Fire detectors shall comply with the following provisions:

(a) Fire detectors shall be constructed and installed to assure their ability to resist without failure all vibration, inertia, and other loads to which they would be subjected in operation.

(b) Fire detectors shall be unaffected by 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 electric circuit associated with the fire-detection system.

(d) Wiring and other components of detector systems which are located in fire zones shall be of fire-resistant construction.

(e) Detector system components for any fire zone shall not pass through other fire zones, unless they are protected against the possibility of false warnings resulting from fires in zones through which they pass. This requirement shall not be applicable with respect to zones which are simultaneously protected by the same detector and extinguisher systems.

§ 4b.486 *Fire walls.* All engines, auxiliary power units, fuel-burning heaters, and other combustion equipment which are intended for operation in flight shall be isolated from the remainder of the airplane by means of fire walls, shrouds, or other equivalent means. The following shall apply.

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

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

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

§ 4b.487 *Cowling and nacelle skin.* (a) Cowling shall be constructed and supported so as to make it capable of resisting all vibration, inertia, and air loads to which it would be subjected in operation.

(b) Cowling shall have drainage and ventilation provisions as prescribed in § 4b.489.

(c) On airplanes equipped with a diaphragm complying with § 4b.488, the parts of the accessory section cowling which might be subjected to flame in the event of a fire in the engine power section of the nacelle shall be constructed of fireproof material and shall comply with the provisions of § 4b.486.

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

(e) The airplane shall be so designed and constructed that fire originating in the engine power or accessory sections cannot enter, either through openings or by burning through external skin, into any other zone of the nacelle where such fire would create additional hazards. If the airplane is provided with a retractable landing gear, this provision shall apply with the landing gear retracted. Fireproof materials shall be used for all nacelle skin areas which might be subjected to flame in the event of a fire originating in the engine power or accessory sections.

§ 4b.488 *Engine accessory section diaphragm.* Unless equivalent protection can be shown by other means, a diaphragm shall be provided on air-cooled engines to isolate the engine power section and all portions of the exhaust system from the engine accessory compartment. This diaphragm shall comply with the provisions of § 4b.486.

§ 4b.489 *Drainage and ventilation of fire zones.* (a) Provision shall be made for the rapid and complete drainage of all portions of designated fire zones in the event of failure or malfunctioning of components containing flammable fluids. The drainage provisions shall be so arranged that the discharged fluid will not cause an additional fire hazard.

(b) All designated fire zones shall be ventilated to prevent the accumulation of flammable vapors. Ventilation openings shall not be placed in locations which would permit the entrance of flammable fluids, vapors, or flame from other zones. The ventilation provisions shall be so arranged that the discharged vapors will not cause an additional fire hazard.

(c) Except with respect to the engine power section of the nacelle and the combustion heater ventilating air ducts, provision shall be made to permit the crew to shut off sources of forced ventilation in any fire zone, unless the extinguishing agent capacity and rate of discharge are based on maximum air flow through the zone.

§ 4b.490 *Protection of other airplane components against fire.* All airplane surfaces aft of the nacelles, in the region of one nacelle diameter on both sides of the nacelle center line, shall be constructed of fire-resistant material. This provision need not be applied to tail surfaces lying behind nacelles, unless the dimensional configuration of the aircraft is such that the tail surfaces could be affected readily by heat, flames, or sparks emanating from a designated fire zone or engine compartment of any nacelle.

SUBPART F—EQUIPMENT

GENERAL

§ 4b.600 *Scope.* The required basic equipment as prescribed in this subpart is the minimum which shall be installed in the airplane for certification. Such additional equipment as is necessary for a specific type of operation is prescribed in the operating rules of this subchapter.

§ 4b.601 *Functional and installational requirements.* Each item of equipment shall be:

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

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

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

(d) Demonstrated to function properly in the airplane.

§ 4b.602 *Required basic equipment.* The equipment listed in §§ 4b.603 through 4b.605 shall be the required basic equipment. (See § 4b.600.)

§ 4b.603 *Flight and navigational instruments.* (See § 4b.612 for installation requirements.)

