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CIVIL AERONAUTICS MANUALS—Volume II

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Supplement No. 24 — December 31, 1958

SUBJECT: Revisions to CAM 3 dated October 1956, CAM 4b dated January 1958, and CAM 6 dated November 1956.

This supplement is issued to provide revised pages for the subject manuals. These revisions interpret the term "all components" as it relates to powerplant installations.

Remove and destroy the following pages:	*Insert the following new pages:*
CAM 3—xi and xii	CAM 3—xi and xii
69 through 70–2	69 through 70–2
CAM 4b—xi and xii	CAM 4b—xi and xii
119 and 120	119 through 120–1
CAM 6—vii and viii	CAM 6—vii and viii
21 through 22–1	21 through 22–1

Roy Keeley

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Attachments.

Retracting Mechanism

Wheels and Tires

Brakes

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Hulls and Floats

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Subpart E—Power-Plant Installations; Reciprocating Engines

General

Engines and Propellers

Fuel System

Arrangement

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sure differential valves and of the emergency release valve.

(2) All parts of the pressurization system shall be tested to show proper functioning under all possible conditions of pressure, temperature, and moisture up to the maximum altitude selected for certification.

(3) Flight tests shall be conducted to demonstrate the performance of the pressure supply, pressure and flow regulators, indicators, and warning signals in steady and stepped climbs and descents at rates corresponding with the maximum attainable without exceeding the operating limitations of the airplane up to the maximum altitude selected for certification.

(4) All doors and emergency exits shall be tested to ascertain that they operate properly after being subjected to the flight tests prescribed in subparagraph (3) of this paragraph.

Miscellaneous

3.401 ***Leveling marks.*** **Leveling marks shall be provided for leveling the airplane on the ground.**

Subpart E—Power-Plant Installations; Reciprocating Engines

General

3.411 ***Components.***

(a) The power-plant installation shall be considered to include all components of the airplane which are necessary for its propulsion. It shall also be considered to include all components which affect the control of the major propulsive units of which affect their continued safety of operation.

(b) All components of the power-plant installation shall be constructed, arranged, and installed in a manner which will assure the continued safe operation of the airplane and power plant. Accessibility shall be provided to permit such inspection and maintenance as is necessary to assure continued airworthiness.

[3.411-1 *Powerplant installation components (CAA interpretations which apply to sec. 3.411).* The term "all components" includes engines and propellers and their parts, appurtenances, and accessories which are furnished by the engine or propeller manufacturer and all other components of the powerplant installation which are furnished by the airplane manufacturer. For example: fuel pumps, lines, valves, and other components of the fuel system which are integral parts of the type certificated engine are also components of the airplane powerplant installation.]

(23 F. R. 9018, Nov. 20, 1958, effective Dec. 22, 1958.)

Engines and Propellers

3.415 ***Engines.*** **Engines installed in certificated airplanes shall be of a type which has been certificated in accordance with the provisions of Part 13 of this subchapter.**

3.416 ***Propellers.***

(a) Propellers installed in certificated airplanes shall be of a type which has been certificated in accordance with the provisions of Part 14 of this subchapter.

(b) The maximum engine power and propeller shaft rotational speed permissible for use in the particular airplane involved shall not exceed the corresponding limits for which the propeller has been certificated.

3.417 ***Propeller vibration.*** **In the case of propellers with metal blades or other highly stressed metal components, the magnitude of the critical vibration stresses under all normal conditions of operation shall be determined by actual measurements or by comparison with similar installations for which such measurements have been made. The vibration stresses thus determined shall not exceed values which have been demonstrated to be safe for continuous operation. Vibration tests may be waived and the propeller installation accepted on the basis of service experience, engine or ground tests which show adequate margins of safety, or other considerations which satisfactorily substantiate its safety in this respect. In addition to metal propellers, the Administrator may require that similar substantiation of the vibration characteristics be accomplished for other types of propellers, with the exception of conventional fixed-pitch wood propellers.**

3.418 ***Propeller pitch and speed limitations.*** **The propeller pitch and speed shall be limited to values which will assure safe operation under all normal conditions of operation and will assure compliance with the per-**

formance requirements specified in sections 3.81–3.86.

