R. 2999, Mar. 30, 1962, effective May 3, 1962.)

[7.416 *Unusable fuel supply.* The unusable fuel supply shall be selected by the applicant and shall be established for each tank as not less than the quantity at which the first evidence of malfunctioning occurs under the most adverse condition from the standpoint of fuel feed during all intended operations and flight maneuvers involving use of that tank.]

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-5, 27 F.R. 2999, Mar. 30, 1962, effective May 3, 1962.)

7.417 *Fuel system hot weather operation.*

(a) The fuel system shall be so arranged as to minimize the possibility of the formation of vapor in the system under all normal conditions of operation. Rotorcraft with suction lift fuel systems or systems which have features likely to produce vapor shall be demonstrated to be free from vapor lock when using fuel at a temperature of 110° F. under critical operating conditions.

(b) Category A: To prove satisfactory hot weather operation the rotorcraft shall be climbed from the altitude of the airport chosen by the applicant to an altitude of 5,000 feet above the terrain, or to the altitude at which the rotorcraft is expected to operate, whichever is greater. There shall be no evidence of vapor lock or other malfunctioning. The climb test shall be conducted under the following conditions:

(1) All engines shall operate at maximum continuous power, except that takeoff power shall be used at the beginning of the demonstration for the maximum time interval for which takeoff power is approved for use on the rotorcraft.

(2) The weight shall be with full fuel tanks, minimum crew, and only such ballast as is required to maintain the center of gravity within allowable limits.

(3) The speed of climb shall be the speed for best rate of climb under the conditions of the test.

(4) The fuel temperature shall be not less than 110° F. at the beginning of the demonstration.

(c) Category A: The test prescribed in paragraph (b) of this section shall be performed either in flight or on the ground closely simulating flight conditions. If a flight test is performed in weather sufficiently cold to interfere with the proper conduct of the test, the fuel tank surfaces, fuel lines, and other fuel system parts subjected to cooling action from cold air shall be insulated to simulate, insofar as practicable, flight in hot weather.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.418 *Flow between interconnected tanks.*

(a) Where tank outlets are interconnected and permit flow through the interconnection due to gravity or flight accelerations, it shall not be possible for fuel to flow between tanks in quantities sufficient to cause an overflow of fuel from the tank vent when the rotorcraft is operated in any sustained flight condition.

(b) If it is possible to pump fuel from one tank to another in flight, the design of the fuel tank vents and the fuel transfer system shall be such that structural damage to tanks will not occur in the event of overfilling. In addition, means shall be provided to warn the crew before overflow through the vents occurs.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Fuel Tank Construction and Installation

7.420 *General.*

(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 and their installation shall be designed or protected so as to retain the fuel supply without leakage when the rotorcraft is subjected to the emergency landing conditions specified under section 7.260.

(c) Flexible fuel tank liners shall be of an approved type or shall be shown to be suitable for the particular application.

(d) Integral type fuel tanks shall be provided with facilities for inspection and repair of the tank interior.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.421 *Fuel tank tests.*

(a) Fuel tanks shall be capable of withstanding the following pressure tests without failure or leakage. It shall be acceptable to apply the pressures in a manner simulating the actual pressure distribution in service (where this is practicable).

(1) Conventional metal tanks, nonmetallic tanks the walls of which are not supported by the rotorcraft structure, and integral tanks shall be submitted to a pressure of 3.5 psi unless the pressure developed during the maximum limit acceleration or emergency deceleration (see sec. 7.260) of the rotorcraft with a full tank exceeds this value, in which case a hydrostatic head, or equivalent test, shall be applied to duplicate the acceleration loads insofar as possible, except that the pressure need not exceed 3.5 psi on surfaces not exposed to the acceleration loading.

(2) Nonmetallic tanks the walls of which are supported by the rotorcraft structure shall be submitted to the following tests:

(i) A pressure test of at least 2.0 psi. The test may be conducted on the tank alone in conjunction with the test specified in subdivision (ii) of this subparagraph.

(ii) A pressure test, with the tank mounted in the rotorcraft structure, equivalent to the load developed by the reaction of the contents, when the tanks are full, during the maximum limit acceleration or emergency deceleration (see sec. 7.260) of the rotorcraft, except that the pressure need not exceed 2.0 psi on the surfaces not exposed to the acceleration loading.

(b) Tanks with large unsupported or unstiffened flat areas or other design or construction features the failure or deformation of which could cause fuel leakage shall be capable of withstanding the following test, or other equivalent test, without leakage or failure:

(1) The complete tank assembly together with its supports shall be subjected to a vibration test when mounted in a manner simulating the actual installation.

(2) The tank assembly shall be vibrated for 25 hours while filled two-thirds full of water or any suitable fluid. The amplitude of vibration shall not be less than one thirty-second of an inch, unless otherwise substantiated.

(3) The frequency of vibration shall be 90 percent of the maximum continuous rated speed of the engine unless some other frequency within the normal operating range of speeds of the engine or rotor system is more critical, in which case the latter speed shall be employed and the time of test shall be adjusted to accomplish the same number of vibration cycles.

(4) During the test, the tank assembly shall be rocked at the rate of 16 to 20 complete cycles per minute through an angle of 15° on either side of the horizontal (30° total) about the most critical axis for 25 hours. If motion about more than one axis is likely to be critical, the tank shall be rocked about each axis for 12½ hours.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.422 *Fuel tank installation.*

(a) The method of support for fuel tanks shall not permit harmful concentrations of loads, resulting from the weight of the fuel in the tank, on unsupported tank surfaces. The following shall be applicable:

(1) Pads shall be provided, if necessary, to prevent chafing between the tank and its supports.

(2) Materials employed for padding shall be nonabsorbent or shall be treated to prevent the absorption of fluids.

(3) If flexible tank liners are employed they shall be so supported that the liner is not required to withstand fluid loads.

(4) Interior surfaces of tank compartments shall be smooth and free of projections which could cause wear of the liner, unless provisions are made for protection of the liner at such points or unless the construction of the liner itself provides such protection.

(b) Spaces adjacent to the surfaces of the tank shall be ventilated consistent with the size of the compartment to avoid accumulation of fuel or fumes in these spaces due to minor leakage. If the tank is in a sealed compartment, it shall be acceptable to limit the ventilation to that provided by drain holes of sufficient size and disposition to prevent clogging and to prevent excessive pressure resulting from altitude changes. If flexible tank liners are installed, the design of the venting arrangement for the spaces between the liner and its container shall take into consideration the need for maintaining proper relationship to tank vent pressures for all expected flight conditions.

(c) Location of fuel tanks shall comply with the provisions of section 7.481 (b).

(d) No portion of rotorcraft skin which lies immediately adjacent to a major air egress opening from the engine compartment shall act as the wall of an integral tank.

(e) Fuel tanks shall be isolated from personnel compartments by means of fumeproof and fuelproof enclosures.

(f) Fuel tanks located in close proximity to personnel compartments, engines, or combustion heaters shall be so designed or protected and installed as to assure that they will retain their contents in accidents of a severity which will produce the decelerations specified in section 7.260.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.423. *Fuel tank 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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.424 *Fuel tank sump.*

(a) Each fuel tank shall be provided with a sump having a capacity of not less than either 0.10 percent of the tank capacity or one-sixteenth of a gallon, whichever is greater.

(b) The fuel tank sump capacity specified in paragraph (a) of this section shall be effective with the rotorcraft in all normal flight and ground attitudes, and shall be located so that the sump contents cannot be drawn out through the tank outlet opening. The fuel tank shall be constructed to permit drainage of any hazardous quantity of water from all portions of the tank to the sump when the rotorcraft is in the ground attitude.

(c) Fuel tank sumps shall be provided with an accessible and easily operable drain to permit complete drainage of the sump on the ground. The drain shall discharge clear of all portions of the rotorcraft and shall be provided with means for positive locking of the drain in the closed position, either manually or automatically.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.425 *Fuel tank filler connection.*

(a) 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. The fuel tank filler shall be marked as prescribed in section 7.738 (b) (1).

(b) Recessed fuel tank filler connections which can retain any appreciable quantity of fuel shall incorporate a drain, and the

drain shall discharge clear of all portions of the rotorcraft.

(c) The fuel tank filler cap shall provide a fuel-tight seal under the pressure expected to be encountered in normal operation.

(d) Category A: Fuel tank filler caps or filler cap covers shall incorporate features which provide a warning indication when caps are not fully locked or seated on the filler connection.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.426 *Fuel tank vents and carburetor vapor vents.*

(a) 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 following shall be applicable:

(1) The vents shall be arranged to avoid stoppage by dirt or ice formation.

(2) The vent arrangement shall be constructed to preclude the possibility of siphoning fuel during normal operation.

(3) The venting capacity and vent pressure levels shall be appropriate for the tank installation so as to maintain acceptable differences of pressure between the interior and exterior of the tank during normal flight operation, during maximum rate of ascent and descent, and, if applicable, during refueling and defueling.

(4) Air spaces of tanks with interconnected outlets shall also be interconnected.

(5) There shall be no points in the vent line where moisture could accumulate with the rotorcraft in either the ground or the level flight attitude unless drainage is provided.

(6) Vents and drainage shall not terminate at points where the discharge of fuel from the vent outlet would constitute a fire hazard or from which fumes could enter personnel compartments.

(b) Carburetors which are provided with vapor elimination connections shall be provided with a vent line to lead vapors back to one of the fuel tanks. The vents shall comply with the following:

(1) Provisions shall be incorporated in the vent system to avoid stoppage by ice.

(2) If more than one fuel tank is provided and it is necessary to use the tanks in a definite sequence, the vapor vent return line shall lead back to the fuel tank used for takeoff and landing.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.427 *Fuel tank outlet.* A fuel strainer of 8 to 16 meshes per inch shall be provided either for the fuel tank outlet or for the booster pump. Strainers shall comply with the following:

(a) The clear area of the fuel tank outlet strainer shall not be less than 5 times the area of the fuel tank outlet line.

(b) The diameter of the strainer shall not be less than the diameter of the fuel tank outlet.

(c) Finger strainers shall be accessible for inspection and cleaning.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.428 *Pressure refueling and fueling provisions below fuel level in the tank.* Fueling connections located below the fuel level in a tank shall be provided with means to prevent the escape of hazardous quantities of fuel from the tank in the event of malfunctioning of the fuel entry valve. For systems intended for pressure refueling, in addition to the normal means provided in the rotorcraft for limiting the tank content, a means shall be installed to prevent damage to the tank in case of failure of the normal means.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Fuel System Components

[7.430 *Fuel pumps.*

[(a) *Main pumps.*

[(1) Any fuel pump which is required for proper engine operation or to meet the fuel system requirements of this subpart, except for the provisions of paragraph (b) of this section, shall be considered a main pump.

[(2) Provision shall be made to permit the bypass of all positive displacement fuel pumps except fuel injection pumps approved as part of the engine.

[*Note:* The phrase "fuel injection pump" means a pump which supplies the proper flow and pressure conditions for fuel injection when such injection is not accomplished in a carburetor. Fuel injection is a special form of carburetion: the charging of air or gas with volatile carbon compounds. It is either an intermittent charging of air by discrete metered quantities of fuel such as occurs in a Diesel cylinder or it is a continuous charging of air by fuel, the fuel flow being proportioned to the airflow through the engine. Examples of continuous injection are injections into the supercharger section of a reciprocating engine or into the combustion chambers of a turbine engine.

[(b) *Emergency pumps.* Pumps shall be provided to permit supplying all engines with fuel immediately after the failure of any one main fuel pump except fuel injection pumps approved as part of the engine.]

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-5, 27 F.R. 2999, Mar. 30, 1962, effective May 3, 1962.)

7.431 *Fuel pump installation.*

(a) Provision shall be made to maintain the fuel pressure at the inlet to the carburetor within the range of limits established for proper engine operation.

(b) When necessary for the maintenance of the proper fuel delivery pressure, a connection shall be provided to transmit the carburetor air intake static pressure to the proper fuel pump relief valve connection. In such cases, to avoid erroneous fuel pressure readings, the gauge balance lines shall be independently connected to the carburetor inlet pressure.

(c) The installation of fuel pumps having seals or diaphragms which may be susceptible to leakage shall incorporate provisions for draining away leaking fuel. Drain lines shall terminate at points where discharge of fuel will not create a fire hazard.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.432 *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, valve actuation, and 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 connections in fuel lines which may be under pressure or subjected to axial loading shall employ flexible hose assemblies rather than hose clamp connections.

(d) Flexible hose shall be of an approved type suitable for the application.

(e) Flexible hoses which might be adversely affected by exposure to high temperatures shall not be employed in locations where excessive temperatures will exist during operation or after engine shutdown.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.433 *Fuel lines and fittings in designated fire zones.* Fuel lines and fittings in all designated fire zones (see sec. 7.480) shall comply with the provisions of section 7.483.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.434. *Fuel valves.* In addition to the requirements of section 7.482 for shutoff means, all fuel valves shall be provided with positive stops or suitable index provisions in the "on" and "off" positions, and they shall be supported so that loads resulting from their operation or from accelerated flight conditions are not transmitted to the lines attached to the valve.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.435. *Fuel strainer.*

(a) 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 location.

(b) The strainer shall provide the necessary degree of protection for the fuel pumps, fuel controls, and the engine against dirt, sediment, and other foreign matter which might be present in the fuel. The screen or

straining element shall be able to be easily cleaned.

(c) The strainer shall be mounted in a manner not to cause its weight to be supported by the connecting lines or by the inlet or outlet connections of the strainer itself.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

[7.436 *Fuel system drains.* Drainage of the fuel system shall be accomplished by fuel strainer drains and other drains as provided in section 7.424. The drains shall discharge clear of all portions of the rotorcraft and shall incorporate means for positive locking of the drain in the closed position, either manually or automatically.]

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-5, 27 F.R. 2999, Mar. 30, 1962, effective May 3, 1962.)

7.437 *Fuel quantity indicator.* The fuel quantity indicators (see secs. 7.604(e) and 7.613(b)) shall be installed to clearly indicate to the flight crew the quantity of fuel in each tank in flight. When two or more tanks are closely interconected by a gravity feed system and vented, and it is impossible to feed from each tank separately, only one fuel quantity indicator need be installed.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Oil System

7.440 *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. The oil system for components of the rotor drive system which require continuous lubrication shall be independent of the lubrication systems of the engines to whatever extent is necessary to assure the ability to operate with any engine inoperative and to assure the ability to autorotate safely. (For oil system instruments see secs. 7.604 and 7.735.)

(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 permissible 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 usable oil capacity of 1 gallon for each 40 gallons of usable fuel capacity, by volume, shall be considered acceptable for reciprocating engine installations.

(c) Oil-fuel ratios lower than those prescribed in paragraph (b) of this section shall be acceptable if substantiated by data on the actual oil consumption of the engine.

(d) The ability of the engine and rotor drive system oil cooling provisions to maintain the oil temperature at or below the maximum established value shall be demonstrated in accordance with pertinent provisions of sections 7.450 through 7.455.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.441 *Oil tank construction.* The following requirements shall apply to the construction of the oil tank:

(a) *Oil tank expansion space.*

(1) Oil tanks shall have an expansion space of not less than either 10 percent of the tank capacity or 0.5 gallon, whichever is greater.

(2) Reserve oil tanks which have no direct connection to any engine shall have an expansion space which is not less than 2 percent of the tank capacity.

(3) It shall not be possible to fill the oil tank expansion space inadvertently when the rotorcraft is in the normal ground attitude.

(b) *Oil tank filler connection.*

(1) Recessed oil tank filler connections which can retain any appreciable quantity of oil shall incorporate a drain, and the drain shall discharge clear of all portions of the rotorcraft.

(2) The oil tank filler cap shall provide an oil-tight seal under the pressure expected to be encountered in operation.

(3) Category A: Oil tank filler caps or filler cap covers shall incorporate features which provide a warning indication when caps are not fully locked or seated on the filler connection.

(4) The oil filler shall be marked as prescribed in section 7.738 (b) (2).

(c) *Oil tank vent.*

(1) Oil 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.

(2) Oil tank vents shall be arranged so that condensation of water vapor which might freeze and obstruct the line cannot accumulate at any point. (See also sec. 7.483 (c).)

(d) *Oil tank outlet.* Provision shall be made either to prevent entrance into the tank itself or into the tank outlet of any foreign object which might obstruct the flow of oil through the system. The oil tank outlet shall not be enclosed by any screen or guard which would reduce the flow of oil below a safe value at any operating temperature condition.

(e) *Flexible oil tank liners.* Flexible oil tank liners shall be of an approved type or shall be shown to be suitable for the particular application.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.442 *Oil tank tests.*

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

(b) The provisions of section 7.421 shall be applicable to oil tanks, except that the test pressure specified in section 7.421 (a) shall be 5 psi.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.443 *Oil tank installation.* The oil tank installation shall comply with the provisions of section 7.422, except that the location of an engine oil tank in a designated fire zone shall be acceptable if the tank and its supports are of fireproof construction to the extent that damage by fire to any nonfireproof parts would not result in leakage or spillage of oil.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.444 *Oil lines and fittings.*

(a) *General.* The provisions of section 7.432 shall be applicable to oil lines.

(b) *Lines and fittings in designated fire zones.* Oil lines and fittings in all designated fire zones (see sec. 7.480) shall comply with the provisions of section 7.483.

(c) *Breather lines.*

(1) Breather lines shall be arranged so that condensation of water vapor which might freeze and obstruct the line cannot accumulate at any point.

(2) Breathers shall discharge in a location which will not constitute a fire hazard in case foaming occurs and in a manner so that the emitted oil will not impinge upon the pilots' windshield.

