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CIVIL AERONAUTICS MANUALS—Volume II

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SUBJECT: Revisions to CAM 6 dated November 1956

This supplement is issued to provide changes made to Part 6 of the Civil Air Regulations as a result of the 1956 Annual Airworthiness Review. These revisions were published in Amendment 6–2, effective August 12, 1957.

The new and revised material is indicated by brackets.

Remove and destroy the following pages:

- v through VIII
- 15 and 16
- 21 and 22
- 25 and 26

Insert the following new pages:

- v through VIII
- 15 through 16–3
- 21 through 22–1
- 25 through 26–1

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Attachments.

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

$W=W_N$ 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;

[$W=W_T$ for tail-wheel units (pounds); (1) equal to the static weight on the tail-wheel with the rotorcraft resting on all wheels; (2) equal to the vertical component of the ground reaction which would occur at the tail-wheel 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. 6.246 (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);

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 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.

6.240 *Ski landing conditions.* The structure of a rotorcraft equipped with skis shall be designed in compliance with the loading conditions set forth in paragraphs (a) through (c) 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 6.230 (d).

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

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

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

6.245 *Float landing conditions.* The structure of a rotorcraft equipped with floats shall be designed in compliance with the loading conditions set forth in paragraphs (a) and (b) 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 6.230 (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.

[6.246 *Tail-wheel 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 the provisions of section 6.230.

[(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 landing; 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 section 6.230.

[(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 6.230.

[(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. 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 assumed 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 also be assumed to be in the trailing position with the side load acting at the ground contact point.

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

[6.247 *Skid gear ground loading condition.* The structure of a rotorcraft equipped with skid type landing gear shall be assumed to be subjected to the loading conditions in accordance with paragraphs (a) through (d) of this section.

[(a) The design weight, center of gravity, and load factor shall be in accordance with the provisions of section 6.230. Structural yielding of the elastic spring member under the limit loading conditions shall be acceptable. The design ultimate loads considered for the elastic spring member need not exceed those obtained in a drop test of the skid gear from a drop height equal to 1.5 times that specified in section 6.237 (a).

[(b) The ground loads resulting from the landing conditions specified in paragraph (c) of this section shall be applied to the skid gear in its most critically deflected position for the particular landing condition being considered and a rational distribution of the ground reactions along the skid tube bottom shall be made.

[(c) The following landing conditions shall be considered:

[(1) *Level landing; vertical reactions.* The rotorcraft shall be assumed to contact the ground along the bottom of both skids. Vertical ground reactions shall be applied in accordance with the provisions of paragraphs (a) and (b) of this section.

[(2) *Level landing with drag.* The rotorcraft shall be assumed to contact the ground along the bottom of both skids with vertical ground reactions in combination with a horizontal drag reaction equal to 50 percent of the vertical reaction applied at the ground. The resultant ground load shall be equal to the vertical load specified in subparagraph (1) of this paragraph and shall be directed through the center of gravity of the rotorcraft.

[(3) *Level landing with side load.* The rotorcraft shall be assumed to contact the ground along the bottom of both skids with vertical ground reactions in combination with a horizontal side reaction equal to 25 percent of the vertical ground reaction. The vertical ground reaction shall be equal to the vertical load specified in subparagraph (1) of this paragraph and shall be equally divided between the two skids. The total side load shall be applied along the length of one skid only. Unbalanced moments shall be assumed resisted by angular inertia forces. Both the inward and outward acting side loading conditions for the skid gear shall be investigated.

[(4) *One-skid landing condition.* In the level attitude, the rotorcraft shall be assumed to contact the ground on one skid only. The vertical load shall be the same as that obtained on the one side in the condition specified in subparagraph (1) of this paragraph. Unbalanced moments shall be assumed to be resisted by angular inertia forces.