3.419 ***Speed limitations for fixed-pitch propellers, ground adjustable pitch propellers, and automatically varying pitch propellers which cannot be controlled in flight.***

(a) During take-off and initial climb at best rate-of-climb speed, the propeller, in the case of fixed-pitch or ground adjustable types, shall restrain the engine to a speed not exceeding its maximum permissible take-off speed and, in the case of automatic variable-pitch types, shall limit the maximum governed engine revolutions per minute to a speed not exceeding the maximum permissible take-off speed. In demonstrating compliance with this provision the engine shall be operated at full throttle or the throttle setting corresponding to the maximum permissible take-off manifold pressure.

(b) During a closed throttle glide at the placard, "never-exceed speed" (see sec. 3.739), the propeller shall not cause the engine to rotate at a speed in excess of 110 percent of its maximum allowable continuous speed.

3.419–1 *Propeller pitch and speed limitations (CAA interpretations which apply to sec. 3.419).*

(a) The low pitch setting should comply with section 3.419 (a) which states that the propeller shall not exceed the rated engine takeoff r. p. m. with takeoff power (full throttle unless limited by manifold pressure) during takeoff and initial climb at best rate of climb speed. It is not permissible to use a lower pitch setting than that specified above in order to obtain takeoff r. p. m. at the best angle of climb speed for the purpose of showing compliance with section 3.85 (c), Balked Landing Conditions. An exception to the above may be granted in the specific case covered by section 3.85–5 when satisfactory engine cooling can be demonstrated at the best angle of climb speed in the balked landing configuration (sec. 3.85 (c)). However, in cases where the interpretation of section 3.85 does not govern, it will be necessary to conduct the balked landing climb with whatever r. p. m. is possible without exceeding the engine takeoff limitations with the low pitch setting determined in accordance with section 3.419 (a).

(b) In cases where the airplane is to be operated using either the water injection or dry takeoff power ratings of the engines, the low pitch stop setting shall be determined on the basis of whichever rating will result in the lower pitch. This will generally be the "dry" rating. In instances where the airplane is intended to be operated only at the water injection takeoff power ratings of the engines, the low pitch stop for the propellers should be determined on that basis. These settings are to be determined in the usual manner with the airplane static unless there are unconventional features in the propeller installation requiring this determination by some other means.

(c) In cases where dual engines drive a single propeller through free wheeling clutches, the setting of the low pitch stop should be such that the propeller will not overspeed when takeoff power is applied to one engine at an airplane speed of V_2.

(Supp. 10, 16 F. R. 3291, Apr. 14, 1951.)

3.420 ***Speed and pitch limitations for controllable pitch propellers without constant speed controls.*** **The stops or other means incorporated in the propeller mechanism to restrict the pitch range shall limit (a) the lowest possible blade pitch to a value which will assure compliance with the provisions of section 3.419 (a), and (b) the highest possible blade pitch to a value not lower than the flattest blade pitch with which compliance with the provisions of section 3.419 (b) can be demonstrated.**

3.421 ***Variable pitch propellers with constant speed controls.***

(a) Suitable means shall be provided at the governor to limit the speed of the propeller. Such means shall limit the maximum governed engine speed to a value not exceeding its maximum permissible takeoff revolutions per minute.

(b) The low pitch blade stop, or other means incorporated in the propeller mechanism to restrict the pitch range, shall limit the speed of the engine to a value not exceeding 103 percent of the maximum permissible takeoff revolutions per minute under the following conditions:

(1) Propeller blades set in the lowest possible pitch and the governor inoperative.

(2) Engine operating takeoff manifold pressure with the airplane stationary and with no wind.