(3) The breather shall not discharge into the engine air induction system. (See also sec. 7.483 (c).)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.445 *Oil valves.*

(a) The requirements of section 7.482 for shutoff means shall be complied with. Closing of oil shutoff means shall not prevent autorotation of the rotors.

(b) All oil valves shall be provided with positive stops or suitable index provisions in the "on" and "off" positions, and they shall be supported so that loads resulting from their operation or from accelerated flight conditions are not transmitted to the lines attached to the valves.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.446 *Oil radiators.*

(a) Oil radiators shall be capable of withstanding without failure all vibration, inertia, and oil pressure loads to which they would be subjected in operation.

(b) Oil radiator air ducts shall be located or so equipped that, in case of fire, flames cannot impinge directly upon the radiator with the airflow as it would exist either with the engine operating or inoperative.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

[7.447 *Oil filters.* If the powerplant installation incorporates an oil filter (strainer), the filter shall be constructed and installed so that oil will continue to flow at the normal rate through the remainder of the system when the flow of oil through the filter element is completely blocked.]

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-5, 27 F.R. 2999, Mar. 30, 1962, effective May 3, 1962.)

7.448 *Oil system drains.* Accessible drains shall be provided to permit safe drainage of the entire oil system and shall incorporate means for the positive locking of the drain in the closed position, either manually or automatically. (See also sec. 7.483 (c).)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Cooling System

7.450 *General.* The powerplant cooling provisions shall be capable of maintaining the temperatures of all powerplant components, engine fluids, and the carburetor intake air within safe values under all conditions of ground and flight operation. Cooling provisions shall also be provided to maintain the fluids in any power transmission within safe values under conditions of ground and flight operations. (For cooling system instruments see secs. 7.604 and 7.734.)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.451 *Cooling tests.*

(a) *General.* Compliance with the provisions of section 7.450 shall be demonstrated by flight tests in which the temperatures of selected powerplant components, engine(s), and transmission fluids are obtained under critical ground, water, and flight operating conditions. If the tests are conducted under conditions which deviate from the maximum anticipated air temperature (see paragraph (b) of this section), the recorded powerplant temperatures shall be corrected in accordance with the provisions of paragraphs (c) and (d) 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 engine(s) involved, and the mixture settings shall be those used in normal operation. The test procedures shall be as outlined in sections 7.452 through 7.455.

(b) *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.

(c) *Correction factor for cylinder head, oil inlet, carburetor air, and engine and transmission coolant outlet temperatures.* The cylinder head, oil inlet, carburetor air, and engine coolant outlet 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 head, oil, air, or coolant temperature recorded during the cooling test, unless a more rational correction is shown to be applicable.

(d) *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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.452 *Climb cooling test procedure.* Climb cooling tests shall be conducted on all Category A rotorcraft in accordance with paragraphs (a) through (d) of this section. Such tests shall be conducted on all multiengine Category B rotorcraft that are certificated in accordance with the Transport Category A powerplant installation requirements as well as with section 7.384(a) at the steady rate of climb or descent established in accordance with section 7.115(b)(2).

(a) The climb or descent cooling test shall be conducted with the engine inoperative which produces the most adverse cooling conditions for the engine(s) and powerplant components remaining in operation.

(b) All remaining engine(s) shall be operated at their maximum continuous power or at full throttle when above the critical altitude.

(c) After stabilizing temperatures in flight, the climb shall be started at or below the lower of the altitudes specified in subparagraphs (1) and (2) of this paragraph and shall be continued until at least 5 minutes after the occurrence of the highest temperature recorded, or until the maximum altitude is reached for which certification is desired. For Category B rotorcraft which do not have a positive rate of climb, the descent shall start at the all-engine-critical altitude and terminate at the higher of the altitudes specified in subparagraphs (3) and (4) of this paragraph:

(1) 1,000 feet below the engine critical altitude,

(2) 1,000 feet below the maximum altitude at which the rate of climb is equal to 150 fpm,

(3) The altitude at which level flight can be maintained with one engine operative, or

(4) Sea level.

(d) The climb or descent shall be conducted at an airspeed selected to represent a normal operational practice for the configuration being tested. However, if it is determined that characteristics of the cooling provisions make them sensitive to rotorcraft speed, the most critical airspeed shall be used, but need not exceed the speeds established in accordance with section 7.115 (a) (2) or (b) (2). It shall be acceptable to conduct the climb cooling test in conjunction with the takeoff cooling test of section 7.453.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.453 *Category A; takeoff cooling test procedure.* A takeoff cooling test shall be conducted to demonstrate cooling during takeoff and during subsequent climb with one engine inoperative. The following procedure shall be applicable:

(a) The takeoff cooling test shall be commenced by stabilizing temperatures while hovering in ground effect with all engines operating at necessary power, with the appropriate cowl flap and shutter settings, and at the maximum weight for which certification is sought.

(b) After all temperatures have stabilized, the climb shall be started at the lowest practicable altitude and shall be conducted with one engine inoperative.

(c) The remaining engines shall be operated at takeoff rpm and power (or at full throttle when above the takeoff critical altitude) for the same time interval as takeoff power is used during determination of the takeoff flight path (see sec. 7.114(a)).

(d) At the end of the time interval prescribed in paragraph (c) of this section the power shall be reduced to the maximum continuous power and the climb continued until at least 5 minutes after the occurrence of the highest temperature recorded.

(e) The speeds shall be those used during determination of the takeoff flight path (see sec. 7.114 (a)).

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.454 *Category B; cooling test procedure.* Cooling tests shall be conducted on all Category B rotorcraft in accordance with paragraphs (a) through (e) of this section (see sec. 7.452 for climb cooling tests where applicable).

(a) The cooling test shall be commenced by stabilizing temperatures while hovering in ground effect with necessary power and appropriate cowl flaps and shutter settings and at the maximum weight for which certification is sought.

(b) After all temperatures have stabilized, the climb shall be started at the lowest practicable altitude with takeoff power.

(c) Takeoff power shall be used for the same time interval as takeoff power is used during determination of the takeoff flight path (see sec. 7.114 (b)).

(d) At the end of the time interval prescribed in paragraph (c) of this section the power shall be reduced to the maximum continuous power and the climb continued until at least 5 minutes after the occurrence of the highest temperature recorded.

(e) The cooling test shall be conducted at an airspeed corresponding to normal operational practice for the configuration being tested. However, if it is determined that characteristics of the cooling provisions make them sensitive to rotorcraft speed, the most critical airspeed shall be used, but need not exceed the best rate-of-climb speed with maximum continuous power.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.455 *Hovering cooling test procedures.* Hovering cooling tests shall be conducted as follows:

(a) At maximum certificated weight or at the highest weight at which the rotorcraft is capable of hovering, if less than maximum certificated weight, at sea level using the power required to hover but not exceeding maximum continuous power, in the ground effect with still wind until at least 5 minutes after the occurrence of the highest temperature recorded.

(b) With all engines operating at maximum continuous power, the rotorcraft at maximum certificated weight, and the altitude resulting in zero rate of climb for this configuration until at least 5 minutes after the occurrence of the highest temperature recorded.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Induction and Exhaust Systems

7.460 *General.*

(a) The engine air induction system shall permit supplying the proper quantity of air to the engine under all conditions of operation.

(b) The induction system shall provide air for proper fuel metering and mixture distribution with the induction system valves in any position.

(c) Air intakes shall not open either within the engine accessory section or other areas of the powerplant compartment where emergence of backfire flame would constitute a fire hazard.

(d) Each engine shall be provided with an alternate air source.

(e) Alternate air intakes shall be so located as to preclude the entrance of rain, ice, or any other foreign matter.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.461 *Induction system deicing and anti-icing provisions.*

(a) *General.* The engine air induction system shall incorporate means for the prevention and elimination of ice accumulations.

(b) *Heat rise.* Unless it is demonstrated that other means will accomplish the intent of paragraph (a) of this section, compliance with the following heat-rise provisions shall be demonstrated in air free of visible moisture at a temperature of 30° F.:

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

gines are operating at 60 percent of their maximum continuous power.

(2) 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. when the engines are operating at 60 percent of their maximum continuous power.

(3) Rotorcraft equipped with altitude engines employing conventional venturi carburetors shall have a preheater capable of providing a heat rise of 120° F. when the engines are operating at 60 percent of their maximum continuous power.

(4) 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. when the engines are operating at 60 percent of their maximum continuous power.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.462 *Carburetor air preheater design.* Carburetor air preheater shall incorporate the following provisions:

(a) Means shall be provided to assure ventilation of the preheater when the engine is being operated with cold air.

(b) The preheater shall be constructed to permit inspection of exhaust manifold parts which it surrounds and also to permit inspection of critical portions of the preheater itself.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.463 *Induction system ducts.* Induction system ducts shall incorporate the following provisions:

(a) Induction system ducts ahead of the first stage of the supercharger shall be provided with drains to prevent hazardous accumulations of fuel and moisture in the ground attitude. The drains shall not discharge in locations which might cause a fire hazard.

(b) Sufficient strength shall be incorporated in the ducts to prevent induction system failures resulting from normal backfire conditions.

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

(d) Induction system ducts within any fire zone for which a fire-extinguishing system is required shall be of fire-resistant construction.

Note: Fireproof ducts are required in instances in which the duct may pass through a firewall.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.464 *Induction system screens.* If induction system screens are employed, they shall comply with the following provisions:

(a) Screens shall be located upstream from the carburetor.

(b) Screens shall not be located in portions of the induction system which constitute the only passage through which air can reach the engine, unless the screen is so located that it can be deiced by heated air.

(c) Deicing of induction system screens by means of alcohol alone in lieu of heated air shall not be acceptable.

(d) It shall not be possible for fuel to impinge upon the screens.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.465 *Carburetor air cooling.* Installations employing two-stage superchargers shall be provided with means to maintain the air temperature at the inlet to the carburetor at or below the maximum established value. Demonstration of compliance with this provision shall be accomplished in accordance with section 7.451.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.466 *Inter-coolers and after-coolers.* Inter-coolers and after-coolers shall be capable of withstanding without failure all vibration,

inertia, and air pressure loads to which they would be subjected in operation.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.467 *Exhaust system and installation components.*

(a) *General.*

(1) The exhaust system shall be constructed and arranged to assure the safe disposal of exhaust gases without the existence of a fire hazard or carbon monoxide contamination of air in personnel compartments.

(2) Unless appropriate precautions are taken, exhaust system parts shall not be located in hazardous proximity to portions of any system carrying flammable fluids or vapors nor shall they be located under portions of such systems where the latter could be subject to leakage.

(3) All rotorcraft components upon which hot exhaust gases might impinge, or which could be subjected to high temperatures due to proximity to exhaust system parts, shall be constructed of fireproof material. All exhaust system components shall be separated by means of fireproof shields from adjacent portions of the rotorcraft which are outside the engine compartment.

(4) Exhaust gases shall not discharge in a manner to cause a fire hazard with respect to any flammable fluid vent or drain.

(5) Exhaust gases shall not discharge at a location which will cause a glare seriously affecting pilot visibility at night.

(6) All exhaust system components shall be ventilated to prevent the existence of points of excessively high temperature.

(7) Exhaust shrouds shall be ventilated or insulated to avoid during normal operation a temperature sufficiently high to ignite any flammable fluids or vapors external to the shrouds.

(b) *Exhaust piping.*

(1) Exhaust piping shall be constructed of material resistant to heat and corrosion, and shall incorporate provisions to prevent failure due to expansion when heated to operating temperatures.

(2) Exhaust pipes shall be supported to withstand all vibration and inertia loads to which they would be subjected in operation.

(3) Portions of the exhaust piping which are connected to components between which relative motion could exist shall incorporate provisions for flexibility.

(c) *Exhaust heat exchangers.*

(1) Exhaust heat exchangers shall be constructed and installed to assure their ability to withstand without failure all vibration, inertia, and other loads to which they would be subjected in operation.

(2) Exhaust heat exchangers shall be constructed of materials which are suitable for continued operation at high temperatures and which are resistant to corrosion due to elements contained in exhaust gases.

(3) Provision shall be made for the inspection of all critical portions of exhaust heat exchangers.

(4) Exhaust heat exchangers shall incorporate cooling provisions wherever they are subject to contact with exhaust gases.

(5) Exhaust heat exchangers or muffs shall incorporate no stagnant areas or liquid traps which would increase the possibility of ignition of flammable fluids or vapors which might be present in case of failure or malfunctioning of components carrying flammable fluids.

(d) *Exhaust heating of ventilating air.* If an exhaust heat exchanger is used for heating ventilating air used by personnel, a secondary heat exchanger shall be provided between the primary exhaust gas heat exchanger and the ventilating air system, unless it is demonstrated that other means used preclude harmful contamination of the ventilating air.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Powerplant Controls and Accessories

7.470 *Powerplant controls; general.* The provisions of section 7.353 shall be applicable to all powerplant controls with respect to location and arrangement, and the provisions of section 7.737 shall be applicable to all powerplant controls with respect to marking. All flexible powerplant controls shall be of an approved type. In addition, all powerplant controls shall comply with the following:

(a) Controls shall be so located that they cannot be inadvertently operated by personnel entering, leaving, or making normal movements in the cockpit.

(b) Controls shall maintain any set position without constant attention by flight personnel. They shall not creep due to control loads or vibration.

(c) Controls shall have strength and rigidity to withstand operating loads without failure and without excessive deflection.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.471 *Throttle and A. D. I. system 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 in such a manner that proper synchronization of the power of all engines can be readily achieved.

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

(c) If an antidetonant injection system is provided, the control shall be incorporated in the throttle controls, except that a separate control may be provided for the antidetonant injection pump.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.472 *Ignition switches.* Ignition switches shall provide control for each ignition circuit on each engine. Means shall be provided for quickly shutting off all ignition by the grouping of switches or by providing a master ignition control. If a master ignition control is provided, a guard shall be incorporated to prevent inadvertent operation of the control.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.473 *Mixture controls.*

(a) 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.

(b) Any intermediate position of the mixture controls which corresponds with a normal operating setting shall be provided with a means of identification by feel and by vision.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.474. *Carburetor air preheat controls.* Separate carburetor air preheat controls shall be provided to regulate the temperature of the carburetor air for each engine.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.475 *Supercharger controls.* Supercharger controls shall be accessible to the pilots, except where a separate flight engineer station with a control panel is provided, in which case they shall be accessible to the flight engineer.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.476 *Rotor brake controls.* It shall be physically impossible to apply inadvertently the rotor brake in flight. A means shall be provided to warn the crew if the rotor brake has not been completely released prior to takeoff.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.477 *Powerplant accessories.*

(a) 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.

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(b) Items of electrical equipment subject to arcing or sparking shall be installed in such a way as to minimize the possibility of their igniting flammable fluids or vapors which might be present.

(c) If continued rotation of an engine-driven cabin supercharger or any remote accessory driven by the engine will constitute a hazard in case malfunctioning occurs, means shall be provided to prevent hazardous rotation of such accessory without interfering with the continued operation of the engine. (See also sec. 7.358(c).)

Note: Hazardous rotation may involve consideration of mechanical damage or sustained air flows which may be dangerous under certain conditions.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.478 *Engine ignition systems.*

(a) Battery ignition systems shall be supplemented with a generator which is automatically made available as an alternate source of electrical energy to permit continued engine operation in the event of the depletion of any battery.

(b) The capacity of batteries and generators shall be sufficient to meet the simultaneous demands of the engine ignition system and the greatest demands of any rotorcraft electrical system components which draw electrical energy from the same source.

(1) The design of the engine ignition system shall take into consideration the condition of an inoperative generator and the condition of a completely depleted battery when the generator is running at its normal operating speed.

(2) If only one battery is provided, the design of the engine ignition system shall take into consideration the condition in which the battery is completely depleted and the generator is operating at idling speed.

(3) Portions of magneto ground wires for separate ignition circuits which lie on the engine side of the firewall shall be installed, located, or protected so as to minimize the possibility of simultaneous failure of two or more wires as a result of mechanical damage, electrical faults, etc.

(4) Ground wires for any engine shall not be routed through fire zones, except those associated with the engine which the wires serve, unless those portions of the wires which are located in such fire zones are fireproof or are protected against the possibility of damage by fire in a manner to render them fireproof. (See sec. 7.472 for ignition switches.)

(5) Ignition circuits shall be electrically independent of all other electrical circuits except circuits used for analyzing the operation of the ignition system.

(c) Means shall be provided to warn flight personnel if malfunctioning of any part of the electrical system is causing the continuous discharging of a battery which is necessary for engine ignition. (See sec. 7.472 for ignition switches.)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Powerplant Fire Protection

7.480 *Designated fire zones.*

(a) Designated fire zones shall comprise the following regions: (See also sec. 7.385.)

(1) Engine power section,

(2) Engine accessory section,

(3) Complete powerplant compartments in which no isolation is provided between the engine power section and the engine accessory section,

(4) Auxiliary power unit compartments, and

(5) Fuel-burning heaters and other combustion equipment installations as defined by section 7.383.

(b) Designated fire zones shall be protected from fire by compliance with sections 7.481 through 7.489.

Note: For Category B rotorcraft, the powerplant fire protection provisions are intended to insure that the main and auxiliary rotors and controls remain operable, that the essential rotorcraft structure remains intact, and that the passengers and crew are otherwise protected for a period of at least 5 minutes after the start of an engine fire to permit a controlled autorotative landing.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.481 *Flammable fluids.*

(a) No tanks or reservoirs which are a part of a system containing flammable fluids or gases shall be located in designated fire zones, except where the fluid contained, the design of the system, the materials used in the tank and its supports, the shutoff means, all connections, lines, and controls are such as to provide an equally high degree of safety.