(a) Air-speed indicating system,

(b) Altimeter (sensitive),

(c) Clock (sweep-second),

(d) Free air temperature indicator,

(e) Gyroscopic bank and pitch indicator,

(f) Gyroscopic rate-of-turn indicator (with bank indicator),

(g) Gyroscopic direction indicator,

(h) Magnetic direction indicator,

(i) Rate-of-climb indicator (vertical speed),

(j) Maximum allowable air-speed indicator if an air-speed limitation results from compressibility hazards. (See § 4b.710.)

§ 4b.604 *Powerplant instruments.* (See § 4b.613 for installation requirements.)

(a) Carburetor air temperature indicator for each engine,

(b) Coolant temperature indicator for each liquid-cooled engine,

(c) Cylinder head temperature indicator for each air-cooled engine,

(d) An individual fuel pressure indicator for each engine and either an independent warning device for each engine or a master warning device for all engines with means for isolating the individual warning circuit from the master warning device,

(e) Fuel flowmeter indicator or fuel mixture indicator for each engine not equipped with an automatic altitude mixture control,

(f) Fuel quantity indicator for each fuel tank,

(g) Manifold pressure indicator for each engine,

(h) An individual oil pressure indicator for each engine and either an independent warning device for each engine or a master warning device for all engines with means for isolating the individual warning circuit from the master warning device,

(i) Oil quantity indicator for each oil tank when a transfer or oil reserve supply system is used,

(j) Oil temperature indicator for each engine,

(k) Tachometer for each engine,

(l) Fire warning indicators (see § 4b.485),

(m) A device for each engine capable of indicating to the flight crew during flight any change in the power output, if the engine is equipped with an automatic propeller feathering system the operation of which is initiated by a power output measuring system or if the total engine cylinder displacement is 2,000 cubic inches or more.

(n) A means for each reversing propeller to indicate to the pilot when the propeller is in reverse pitch.

(h) *Protective breathing system.* When protective breathing equipment is required by the Civil Air Regulations, it shall be designed to protect the flight crew from the effects of smoke, carbon dioxide, and other harmful gases while on flight deck duty and while combating fires in cargo compartments (see § 4b.380 (c)). The protective breathing equipment and the necessary supply of oxygen shall be in accordance with the following provisions.

(1) The protective breathing equipment shall include masks covering the eyes, nose, and mouth, or only the nose and mouth where accessory equipment is provided to protect the eyes.

(2) A supply of protective oxygen per crew member shall be of 15-minute duration at a pressure altitude of 8,000 feet and a respiratory minute volume of 30 liters per minute BTPD.

NOTE: When a demand type oxygen system is employed, a supply of 300 liters of free oxygen at 70° F. and 760 mm Hg. pressure is considered to be of 15-minute duration at the prescribed altitude and minute volume. When a continuous flow protective breathing system is used, including a mask with a standard rebreather bag, a flow rate of 60 liters per minute at 8,000 feet (45 liters per minute at sea level) and a supply of 600 liters of free oxygen at 70° F. and 760 mm Hg. pressure is considered to be of 15-minute duration at prescribed altitude and minute volume. (BTPD refers to body temperature conditions, i. e., 37° C., at ambient pressure, dry.)

§ 4b.652 *Engine-driven accessories.* Engine-driven accessories essential to safe operation of the airplane shall be so distributed among two or more engines that the failure of any one engine will not impair the safe operation of the airplane.

§ 4b.653 *Hydraulic systems; strength*—(a) *Structural loads.* All elements of the hydraulic system shall be designed to withstand, without detrimental permanent deformation, all structural loads which may be imposed simultaneously with the maximum hydraulic loads occurring in operation.

(b) *Proof pressure tests.* All elements of the hydraulic system shall be tested to a proof pressure of 1.5 times the maximum pressure to which the part will be subjected in normal operation. In such test no part of the hydraulic system shall fail, malfunction, or suffer detrimental deformation.

(c) *Burst pressure strength.* Individual hydraulic system elements shall be designed to withstand pressures which are sufficiently increased over the pressures prescribed in paragraph (b) of this section to safeguard against rupture under service conditions.