3.422 *Propeller clearance.* With the airplane loaded to the maximum weight and most adverse center of gravity position and the propeller in the most adverse pitch position, propeller clearances shall not be less than the following, unless smaller clearances are properly substantiated for the particular design involved:

(a) *Ground clearance.*

(1) Seven inches (for airplanes equipped with nose wheel type landing gears) or 9 inches (for airplanes equipped with tail wheel type landing gears) with the landing gear statically deflected and the airplane in the level, normal takeoff, or taxiing attitude, whichever is most critical.

(2) In addition to subparagraph (1) of this paragraph, there shall be positive clearance between the propeller and the ground when, with the airplane in the level takeoff attitude, the critical tire is completely deflated and the corresponding landing gear strut is completely bottomed.

(b) *Water clearance.* A minimum clearance of 18 inches shall be provided unless compliance with section 3.147 can be demonstrated with lesser clearance.

(c) *Structural clearance.*

(1) One inch radial clearance between the bladetips and the airplane structure, or whatever additional radial clearance is necessary to preclude harmful vibration of the propeller or airplane.

(2) One-half inch longitudinal clearance between the propeller blades or cuffs and stationary portions of the airplane. Adequate positive clearance shall be provided between other rotating portions of the propeller or spinner and stationary portions of the airplane.

3.422–1 *Propeller clearance on tricycle gear airplanes (CAA interpretations which apply to sec. 3.422 (a) (1)).* In determining minimum propeller clearance for aircraft equipped with tricycle gear, dynamic effects need not be considered.

(Supp. 10, 16 F. R. 3291, Apr. 14, 1951.)

3.422–2 *Propeller clearance on aircraft with leaf spring type shock struts (CAA interpretations which apply to sec. 3.422 (a) (2)).* Section 3.422 (a) (2) applies only to conventional landing gear struts employing fluid and for mechanical means for absorbing landing shocks. For aircraft employing struts of the leaf spring type, a deflection corresponding to 1.5g should be used to determine whether positive clearance exists.

(Supp. 10, 16 F. R. 3291, Apr. 14, 1951.)

Fuel System

3.429 *General.* The fuel system shall be constructed and arranged in a manner to assure the provision of fuel to each engine at a flow rate and pressure adequate for proper engine functioning under all normal conditions of operation, including all maneuvers and acrobatics for which the airplane is intended.

Arrangement

3.430 *Fuel system arrangement.* Fuel systems shall be so arranged as to permit any one fuel pump to draw fuel from only one tank at a time. Gravity feed systems shall not supply fuel to any one engine from more than one tank at a time unless the tank air spaces are interconnected in such a manner as to assure that all interconnected tanks will feed equally. (See also sec. 3.439.)

3.431 *Multiengine fuel system arrangement.* The fuel systems of multiengine airplanes shall be arranged to permit operation in at least one configuration in such a manner that the failure of any one component will not result in the loss of power of more than one engine and will not require immediate action by the pilot to prevent the loss of power of more than one engine. Unless other provisions are made to comply with this requirement, the fuel system shall be arranged to permit supplying fuel to each engine through a system entirely independent of any portion of the system supplying fuel to the other engines.

NOTE: It is not necessarily intended that fuel tanks proper be separate for each engine if a common tank is provided with separate outlets and the remainder of the fuel system is independent.

3.431–1 *Multiengine single tank fuel system (CAA policies which apply to sec. 3.431).*

When a common fuel tank is provided in multiengine aircraft, unless other acceptable provisions are made, a shutoff valve should be installed at the tank outlet of each individual fuel system. This valve may also serve as the fire wall shutoff valve required by section 3.551, provided the line between the valve and the engine compartment does not contain a hazardous amount of fuel (more than 1 quart) which can drain into the engine compartment.

(22 F. R. 4877, July 11, 1957, effective Aug. 1, 1957.)