(b) Fuel tanks shall be isolated from the engines by a firewall or shroud. Not less than one-half inch of clear airspace shall be provided between any tank or reservoir and a firewall or shroud isolating a designated fire zone, unless other equivalent means are used to protect against heat transfer from the fire zone to the flammable fluid.

(c) If absorbent materials are located in proximity to flammable fluid system components which might be subject to leakage, such materials shall be covered or treated to prevent the absorption of hazardous quantities of fluids.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.482 *Shutoff means.*

(a) Means shall be provided for shutting off or otherwise preventing hazardous quantities of fuel, oil, deicer, and other flammable fluids from flowing into, within, or through any designated fire zone specified in section 7.480(a), except that means need not be provided to shut off flow in lines forming an integral part of an engine. Closing any fuel shutoff valve for any engine shall not affect more than the selected engine.

(1) *Category A.* It shall be shown that no hazardous quantity of flammable fluid could drain into any designated fire zone after shutting off has been accomplished. Closing the fuel shutoff valve for any engine shall not make any of the fuel supply unavailable to the remaining engines.

(2) *Category B.* In installations using engines of less than 500 cubic inches displacement, shutoff means need not be provided for engine oil systems.

(b) Operation of the shutoff means shall not interfere with the subsequent emergency operation of other equipment, such as declutching the engine from the rotor drive.

(c) The shutoff means shall be located outside of designated fire zones, unless an equally high degree of safety is otherwise provided (see sec. 7.481).

(d) Provision shall be made to guard against inadvertent operation of the shutoff means, and to make it possible for the crew to reopen the shutoff means in flight after it has once been closed.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.483 *Lines and fittings.*

(a) All lines and fittings carrying flammable fluids in areas subject to engine fire conditions shall be fire resistant, except as otherwise provided in this section. If flexible hose is used, the assembly of hose and end fittings shall be of an approved type. The provisions of this paragraph shall not apply to those lines and fittings which form an integral part of the engine.

(b) Vent and drain lines and their fittings shall be subject to the provisions of paragraph (a) of this section unless a failure of such line or fitting will not result in, or add to, a fire hazard.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7–4, 24 F.R. 7074, Sept. 1, 1959, effective Oct. 1, 1959.)

7.484 *Fire-extinguishing systems.*

(a) *General.*

(1) Fire-extinguishing systems shall be provided to serve all designated fire zones except that such systems need not be provided on Category B rotorcraft employing engines of 1,500 cubic inches or less displacement.

(2) On multiengine rotorcraft, the fire-extinguishing system, the quantity of extinguishing agent, and the rate of discharge shall be such as to provide two adequate discharges. It shall be possible to direct both discharges to any main engine installation.

Individual "one-shot" systems shall be acceptable in the case of auxiliary power units, fuel-burning heaters, and other combustion equipment. On single-engine rotorcraft, the quantity of extinguishing agent and the rate of discharge shall be such as to provide one adequate discharge for the engine compartment.

(3) The fire-extinguishing system for a powerplant shall be capable of protecting simultaneously all zones of the powerplant compartment for which protection is provided.

(b) *Fire-extinguishing agents.*

(1) Extinguishing agents employed shall be methyl bromide, carbon dioxide, or any other agent which has been shown to provide equivalent extinguishing action.

(2) If methyl bromide, carbon dioxide, or any other toxic extinguishing agent is employed, provision shall be made to prevent the entrance of harmful concentrations of fluid or fluid vapors into any personnel compartment either due to leakage during normal operation of the rotorcraft or as a result of discharging the fire extinguisher on the ground or in flight even though a defect may exist in the extinguishing system. Compliance with this requirement shall be demonstrated by appropriate tests.

(3) If a methyl bromide system is provided, the containers shall be charged with a dry agent and shall be sealed by the fire extinguisher manufacturer or by any other party employing appropriate recharging equipment.

(c) *Extinguishing agent container pressure relief.* Extinguishing agent containers shall be provided with a pressure relief to prevent bursting of the container due to excessive internal pressures. The following provisions shall apply:

(1) The discharge line from the relief connection shall terminate outside the rotorcraft in a location convenient for inspection on the ground.

(2) An indicator shall be provided at the discharge end of the line to provide a visual indication when the container has discharged.

(d) *Extinguishing agent container compartment temperature.* Under all conditions in which the rotorcraft is intended for operation, the temperature range of the extinguishing agent containers shall be maintained to assure that the pressure in the containers can neither fall below the minimum necessary to provide an adequate rate of extinguishing agent discharge nor rise above a safe limit so that the system will not be prematurely discharged.

(e) *Fire-extinguishing system materials.* Materials in the fire-extinguishing system shall not react chemically with the extinguishing agent so as to constitute a hazard. All components of the fire-extinguishing systems located in engine compartments shall be constructed of fireproof materials.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.485 *Fire-detector systems.* Quick-acting fire detectors of an approved type shall be provided in all designated fire zones, except on Category B rotorcraft employing engines of 900 cubic inches or less displacement. The fire detectors shall be sufficient in number and location to assure prompt detection of fire in such zones. Fire detectors shall comply with the following provisions:

(a) Fire detectors shall be constructed and installed to assure their ability to resist without failure all vibration, inertia, and other loads to which they would be subjected in operation.

(b) Fire detectors shall be unaffected by exposure to oil, water, or other fluids or fumes which might be present.

(c) Means shall be provided to permit the crew to check in flight the functioning of the electrical circuit associated with the fire-detector system.

(d) Wiring and other components of the fire-detector systems which are located in engine compartments shall be of fire-resistant construction.

(e) Detector system components for any fire zone shall not pass through other fire zones, unless they are protected against the possibility of false warnings resulting from fires in zones through which they pass. This requirement shall not be applicable with respect to zones which are simultaneously protected by the same detector and extinguishing systems.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.486 *Firewalls.* Engines shall be isolated from personnel compartments by means of firewalls, shrouds, or other equivalent means. They shall be similarly isolated from the structure, controls, rotor mechanism, and other parts essential to controlled flight and landing of the rotorcraft, unless such parts are protected in accordance with the provisions of section 7.384. All 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 firewalls, shrouds, or other equivalent means. In complying with the provisions of this section, account shall be taken of the probable path of a fire as affected by the airflow in normal flight and in autorotation. The following shall apply:

(a) Firewalls 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.

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

(c) Firewalls and shrouds shall be constructed of fireproof material and shall be protected against corrosion.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.487 *Cowling.*

(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) Cowling shall have drainage and ventilation provisions as prescribed in section 7.489.

(c) On rotorcraft equipped with a diaphragm [to isolate the engine power section from the engine accessory section], the parts of the accessory section cowling which might be subject to flame in the event of a fire in the engine power section of the powerplant shall be constructed of fireproof material and shall comply with the provisions of section 7.486.

(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.

(e) Category A: The rotorcraft shall be so designed and constructed that fire originating in any fire zone cannot enter, either through openings or by burning through external skin, into any other zone or region where such fire would create additional hazards. If the rotorcraft is provided with a retractable landing gear, this provision shall apply with the landing gear retracted. Fireproof materials shall be used for all skin areas which might be subjected to flame in the event of a fire originating in the engine power or accessory sections.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7–5, 27 F.R. 2999, Mar. 30, 1962, effective May 3, 1962.)

7.489 *Drainage and ventilation of fire zones.*

(a) Complete drainage of all portions of designated fire zones shall be provided to minimize the hazards resulting from failure or malfunctioning of components containing flammable fluids. The drainage provisions shall be effective under conditions expected to prevail when drainage is needed and shall be so arranged that the discharged fluid will not cause an additional fire hazard.

(b) All designated fire zones shall be ventilated to prevent the accumulation of flammable vapors. Ventilation openings shall not be placed in locations which would permit the entrance of flammable fluids, vapors, or flame from other zones. The ventilation provisions shall be so arranged that the discharged vapors will not cause an additional fire hazard.

(c) Category A: Except with respect to the engine power section of the powerplant compartment, provision shall be made to permit the crew to shut off sources of forced ventilation in any fire zone, unless the amount of extinguishing agent and rate of discharge are based on maximum airflow through the zone.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Subpart F—Equipment

General

7.600 *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 regulations in this subchapter.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.601 *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; and

(d) Demonstrated to function properly in the rotorcraft.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.602 *Required basic equipment.* The equipment listed in sections 7.603 through 7.605 shall be the required basic equipment. (See sec. 7.600.)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.603 *Flight and navigational instruments.* (See sec. 7.612 for installation requirements.)

(a) Airspeed indicating system.

(b) Altimeter (sensitive).

(c) Clock (sweep-second).

(d) Free-air temperature indicator.

(e) Gyroscopic bank and pitch indicator (non-tumbling type).

(f) Gyroscopic rate-of-turn indicator (with bank indicator).

(g) Gyroscopic direction indicator.

(h) Magnetic direction indicator.

(i) Rate-of-climb indicator (vertical speed).

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.604 *Powerplant instruments.* (See sec. 7.613 for installation requirements.)

(a) Carburetor air temperature indicator for each engine.

(b) Cylinder head temperature indicator for each air-cooled engine, or coolant temperature indicator for each liquid-cooled engine.

(c) Category A: An individual fuel pressure indicator for each engine and either an independent warning device for each engine or a master warning device for all engines with means for isolating the individual warning circuit from the master warning device.

(d) Category B: An individual fuel pressure indicator for each engine.

(e) Fuel quantity indicator for each fuel tank. (See sec. 7.437.)

[(f) A warning device to indicate low fuel in each tank if an engine can be supplied with fuel from more than one tank. The fuel in any tank shall be considered to be low if

a five-minute usable fuel supply remains when the rotorcraft is in the most adverse condition, from the standpoint of fuel feed from that tank, whether or not that condition can be sustained for five minutes.]

(g) Manifold pressure indicator for each engine, if altitude engines are used.

(h) Category A: An individual oil pressure indicator for each engine and either an independent warning device for each engine or a master warning device for all engines with means for isolating the individual warning circuit from the master warning device.

(i) Category B: An individual oil pressure indicator for each engine.

(j) Oil pressure warning device for each pressure-lubricated gear box to indicate when the oil pressure falls below a safe value.

(k) Oil quantity indicator for each oil tank and each rotor drive gear box, if lubricant is self-contained. (See sec. 7.613(d).)

(l) Oil temperature indicator for each engine.

[(m) Oil temperature warning device to indicate when the oil temperature exceeds a safe value in each main rotor drive gearbox, including those gearboxes essential to rotor phasing, having an oil system independent of the engine oil system.]

(n) Tachometer for each engine. (These tachometers may be combined in a single instrument with that required by paragraph (o) of this section, except that such an instrument shall indicate rotor rpm during autorotation.)

(o) Tachometer(s) to indicate rotor rpm of the main rotor(s), or for each main rotor, the speed of which can vary appreciably with respect to another main rotor.

(p) Category A: Fire-warning indicators. (See sec. 7.485.)

(q) Category B: Fire-warning indicators when fire detection is required. (See sec. 7.485.)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-5, 27 F.R. 2999, Mar. 30, 1962, effective May 3, 1962.)

7.605 *Miscellaneous equipment.* There shall be installed:

(a) Approved seats for all occupants. (See sec. 7.355.)

(b) Approved individual safety belts for all occupants. (See sec. 7.643.)

(c) Master switch arrangement for electrical circuits other than ignition. (See sec. 7.622(c).)

(d) Source(s) of electrical energy. (See sec. 7.620.)

(e) Electrical protective devices. (See sec. 7.624.)

(f) Hand fire extinguishers. (See secs. 7.380(a) and 7.381 (e) and (f).)

(g) Windshield wiper or equivalent for each pilot station. (See sec. 7.351(b).)

(h) Radio communication system (two-way.)

(i) Ignition switch for each and all engines. (See sec. 7.472.)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.606. *Equipment, systems, and installations.*

(a) *Functioning and reliability.* All equipment, systems, and installations, the functioning of which is necessary in showing compliance with the regulations in this subchapter, shall be designed and installed to insure that they will perform their intended functions reliably under all reasonably foreseeable operating conditions.

(b) *Hazards.* All equipment, systems, and installations shall be designed to safeguard against hazards to the rotorcraft in the event of their malfunctioning or failure.

(c) *Category A; power supply.* Where an installation, the functioning of which is necessary in showing compliance with the regulations in this subchapter, requires a power supply, such installation shall be considered an essential load on the power supply, and the power sources and the system shall be capable of supplying the following power

loads in probable operating combinations and for probable durations:

(1) All loads connected to the system with the system functioning normally.

(2) All essential loads after failure of any one prime mover, power converter, or energy storage device.

(3) All essential loads after failure of any one engine on two- or three-engine rotorcraft, or after failure of any two engines on rotorcraft with four or more engines.

(4) In determining the probable operating combinations and durations of essential loads for the partial power failure conditions prescribed in subparagraphs (2) and (3) of this paragraph, it shall be permissible to assume that the power loads are reduced in accordance with a monitoring procedure which is consistent with safety in the types of operations authorized. If a particular load is not required to maintain controlled flight, it need not be considered for the two-engine-inoperative condition on rotorcraft with four or more engines as prescribed in subparagraph (3) of this paragraph.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Instruments; Installation

7.610 *General.* The provisions of sections 7.611 through 7.613 shall apply to the installation of instruments in rotorcraft.

Note: It may be necessary to duplicate certain instruments at two or more crew stations to meet the instrument visibility requirements prescribed in section 7.611, or when required by the operating rules of the regulations in this subchapter for reliability or cross check purposes in particular types of operations. In this case independent operating systems are required in accordance with the provisions of section 7.612(f).

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.611 *Arrangement and visibility of instrument installations.*

(a) Flight, navigation, and powerplant instruments for use by each pilot shall be plainly visible to him from his station with the minimum practicable deviation from his normal position and line of vision when he is looking out and forward along the flight path.

(b) The required instruments consisting of the airspeed indicator, gyroscopic direction indicator, gyroscopic bank and pitch indicator, gyroscopic turn and bank indicator, altimeter, rate-of-climb indicator, rotor tachometer(s), and manifold pressure indicator, shall be grouped and shall be centered as nearly as practicable about the vertical plane of the pilot's forward vision. Additional instruments considered of prime importance to the safe operation of the rotorcraft shall be included in the grouping.

(c) All other required powerplant instruments shall be closely grouped on the instrument panel.

(d) Identical powerplant instruments for the several engines shall be located to prevent any misleading impression as to the engines to which they relate.

(e) Powerplant instruments vital to the safe operation of the rotorcraft shall be plainly visible to the appropriate crewmembers.

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

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.612 *Flight and navigational instruments.*

(a) *Airspeed indicating systems.*

(1) Airspeed indicating instruments shall be calibrated to indicate true airspeed at sea level in the standard atmosphere with a minimum practicable instrument calibration error when the corresponding pitot and static pressures are applied to the instrument.

(2) The airspeed indicating system shall be calibrated to determine the system error; i.e., the relation between IAS and

CAS. This calibration shall be determined over an appropriate range of speeds:

(i) In flight for the flight conditions of climb, level flight, an autorotation; and,

(ii) In ground effect during the accelerated takeoff run.

(3) *Category A and Category B; multiengine rotorcraft.* The airspeed error of the installation, including the airspeed indicator instrument calibration error, shall not exceed 3 percent or 5 mph, whichever is greater:

(i) Throughout the speed range in level flight at forward speeds of 10 mph or over, and

(ii) Through the speed range in climb of 10 mph below the takeoff climbout safety speed (see sec. 7.114(a)) to 10 mph above the best rate-of-climb speed.

(4) *Category B; single-engine rotorcraft.* Calibration of the airspeed indicator shall be made in flight at all forward speeds of 10 mph or over. The airspeed error of the installation, including the airspeed indicator instrument calibration error, shall not exceed 3 percent or 5 mph, whichever is greater, at any forward speed above 80 percent of the climbout speed.

(5) The airspeed indicating system shall be arranged insofar as practicable to preclude malfunctioning or serious error due to the entry of moisture, dirt, or other substances.

(6) The airspeed indicating system shall be provided with a heated pitot tube or equivalent means of preventing malfunctioning due to icing.

(b) *Static air vent and pressure altimeter systems.*

(1) All instruments provided with static air case connections shall be vented to the outside atmosphere through an appropriate piping system.

(2) The vent(s) shall be so located on the rotorcraft that its orifices will be least affected by airflow variation, moisture, or other foreign matter.

(3) The installation shall be such that the system will be airtight, except for the vent into the atmosphere.

(4) Pressure altimeters shall be of an approved type and shall be calibrated to indicate pressure altitude in standard atmosphere with a minimum practicable instrument calibration error when the corresponding static pressures are applied to the instrument.

(5) The design and installation of the altimeter system shall be such that the error in indicated pressure altitude at sea level in standard atmosphere, excluding instrument calibration error, does not result in a reading more than 30 feet high nor more than 30 feet low in the level flight speed range 0 mph to 0.9 V_H.

(c) *Magnetic direction indicator.*

(1) The magnetic direction indicator shall be installed so that its accuracy will not be excessively affected by the rotorcraft's vibration or magnetic fields of a permanent or transient nature.

(2) After the magnetic direction indicator has been compensated, the calibration shall be such that the deviation in level flight does not exceed $\pm 10°$ on any heading.

(3) A calibration placard shall be provided as specified in section 7.733.

(d) *Automatic pilot system.* If an automatic pilot system is installed, it shall be of an approved type, and the following shall be applicable:

(1) The system shall be so designed that the automatic pilot can either:

(i) Be quickly and positively disengaged by the human pilots to prevent it from interfering with their control of the rotorcraft, or

(ii) Be sufficiently overpowered by one human pilot to enable him to control the rotorcraft.

