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UNITED STATES OF AMERICA
CIVIL AERONAUTICS BOARD
WASHINGTON, D. C.

Civil Air Regulations Amendment 6-4
Effective: May 16, 1953
Adopted: April 9, 1953

ROTORCRAFT AIRWORTHINESS

A number of important substantive changes to Part 6 are contained in this amendment. Among these, section 6.420 which specifies the usable fuel capacity for rotorcraft certification is amended to require the carriage of sufficient usable fuel for at least one hour's operation at maximum continuous power and rpm. Previously, usable fuel was related directly to maximum continuous horsepower. Also, where more than one fuel tank is provided a low level fuel warning indicator is required by this section.

Extensive changes also are being made to the structural provisions of this part. Section 6.212 is amended to reduce the minimum positive maneuvering limit load factor from 2.5 to 2.0. Section 6.221 is amended to relax the present requirements to permit auxiliary rotors with detachable blades to be substantiated for centrifugal loads resulting from the maximum design rotor rpm. Section 6.230 is amended to permit the manufacturer to assume rotor lift equal to at least 1/2 of the design maximum weight during structural tests involving landing impact loads. Prior to the adoption of this amendment, no rotor lift could be assumed in the analysis of landing loads.

Section 6.237 is amended to prescribe new shock absorption tests. These tests now permit the introduction of rotor lift either by energy absorbing devices or by use of an effective mass.

Section 6.245 is amended to reduce by 25% the vertical load to be applied during the testing of the float landing conditions.

Sections 6.382, 6.384, 6.480, 6.482, and 6.483 are amended, and new sections 6.485 through 6.487 added. These changes to the existing fire prevention provisions are intended to afford greater protection to crew and passengers in the event of fire during flight. The general intent of these changes is to provide protection from powerplant fires to a degree which will assure that a controlled autorotational landing can be made during a period of at least 5 minutes after the start of an engine fire.

Section 6.414 is amended to permit, within limitations, the use of analytical methods for determining the critical speeds of shafting as necessary in the application of this section.

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In addition there are a number of changes to this part of an editorial or clarifying nature.

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.

In consideration of the foregoing the Civil Aeronautics Board hereby amends Part 6 of the Civil Air Regulations (14 CFR, Part 6, as amended) effective May 16, 1953:

1. By amending § 6.1 (a) (3) by adding the reference "(See § 6.18.)".

2. By amending § 6.1 (g) (5) (i) by deleting the word "or" and substituting in lieu thereof the word "and".

3. By amending § 6.15 (c) to read as follows:

6.15 Inspections and tests. * * *

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

4. By amending § 6.101 (b) (2) to read as follows:

6.101 Weight limitations. * * *

(b) * * *

(2) usable fuel for one hour's operation at the maximum continuous power and rpm.

5. By amending § 6.101 (b) (4) to read as follows:

6.101 Weight limitations. * * *

(b) * * *

(4) 170 pounds in all seats, except that when the maximum permissible weight to be carried in a seat is less than 170 pounds it shall be acceptable to use this lesser weight. (See § 6.738 (a).)

6. By amending § 6.101 (d) (3) to read as follows:

6.101 Weight limitations. * * *

(d) * * *

(3) oil in the quantity determined in accordance with the provisions of § 6.440 (b).

7. By amending § 6.120 (b) by adding after the word "possible" the phrase "to maintain a flight condition and".

8. By amending § 6.121 (b) by deleting the words "the maximum permissible forward speed" and substituting in lieu thereof "V_{NE} (see § 6.711.)".

9. By amending § 6.212 by deleting from the second sentence the numeral "2.5" and substituting in lieu thereof the numeral "2.0".

10. By amending § 6.221 by deleting from the second sentence the clause "centrifugal loads of twice those resulting when the rotor is driven by the engine at its maximum continuous speed." and inserting in lieu thereof the clause "centrifugal loads resulting from the maximum design rotor rpm."

11. By amending § 6.230 (c), (d), and (e) to read as follows:

6.230 General. * * *

(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 1/2 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 for 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 § 6.237, except in conditions in which other values of load factor 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.

12. By amending § 6.230 by adding a new paragraph (f) to read as follows:

6.230 General. * * *

(f) Landing gear arrangement. The provisions of §§ 6.231 through 6.236 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.

13. By amending § 6.231 (b) (2) by adding the following: "For the attitude prescribed in § 6.231 (a) (1) the resulting pitching moment shall be assumed resisted by the forward gear, while for the attitude prescribed in § 6.231 (a) (2) the resulting pitching moment shall be assumed resisted by angular inertia forces."

14. By amending § 6.237 to read as follows:

6.237 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 § 6.230 (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 § 6.230 (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.

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

$$W_e = W\left[\frac{h + (1-L)d}{h + d}\right]; \text{ and } n = n_j \frac{W_e}{W} + L;$$

where:

W_e = the effective weight to be used in the drop test (lbs);

$W = W_M$ for main gear units (lbs), equal to the static reaction on the particular unit with the rotorcraft in the most critical attitude;

$W = W_N$ for nose gear units (lbs), equal to the vertical component of the static 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;

h = specified free drop height (inches);

L = ratio of assumed rotor lift to the rotorcraft weight, not in excess of 0.5;

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);

n = limit inertia load factor;

n_j = the load factor during impact developed on the mass used in the drop test (i.e., the acceleration dv/dt in g's recorded in the drop test plus 1.0).