3.432 ***Pressure cross feed arrangements.*** **Pressure cross feed lines shall not pass through portions of the airplane devoted to carrying personnel or cargo, unless means are provided to permit the flight personnel to shut off the supply of fuel to these lines, or unless any joints, fittings, or other possible sources of leakage installed in such lines are enclosed in a fuel- and fume-proof enclosure which is ventilated and drained to the exterior of the airplane. Bare tubing need not be enclosed but shall be protected where necessary against possible inadvertent damage.**

Operation

3.433 ***Fuel flow rate.*** **The ability of the fuel system to provide the required fuel flow rate and pressure shall be demonstrated when the airplane is in the attitude which represents the most adverse condition from the standpoint of fuel feed and quantity of unusable fuel in the tank. During this test fuel shall be delivered to the engine at the applicable flow rate (see secs. 3.434–3.436) and at a pressure not less than the minimum required for proper carburetor operation. A suitable mock-up of the**

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inspections or overhaul periods. (See secs. 4b.604 and 4b.613 for instrument installation and marking.)

(a) *Scope.* 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.

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

(d) *Electrical bonding.* 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 airplane.

4b.400–1 *Engine and propeller operation (CAA policies which apply to sec. 4b.400).* The engines and propellers should be observed during the flight test program to determine satisfactory operation of these systems and their associated components.

(19 F. R. 4463, July 20, 1954, effective Sept. 1, 1954.)

[4b.400–2 *Powerplant installation components (CAA interpretations which apply to sec. 4b.400).* The term "all components" includes engines and propellers and their parts, appurtenances, and accessories which are furnished by the engine or propeller manufacturer and all other components of the powerplant installation which are furnished by the airplane manufacturer. For example: fuel pumps, lines, valves, and other components of the fuel system which are integral parts of the type certificated engine are also components of the airplane powerplant installation.]

(23 F. R. 9018, Nov. 20, 1958, effective Dec. 22, 1958.)

4b.401 *Engines.*

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

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

(c) *Control of engine rotation.* Means shall be provided for individually stopping and restarting the rotation of any engine in flight, except that for turbine engine installations means for stopping the rotation need be provided only if such rotation could jeopardize the safety of the airplane. 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. If hydraulic propeller feathering systems are used for this purpose, the feathering lines on all airplanes manufactured after June 30, 1954, shall be fire-resistant under the operating conditions which may be expected to exist when feathering is being accomplished. (See also sec. 4b.449.)

(d) *Rotor blade protection.* Turbine powerplant installations shall include a means of protection such that the occurrence of rotor blade failure in any engine will not affect the operation of remaining engines nor jeopardize the continued safe operation of the airplane, unless the engine type certificate specifies that the engine rotor cases have been substantiated as capable of containing the damage resulting from rotor blade failure.

(e) *Engine turbine rotor.* Design precautions shall be taken to minimize the probability of jeopardizing the safety of the airplane in the event of engine turbine rotor failure, unless the engine type certificate specifies that the turbine rotors have been demonstrated to provide sufficient strength to withstand damage inducing factors such as those which might result from abnormal rotor speeds, temperature, or vibration and the design and functioning of the powerplant systems associated with engine control devices, systems, and instrumentation are such as to give reasonable assurance that those engine operating limitations which adversely affect turbine rotor structural integrity will not be exceeded in service.

4b.401–1 *Approval of automatic propeller feathering system (CAA policies which apply to sec. 4b.401 (c))*. All parts of the feathering device which are integral with the propeller or attached to it in a manner that may affect propeller airworthiness should be considered from the standpoint of the applicable provisions of Part 14. The determination of the continuing eligibility of the propeller under the existing type certificate, when the device is installed or attached, will be made on the following basis:

(a) The automatic propeller feathering system should not adversely affect normal propeller operation and should function properly under all temperature, altitude, airspeed, vibration, acceleration, and other conditions to be expected in normal ground and flight operation.

(b) The automatic device should be demonstrated to be free from malfunctioning which may cause feathering under any conditions other than those under which it is intended to operate. For example, it should not cause feathering during:

(1) Momentary loss of power.

(2) Approaches with reduced throttle settings.