(2) A means shall be provided to indicate readily to the pilot the alignment of the actuating device in relation to the control system which it operates, except when automatic synchronization is provided.

(3) The manually operated control(s) for the system's operation shall be readily accessible to the pilots.

(4) The automatic pilot system shall be of such design and so adjusted that, within the range of adjustment available to the human pilot, it cannot produce hazardous loads on the rotorcraft or create hazardous deviations in the flight path under any conditions of flight appropriate to its use either during normal operation or in the event of malfunctioning, assuming that corrective action is initiated within a reasonable period of time.

(e) *Category A; instruments utilizing a power supply.* Each required flight instrument utilizing a power supply shall be provided with two independent sources of power, a means of selecting either power source, and a means of indicating the adequacy of the power being supplied to the instrument. The installation and power supply system shall be such that failure of any flight instrument connected to one source, or of the energy supply from one source, or a fault in any part of the power distribution system, will not interfere with the proper supply of energy from the other source. (See also secs. 7.606, 7.620, and 7.654.)

[(f) *Duplicate instrument systems.* If duplicate flight instruments are required by the operating parts of the Civil Air Regulations (see note under section 7.610), the provisions of subparagraphs (1) through (3) of this paragraph shall apply:

[(1) The operating system for flight instruments used by the first pilot, which are required to be duplicated at other flight crew stations, shall be completely independent of the operating system provided for other flight crew stations.

[(2) Only the required flight instruments and duplicates of required instruments provided for use of the first pilot shall be connected to the operating system provided for the first pilot.

[(3) When other than required instruments and duplicates are connected to other than the first pilot's operating system, provision shall be made to disconnect or isolate in flight such other instruments.]

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7–4, 24 F.R. 7074, Sept. 1, 1959, effective Oct. 1, 1959; Amdt. 7–5, 27 F.R. 2999, Mar. 30, 1962, effective May 3, 1962.)

7.613 *Powerplant instruments.*

(a) *Instrument lines.*

(1) Powerplant 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.

(2) The provisions of sections 7.432 and 7.433 shall be made applicable to powerplant instrument lines.

(b) *Fuel quantity indicator.* Means shall be provided to indicate to the flight crew the quantity in gallons or equivalent units of usable fuel in each tank during flight. The following shall apply:

(1) Tanks, the outlets and airspaces of which are interconnected, shall be considered as one tank for the purpose of providing separate indicators.

(2) Exposed sight gauges shall be protected against damage.

(3) 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 unusuable fuel supply as defined by section 7.416. (See sec. 7.736.)

(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.* A stick gauge or other equivalent means shall be provided to indicate the quantity of oil in each tank and in each transmission gear box. (See sec. 7.735.)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Electrical Systems and Equipment

7.620 *General.* The provisions of sections 7.621 through 7.626 shall apply to all electrical systems and equipment (see also sec. 7.606).

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.621 *Electrical system capacity.* The required generating capacity and the number and type of power sources shall be determined by an electrical load analysis and shall comply with section 7.606.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.622 *Generating system.*

(a) The generating system shall be considered to include electrical power sources, main power busses, transmission cables, and associated control, regulation, and protective devices.

[(b) The generating system shall be designed so that:

[(1) The power sources function properly when independent and when connected in combination;

[(2) The failure or malfunctioning of any power source cannot create a hazard or impair the ability of the remaining sources to supply essential loads;

[(3) The system voltage and frequency (as applicable) at the terminals of all essential load equipment can be maintained within the limits for which the equipment is designed, during any probable operating condition;

[(4) System transients initiated by switching, fault clearing, or other causes, do not render essential loads inoperative, and do not introduce a smoke or fire hazard.]

(c) Means accessible in flight to appropriate crewmembers shall be provided for the individual and collective disconnection of electrical power sources from the main bus.

(d) Means shall be provided to indicate to appropriate crewmembers those generating system quantities which are essential for the safe operation of the system.

Note: The voltage and current supplied by each generator are quantities considered essential.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7–5, 27 F.R. 2999, Mar. 30, 1962, effective May 3, 1962.)

7.623 *Distribution system.*

(a) The distribution system shall be considered to include all distribution busses, their associated feeders, and control and protective devices.

(b) Category A: Individual distribution systems shall be designed to insure that essential load circuits can be supplied in the event of reasonably probable faults or open circuits.

(c) Where two independent sources of electrical power for particular equipment or systems are required by the regulations in this subchapter, their electrical energy supply shall be assured.

Note: Various means may be used to assure a supply, such as duplicate electrical equipment, throw-over switching, and multichannel or loop circuits separately routed.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.624 *Electrical protection.*

(a) Automatic protective devices shall be provided to minimize distress to the electrical system and hazard to the rotorcraft in the event of wiring faults or serious malfunctioning of the system or connected equipment.

(b) Category A: In the generating system, means shall be provided to automatically de-energize and disconnect from the main bus any power source which develops hazardous overvoltage.

(c) All resettable type circuit protective devices shall be so designed that, when an overload or circuit fault exists, they will open the circuit irrespective of the position of the operating control.

[(d) If the ability to reset a circuit breaker or to replace a fuse is essential to safety in flight, such circuit breaker or fuse

shall be so located and identified that it can be readily reset or replaced in flight.]

(e) Circuits for essential loads shall have individual circuit protection.

Note: This provision does not necessarily require individual protection for each circuit in an essential load system; e.g., each position light in the system.

(f) If fuses are used, there shall be provided spare fuses for use in flight equal to at least 50 percent of the number of fuses of each rating required for complete circuit protection.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-5, 27 F.R. 2999, Mar. 30, 1962, effective May 3, 1962.)

7.625 *Electrical equipment and installation.*

(a) In showing compliance with section 7.606 (a) and (b) with respect to the electrical system, equipment, and installation, consideration shall be given to critical environmental conditions.

Note: Critical environmental conditions may include temperature, pressure, humidity, ventilation, position, acceleration, vibration, and presence of detrimental substances.

(b) All electrical equipment, controls, and wiring shall be so installed that operation of any one unit or system of units will not affect adversely the simultaneous operation of any other electrical unit or system of units essential to the safe operation of the rotorcraft.

(c) Cables shall be grouped, routed, and spaced so that damage to essential circuits will be minimized in the event of faults in heavy current-carrying cables.

(d) Storage batteries shall be of such design and so installed that:

(1) Safe cell temperatures and pressures are maintained during any probable charging or discharging condition. No uncontrolled increase in cell temperature shall result when the storage battery is recharged (after previous complete discharge) at maximum regulated voltage, during a flight of maximum duration, under the most adverse cooling condition likely to occur in service. Tests to demonstrate compliance with this regulation shall not be required if satisfactory operating experience with similar batteries and installations has shown that maintaining safe cell temperatures and pressures presents no problem.

(2) Explosive or toxic gases emitted by the storage battery in normal operation, or as the result of any probable malfunction in the charging system or the battery installation, shall not accumulate in hazardous quantities within the rotorcraft.

(3) Corrosive fluids or gases which may be emitted or spilled from the storage battery shall not damage surrounding rotorcraft structure or adjacent essential equipment.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-4, 24 F.R. 7074, Sept. 1, 1959, effective Oct. 1, 1959.)

7.626 *Electrical system fire and smoke protection.* The design and installation of all components of the electrical system shall comply with the pertinent fire and smoke protection provisions of sections 7.358(c) and 7.385. All electrical cables, terminals, and equipment which are necessary in emergency procedures and which are located in designated fire zones shall be fire-resistant.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

[7.627 *Electrical system tests.* When laboratory tests of the electrical system are conducted, they shall be performed on a mock-up utilizing the same generating equipment complement as in the rotorcraft. The equipment shall simulate the electrical characteristics of the distribution wiring and connected loads to the extent necessary for valid test results. Laboratory generator drives shall simulate the actual prime movers on the rotorcraft with respect to their reaction to generator loading, including loading due to faults. When the conditions of flight cannot be simulated adequately in the laboratory or by ground tests on the prototype rotorcraft, flight tests shall be conducted.]

(Added by Amdt. 7-5, 27 F.R. 2999, Mar. 30, 1962, effective May 3, 1962.)

Lights

7.630 *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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.631 *Landing lights.*

(a) When landing or hovering lights are required, they 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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.632 *Position light system installation.*

(a) *General.* In addition to this section, the provisions of sections 7.633 through 7.635 shall be applicable to the position light system as a whole. The position light system shall include the items specified in paragraphs (b) through (d) of this section.

(b) *Forward position lights.* Forward position lights shall consist of a red and a green light spaced laterally as far apart as practicable and installed forward on the rotorcraft in such a location that, with the rotorcraft in normal flying position, the red light is displayed on the left side and the green light is displayed on the right side. The individual lights shall be of an approved type.

(c) *Rear position light.* The rear position light shall consist of a white light mounted on the rotorcraft as far aft as practicable. The light shall be of an approved type.

(d) *Light covers and color filters.* Light covers or color filters used shall be of flame-resistant material and shall be constructed so that they will not change color or shape or suffer any appreciable loss of light transmission during normal use.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7–1, 22 F.R. 1275, Mar. 1, 1957, effective Apr. 1, 1957.)

7.633 *Position light system dihedral angles.* The forward and rear position lights as installed on the rotorcraft shall show unbroken light within dihedral angles specified in paragraphs (a) through (c) of this section.

(a) Dihedral angle *L* (left) shall be considered formed by two intersecting vertical planes, one parallel to the longitudinal axis of the rotorcraft and the other at 110° to the left of the first, when looking forward along the longitudinal axis.

(b) Dihedral angle *R* (right) shall be considered formed by two intersecting vertical planes, one parallel to the longitudinal axis of the rotorcraft and the other at 110° to the right of the first, when looking forward along the longitudinal axis.

(c) Dihedral angle *A* (aft) shall be considered 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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.634 *Position light distribution and intensities.*

(a) *General.* The intensities prescribed in this section are those to be provided by new equipment with all light covers and color filters 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 rotorcraft. The light distribution and intensities of position

lights shall comply with the provisions of [paragraph (b)] of this section.

(b) *Forward and rear position lights.* The light distribution and intensities of forward and rear position lights shall be expressed in terms of minimum intensities in the horizontal plane, minimum intensities in any vertical plane, and maximum intensities in overlapping beams within dihedral angles *L, R,* and *A,* and shall comply with the provisions of subparagraphs (1) through (3) of this paragraph.

(1) *Intensities in horizontal plane.* The intensities in the horizontal plane shall not be less than the values given in figure 7–1. (The horizontal plane is the plane containing the longitudinal axis of the rotorcraft and is perpendicular to the plane of symmetry of the rotorcraft.)

(2) *Intensities above and below horizontal.* The intensities in any vertical plane shall not be less than the appropriate value given in figure 7–2, where I is the minimum intensity prescribed in figure 7–1 for the corresponding angles in the horizontal plane. (Vertical planes are planes perpendicular to the horizontal plane.)

(3) *Overlaps between adjacent signals.* The intensities in overlaps between adjacent signals shall not exceed the values given in figure 7–3, except that higher intensities in the overlaps shall be acceptable with the use of main beam intensities substantially greater than the minima specified in figures 7–1 and 7–2 if the overlap intensities in relation to the main beam intensities are such as not to affect adversely signal clarity.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7–1, 22 F.R. 1275, Mar. 1, 1957, effective Apr. 1, 1957; Amdt. 7–5, 27 F.R. 2999, Mar. 30, 1962, effective May 3, 1962.)

Dihedral angle (light involved)	Angle from right or left of longitudinal axis, measured from dead ahead	Intensity (candles)
L and R (forward red and green)	0° to 10°	40
	10° to 20°	30
	20° to 110°	5
A (rear white)	110° to 180°	20

Figure 7–1—Minimum Intensities in the Horizontal Plane of Forward and Rear Position Lights

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°	[0.05 I]

Figure 7–2—Minimum Intensities in any Vertical Plane of Forward and Rear Position Lights

Overlaps	Maximum intensity	
	Area A (candles)	Area B (candles)
Green in dihedral angle L	10	1
Red in dihedral angle R	10	1
Green in dihedral angle A	5	1
Red in dihedral angle A	5	1
Rear white in dihedral angle L	5	1
Rear white in dihedral angle R	5	1

NOTE: Area A includes all directions in the adjacent dihedral angle which pass through the light source and which intersect the common boundary plane at more than 10 degrees but less than 20 degrees. Area B includes all directions in the adjacent dihedral angle which pass through the light source and which intersect the common boundary plane at more than 20 degrees.

Figure 7–3—Maximum Intensities in Overlapping Beams of Forward and Rear Position Lights

7.635 *Color specifications.* The colors of the position lights shall have the International Commission on Illumination chromaticity coordinates as set forth in paragraphs (a) through (c) of this section.

(a) *Aviation red.*

y is not greater than 0.335,

z is not greater than 0.002;

(b) *Aviation green.*

x is not greater than $0.440-0.320y$,

x is not greater than $y-0.170$,

y is not less than $0.390-0.170x$;

(c) *Aviation white.*

x is not less than 0.350,

x is not greater than 0.540,

$y-y_0$ is not numerically greater than 0.01,

y_0 being the y coordinate of the Planckian radiator for which $x_0=x$.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.636 *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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.637 *Anticollision light system.* An anticollision light system shall be installed which shall consist of one or more approved anticollision lights so located that the emitted light will not be detrimental to the crew's vision and will not detract from the conspicuity of the position lights. The system shall comply with the provisions of pargraphs (a) through (d) of this section.

(a) *Field of coverage.* The system shall consist of such lights as will afford coverage of all vital areas around the rotorcraft with due consideration to the physical configuration and the flight characteristics of the rotorcraft. In any case, the field of coverage shall extend in all directions within 30° above and 30° below the horizontal plane of the rotorcraft, except that a solid angle or angles of obstructed visibility totaling not more than [0.5] steradians shall be permissible.

(b) *Flashing characteristics.* The arrangement of the system, i.e., number of light sources, beam width, speed of rotation, etc., shall be such as to give an effective flash frequency of not less than 40 and not more than 100 cycles per minute. The effective flash frequency shall be the frequency at which the rotorcraft's complete anticollision light system is observed from a distance, and shall apply to all sectors of light including the overlaps which might exist when the system consists of more than one light source. In overlaps, flash frequencies higher than 100 cycles per minute shall be permissible, except that they shall not be higher than 180 cycles per minute.

(c) *Color.* The color of the anticollision lights shall be aviation red in accordance with section 7.635(a).

(d) *Light intensity.* The minimum light intensities in all vertical planes, measured with the red filter and expressed in terms of "effective" intensities, shall be in accordance with figure 7-4. The following relation shall be assumed:

$$I_e = \frac{\int_{t_1}^{t_2} I(t)\,dt}{0.2 + (t_2 - t_1)};$$

where:

I_e = effective intensity (candles).

$I(t)$ = instantaneous intensity as a function of time,

$t_2 - t_1$ = flash time interval (seconds).

Note: Normally, the maximum value of effective intensity is obtained when t_2 and t_1 are so chosen that the effective intensity is equal to the instantaneous intensity at t_2 and t_1.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-1, 22 F.R. 1275, Mar. 1, 1957, effective Apr. 1, 1957; Amdt. 7-5, 27 F.R. 2999, Mar. 30, 1962, effective May 3, 1962.)

Angle below or above horizontal plane	Effective intensity (candles)
0° to 5°	100
5° to 10°	60
10° to 20°	20
20° to 30°	10

Figure 7-4—Minimum effective intensitics for anti-collision lights.

Safety Equipment

7.640 *General.* Required safety equipment which the crew is expected to operate at a time of emergency such as flares and automatic liferaft releases, shall be readily accessible. (See also sec. 7.738(e).)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.641. *Flares.* When parachute flares are installed, they shall be of an approved type and installed in accordance with section 7.642.

New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.642 *Flare installation.*

(a) Parachute flares shall be releasable from the pilot compartment and installed to

minimize the [probability] 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 be designed to withstand such loads.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-5, 27 F.R. 2999, Mar. 30, 1962, effective May 3, 1962.)

7.643 *Safety belts.* Safety belts shall be of an approved type (see sec. 7.355(c)(2)). When means are provided to indicate to the passengers when seat belts should be fastened, the device shall be so installed that it can be operated from the seat of either the pilot or copilot.

New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.644 *Emergency flotation and signaling equipment.* When emergency flotation and signaling equipment is required by the operating rules of the regulations in this subchapter, such equipment shall comply with the provisions of paragraphs (a) through (d) of this section.

(a) *Liferafts.* Liferafts shall be of an approved type. Unless excess rafts of sufficient capacity are provided, the buoyancy and seating capacity beyond the rated capacity of the rafts shall be such as to accommodate all occupants of the rotorcraft in the event of a loss of one liferaft of the largest rated capacity on board. Each liferaft shall be equipped with a trailing line and with a static line, the latter designed to hold the raft near the rotorcraft but to release it in case the rotorcraft becomes totally submerged. Each raft shall contain obvious markings of instruction on its operation.

(b) *Liferaft equipment.* Approved equipment intended for survival shall be attached to each liferaft and marked for identification and method of operation.

Note: The extent and type of survival equipment will depend upon the route over which the rotorcraft is operated.

(c) *Long-range signaling device.* An approved long-range signaling device shall be provided for use in one of the liferafts.

(d) *Life preservers.* Life preservers shall be of an approved type.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-4, 24 F.R. 7074, Sept. 1, 1959, effective Oct. 1, 1959.)

7.645 *Stowage of safety equipment.* Special stowage provisions shall be made for all prescribed safety equipment to be used in emergencies. The stowage provisions shall be such that the equipment is directly accessible and its location is obvious. All safety equipment shall be protected against inadvertent damage. The stowage provisions shall be marked conspicuously to identify the contents and to facilitate removal of the equipment. In addition, the following shall specifically apply:

(a) *Emergency exit means.* The stowage provisions for the emergency exit descent device required by section 7.357(d)(6) shall be located at the exits which they are intended to serve.