NOTE: The following pressures, in terms of percentage of maximum operating pressure for the particular element, in most instances are sufficient to insure against rupture in service: 250 percent in units under oil pressure, 400 percent in units containing air and oil under pressure and in lines, hoses, and fittings, 300 percent in units of system subjected to back pressure.

§ 4b.654 *Hydraulic systems; design*—(a) *Pressure indication.* A means shall be provided to indicate the pressure in each main hydraulic power system.

(b) *Pressure limiting provisions.* Provision shall be made to assure that pressures in any part of the system will not exceed a safe limit above the maximum operating pressure of the system and to insure against excessive pressures resulting from fluid volumetric changes in all lines which are likely to remain closed long enough for such changes to take place. In addition, consideration shall be given to the possible occurrence of detrimental transient (surge) pressures during operation.

(c) *Installation.* Hydraulic lines, fittings, and components shall be installed and supported to prevent excessive vibration and to withstand inertia loads. All elements of the installation shall be protected from abrasion, corrosion, and mechanical damage.

(d) *Connections.* Flexible hose, or other means of providing flexibility, shall be used to connect points in a hydraulic fluid line between which there is relative motion or differential vibration.

§ 4b.655 *Hydraulic system fire protection.* When flammable type hydraulic fluid is used, the hydraulic system shall comply with the provisions of §§ 4b.385, 4b.481, 4b.482, and 4b.483.

§ 4b.658 *Vacuum systems.* (a) Means, in addition to the normal pressure relief, shall be provided to relieve automatically the pressure in the discharge lines from the vacuum pump, if the delivery temperature of the air reaches an unsafe value.

(b) Vacuum system lines and fittings on the discharge side of the pump which might contain flammable vapors or fluids shall comply with § 4b.483 if they are located in a designated fire zone. Other vacuum system components located in designated fire zones shall be fire-resistant.

SUBPART G—OPERATING LIMITATIONS AND INFORMATION

GENERAL

§ 4b.700 *Scope.* (a) The operating limitations listed in §§ 4b.710 through 4b.723 shall be established as prescribed in this part.

(b) The operating limitations, together with any other information concerning the airplane found necessary for safety during operation, shall be included in the Airplane Flight Manual (§ 4b.740), shall be expressed as markings and placards (§ 4b.730), and shall be made available by such other means as will convey the information to the crew members.

OPERATING LIMITATIONS

§ 4b.710 *Air-speed limitations; general.* When air-speed limitations are a function of weight, weight distribution, altitude, or Mach number, the values corresponding with all critical combinations of these values shall be established.

§ 4b.711 *Never-exceed speed V_{NE}.* (a) To allow for possible variations in the airplane characteristics and to minimize the possibility of inadvertently exceeding safe speeds, the never-exceed speed V_{NE} shall be a speed established sufficiently below the lesser of:

(1) The design dive speed V_D chosen in accordance with § 4b.210 (b) (5), or

(2) The maximum speed demonstrated in flight in accordance with § 4b.190.

(b) In the absence of a rational investigation, the value of V_{NE} shall not exceed 0.9 times the lesser of the two speeds referred to in paragraph (a) of this section.

§ 4b.712 *Normal operating limit speed V_{NO}.* (a) The normal operating limit speed V_{NO} shall be established not to exceed the design cruising speed V_C chosen in accordance with § 4b.210 (b) (4) and sufficiently below the never-exceed speed V_{NE} to make it unlikely that V_{NE} would be exceeded in a moderate upset occurring at V_{NO}.

(b) In the absence of a rational investigation, the value of V_{NO} shall not exceed 0.9 times V_{NE}.

§ 4b.713 *Maneuvering speed.* The maneuvering speed shall not exceed the design maneuvering speed V_A determined in accordance with § 4b.210 (b) (2).

§ 4b.714 *Flap extended speed V_{FE}.* (a) The flap extended speed V_{FE} shall be established not to exceed the lesser of:

(1) The design flap speed V_F chosen in accordance with § 4b.210 (b) (1), or

(2) The design speed for slipstream effects with flaps in the landing position, chosen in accordance with § 4b.221.

(b) The value of V_{FE} established in accordance with paragraph (a) of this section shall not be less than a value which provides a safe speed margin above the stall during approach and landing.