(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 0.75 times the rotorcraft maximum weight, 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.

15. By amending § 6.245 (a) (1) by adding the following clause to the last sentence: "or shall be assumed to be the same as the load factor determined for the ground type landing gear."

16. By amending § 6.245 (b) to read as follows:

6.245 Float landing conditions. * * *

(b) Side load condition. The vertical load in this condition equal to 0.75 the vertical load prescribed in subparagraph (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.

17. By amending § 6.251 (c) by deleting from the second sentence the phrase: "by a factor of 1.5." and substituting in lieu thereof the clause: ", as defined by the power conditions in § 6.1 (g) (3), by a factor of 1.33."

18. By amending § 6.306 (c) and (d) to read as follows:

6.306 Material strength properties and design values. * * *

(c) ANC-5, ANC-18, and ANC-23, Part II values shall be used unless shown to be inapplicable in a particular case.

NOTE: ANC-5, "Strength of Metal Aircraft Elements," ANC-18, "Design of Wood Aircraft Structures," and ANC-23, "Sandwich Construction for Aircraft," are published by the Subcommittee on Air Force-Navy-Civil Aircraft Design Criteria, 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.

19. By adding a new § 6.313 to read as follows:

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

20. By amending § 6.338 to read as follows:

6.338 Skis. Skis shall be of an approved type. The maximum limit load rating of each ski shall not be less than the maximum limit load determined in accordance with the applicable ground load requirements of this part.

21. By redesignating §§ 6.340 and 6.341 as §§ 6.341 and 6.342, respectively.

22. By adding a new § 6.340 to read as follows:

6.340 Floats. Floats shall be of an approved type and shall comply with the provisions of §§ 6.341 and 6.342.

23. By amending redesignated § 6.342 (a) by deleting from the second sentence the words "maximum expected vertical load" and substituting in lieu thereof "vertical loads prescribed in § 6.245 (a)".

24. By amending redesignated § 6.342 (b) by deleting from the first sentence the words "maximum expected vertical, horizontal, and side loads" and substituting in lieu thereof "vertical, horizontal, and side loads prescribed in § 6.245".

25. By amending § 6.382 to read as follows:

6.382 Cargo and baggage compartments. Cargo and baggage compartments shall be constructed of or completely lined with fire-resistant

material, except that flame-resistant materials shall be acceptable in compartments which are readily accessible to a crew member in flight. 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.

26. By amending § 6.384 to read as follows:

6.384 Fire protection of structure, controls, and other parts. All structure, controls, rotor mechanism, and other parts essential to a controlled landing of the rotorcraft which would be affected by powerplant fires shall either 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 §§ 6.480 and 6.483 (a).)

27. By amending § 6.414 to read as follows:

6.414 Shafting critical speed. The critical speeds of all shafting shall be determined by actual demonstration, except that analytical methods shall be acceptable for determining these speeds if the Administrator finds that reliable methods of analysis are available for the particular design. If the critical speeds lie within or close to the operating ranges for idling, power-on, and autorotative conditions, it shall be demonstrated by tests that the resultant stresses are within safe limits. If analytical methods are used and indicate that no critical speeds lie within the permissible operating ranges, the margins between the calculated critical speeds and the limits of the permissible operating ranges shall be adequate to allow for possible variations of the computed values from actual values.

28. By amending § 6.420 to read as follows:

6.420 Capacity and feed. The usable fuel capacity shall not be less than that required for one hour's operation at maximum continuous power and rpm. Gravity feed or mechanical pumping of fuel shall be employed. Air-pressure fuel systems shall not be allowed. The fuel supply system shall be arranged so that, in so far as practicable, the entire fuel supply can be utilized in the maximum inclinations of the fuselage for any sustained conditions of flight, and so that the feed ports will not be uncovered during normal maneuvers involving moderate rolling or sideslipping. On rotorcraft with more than one fuel tank (see § 6.422 (e)) the system shall feed fuel promptly after one tank is turned off and another tank is turned on, and there shall be installed in addition to the fuel quantity indicator (see § 6.604 (a) (1)) a warning device to indicate when the fuel in any tank becomes low.

NOTE: The fuel in any tank is considered to be low when there remains approximately a five-minute supply with the rotorcraft in the most critical sustained flight attitude.

29. By amending § 6.462 (c) to read as follows:

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

(c) Rotorcraft equipped with sea level engines employing carburetors which embody features tending to reduce the possibility of ice formation shall be provided with a sheltered alternate source of air. The preheat supplied to this alternate air intake shall be not less than that provided by the engine cooling air downstream of the cylinders.

30. By amending § 6.480 by adding a note to read as follows:

6.480 General. * * *

NOTE: The powerplant fire protection provisions are intended to insure that the main and auxiliary rotors and controls remain operable, 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 autorotational landing.