(b) *Liferafts.* Liferafts shall be stowed near exits through which the rafts can be launched during an unplanned ditching. Rafts automatically or remotely released on the outside of the rotorcraft shall be attached to the rotorcraft by means of the static line prescribed in section 7.644(a).

(c) *Long-range signaling device.* The stowage provisions for the long-range signaling device required by section 7.644(c) shall be located near an exit to be available during an unplanned ditching.

(d) *Life preservers.* Life preservers shall be so located that they are within easy reach of each occupant while seated.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.646 *Oxygen equipment and supply.*

(a) *Protective breathing equipment.* When protective breathing equipment is required by the operating rules of the regula-

tions in this subchapter, it shall be designed to protect the flight crew from the effects of smoke, carbon dioxide, and other harmful gases while on flight deck duty. The protective breathing equipment and the necessary supply of oxygen shall be in accordance with the following provisions:

(1) The protective breathing equipment shall include masks covering the eyes, nose, and mouth, or only the nose and mouth where accessory equipment is provided to protect the eyes.

(2) A supply of protective oxygen per crewmember shall be of 10 minutes duration at a pressure altitude of 8,000 feet and a respiratory minute volume of 30 liters per minute BTPD.

Note: When a demand-type oxygen system is employed, a supply per crewmember of 200 liters of free oxygen at 70° F. and 760 mm. Hg pressure is considered to be of 10 minutes duration at the prescribed altitude and minute volume. BTPD refers to body temperature conditions; i.e., 37° C. at ambient pressure, dry.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Miscellaneous Equipment

7.650 *Hydraulic systems; strength.*

(a) *Structural loads.* All elements of the hydraulic system shall be designed to withstand, without detrimental permament deformation, all structural loads which may be imposed simultaneously with the maximum hydraulic loads occurring in operation.

(b) *Proof pressure tests.* All elements of the hydraulic system shall be tested to a proof pressure of 1.5 times the maximum pressure to which the part will be subjected in normal operation. In such test, no part of the hydraulic system shall fail, malfunction, or suffer detrimental deformation.

(c) *Burst pressure strength.* Individual hydraulic system elements shall be designed to withstand pressures which are sufficiently increased over the pressures prescribed in paragraph (b) of this section to safeguard against rupture under service conditions.

Note: The following pressures, in terms of percentages of maximum operating pressures for particular elements, in most instances are sufficient to insure against rupture in service: 250 percent in units under oil pressure; 400 percent in units containing air and oil under pressure and in lines, hoses, and fittings; and 300 percent in units of system subjected to back pressure.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.651 *Hydraulic systems; design.* The provisions of section 7.606 shall apply to hydraulic systems and equipment.

(a) *Pressure indication.* A means shall be provided to indicate the pressure in each main hydraulic power system.

(b) *Pressure limiting provisions.* Provision shall be made to assure that pressures in any part of the system will not exceed a safe limit above the maximum operating pressure of the system and to insure against excessive pressures resulting from fluid volumetric changes in all lines which are likely to remain closed long enough for such changes to take place. In addition, consideration shall be given to the possible occurrence of detrimental transient (surge) pressures during operation.

(c) *Installation.* Hydraulic lines, fittings, and components shall be installed and supported to prevent excessive vibration and to withstand inertia loads. All elements of the installation shall be protected from abrasion, corrosion, and mechanical damage.

(d) *Connections.* Flexible hose, or other means of providing flexibility, shall be used to connect points in a hydraulic fluid line between which there is relative motion or differential vibration.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.652 *Hydraulic system fire protection.* When flammable type hydraulic fluid is used, the hydraulic system shall comply with the provisions of sections 7.384 and 7.481 through 7.483.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

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7.653 *Radio installation.*

(a) Radio communication and navigational equipment installations in the rotorcraft should be free from hazards in themselves, in their method of operation, and in their effects on other components of the rotorcraft. In showing compliance with this requirement, consideration shall be given to critical environmental conditions.

Note: Critical environmental conditions may include temperature, pressure, humidity, ventilation, position, acceleration, vibration, and presence of detrimental substances.

(b) All radio communication and navigational equipment, controls, and wiring shall be so installed that operation of any one unit or system of units will not affect adversely the simultaneous operation of any other radio or electronic unit or system of units required by the regulations in this subchapter.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.654 *Vacuum systems.*

(a) Means, in addition to the normal pressure relief, shall be provided to relieve automatically the pressure in the discharge lines from the vacuum air pump if the delivery temperature of the air reaches an unsafe value.

(b) Vacuum air system lines and fittings on the discharge side of the pump which might contain flammable vapors or fluids shall comply with section 7.483 if they are located in a designated fire zone. Other vacuum air system components located in designated fire zones shall be fire-resistant.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Subpart G—Operating Limitations and Information

General

7.700 *Scope.*

(a) The operating limitations in sections 7.710 through 7.718 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 (sec. 7.740), shall be expressed as markings and placards (sec. 7.730), and shall be made available by such other means as will convey the information to the crewmembers.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Operating Limitations

7.710 *Airspeed limitations; general.* When airspeed limitations are a function of weight, weight distribution, altitude, rotor speed, power, or other factors, the values corresponding with all critical combinations of these values shall be established.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.711 *Never-exceed speed V_{NE}.*

(a) The never-exceed speed shall be established. It shall not be less than the best rate-of-climb speed with all engines operating at maximum continuous power, nor greater than either of the following:

(1) 0.9 V established in accordance with section 7.204, or

(2) 0.9 times the maximum speed demonstrated in accordance with section 7.140.

(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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

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

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.713 *Rotor speed.* Rotor rpm limitations shall be established as set forth in

paragraphs (a) and (b) of this section. (See also sec. 7.710.)

(a) *Maximum power off (autorotation).* Not to exceed 95 percent of the maximum design rpm determined under section 7.204(b) or 95 percent of the maximum rpm demonstrated during the type tests (see sec. 7.103 (b)), whichever is less.

(b) *Minimum.*

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

(i) The minimum demonstrated during the type test (see sec. 7.103(b)), or

(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 sec. 7.103(a)), or

(ii) The minimum determined by design substantiation and not higher than a value determined in compliance with section 7.103(a).

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

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

(a) *Takeoff operation.* The takeoff 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 for use of the power which corresponds with the values established in subparagraphs (1) and (2) of this paragraph.

(4) Where the time limit established in subparagraph (3) of this paragraph exceeds two minutes, the maximum allowable cylinder head or coolant outlet and oil temperatures.

(5) Maximum cylinder head or coolant outlet and oil temperatures, if these differ from the maximum limits for continuous operation.

(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) Maximum permissible manifold pressure.

(3) Maximum allowable cylinder head or coolant outlet and oil temperatures.

(4) The minimum rotational speed demonstrated in compliance with the rotor speed requirements as prescribed in section 7.713 (b) (2).

[(c) *Fuel grade or specification designation.* The minimum fuel grade for reciprocating engines or the fuel designation for turbine engines, required for the operation of the engine within the limitations prescribed in paragraphs (a) and (b) of this section.]

(d) *Cooling limitations.* The maximum sea level temperature for which satisfactory cooling has been demonstrated.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7–5, 27 F.R. 2999, Mar. 30, 1962, effective May 3, 1962.)

7.715 *Limiting height-speed envelope.* 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 sections 7.111(a), 7.111(b), and 7.741(f).)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7–4, 24 F.R. 7074, Sept. 1, 1959, effective Oct. 1, 1959.)

7.716 *Rotorcraft weight and center of gravity limitations.* The rotorcraft weight and center of gravity limitations to be estab-

lished are those required to be determined by sections 7.101 and 7.102.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.717 *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 section 7.718. This finding shall be based upon the workload imposed upon individual crewmembers with due consideration given to the accessibility and the ease of operation of all necessary controls by the appropriate crewmembers.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.718 *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 this subchapter.)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.719 *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. Such components shall be identified by serial numbers or by other equivalent means.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Markings and Placards

7.730 *General.*

(a) The markings and placards specified in sections 7.731 through 7.738 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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.731 *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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.732 *Airspeed indicator.* Instrument indications shall be in terms of indicated air speed. The markings set forth in paragraphs (a) through (c) of this section shall be used to indicate to the pilot the maximum and minimum permissible speeds and the normal precautionary operating ranges. (See secs. 7.612(a), 7.710, 7.711, 7.712, 7.713, and 7.715.)

(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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.733 *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) of this section. (See sec. 7.612(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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.734 *Powerplant instruments; general.* All required powerplant instruments shall be marked as follows:

(a) The maximum and the minimum, if applicable, safe operational 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 operational limits.

(c) The takeoff and precautionary ranges shall be marked with a yellow arc.

(d) Engine or rotor speed ranges which are restricted because of excessive vibration stresses shall be marked with red arcs.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.735 *Oil quantity indicator.* Oil quantity indicators shall be marked in sufficient increments to indicate readily and accurately the quantity of oil. (See sec. 7.613 (d).)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.736 *Fuel quantity indicator.* When the unusable fuel supply for any tank exceeds one gallon or 5 percent of the tank capacity, whichever is 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 sections 7.421 and 7.613(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 sec. 7.741(g).)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.737 *Control markings.*

(a) *General.* All cockpit controls including those referred to in paragraphs (b) and (c) of this section shall be plainly marked as to their function and method of operation. (See sec. 7.353.)

(b) *Powerplant fuel controls.* The powerplant fuel controls shall be marked in accordance with subparagraphs (1) through (4) of this paragraph.

(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 in accordance with subparagraphs (1) and (2) of this paragraph.

(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 crewmembers 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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.738 *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

sec. 7.102(b)), a placard shall be permanently attached to the seat structure stating the maximum allowable weight of the occupant to be carried.

(b) *Fuel and oil filler openings.* The information required by subparagraphs (1) and (2) of this paragraph shall be marked on or adjacent to the appropriate filler cover.

(1) The word "fuel," the minimum permissible fuel [grade or designation] for the engines installed, and the usable fuel tank capacity. (See sec. 7.425(a).)

(2) The word "oil" and the oil tank capacity. (See sec. 7.441(b)(4).)

(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 sec. 7.357.)

(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 FAA 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 liferaft 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.

[(f) *Tail rotor.* The tail rotor shall be marked so that the rotor disc will be conspicuous under all normal ground conditions.]

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-5, 27 F.R. 2999, Mar. 30, 1962, effective May 3, 1962.)

Rotorcraft Flight Manual

7.740 *General.*

(a) A Rotorcraft Flight Manual shall be furnished with each rotorcraft.

(b) The portions of the manual listed in sections 7.741 through 7.744 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.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.741 *Operating limitations.* The operating limitations set forth in paragraphs (a) through (g) of this section shall be furnished with each rotorcraft.

(a) *Airspeed and rotor limitations.* Sufficient information necessary for the marking of the limitations on or adjacent to the indicators shall be furnished. (See sec. 7.732.) 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 sec. 7.714) and to permit marking the instruments as required by sections 7.734 through 7.736.

(c) *Weight and loading distribution.* The rotorcraft weights and center of gravity limits required by sections 7.101 and 7.102 shall be included, together with the items of equipment on which the empty weight is based. Where the variety of possible loading conditions warrants, instruction 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 section 7.717 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 sec. 7.718.)

(f) *Limiting heights.* Sufficient information shall be included to outline the limiting heights and corresponding speeds for safe landing after power failure. (See sec. 7.715.)

(g) *Unusable fuel.* If the unusable fuel supply in any tank exceeds one gallon or 5 percent of the tank capacity, whichever is 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 sec. 7.421.)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.742 *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. If applicable, the procedures to be followed in the event of engine failure including minimum speeds, trim, operation of remaining engines, etc., shall be described.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.743 *Performance information.*

(a) *Category A; performance data.* A summary of all performance data shall be given, including performance data necessary for the application of the operating rules of this subchapter, together with descriptions of the conditions, airspeeds, etc., under which these data were determined. In addition, the information required by subparagraphs (1) through (3) of this paragraph shall be included.

(1) *Airspeeds.* The indicated airspeeds corresponding with those determined for takeoff shall be listed together with the procedures to be followed in the event the critical engine becomes inoperative during takeoff (see sec. 7.742). Airspeed calibrations shall be included. (See sec. 7.612(a) (2) and (3).)

(2) *Autorotative landing technique.* Description of the techniques, associated airspeed, and rates of descent for autorotative landings shall be included. (See sec. 7.118 (b).)

(3) *Maximum allowable wind.* Information relative to the maximum allowable wind for safe operation near the ground shall be included. (See sec. 7.121(d).)

(b) *Category B; performance information.* Information relative to the items of performance set forth in subparagraphs (1) through (5) of this paragraph, including any additional performance data necessary for the application of the operating rules of this subchapter, shall be given.

(1) The takeoff distance and the takeoff safety airspeed 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 sec. 7.114.)

(2) The steady rates of climb and hovering ceiling together with the corresponding airspeeds and other pertinent information, including the calculated effect of altitude and temperature. (See secs. 7.115 and 7.116.)

(3) The landing distance, appropriate glide airspeed, and the type of landing surface together with any pertinent information which might affect this distance, including the calculated effect of altitude and temperature. (See secs. 7.117 and 7.118.)

(4) Maximum wind allowable for safe operation near the ground. (See sec. 7.121 (d).)

(5) The airspeed calibrations. (See sec. 7.612(a) (2), (3), and (4).)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956; as amended by Amdt. 7-4, 24 F.R. 7074, Sept. 1, 1959, effective Oct. 1, 1959.)

7.744 *Marking and placard information.* (See sec. 7.730.)

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Rotorcraft Identification Data

7.750 *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 section 1.50 of this subchapter.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

7.751 *Identification marks.* The nationality and registration marks shall be permanently affixed in accordance with section 1.100 of this subchapter.

(New Part 7, 21 F.R. 3743, June 2, 1956, effective Aug. 1, 1956.)

Appendix A

Special Civil Air Regulations Which Affect Part 7

SPECIAL CIVIL AIR REGULATION NO. SR–392C

Effective: Feb. 3, 1962
Adopted: Jan. 30, 1962
Published: Feb. 3, 1962
(27 F.R. 1008)

Facilitation of Experiments With Exterior Lighting Systems

Special Civil Air Regulation No. SR–392B, adopted on February 25, 1957, permits experimentation with exterior lighting systems, which do not comply with the standards prescribed in the Civil Air Regulations, on aircraft with standard airworthiness certificates. Several conditions are imposed to insure that the number of aircraft engaged in the experiments is reasonably limited; that the experimental exterior lights are in fact installed for bonafide experimentation; and that the results of such experimentation become generally available. This special regulation expires on February 25, 1962.

In a notice of proposed rule making contained in Draft Release No. 61–27 and published in the Federal Register, December 23, 1961 (26 F.R. 12294), the Agency gave notice that it has under consideration the termination of SR–392B and requested comments from interested persons concerning this matter. In response to such request, the Agency has received numerous reports, arguments and other evidence. However, the volume of the comments received is such that there is not sufficient time remaining to review and evaluate such comments prior to the termination of SR–392B. Therefore, in order to afford the Agency the opportunity to fully consider all the relevant matter presented and to take whatever additional rule making action that may be indicated, it is necessary to extend the termination date of SR–392B to June 25, 1962.

Since this regulation continues in effect the provisions of the previous regulation and imposes no additional burden upon any person, compliance with the notice and public procedure provisions of the Administrative Procedure Act is unnecessary and good cause exists for making this regulation effective on less than 30 days' notice.

In consideration of the foregoing, the following Special Civil Air Regulation is adopted to become effective on February 3, 1962:

Contrary provisions of the Civil Air Regulations notwithstanding, experimental exterior lighting equipment which does not comply with the relevant specifications contained in the Civil Air Regulations may, subject to the approval of the Administrator, be installed and used on aircraft for the purpose of experimentation intended to improve exterior lighting for a period not to exceed 6 months: *Provided*, That

(1) The Administrator may grant approval for additional periods if he finds that the experiments can be reasonably expected to contribute to improvements in exterior lighting;

(2) Not more than 15 aircraft possessing a U.S. certificate of airworthiness may have installed at any one time experimental exterior lighting equipment of one basic type;

(3) The Administrator shall prescribe such conditions and limitations as may be necessary to insure safety and avoid confusion in air navigation;

(4) The person engaged in the operation of the aircraft shall disclose publicly the deviations of the exterior lighting from the relevant specifications contained in the Civil Air Regulations at times and in a manner prescribed by the Administrator; and

(5) Upon application for approval to conduct experimentation with exterior lighting, the applicant shall advise the Administrator of the specific purpose of the experiments to be conducted; and, at the conclusion of the approved period of experimentation, he shall advise the Administrator of the detailed results thereof.

This regulation supersedes Special Civil Air Regulation No. SR–392B and shall terminate June 25, 1962, unless sooner superseded or rescinded.

SPECIAL CIVIL AIR REGULATION NO. SR–392D

Effective: June 25, 1962
Adopted: June 22, 1962
Published: June 26, 1962
(27 F.R. 5979)

Display of Experimental Exterior Lighting Systems
Approved for Use on Aircraft

Special Civil Air Regulation No. SR–392B, adopted on February 25, 1957, and superseded by SR–392C on February 3, 1962, permitted experimentation with exterior lighting systems that did not comply with the standards prescribed in the Civil Air Regulations on aircraft with standard airworthiness certificates. Several conditions were imposed to insure that the number of aircraft engaged in the experiments was reasonably limited; that the experimental exterior lights were in fact installed for bona fide experimentation; and that the results of such experimentation became generally available.