(c) It shall be acceptable to establish supplementary values of V_{FE} for other combinations of flap setting, air speed, and engine power, if the structure and the flight characteristics of the airplane have been shown to be satisfactory for such combinations.

§ 4b.715 *Landing gear operating speed V_{LO}.* The landing gear operating speed V_{LO} shall be established not to exceed a speed at which it is safe to extend or retract the landing gear as limited by design in accordance with § 4b.334 or by flight characteristics.

§ 4b.716 *Landing gear extended speed V_{LE}.* The landing gear extended speed V_{LE} shall be established not to exceed a speed at which it has been shown that the airplane can be safely flown with the landing gear secured in the fully extended position, and for which the structure has been proven in accordance with § 4b.334.

§ 4b.717 *Minimum control speed V_{MC}.* (See § 4b.133.)

§ 4b.718 *Powerplant limitations.* The following powerplant limitations shall be established for the airplane. They shall not exceed the corresponding limits established as a part of the type certification of the engine and propeller installed in the airplane.

(a) *Take-off operation.* (1) Maximum rotational speed (r. p. m.),

(2) Maximum permissible manifold pressure,

a smaller capacity shall be acceptable if operating limitations are established to assure that in service the accumulation of water will not exceed the sump capacity.

55. By amending § 4b.430 (a) (3) by adding the word "Reciprocating" at the beginning of the second sentence.

56. By amending § 4b.430 (b) (1) by inserting the words "reciprocating engine" between the words "of" and "installations".

57. By amending § 4b.431 (a) by adding a new sentence at the end thereof to read as follows: "In turbine engine fuel systems, provisions shall be made to maintain the fuel pressure at the inlet to the engine fuel system within the limits established for engine operation."

58. By amending § 4b.435 by adding a new paragraph (d) to read as follows:

4b.435 Fuel strainer. * * *

(d) When filter or strainers susceptible to icing are incorporated in the fuel system, a means shall be provided to maintain automatically the fuel flow in the event ice particles accumulate and restrict flow by clogging the filter or screen.

59. By amending § 4b.437 (c) by adding a new sentence at the end thereof to read as follows: "For turbine-powered airplanes, the design of the jettisoning system shall be such that it would not be possible to jettison fuel in the tanks used for take-off and landing below the level providing climb from sea level to 10,000 feet and thereafter providing 45 minutes cruise at a speed for maximum range."

60. By amending § 4b.451 (c) to read as follows:

4b.451 Cooling tests. * * *

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

61. By amending § 4b.604 by deleting paragraph (b).

62. By amending § 4b.637 by adding a new sentence at the end thereof to read as follows: "If an additional anti-collision light is installed on the bottom of the fuselage, the prescribed limits of effective flash frequency in the overlap region of the two light beams need not be met."

63. By amending § 4b.643 by adding a new sentence at the end thereof to read as follows: "In the case of safety belts for berths, the forward load factor need not be applied."

64. By amending § 4b.711 (b) by adding a note at the end thereof to read as follows:

NOTE: Where speeds are limited by compressibility effects, this section is intended to provide an adequate margin between M_{NE} and the lowest of the following Mach values: M_D, M_{DF}, or the Mach number where adverse flight characteristics, such as the following, occur: Undue reduction in ability to recover; rapid or large changes in stability during level flight or recovery which would cause the airplane to exceed structural limits; buffeting so severe as to endanger the structural integrity of the airplane. The speed margin required usually depends upon the effectiveness of the warning provided to the pilots whenever M_{NE} is reached or exceeded, and upon the recovery or speed control characteristics of the airplane. In any case the margin should be sufficient: To enable recovery from mild upsets due to gusts or inadvertent control movements or trim changes; to allow for inadvertent increases in Mach number due to horizontal gusts or temperature inversions; and, for instrument inaccuracies or airplane production differences. The probability of the simultaneous occurrence of the aforementioned speed margin conditions are usually considered, but the effects of all such conditions are not necessarily additive.

65. By amending §§ 4b.718 (a) (4), (a) (5) and (b) (3) by deleting in each instance the words "or coolant outlet".