31. By amending § 6.482 by adding the following: "Shutoff valves and their controls shall be located on the remote side of the fire wall from the engine, unless it is shown that the valve will perform its intended functions under all fire conditions likely to result from an engine fire. In installations using engines of less than 500 cu. in. displacement, shutoff means need not be provided for engine oil systems."

32. By amending § 6.483 (a) to read as follows:

6.483 Fire wall.

(a) Engines shall be isolated from personnel compartments by means of fire walls, shrouds, or other equivalent means. They shall be similarly isolated from the structure, controls, rotor mechanism, and other parts essential to a controlled landing of the rotorcraft, unless such parts are protected in accordance with the provisions of § 6.384. 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 fire walls, shrouds, or other equivalent means. In complying with the provisions of this paragraph, account shall be taken of the probable path of a fire as affected by the air flow in normal flight and in autorotation. (See also § 6.486.)

33. By adding a new § 6.485 to read as follows:

6.485 Lines and fittings. All lines and fittings carrying flammable fluids or gases in areas subject to engine fire conditions shall comply with the provisions of paragraphs (a) through (c) of this section.

(a) Lines and fittings which are under pressure, or which attach directly to the engine, or which are subject to relative motion between components shall be flexible, fire-resistant lines with fire-resistant end fittings of the permanently attached, detachable, or other approved types. The provisions of this paragraph shall not apply to those lines and fittings which form an integral part of the engine.

(b) Lines and fittings which are not subject to pressure or to relative motion between components shall be of fire-resistant materials.

(c) Vent and drain lines and fittings shall be subject to the provisions of paragraphs (a) and (b) unless a failure of such line or fitting will not result in, or add to, a fire hazard.

34. By adding a new § 6.486 to read as follows:

6.486 Flammable fluids.

(a) Fuel tanks shall be isolated from the engine by a fire wall or shroud. On all rotorcraft having engines of more than 900 cu. in. displacement, oil tanks and other flammable fluid tanks shall be similarly isolated unless the fluid contained, the design of the system, the materials used in the tank, the shutoff means, all connections, lines, and controls are such as to provide an equally high degree of safety.

(b) Not less than one-half inch of clear air space shall be provided between any tank and the isolating fire wall or shroud, unless other equivalent means are used to protect against heat transfer from the engine compartment to the flammable fluid.

35. By adding a new § 6.487 to read as follows:

6.487 Fire detector systems. On all rotorcraft having engines of more than 900 cu. in. displacement, quick-acting fire detectors of an approved type shall be provided in all engine compartments, and they shall be sufficient in number and location to assure prompt detection of engine fires. Fire detector systems 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 the 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.

36. By adding a new § 6.488 to read as follows:

6.488 Fire extinguisher systems.

(a) General.

(1) On all rotorcraft having engines of more than 1,500 cu. in. displacement, fire extinguisher systems shall be provided to serve all engine compartments and engine induction systems.

(2) On single-engine rotorcraft, the fire extinguisher system, the quantity of extinguishing agent, and the rate of discharge shall be such as to provide an adequate discharge for the engine compartment. On multiengine rotorcraft, the system shall provide two adequate discharges, and it shall be possible to direct both discharges to any engine compartment.

(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 concentration of fluid or fluid vapors into any personnel compartments 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 extinguisher system materials. Materials in the fire extinguisher system shall not react chemically with the extinguishing agent so as to constitute a hazard. All components of the fire extinguisher systems located in engine compartments shall be constructed of fireproof materials.

37. By amending § 6.620 (c) by deleting the first sentence and substituting in lieu thereof the following: "Electrical sources of power shall have sufficient capacity during all normal flight operating conditions to supply the electrical load requirements without electrical or thermal distress."

38. By amending § 6.626 by deleting the words "used in flight" and substituting in lieu thereof the words "essential to safety in flight".

39. By amending § 6.631 (a) to read as follows:

6.631 Landing lights.

(a) When landing or hovering lights are required, they shall be of an approved type.

40. By amending § 6.710 by inserting the words "rotor speed, power," after the word "altitude,".

41. By amending § 6.711 (a) by deleting from the second sentence the phrase "the maximum level flight speed with all engines operating at maximum continuous rpm and 90 percent of maximum continuous power" and substituting in lieu thereof "the best rate of climb speed".

42. By amending § 6.713 by adding after the first sentence the reference: "(See also § 6.710.)".

43. By amending § 6.714 (b) (2) by adding at the end of the subparagraph the reference: "(See §§ 6.103, 6.710, and 6.711.)".

44. By amending § 6.719 by adding at the end of the section the following sentence: "Such components shall be identified by serial number or by other equivalent means."

45. By amending § 6.732 by deleting the reference: "(See § 6.612 (a).)" and substituting in lieu thereof the reference: "(See §§ 6.612 (a), 6.710, 6.711, 6.712, 6.713, and 6.715.)".

(Sec. 205 (a), 52 Stat. 984; 49 U.S.C. 425 (a). Interpret or apply secs. 601, 603, 52 Stat. 1007, as amended, 1008; 49 U.S.C. 551, 553)

By the Civil Aeronautics Board:

/s/ M. C. Mulligan

M. C. Mulligan
Secretary

(SEAL)

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