In a notice of proposed rule making contained in Draft Release No. 61–27 and published in the Federal Register, December 23, 1961 (26 F.R. 12294), the Agency gave notice that it had under consideration the termination of SR–392B, which was then in effect, and requested comments from interested persons. However, the nature of the comments received was such that there was not sufficient time remaining, before the February 25, 1962, termination date specified in SR–392B, for their proper review and evaluation. To provide the time needed, the Agency adopted SR–392C which superseded SR–392B without revision other than extension of the termination date from February 25, 1962, to June 25, 1962.

On April 3, 1962, the Agency convened a public conference (previously announced by a notice of conference dated February 12, 1962) to give persons interested in SR–392C an opportunity to supplement their written comments with oral presentations, to make additional evidence available, and to participate in direct discussions wth government-industry technical people in the aircraft lighting field.

From a study of all comments made on the issue, those who support the need for an extension of SR–392C contend essentially as follows: (1) Experimental lighting systems now operating under SR–392C are more effective than the system prescribed in the Civil Air Regulations; (2) much money and time has been invested in the experiments, which would be wasted if SR–392C were terminated; (3) extension would continue grass-roots cooperation between experienced FAA inspectors and inventors, and stimulate inventive initiatives; (4) unrestrictive field testing would insure reliability of new lighting equipment by exposing it to actual service conditions; (5) a new lighting concept cannot attract financing, or interest manufacturing management, unless its sales potential is established by flight demonstrations to prospective customers; and (6) there is no satisfactory alternative to extension of SR–392C.

After more than 10 years of experimentation under the provisions of SR–392C and predecessor special regulations, the evidence supporting the contention that various experimental lighting systems surpass the standard system now prescribed in the Civil Air Regulations remains inconclusive. For the most part, reports submitted by experimenters contain subjective evaluations of proposed systems without the use of experimental controls to insure a valid basis for comparison. Tests and studies conducted by the Navy Department and by the Agency's National Aviation Facilities Experimental Center have not corroborated the advantages claimed by private experimenters for their respective systems.

The experiments were no doubt expensive and time-consuming, but the persons who undertook them did so voluntarily and with no assurance of success. In any case, the costs incurred in such experiments do not justify the indefinitely prolonged display of experimental lighting systems, since these systems necessarily introduce some degree of ambiguity and confusion in night operations.

Termination of SR–392C would not prevent further lighting experimentation since such experiments could still be performed under the terms of an experimental airworthiness certificate. There appears to be no reason why cooperation between FAA inspectors and inventors would necessarily diminish if further lighting experiments were conducted only on that basis.

The point that unrestricted field testing insures reliability of experimental lighting equipment is largely irrelevant since the objective of SR–392C was to facilitate experiments with new lighting concepts rather than to achieve component reliability. Component technology is not in question; and, in any case, there is no evidence that unusual problems exist. Further, reliability can be attained to a large extent by laboratory tests in a simulated environment, a practice which has worked satisfactorily in the past.

It may be true that the privileges granted by SR–392C (as opposed to the generally more restrictive terms of experimental airworthiness certificates) make it easier to finance new lighting concepts, but similar privileges are not granted to those who experiment with aircraft in other ways. This preference for one class of experimenters over all other classes has not been justified in terms of safety improvements achieved to date.

Reasonable alternatives to SR–392C are, in fact, open to experimenters. Experiments may be conducted under the terms of an experimental airworthiness certificate; and the Agency's well-equipped experimental facilities, with trained personnel, are now available for cooperative evaluation of new lighting concepts developed by inventors.

For these reasons, the Agency concludes that the arguments offered in support of an extension of SR–392C are not persuasive; and SR–392C will not be continued in effect beyond June 25, 1962. However, the Agency believes that a reasonable transition period of not less than one year should be established. This would permit 6 months for completion of experiments begun before June 25, 1962, the maximum period of experimentation permitted under SR–392C without special permission, and would allow not less than an additional 6 months for airplane modifica-

tions that may be necessitated by the termination of experimentation hereunder.

The various experiments which were conducted under the provisions of SR–392C and predecessor special regulations, although inconclusive, have, nevertheless, helped to crytallize the Agency's position on the need for revisions of the currently effective exterior lighting regulations. Therefore, a proposed rule concerning these requirements is under study by the Agency. If rule making action is initiated as a result of this study, it may ultimately effect some of the details of the lighting systems now required to be installed on aircraft. Moreover, if such rule making action is initiated it may not be completed before December 25, 1962. In such case, a requirement to accomplish the necessary modifications within one year after the termination of SR–392C, i.e., by June 25, 1963, may not provide the operator with a period of 6 months in which to accomplish the modifications, if any, required by the regulation.

In order to permit an adequate transition period for the accomplishment of any necessary modifications, this regulation permits the current experimental lighting systems to be used until June 25, 1963, or 6 months after completion of the proposed rule making action in regard to exterior lighting systems, whichever date is later. If, however, the Agency finds at the conclusion of its studies that rule making action will not be adopted an appropriate notice thereof will be issued and published in the Federal Register. In such case this regulation also permits the experimental lighting systems to be used until June 25, 1963, or 6 months after such notice is published in the Federal Register, whichever date is later.

In consideration of the foregoing, the following Special Civil Air Regulation is adopted to become effective on June 25, 1962:

Contrary provisions of the Civil Air Regulations notwithstanding, experimental exterior lighting systems which do not not comply with the Civil Air Regulations, and which were installed for the purposes of experimentation on aircraft with standard airworthiness certificates under the provisions of SR–392B or SR–392C, may be displayed until:

(1) 6 months after the date of publication in the Federal Register of either

(i) revised standards adopted by the Agency for exterior lighting systems, or

(ii) a notice that rule making action to revise such standards will not be adopted by the Agency; or

(2) June 25, 1963, if later than that specified in paragraph (1).

This Special Civil Air Regulation shall remain in effect until superseded or rescinded.

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SPECIAL CIVIL AIR REGULATION NO. SR–425C

Effective: June 6, 1961
Adopted: May 31, 1961
Published: June 6, 1961
(26 F.R. 4990)

Provisional Certification and Operation of Aircraft

Special Civil Air Regulation No. SR–425A was adopted on July 22, 1958, to provide for provisional certification of turbine-powered transport category airplanes in order to permit certain air carriers and manufacturers to conduct crew training, service testing, and simulated air carrier operations prior to introduction of the airplanes into commercial service. The objective of this regulation was to provide a means whereby the air carriers and manufacturers could obtain as much experience as possible with turbine-powered airplanes which, although safe for flight, had not been approved for the issuance of a type certificate.

Special Civil Air Regulation No. SR–425B, which superseded SR–425A, was adopted on April 7, 1960, to extend the application of the regulation to: (1) piston-engine transport category aircraft, including rotorcraft; and (2) personal and executive type aircraft, including rotorcraft, irrespective of powerplant type. In addition, this regulation permitted operations such as sales demonstrations and market surveys with aircraft having a provisional type and airworthiness certificate.

To accomplish this, SR–425B provided for, among other things, the issuance of two classes of provisional type and airworthiness certificates. Class I provisional and airworthiness certificates could be issued for all types of aircraft for operation by the aircraft manufacturer. Class II provisional type and airworthiness certificates could be issued only for transport category aircraft, but these aircraft could be operated by either the aircraft manufacturer or a certificated air carrier. In general, the requirements for the issuance of Class I provisional certificates were less stringent, and the operating limitations less confining, than those for the issuance of Class II provisional certificates.

Under the provisions of SR–425B, however, eligibility to apply for Class I provisional certificates was limited to aircraft manufacturers. A recommendation that this eligibility be extended to include engine manufacturers had been evaluated by the Agency prior to the adoption of SR–425B, but rule making action on such extension was deferred until additional experience with provisional certification could be acquired.

Experience accumulated since the adoption of SR–425B has indicated that it would be practicable for engine manufacturers, who have altered a type certificated aircraft by installing type certificated engines of their own manufacture in place of the original engines, to show compliance with the currently effective requirements for issuance of Class I provisional type and provisional airworthiness certificates; and that compli-

ance with these requirements will insure safe operation of provisionally certificated aircraft by such engine manufacturers. Further, the Agency believes that operations conducted by engine manufacturers under the terms of Class I provisional certificates, for the purpose of sales demonstrations, market surveys, and other similar activities related to the sale of their engines, would contribute to the promotion and development of civil aeronautics in the United States.

SR–425B is therefore being superseded by SR–425C to permit certain engine manufacturers to apply for Class I provisional type and provisional airworthiness certificates if they have applied for the issuance of a supplemental type certificate.

Since this is a superseding regulation which relieves restrictions and imposes no additional burden on any person, notice and public procedures hereon are unnecessary, and this regulation may be made effective on less than 30 days' notice.

In consideration of the foregoing, the following Special Civil Air Regulation is adopted to become effective June 6, 1961:

GENERAL

1. *Applicability.* Contrary provisions of the Civil Air Regulations notwithstanding, provisional type and airworthiness certificates, amendments to provisional type certificates, and provisional amendments to type certificates, will be issued as prescribed in this regulation to a manufacturer or an air carrier. As used in this regulation, a manufacturer shall mean only a manufacturer who is a citizen of the United States; and the term air carrier shall not include an air taxi operator.

2. *Eligibility.*

(a) A manufacturer of aircraft manufactured by him within the United States may apply for Class I or Class II provisional type and provisional airworthiness certificates, for amendments to provisional type certificates held by him, and for provisional amendments to type certificates held by him.

(b) An air carrier holding an air carrier operating certificate authorizing him to conduct operations under Parts 40, 41, 42, or 46 of the Civil Air Regulations may apply for Class II provisional airworthiness certificates for transport category aircraft which meet the conditions of either subparagraphs (1) or (2) of this paragraph.

(1) The aircraft has a currently valid Class II provisional type certificate or an amendment thereto;

(2) The aircraft has a currently valid provisional amendment to a type certificate which was preceded by a corresponding Class II provisional type certificate.

(c) An engine manufacturer who has altered a type certificated aircraft by installing different type certificated engines, manufactured by him within the United States, in place of the original engines, may apply for Class I provisional type and provisional airworthiness certificates for such aircraft, and for amendments to Class I provisional type certificates held by him, if the basic aircraft, before alteration was type certificated in the normal, utility, acrobatic, or transport category.

3. *Application.*

(a) *General.* Applications for provisional type and airworthiness certificates, for amendments to provisional type certificates, and for provisional amendments to type certificates, shall be submitted to the Chief, Flight Standards Division, FAA, of the Regional Office in which the manufacturer or air carrier is located and shall be accompanied by the pertinent information specified in this regulation.

4. *Duration.* Unless sooner surrendered, superseded, revoked, or otherwise terminated, certificates and amendments thereto, shall have periods of duration in accordance with paragraphs (a) through (f) of this section.

(a) A Class I provisional type certificate shall remain in effect for 24 months after the date of its issuance or until the date of issuance of the corresponding type or supplemental type certificate, whichever occurs first.

(b) A Class I provisional type certificate shall expire immediately upon issuance of a Class II provisional type certificate for aircraft of the same type design.

(c) A Class II provisional type certificate shall remain in effect for 6 months after the date of its issuance or 60 days after the date of issuance of the corresponding type certificate, whichever occurs first.

(d) An amendment to a Class I or a Class II provisional type certificate shall remain in effect for the duration of the corresponding provisional type certificate.

(e) A provisional amendment to a type certificate shall remain in effect for 6 months after its approval or until the amendment to the type certificate is approved, whichever occurs first.

(f) Provisional airworthiness certificates shall remain in effect for the duration of the corresponding provisional type certificate, amendment to a provisional type certificate, or a provisional amendment to the type certificate.

5. *Transferability of certificates.* Certificates issued pursuant to this regulation are not transferable except that a Class II provisional airworthiness certificate may be transferred to an air carrier eligible to apply for such certificate under section 2 of this regulation.

6. *Display of certificates and markings.* A provisional airworthiness certificate shall be prominently displayed in the aircraft for which it is issued. The words "Provisional Airworthiness" shall be painted in letters not less than 2 inches high on the exterior of such aircraft adjacent to each entrance to the cabin and cockpit of the aircraft.

REQUIREMENTS FOR ISSUANCE

7. *Class I provisional type certificates.* A Class I provisional type certificate and amendments thereto will be issued for a particular type design when the eligible aircraft or engine manufacturer shows compliance with the provisions of paragraphs (a) through (f) of this section, and an authorized representative of the Administrator finds, on the basis of information submitted to him by the manufacturer in com-

pliance with the provisions of this section and of other relevant information, that there is no feature, characteristic, or condition which would render the aircraft unsafe when operated in accordance with the limitations established in paragraph (d) of this section and in section 13 of this regulation.

(a) The manufacturer has applied for the issuance of a type or supplemental type certificate for the aircraft.

(b) The manufacturer certifies that the aircraft has met the provisions of subparagraphs (1) through (3) of this paragraph.

(1) The aircraft has been designed and constructed in accordance with the airworthiness requirements applicable to the issuance of the type or supplemental type certificate for the aircraft;

(2) The aircraft substantially complies with the applicable flight characteristics requirements for the type or supplemental type certificate;

(3) The aircraft can be operated safely under the appropriate operating limitations specified in this regulation.

(c) The manufacturer has submitted a report showing that the aircraft had been flown in all maneuvers necessary to show compliance with the flight requirements for the issuance of the type or supplemental type certificate and to establish that the aircraft can be operated safely in accordance with the limitations specified in this regulation.

(d) The manufacturer has established limitations with respect to weights, speeds, flight maneuvers, loading, operation of controls and equipment, and all other relevant factors. The limitations shall include all the limitations required for the issuance of a type or supplemental type certificate for the aircraft: *Provided,* That, where such limitations have not been established, appropriate restrictions on the operation of the aircraft shall be established.

(e) The manufacturer has established an inspection and maintenance program for the continued airworthiness of the aircraft.

(f) A prototype aircraft has been flown by the manufacturer for at least 50 hours pursuant to the authority of an experimental certificate issued under Part 1 of the Civil Air Regulations or under the auspices of a United States military service: *Provided,* That the number of flight hours may be reduced by the authorized representative of the Administrator in the case of an amendment to a provisional type certificate.

8. *Class I provisional airworthiness certificates.* Except as provided in section 12 of this regulation, a Class I provisional airworthiness certificate will be issued for an aircraft, for which a Class I provisional type certificate is in effect, when the eligible aircraft or engine manufacturer shows compliance with the provisions of paragraphs (a) through (d) of this section, and an authorized representative of the Administrator finds that there is no feature, characteristic, or condition of the aircraft which would render the aircraft unsafe when operated in accordance with the limitations established in sections 7(d) and 13 of this regulation.

(a) The manufacturer is the holder of the provisional type certificate for the aircraft.

(b) The manufacturer submits a statement that the aircraft conforms to the type design corresponding with the provisional type certificate and has been found by him to be in safe operating condition under the applicable limitations.

(c) The aircraft has been flown at least 5 hours by the manufacturer.

(d) The aircraft has been supplied with a provisional aircraft flight manual or other document and appropriate placards containing the limitations required by sections 7(d) and 13 of this regulation.

9. *Class II provisional type certificates.* A Class II provisional type certificate and amendments thereto will be issued for a particular transport category type design when the manufacturer of the aircraft shows compliance with the provisions of paragraphs (a) through (h) of this section, and an authorized representative of the Administrator finds, on the basis of information submitted to him by the manufacturer in compliance with the provisions of this section and of other relevant information, that there is no feature, characteristic, or condition which would render the aircraft unsafe when operated in accordance with the limitations established in paragraph (f) of this section and in sections 13 and 14 of this regulation.

(a) The manufacturer has applied for the issuance of a transport category type certificate for the aircraft.

(b) The manufacturer holds a type certificate and a currently effective production certificate for at least one other aircraft in the same transport category as the subject aircraft.

(c) The Agency's official flight test program with respect to the issuance of a type certificate for the aircraft is in progress.

(d) The manufacturer certifies that the aircraft has met the provisions of subparagraphs (1) through (3) of this paragraph.

(1) The aircraft has been designed and constructed in accordance with the airworthiness requirements applicable to the issuance of the type certificate for the aircraft;

(2) The aircraft substantially complies with the applicable flight characteristics requirements for the type certificate;

(3) The aircraft can be operated safely under the appropriate operating limitations specified in this regulation.

(e) The manufacturer has submitted a report showing that the aircraft had been flown in all maneuvers necessary to show compliance with the flight requirements for the issuance of the type certificate and to establish that the aircraft can be operated safely in accordance with the limitations specified in this regulation.

(f) The manufacturer has prepared a provisional aircraft flight manual which includes limitations with respect to weights, speeds, flight maneuvers, loading, operation of controls and equipment, and all other relevant factors. The limitations shall include all the limitations required for the issuance of a type certificate for the aircraft: *Provided,* That, where such limitations have not been established, the provisional flight manual shall contain appropriate restrictions on the operation of the aircraft.

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(g) The manufacturer has established an inspection and maintenance program for the continued airworthiness of the aircraft.

(h) A prototype aircraft has been flown by the manufacturer for at least 100 hours pursuant to the authority of either an experimental certificate issued under Part 1 of the Civil Air Regulations or a Class I provisional airworthiness certificate: *Provided,* That the number of flight hours may be reduced by the authorized representative of the Administrator in the case of an amendment to a provisional type certificate.

10. *Class II provisional airworthiness certificates.* Except as provided in section 12 of this regulation, a Class II provisional airworthiness certificate will be issued for an aircraft, for which a Class II provisional type certificate is in effect, when the applicant shows compliance with the provisions of paragraphs (a) through (e) of this section, and an authorized representative of the Administrator finds that there is no feature, characteristic, or condition of the aircraft which would render the aircraft unsafe when operated in accordance with the limitations established in sections 9(f), 13, and 14 of this regulation.