(c) The automatic propeller feathering system should be capable of operating in its intended manner whenever the throttle control is in the normal position to provide takeoff power. No special operations at the time of engine failure should be necessary on the part of the crew in order to make the automatic feathering system operative.

(d) The automatic propeller feathering installation should be such that not more than one engine will be feathered automatically even if more than one engine fails simultaneously.

(e) The automatic propeller feathering installation should be such that normal operation may be regained after the propeller has begun to feather automatically.

(f) The automatic propeller feathering installation should incorporate a switch or equivalent means by which to make the system inoperative. (See also sec. 4b.10–2.)

(19 F. R. 1818, Apr. 2, 1954, effective Apr. 2, 1954.)

4b.401–2 *Propeller feathering system operational tests (CAA policies which apply to sec. 4b.401 (c))*.

(a) Tests should be conducted to determine the time required for the propeller to change from windmilling (with the propeller controls set for takeoff) to the feathered position at the takeoff safety speed, V_2.

(b) The propeller feathering system should be tested to demonstrate nonrotation up to 1.2 times the maximum level flight speed with one engine inoperative or the speed employed in emergency descents whichever is higher with:

Critical engine—inoperative.
Wing flaps—retracted.
Landing gear—retracted.
Cowl flaps—closed.

A sufficient speed range should be covered to assure that the propeller feathering angle established on the basis of the high speed requirement should not permit rotation in reverse at the lower speeds. In addition, the propeller should not inadvertently unfeather during these tests.

(c) In order to demonstrate that the feathering system operates satisfactorily, the propeller should be feathered and unfeathered at the maximum operating altitude established in accordance with section 4b.722. The following data should be recorded:

Time to feather propeller at the one-engine-inoperative cruising speed.
Time to unfeather propeller to 1000 r. p. m. at maximum operating altitude and one-engine-inoperative cruising speed.
Altitude of propeller feathering tests.
Ambient air temperature of propeller feathering tests.

(19 F. R. 4463, July 20, 1954, effective Sept. 1, 1954.)

4b.401–3 *Continued rotation of turbine engines (CAA policies which apply to sec. 4b.401 (c))*.

(a) If means are not provided to completely stop the rotation of turbine engines it should be shown that continued rotation,[24] either windmilling or controlled, of a shutdown turbine engine will not cause:

(1) Powerplant (including engine and accessories) structural damage which will adversely affect other engines or the aircraft structure;

(2) Flammable fluid to be pumped into a fire or onto an ignition source; or

[24] It may be assumed that the conditions in paragraph (a) will not occur at engine rotor speeds up to 400 r. p. m.

(3) A vibration mode which will adversely affect the aerodynamic or structural integrity of the airplane.

(b) Feathered propellers, brakes, doors or other means used to control turbine engine rotation need not produce a complete stop of engine rotation [24] under all flight conditions unless continued rotation will result in any of the conditions set forth in paragraph (a).

(c) If engine induction air duct doors, or shaft, or other types of brakes [25] are provided

[24] It may be assumed that the conditions in paragraph (a) will not occur at engine rotor speeds up to 400 r.p.m.

[25] The provision of doors or brakes is a protective feature to assure that the conditions of paragraph (a) will not occur. Such provision, therefore, should be of a high order of reliability, and the probability should be remote that doors or brakes will not function normally on demand.

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Powerplant Controls and Accessories

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 rotorcraft.

[6.400–1 *Powerplant installation components (CAA interpretations which apply to sec. 6.400).* The term "all components" includes engines and their parts, appurtenances, and accessories which are furnished by the engine manufacturer and all other components of the powerplant installation which are furnished by the rotorcraft manufacturer. For example: fuel pumps, lines, valves, and other components of the fuel system which are integral parts of the type certificated engine are also components of the rotorcraft powerplant installation.]

(23 F. R. 9018, Nov. 20, 1958, effective Dec. 22, 1958.)

6.401 *Engines.*

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

(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.

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