[(d) *Special conditions for the skid gear.*

[(1) A ground reaction load equal to 1.33 times the maximum weight of the rotorcraft acting up and aft at an angle of 45 degrees to the horizontal shall be assumed. The load shall be distributed symmetrically between the two skids and shall be assumed concentrated at the forward end of the straight portion of the skid tube. This loading condition shall apply only to the forward end of skid tube and its attachment to the rotorcraft.

[(2) A vertical ground reaction load equal to one-half the vertical load of § 6.247 (c) (1) shall be assumed with the rotorcraft in the level attitude. This load shall be applied to the skid tube and shall be assumed concentrated at a point midway between the skid tube attachments. This loading condition shall apply

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only to the skid tube and its attachment to the rotorcraft.]

Main Component Requirements

6.250 *Main rotor structure.* The requirements of paragraphs (a) through (f) 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 repeated loading conditions. 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 6.204. The service life of such parts shall be determined by fatigue tests or by other methods found acceptable by the Administrator.

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

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

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

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

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

6.250–1 *Service life of main rotors (CAA policies which apply to sec. 6.250 (a)).* Several methods which have been found acceptable by the Administrator for determining the service life of main rotors are outlined in appendix A for the guidance of the industry in complying with section 6.250 (a).

(16 F. R. 3405, Apr. 19, 1951, effective May 1, 1951.)

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

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

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

(c) The engine mount and adjacent fuselage structure shall be designed to withstand loads occurring in the rotorcraft under the accelerated flight and landing conditions, including the effects of engine torque loads. In the case of engines having 5 or more cylinders, the limit torque shall be obtained by multiplying the mean torque, as defined by the power conditions in section 6.1 (g) (3), by a factor of 1.33. For 4-, 3-, and 2-cylinder engines the factors shall be 2, 3, and 4, respectively.

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

Emergency Landing Conditions

6.260 *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. 6.355), will escape serious injury in

the event of a minor crash landing (with wheels up if the rotorcraft is equipped with retractable landing gear) in which the occupants experience the following ultimate inertia forces relative to the surrounding structure.

(1) Upward 1.5g (downward 4.0g).

(2) Forward 4.0g.

(3) Sideward 2.0g.

(b) The use of a lesser value of the downward inertia force specified in paragraph (a) of this section shall be acceptable if it is shown that the rotorcraft structure can absorb the landing loads corresponding with the design maximum weight and an ultimate descent ve-

selected combinations of loads may be used, provided the required strength in all specified directions is substantiated. (TSO C–25 Aircraft Seats and Berths, outlines acceptable methods for testing seats and berths.)

(18 F. R. 5564, Sept. 17, 1953, effective Sept. 30, 1953.)

6.356 *Cargo and baggage compartments.* (See also sec. 6.382.)

(a) Each cargo and baggage compartment shall be designed for the placarded maximum weight of contents and the critical load distributions at the appropriate maximum load factors corresponding with all specified flight and ground load conditions, excluding the emergency landing conditions of section 6.260.

(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.

6.357 *Emergency exits.*

(a) Closed cabins on rotorcraft carrying more than 5 persons shall be provided with an emergency exit. Additional exits shall be provided where the total seating capacity is more than 15. The provisions of subparagraphs (1) through (6) of this paragraph shall apply. (See also sec. 6.738 (c).)

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

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

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

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

(5) At least one emergency exit shall be on the opposite side of the cabin from the main door.

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

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

Fire Prevention

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

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

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 com-**

partment, and so that any breakage or failure of such items will not create a fire hazard.

6.383 *Heating systems.*

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

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

(c) *Combustion heaters.* Gasoline-operated combustion heaters shall be of an approved type and shall be installed so as to comply with the applicable sections of the powerplant installation requirements covering fire hazards and precautions. All applicable requirements concerning fuel tanks, lines, and exhaust systems shall be considered. (See secs. 6.422 through 6.428 and 6.463.) [In addition to the components provided for normal continuous control of air temperature, air flow, and fuel flow, means independent of such components shall be provided for each heater to automatically shut off and hold off the ignition and fuel supply to the heater at a point remote from the heater when the heat exchanger temperature or ventilating air temperature exceeds safe limits or when either the combustion air flow or the ventilating air flow becomes inadequate for safe operation.]