(a) The applicant submits evidence that a Class II provisional type certificate for the aircraft has been issued to the manufacturer.

(b) The applicant submits a statement by the manufacturer that the aircraft has been manufactured under a quality control system adequate to insure that the aircraft conforms to the type design corresponding with the provisional type certificate.

(c) The applicant submits a statement that the aircraft has been found by him to be in a safe operating condition under the applicable limitations.

(d) The applicant submits a statement that the aircraft has been flown at least 5 hours by the manufacturer.

(e) The aircraft has been supplied with a provisional aircraft flight manual containing the limitations required by sections 9(f), 13, and 14 of this regulation.

11. *Provisional amendments to type certificate.* A provisional amendment to a type certificate will be approved when the manufacturer of the type certificated aircraft shows compliance with the provisions of paragraphs (a) through (g) of this section, and an authorized representative of the Administrator finds, on the basis of information submitted to him by the manufacturer in compliance with the provisions of this section and of other relevant information, that there is no feature, characteristic, or condition which would render the aircraft unsafe when operated in accordance with the limitations established in paragraph (e) of this section, and section 13 and, if applicable, section 14 of this regulation.

(a) The manufacturer has applied for an amendment to the type certificate.

(b) The Agency's official flight test program with respect to the amendment of the type certificate is in progress.

(c) The manufacturer certifies that the aircraft has met the provisions of subparagraphs (1) through (3) of this paragraph.

(1) The modification involved in the amendment to the type certificate has been designed and constructed in accordance with the airworthiness requirements applicable to the issuance of the type certificate for the aircraft;

(2) The aircraft substantially complies with the applicable flight characteristics requirements for the type certificate;

(3) The aircraft can be operated safely under the appropriate operating limitations specified in this regulation.

(d) The manufacturer has submitted a report showing that the aircraft incorporating the modifications involved had been flown in all maneuvers necessary to show compliance with the flight requirements applicable to these modifications and to establish that the aircraft can be operated safely in accordance with the limitations specified in this regulation.

(e) The manufacturer has established, in a provisional aircraft flight manual or other document and appropriate placards, limitations with respect to weights, speeds, flight maneuvers, loading, operation of controls and equipment, and all other relevant factors. The limitations shall include all the limitations required for the issuance of a type certificate for the aircraft: *Provided,* That, where such limitations have not been established, appropriate restrictions on the operation of the aircraft shall be established.

(f) The manufacturer has established an inspection and maintenance program for the continued airworthiness of the aircraft.

(g) An aircraft modified in accordance with the corresponding amendment to the type certificate has been flown by the manufacturer for the number of hours found necessary by the authorized representative of the Administrator, such flights having been conducted pursuant to the authority of an experimental certificate issued under Part 1 of the Civil Air Regulations.

12. *Provisional airworthiness certificates corresponding with provisional amendment to type certificate.* A Class I or a Class II provisional airworthiness certificate, as specified in section 2 of this regulation, will be issued for an aircraft, for which a provisional amendment to the type certificate has been issued, when the applicant shows compliance with the provisions of paragraphs (a) through (e) of this section, and an authorized representative of the Administrator finds that there is no feature, characteristic, or condition of the aircraft, as modified in accordance with the provisionally amended type certificate, which would render the aircraft unsafe when operated in accordance with the limitations established in sections 11(e) and 13 and, if applicable, section 14 of this regulation.

(a) The applicant submits evidence that approval has been obtained for the relevant provisional amendment to the type certificate for the aircraft.

(b) The applicant submits evidence that the modification to the aircraft was accomplished under a quality control system adequate to insure that the modification conforms to the provisionally amended type certificate.

(c) The applicant submits a statement that the aircraft has been found by him to be in a safe operating condition under the applicable limitations.

(d) The applicant submits a statement that the aircraft has been flown at least 5 hours by the manufacturer.

(e) The aircraft has been supplied with a provisional aircraft flight manual or other document and appropriate placards containing the limitations required by sections 11(e) and 13 and, if applicable, section 14 of this regulation.

OPERATING LIMITATIONS

13. *Operation of provisionally certificated aircraft.* An aircraft for which a provisional airworthiness certificate has been issued shall be operated only by a person eligible to apply for a provisional airworthiness certificate in accordance with section 2 of this regulation. Operations shall be in compliance with paragraphs (a) through (j) of this section.

(a) The aircraft shall not be operated in air transportation unless so authorized in a particular case by the Director, Bureau of Flight Standards.

(b) Operations shall be restricted to the United States, its Territories and possessions.

(c) The aircraft shall be limited to the types of operations listed in subparagraphs (1) through (7) of this paragraph.

(1) Flights conducted by the aircraft or engine manufacturer in direct conjunction with the type or supplemental type certification of the aircraft;

(2) Training of flight crews, including simulated air carrier operations;

(3) Demonstration flights conducted by the manufacturer for prospective purchasers;

(4) Market surveys by the manufacturer;

(5) Flight checking of instruments, accessories, and equipment, the functioning of which does not adversely affect the basic airworthiness of the aircraft;

(6) Service testing of the aircraft;

(7) Such additional operations as may be specifically authorized by the authorized representative of the Administrator.

(d) All operations shall be conducted within the prescribed limitations displayed in the aircraft or set forth in the provisional aircraft flight manual or other document containing the limitations for the safe operation of the aircraft: *Provided,* That operations conducted in direct conjunction with the type or supplemental type certification of the aircraft shall be subject to the experimental aircraft limitations of section 1.74 of Part 1 of the Civil Air Regulations, and all "flight tests" as defined in section 60.60 of the Civil Air Regulations shall be conducted in accordance with the requirements of section 60.24 of that part.

(e) The operator shall establish procedures for the use and guidance of flight and ground personnel in the conduct of operations

under this section. Specific procedures shall be established for operations from and into airports where the runways require takeoffs or approaches over populated areas. All procedures shall be approved by an authorized representative of the Administrator. All operations shall be conducted in accordance with such approved procedures.

(f) The operator shall insure that each flight crewmember is properly certificated and possesses adequate knowledge of, and familiarity with, the aircraft and the procedures to be used by him.

(g) The aircraft shall be maintained in accordance with applicable Civil Air Regulations, with the inspection and maintenance program established in accordance with this regulation, and with any special inspections and maintenance conditions prescribed by an authorized representative of the Administrator.

(h) No aircraft shall be operated under authority of a provisional airworthiness certificate if the manufacturer or the authorized representative of the Administrator determines that a change in design, construction, or operation is necessary to insure safe operation, until such change is made and approved by the authorized representative of the Administrator. Section 1.24 of Part 1 of the Civil Air Regulations shall be applicable to operations under this section.

(i) Only those persons who have a bona fide interest in the operations permitted under this section or who are specifically authorized by both the manufacturer and the authorized representative of the Administrator may be carried in provisionally certificated aircraft: *Provided,* That they have been advised by the operator of the provisional certification status of the aircraft.

(j) The authorized representative of the Administrator may prescribe such additional limitations or procedures as he finds necessary. This shall include limitations on the number of persons who may be carried aboard the aircraft.

14. *Additional limitations to operations by air carriers.* In addition to the limitations in section 13 of this regulation, operations by air carriers shall be subject to the provisions of paragraphs (a) through (d) of this section.

(a) In addition to crewmembers, the aircraft may carry only those persons who are listed in section 40.356(c) of Part 40 of the Civil Air Regulations or who are specifically authorized by both the air carrier and the authorized representative of the Administrator.

(b) The air carrier shall maintain current records for each flight crewmember. These records shall include such information as is necessary to show that each flight crewmember is properly trained and qualified to perform his assigned duties.

(c) The appropriate instructor, supervisor, or check airman shall certify to the proficiency of each flight crewmember and such certification shall become a part of the flight crewmember's record.

(d) A log of all flights conducted under this regulation, and accurate and complete records of inspections made and maintenance accomplished, shall be kept by the air carrier and made available to the manufacturer and to an authorized representative of the Administrator.

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15. *Other operations.* The Director, Bureau of Flight Standards, may credit toward the aircraft proving test requirements of the applicable air carrier regulations such operations conducted pursuant to this special regulation as he finds have met the applicable aircraft proving test requirements: *Provided,* That he also finds that there is no significant difference between the provisionally certificated aircraft and the aircraft for which application is made for operation pursuant to an air carrier operating certificate.

CERTIFICATES ISSUED UNDER SR–425A AND SR–425B

16. *Duration.* Currently valid provisional type and airworthiness certificates issued in accordance with Special Civil Air Regulations Nos. SR–425A and SR–425B shall remain in effect for the durations and under the conditions prescribed in those regulations.

This special regulation supersedes Special Civil Air Regulation No. SR–425B and shall terminate on June 30, 1963, unless sooner superseded, rescinded, or otherwise terminated.

Addendum

Preambles of Amendments to Civil Air Regulations Part 7

NOTE

Part 7 of the Civil Air Regulations was adopted by the Civil Aeronautics Board on May 25, 1956, to become effective on August 1, 1956. The preamble of the new part, and the preambles of amendments thereto, are given in the attached pages.

New Part 7

Rotorcraft Airworthiness; Transport Categories	Adopted: May 25, 1956 Effective: Aug. 1, 1956 Published: June 2, 1956 (21 F.R. 3743)

Until the present time, all of the effective airworthiness requirements for rotorcraft were contained in Part 6 of the Civil Air Regulations. These requirements were based mainly upon experience with rotorcraft of relatively small size, and very little distinction was made between large and small rotorcraft or between rotorcraft intended for general and air carrier service.

Since the adoption of Part 6 the size and complexity of rotorcraft equipment have grown, and with each new design development in this field an attempt was made to accommodate the changes within the framework of Part 6. This became more difficult to do because when catering to the larger and more complicated rotorcraft the airworthiness provisions for smaller, more basic, rotorcraft became unnecessarily complex. Therefore, it has become apparent that the existing regulations in Part 6 are not suitable for the certification requirements applicable to both large and small rotorcraft and rotorcraft to be utilized in the transport category class require a set of provisions peculiar to their needs.

In recognition of this situation, the Board, in recent years, has conducted studies with the view to establishing airworthiness requirements for large rotorcraft which are intended to be used in air carrier service. These studies have resulted in a categorization of rotorcraft with corresponding airworthiness requirements. The three categories being established are the "Normal Category" for rotorcraft of 6,000 pounds or less maximum weight, "Transport Category A" for multiengine rotorcraft of unlimited weight, and "Transport Category B" for single or multiengine rotorcraft of 20,000 pounds or less maximum weight. Rotorcraft certificated in either of the transport categories will be eligible for operations in either scheduled or irregular passenger or cargo service.

Concurrently with the adoption of this new Part 7, the Board is adopting amendments to Part 6 of the Civil Air Regulations which make the part applicable to small rotorcraft in the normal category and which simplify and clarify the requirements for certification of such rotorcraft.

In the development of Part 7, consideration was given to the problem of whether specific airworthiness requirements for large rotorcraft should be adopted prior to obtaining significant operating experience in such rotorcraft types, or whether the considerations of the design of large transport category rotorcraft required an early determination of at least the broad objective standards for certification of such large rotorcraft. It is to be desired, and it is the Board's general policy, to have the benefit of experience in advance of adoption of regulations. However, much can be gained by initially establishing broad objective standards and giving the Administrator wide discretion in approving features of design which were not anticipated. Therefore, the Board considers it desirable to promulgate such standards at this time in the belief that safe operations are most assured where basic standards have been established.

After determining that the provisions of Part 6 were not suitable for the certification of large multiengine transport category rotorcraft, and after completion of the aforementioned studies, a notice of proposed rule making (20 F.R. 3114) was circulated as Civil Air Regulation Draft Release No. 55–11 to solicit comment on the proposed categorization of rotorcraft.

Comments received on the subject were almost universally favorable to the Board's adopting objective standards immediately so that the design and construction of large rotorcraft could proceed under some pattern of uniformity. The comment of one industry

observer, however, while acknowledging that experience gained with transport category airplanes could provide guideposts for developing regulations for rotorcraft airworthiness in areas such as structures, design, and construction, nevertheless, expressed reservation as to whether performance requirements could be prepared on the same basis since there was insufficient operational experience with the types of rotorcraft envisaged in the transport-category classes.

In recognition of this valid comment, and because the Board does not intend to limit novel design features or operating techniques which may prove advantageous, the performance specifications in this part are limited in general to requirements for the scheduling of performance data. There are included, however, two quantitative requirements: One is the minimum one-engine-inoperative climb for Transport Category A rotorcraft; and the other, a minimum hovering ceiling for Transport Category B rotorcraft. These climb requirements are expressed in terms of rates of climb. Among the comments received on the proposal were recommendations that these minima be expressed in terms of gradient of climb. While this recommendation has substantial merit, it is considered advisable to retain the more familiar expression for the present and to study the matter at the next Annual Airworthiness Review, since consideration of factors of minimum speed or acceleration may be necessary. It is considered that for the time being the two quantitative requirements are reasonable minima. However, in order to define more fully the level of performance for the rotorcraft, it will be necessary to implement the performance data scheduled under this part with operating limitations relating to the measured performance of the rotorcraft, the dimensions of the heliport used, the adjacent obstacles, and the routes traversed. Because it is considered desirable to obtain experience in the operation of transport category rotorcraft before establishing by regulation specific operating limitations, it is contemplated that in the interim, for air carrier operations and for other operations over highly congested areas, the Administrator will determine that the operations in question are limited in such a manner as to assure a safe operation. Performance operating limitations will, however, be developed and included in the Civil Air Regulations as rapidly as the state of the art permits.

In considering this part, a maximum weight limitation had to be established for Transport Category B rotorcraft. The limit set in the notice of proposed rule making was 17,500 pounds. This limit has been raised to 20,000 pounds upon advice that some manufacturers now have design studies for single-engine rotorcraft which are expected to go over 17,500 pounds. This weight limit appears adequate to assure safety to all Transport Category B rotorcraft and is sufficiently high to include all reported single-engine designs now being developed by the manufacturers.

Another important problem to which the Board gave particular consideration is that of fire protection for structures, controls, and other components of the rotorcraft. The fire protection requirements for Transport Category A rotorcraft are intended to permit extinguishment of a fire and the continuation of the flight to a suitable airport. The Category B requirements, on the other hand, are intended to protect the rotorcraft and its occupants during an immediate descent and landing. The difference in the requirements is considered consistent with the approach taken with respect to the performance requirements applicable to each category.

The issue of appropriate maneuvering load factors for maneuvering conditions (structural requirements) is of significance. The maneuvering load factors included are the 3.5 positive and 1.0 negative, which are the same as in Part 6. The values are unchanged due to lack of substantiation of other values; however, because certain comments questioned the necessity for such high values for transport rotorcraft, this is being made a matter for further study.

Interested persons have been afforded an opportunity to participate in the making of this part (20 F.R. 3114), and due consideration has been given to all relevant matter presented.

Amendment 7–1

Position and Anticollision Light Requirements

Adopted: Feb. 25, 1957
Effective: Apr. 1, 1957
Published: Mar. 1, 1957
(22 F.R. 1275)

The continuing increase in air traffic density and the advent of airplanes capable of appreciably higher speeds than heretofore attained demand further improvement in the exterior lighting of aircraft. The presently effective regulations in Part 7 of the Civil Air Regulations require an approved anticollision light and, in addition, require the installation of a flasher unit in the position light system.

The presently effective specifications for anticollision lights were established a few years ago. They were based upon conclusions reached from experimentation and studies conducted by both industry and government. The use on a relatively large number of aircraft of lights conforming to these specifications has revealed the need for further modification. Furthermore, during the past year or so experimentation has led to the development of condenser-discharge type lights which appear to have certain advantageous features. The inherent characteristics of such lights, however, do not permit compliance with certain of the present specifications. The Board considers that both incandescent and condenser-discharge lights have sufficient advantages to permit their use, provided that the design features essential in an effective anticollision light system are incorporated. Accordingly, section 7.637 is being amended to include new specifications which establish in more detail the essential features of an anticollision light and which at the same time are sufficiently broad to permit the use of new lights currently under development. These specifications will afford coverage of all vital areas around the rotorcraft with due consideration to the physical configuration and flight characteristics of the rotorcraft.

Experience with anticollision lights has shown that the relatively high intensity of these lights may have a deleterious effect on the visibility of the position lights, particularly if the latter are flashing. Apparently the flashing of forward and rear position lights, the fuselage lights, and the anticollision lights is conducive to confusion as regards the direction of flight. Tests have shown that with the presently used system the clearest indication is obtained when, in addition to the flashing anticollision light, the lighting system is limited to two forward lights and a white rear light, and when these three position lights are on steady. In view of the foregoing, the provisions of section 7.632 which require fuselage lights, red tail light, and the flasher are being deleted. Concurrently with this amendment, Part 40 of the Civil Air Regulations is being amended to delete the provision for flashing position lights.

These new specifications for anticollision and position lights will be applicable to all transport category rotorcraft for which application for type certification is made after the effective date of this amendment. However, the new lighting system may be installed on current rotorcraft on a voluntary basis.

It is considered that these new requirements set forth necessary and sufficient conditions for anticollision light systems to provide a reasonable level of safety. However, since these requirements entail more conditions than have been required in the past, experience with them on individual rotorcraft might indicate the need for future revisions, particularly with respect to light intensities and coverage. Further, as current research and development programs progress, the question of color of the light might need re-evaluation. The Board will consider any necessary changes as might be indicated by future developments.

Interested persons have been afforded an opportunity to participate in the making of this amendment (21 F.R. 3388), and due consideration has been given to all relevant matter presented.

Amendment made changes in sections 7.632 and 7.637, and figure 7–1; added figure 7–4; and deleted section 7.634(c).

Amendment 7–2

Miscellaneous Amendments Resulting From the 1957 Annual Airworthiness Review	Adopted:	Apr. 15, 1958
	Effective:	May 17, 1958
	Published:	Apr. 19, 1958 (23 F.R. 2592)

There are contained herein amendments with respect to various issues stemming from the 1957 Annual Airworthiness Review.

The most significant of these amendments deal with the flight requirements. Among these is included an amendment to section 7.103(a) to eliminate the requirement for the installation of a rotor high-pitch stop when it is found that such a stop is unnecessary due to the inherent characteristics of the rotorcraft.

The powerplant and structural fire protection requirements of Part 7 applicable to Category B rotorcraft were designed to protect the rotorcraft for 5 minutes in the event of a powerplant fire. On the other hand, the regulations applicable to Category A rotorcraft were designed to give protection from powerplant fires for a sufficient time to permit continued operation to a landing area. Paragraphs (c) of section 7.111 and (d) of section 7.118 contain options for multiengine Category B rotorcraft which permit them to be certificated under the Category A rotorcraft requirements of these sections when, among other things, the fire protection requirements for Category A rotorcraft are met. This permits the establishment of limiting heights and speeds for safe landing following the failure of only one engine rather than with complete power loss, and the demonstration of an autorotative landing rather than determining the autorotative landing distances. There are contained herein amendments to the aforementioned sections which delete the requirement that multiengine Category B rotorcraft meet the fire protection requirements applicable to Category A rotorcraft when these options are exercised. It is required that the Administrator establish emergency procedures to be followed in the event of a powerplant fire, and these procedures are required to be included in the Airplane Flight Manual for Category B rotorcraft. Such procedures normally entail the execution of an immediate landing. In applying operating limitations to such rotorcraft, it is the Board's understanding that the Administrator will require an immediate landing in the event of fire while in flight.

The takeoff provisions of Part 7 require the establishment of a critical decision point for Category A rotorcraft, at which point the rotorcraft is required to have attained the takeoff safety speed necessary to comply with the climb requirements at that point as well as to be able to be stopped safely following the engine failure at the critical decision point. Section 7.114(a)(2) is being amended to permit the rotorcraft to be at a speed less than the takeoff safety speed at the critical decision point and, after failure of the critical engine at that point, permit continued acceleration so that at the end of the rejected takeoff distance a speed of not less than the takeoff safety speed is attained.

A significant addition to the regulations is included with respect to section 7.401. This section is being amended to require a means of protection against cooling fan blade failures. This amendment permits alternative means of compliance either by containment of the blades in the event of failure or by designing the fan so that it will not fail as a result of engine overspeed.

When this part was originally promulgated the rotorcraft operating limitations with respect to night and instrument flight were included in section 7.120. These limitations are now being placed in section 7.20 with minor editorial changes. The Board appreciates that the development of automatic stabilization devices has progressed rapidly and that the limitations contained herein might be unduly conservative in respect of certain rotorcraft. The Board is, therefore, prepared to reconsider these limitations during future annual airworthiness reviews.

In addition to the aforementioned changes, there are a number of relatively minor amendments dealing with definitions and flight requirements.

Interested persons have been afforded an opportunity to participate in the making of this amendment (22 F.R. 9116), and due consideration has been given to all relevant matter presented.

Amendment made the following changes:

(1) Amended sections 7.1, 7.103(a), 7.111(c), 7.114(a), 7.115 (a) and (b), 7.118 (b), (c), and (d), 7.120(c), 7.123(b), and 7.131; and

(2) Added sections 7.20(c) and 7.401 (d) and (e).

Amendment 7–3

Correction of Amendment 7–2

Adopted: May 16, 1958
Effective: May 17, 1958
Published: May 22, 1958
(23 F.R. 3514)

Civil Air Regulations Amendment 7–2 contained inadvertent editorial errors in sections 7.103(a) and 7.118(b).

Since this regulation corrects errors, is minor in nature, and imposes no additional burden on any person, notice and public procedure hereon are unnecessary.

Amendment corrected sections 7.102(a) and 7.118(b).

Amendment 7–4

Miscellaneous Amendments Resulting From the 1958 Annual Airworthiness Review

Adopted: Aug. 24, 1959
Effective: Oct. 1, 1959
Published: Sept. 1, 1959
(24 F.R. 7074)

There are contained herein amendments as a result of the 1958 Annual Airworthiness Review.

In the flight requirements, a revision to section 7.121 replaces the current requirement for a demonstration of controllability after power failure at only one high speed condition with a requirement for controllability after power failure over the range of air speeds and altitudes for which certification is sought. A revision to section 7.123, while still requiring satisfactory controllability, permits a slight negative slope of the stick position versus speed curve over the speed ranges prescribed.

A number of changes are being made with respect to the structural provisions. The requirement for ground vibration tests previously set forth in section 7.203 is being deleted. This action is based upon the conclusion that if any major component has a natural frequency which would be significantly excited by some operating parameter, such a condition would be revealed in the course of other ground and flight tests. The arbitrary design loads established for primary control systems in section 7.225 preclude the use of some otherwise acceptable installations. Therefore, this section is being revised to permit a rational approach to be used in establishing design loads which will be sufficient to insure a satisfactory control system. Section 7.235, having to do with the braked roll condition, is being amended to indicate that where rotor lift is present a load factor of 1.0 is acceptable in place of 1.33. This is also being reflected in section 7.246.

Several changes are being made to the sections dealing with control system design. One, to section 7.320, adds a requirement aimed at minimizing the possibility of incorrect assembly of the elements of the flight control system. In addition, a new section 7.328 is being included to provide minimum safety standards for power-operated control systems. Another change to the design requirements is being made to section 7.332, wherein the test procedure is being standardized insofar as the attitude of the landing gear is concerned during the drop test.

By the amendment to section 7.483, the use of rigid fuel lines is permitted regardless of whether or not the line is under pressure, provided there is no other requirement for flexibility.

An amendment to section 7.612 establishes more realistic requirements for airspeed indicator accuracy at low speeds. This change is based on the fact that it is extremely difficult to maintain low speeds during climbout and the pilot's attention is not likely to be concentrated on the airspeed indicator during the takeoff maneuver much before climbout speed is reached. Section 7.625 is being amended to cover new types of storage batteries as well as the conventional lead-acid type.

In addition, there are included other changes which are of a clarifying or editorial nature.

Interested persons have been afforded an opportunity to participate in the making of this amendment (24 F.R. 128), and due consideration has been given to all relevant matter presented.

Amendment made the following changes:

(1) Amended sections 7.1(c)(3), 7.120(c), 7.123(b), 7.203, 7.225(a), 7.235, 7.320, 7.328, 7.332(a), 7.334(c), 7.483, 7.612 (a) and (f), 7.625(d), 7.644(d), 7.715, and 7.743(b)(5).

(2) Deleted section 7.20(c); and

(3) Added sections 7.121(e) and 7.246.

Amendment 7–5

Miscellaneous Amendments Resulting From the First Federal Aviation Agency Airworthiness Review	Adopted:	Mar. 27, 1962
	Effective:	May 3, 1962
	Published:	Mar. 30, 1962 (27 F.R. 2999)

As a result of the First Federal Aviation Agency Airworthiness Review, the Agency published a notice of proposed rule making affecting several parts of the Civil Air Regulations. This notice was published in the Federal Register (26 F.R. 5130) and circulated as Civil Air Regulations Draft Release No. 61–12 dated June 8, 1961. There are contained herein amendments to Part 7 of the Civil Air Regulations which stem from this First FAA Airworthiness Review.

Interested persons have been afforded an opportunity to express their comments in regard to the proposal and, in some cases, the proposal has been modified in accordance with such comments. The more significant amendments being adopted by the Agency are discussed herein.

Two changes are being made which affect control systems. Section 7.225 now requires manual control systems to comply with the provisions of that section. Because the word "manual" has erroneously been construed to limit the applicability of this section, it is being amended to make certain that it applies to all control systems. The other change is of an editorial nature, making section 7.226 consistent with the change to Part 6 covering the design of dual flight control systems.

The present requirements on factors of safety and inspections for structural castings specify a special factor of 2.0 for visual inspection only, and a factor of 1.25 when 3 sample castings are subjected to radiographic inspection and strength tests. Section 7.307 is being amended to provide a series of casting factors and corresponding test and inspection requirements which reflect current methods and practices. In addition, a minor revision in the format of this section has been made from that which was proposed and the rule now provides for alternative methods of compliance with the requirements therein.

A revision to the note under section 7.332 dealing with shock absorption tests is being made because it does not reflect the ground loading conditions for tail-wheel type landing gear. It was proposed in Draft Release 61–12 to add a new section 7.342 setting forth minimum design standards for hull and float design of "sea and amphibian type rotorcraft." To avoid having the requirement affect all amphibian rotorcraft, i.e., even those which have an extremely limited capability as an amphibian, the proposal has been confined in applicability only to those rotorcraft which are to be approved for both taking off from and

alighting on water. The requirement is being set forth in a new paragraph (c) under section 7.340 rather than as a new section 7.342 because it is concerned with buoyancy. This change necessitates the inclusion of the word "hulls" in section 7.340.

The upper aisle width specified in section 7.357(g) has been reduced from 20 to 18 inches, for rotorcraft having a passenger seating capacity of 10 or less, on the basis of studies indicating that this reduction would not adversely affect safe emergency evacuation. However, a further reduction of this dimension to 16 inches, as suggested by several interested persons, has not been justified. Biometric data derived from a general sampling of the civilian population reveals that a significant percentage of passengers have a standing hip-breadth exceeding 16 inches, whereas the percentage exceeding 18 inches is negligible. A 16-inch upper aisle width, therefore, introduces the probability that a single passenger may jam the aisle between seats in the excitement and near-panic of an emergency evacuation; and, in any event, movement along the aisle would be retarded by the awkward sideward gait which large-hipped passengers must assume for passage.

It had been proposed that the optional provision of section 7.385, which permits the control of fire once it has started, would be deleted. Comments made on that proposal have led to the conclusion that such an amendment might be unnecessarily restrictive and would not be compatible with other requirements which do permit the control of fire in cargo compartments and nacelles. Accordingly, presently effective section 7.385 remains unchanged. Section 7.412 dealing with fuel line location is being deleted because sections 7.358 and 7.385 cover both the ventilation and fire control aspects of section 7.412.

Section 7.405(e) currently requires each gearbox used in the rotor drive system of a category A helicopter to be bench tested for 150 hours. This test is in addition to a 200-hour endurance test required by other provisions of this part. Because the 200-hour endurance test is adequate to show the structural and functional capacity of the gearbox as an element of the whole helicopter, the additional test now required by section 7.405(e) is not necessary. Therefore, the paragraph is being deleted.

Presently effective sections 7.413 and 7.416 cover the demonstration of adequate fuel flow and the selection of unusuable fuel supply. The demonstration is required to be conducted with unusable fuel supply together with the minimum quantity of fuel necessary for conducting the flow test. As a result of comment received on Draft Release 61–12, specific requirements for demonstrations or tests are being deleted from sections 7.413 and 7.416. Adequate authority for any ground or flight tests which might be required continues to rest in presently effective sections 7.15 and 7.16. The unusable fuel supply is defined as that quantity at which the first evidence of malfunction occurs. This definition is unnecessarily restrictive and is not essential to safety since the rotorcraft is no less airworthy if an unusable fuel supply is selected as a quantity which is in excess of that which would produce a malfunction. Accordingly, the definition of unusable fuel supply is being revised to make it not less than the quantity at which the first evidence of malfunction occurs, the same as in other airworthiness parts. The form of section 7.413 is being arranged to make it consistent with that of corresponding section 4b.413 in Part 4b. This change eliminates the provision that the entire fuel supply be capable of being utilized under certain conditions, "insofar as practicable." Such a requirement is unnecessary even when practicable because a rotorcraft will continue to be airworthy so long as usable fuel can be used regardless of the quantity of unusable fuel.

In addition to the matter of unusable fuel supply, another question has arisen relating to the flow requirements of section 7.413. Section 7.413(c) presently requires that the available fuel flow shall be 150 percent of actual fuel consumption for gravity systems, 0.9 pounds per takeoff horsepower per hour for pump systems, or 125 percent of actual takeoff fuel consumption for pump systems. These margins are not required to insure adequate fuel flow. Furthermore, a margin is unnecessary to offset system deterioration because such deterioration is precluded by proper maintenance, inspection, and overhaul. Accordingly, the presently effective provisions of paragraph (c) of section 7.413 are being deleted. The provisions of paragraph (b) of section 7.416, as proposed, are being transferred to a new paragraph (c) under section 7.413, as an editorial change, since the provision for fuel feed belongs more appropriately in the fuel flow section than in the unusable fuel supply section.

The presently effective provisions of sections 7.414 and 7.430 deal with fuel pumps and fuel flow. In consideration of the changes proposed for section 7.413, these flow provisions become unnecessarily repetitive. Section 7.414 is being deleted, therefore, and all fuel pump requirements are being combined in section 7.430 in a form consistent with other airworthiness parts.

Presently effective section 7.415 also covers fuel flow rate, relative to transfer systems, and bases required flow rates on horsepower output. Since the changes to section 7.413 eliminate the horsepower basis for establishing flow rate, section 7.415 is being deleted.

Presently effective section 7.438 merely repeats the requirement of section 7.604(f) for a low fuel warning device. Therefore, section 7.438 is being deleted and the definition of low fuel is being transferred from the associated note to section 7.604(f).

Section 7.488 requires a fireproof diaphragm to isolate the engine power section and all portions of the exhaust system from the engine accessory compartment, unless equivalent protection can be shown by other means. Fire extinguishing systems are required to be provided in the engine power section, in the engine accessory section, and in complete powerplant compartments. Since it is considered that fire extinguishing systems are equivalent to a diaphragm in providing protection, there is no reason for retaining the provisions of section 7.488. Accordingly, this section is being deleted. Consistent with this change, the reference to section 7.488 in section 7.487(c) is being deleted and, as proposed, a provision is being added making the requirements of section 7.487(c) applicable to any rotorcraft equipped with a diaphragm to isolate the engine power section from the engine accessory section.

Section 7.604(m) currently requires an oil temperature warning device for all rotor drive gearboxes. Because it is doubtful that such devices would further safety in the case of small, noncritical gearboxes of simple design, section 7.604(m) is being amended to require oil temperature warning devices only for each main rotor drive gearbox including those gearboxes essential to rotor phasing.

Several changes are being made to the electric system requirements. Section 7.622(b) is being amended by adding two provisions which relate to the proper functioning of the generating system with respect to load equipment. Section 7.624(d) is also being amended in order to eliminate an unnecessarily restrictive provision requiring that certain electrical protective devices or their controls be accessible for resetting in flight. In addition, a new section 7.627 is being added which is intended to insure the validity of electrical system tests under simulated conditions in the laboratory.

Two changes are being made to the lighting requirements. Figure 7–2 now specifies that position light intensity for angles 40° to 90° above or below the horizontal be at least 2 candles. Because this results in an irrational discontinuity when related to the other data in figure 7–2, figure 7–2 is being amended to require an intensity of 0.05 I for these angles.

The current anticollision light requirements in section 7.637(a) permit .03 steradians blockage. In view of recent qualitative studies, it has been determined that such a limitation might be unduly restrictive. Therefore, section 7.637(a) is being amended to permit 0.5 steradians of obstruction.

Hydraulic system service difficulties have arisen which affect the proposal to add a new section, section 7.653, concerning hydraulic system tests. Therefore, the proposed addition of the new test requirement is not being included at this time. A study of the matter is being made outside the framework of this review.

Part 7 currently does not require the tail rotor to be marked. Because there have been a number of accidents attributable to persons walking into tail rotors, section 7.738(f) is being added to require that tail rotors be marked conspicuously.

Miscellaneous changes of an editorial or clarifying nature are being made to sections 7.11, 7.306, 7.325, 7.436, 7.447, 7.612, 7.634, 7.642, 7.714, and 7.738. Among the miscellaneous amendments there is one to expressly exclude from the provisions of section 7.11(b) consideration of provisional type certificates. While it was proposed that this be accomplished by a note, it now appears that it is more appropriate to include such a provision within section 7.11(b) rather than as a note thereto.

The proposed revisions to section 7.612(a) (3) and (4), have been withdrawn pending completion of a more comprehensive review of rotorcraft airspeed indicating system

regulations. Furthermore, the proposed section 7.612(f)(4) requiring two complete static air pressure operating systems for the required instruments at the first pilot's station has been withdrawn in the light of comment received. It has been determined that one such static air pressure operating system as presently required is all that is necessary as a minimum requirement in the interest of safety. In addition, while not proposed, section 7.436 is being amended to delete redundant and contradictory requirements. This is in accordance with Part 4b requirements and the deletion imposes no additional burden on any person.

Interested persons have been afforded an opportunity to participate in the making of this amendment, and due consideration has been given to all relevant matter presented.

Amendment made the following changes:

(1) Amended sections 7.11(b), 7.225(a), 7.226, 7.306(c), 7.307(b), 7.325(a)(4), 7.332(a), 7.340, 7.357(g), 7.413, 7.416, 7.430, 7.436, 7.447, 7.487(c), 7.604 (f) and (m), 7.612(f), 7.622(b), 7.624(d), 7.634(a), 7.637(a), 7.642(a), 7.714(c), and 7.738(b)(1), and figure 7–2;

(2) Deleted sections 7.405(e), 7.412, 7.414, 7.415, 7.438, and 7.488; and

(3) Added sections 7.627 and 7.738(f).

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