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 secs. 6.480 and 6.483 (a).)

Miscellaneous

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

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

Powerplant Installation

General

6.400 *Scope and general design.*

(a) 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. 6.604 and 6.613 for instrument installation and marking.) The general provisions of paragraphs (b) through (d) of this section shall be applicable.

(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 rotocraft.

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

6.402 *Engine vibration.* The engine shall be installed to preclude harmful vibration of any of the engine parts or any of the components of the rotorcraft. It shall be demonstrated by means of a vibration investigation that the addition of the rotor and the rotor drive system to the engine does not result in modification of engine vibration characteristics to the extent that the principal rotating portions of the engine are subjected to excessive vibratory stresses. It shall also be demonstrated that no portion of the rotor drive system is subjected to excessive vibratory stresses.

Rotor Drive System

6.410 *Rotor drive mechanism.* The rotor drive mechanism shall incorporate a unit which will automatically disengage the engine from the main and auxiliary rotors in the event of power failure. The rotor drive mechanism shall be so arranged that all rotors necessary for control of the rotorcraft in autorotative flight will continue to be driven by the main pumping fuel from an auxiliary tank to a main fuel tank. Mechanical pump systems shall be so arranged that they cannot feed from more than one tank at a time.

6.425 *Fuel system lines and fittings.*

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

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

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

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

(1) For gravity feed systems: 1.5 times the normal flow required to operate the engine at take-off power;

(2) For pump systems: 1.25 times the normal flow required to operate the engine at take-off power.

[(e) Rotocraft with suction lift fuel systems or other fuel system features conducive to vapor formation shall be demonstrated to be free from vapor lock when using fuel at a temperature of 110° F. under critical operating conditions.]

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

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

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

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

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

Oil System

6.440 *General.*

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

(b) The usable oil capacity shall not be less than the product of the endurance of the rotorcraft under critical operating conditions and the maximum oil consumption of the engine under the same conditions, to which product a suitable margin shall be added to assure adequate circulation and cooling of the oil system. In lieu of a rational analysis of rotorcraft endurance and oil consumption, the usable oil capacity of 1 gallon for each 40 gallons of usable fuel quantity shall be considered acceptable. (See also sec. 6.101 (d) (3).)

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

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

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

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

(c) Oil tanks shall be provided with an expansion space of not less than 10 percent of the tank capacity, nor less than one-half gallon. [It shall not be possible inadvertently to fill the oil tank expansion space when the rotorcraft is in the normal ground attitude.]

(d) Oil tanks shall be vented.

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

6.442 *Oil lines and fittings.*

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

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

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

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

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

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

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

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

Cooling System

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

6.451 *Cooling tests.* Compliance with the provisions of section 6.450 shall be demonstrated in flight tests in which engine temperature measurements are obtained under critical flight conditions. Such tests shall be conducted in air at temperatures corresponding with the maximum anticipated air temperatures as specified in paragraph (a) of this section. If the tests are conducted under conditions which deviate from the maximum anticipated air temperature, the recorded powerplant temperatures shall be corrected in accordance with the provisions of paragraphs (b) and (c) of this section. The corrected temperatures determined in this manner shall not exceed the maximum established safe values. The fuel used during the cooling tests shall be of the minimum octane number approved for the engines involved, and the mixture settings shall be those used in normal operation.

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

(b) *Correction factor for cylinder head and oil inlet temperatures.* The cylinder head and oil inlet temperatures shall be corrected by adding the difference between the

maximum anticipated air temperature and the temperature of the ambient air at the time of the first occurrence of maximum cylinder head or oil inlet temperature recorded during the cooling test, unless a more rational correction is shown to be applicable.

(c) *Correction factor for cylinder barrel temperatures.* Cylinder barrel temperatures