6 November 1964

SPECIAL CONDITIONS FOR THE TYPE CERTIFICATION
OF MULTIENGINE TURBINE POWERED AIRCRAFT IN ACCORDANCE WITH
CIVIL AIR REGULATIONS, PART 3

These special conditions have been formulated under the concept of equivalent safety and of providing an aircraft that has no features or characteristics which render it unsafe as provided for in Civil Air Regulations Part 3, dated May 15, 1956, including Amendments 3-1 through 3-8 inclusive. They will be applied against a background of knowledge gained from study of the project as it progresses toward type certification.

AIRFRAME AND EQUIPMENT

1. CAR 3.195 - Engine Torque Effects.

(a) In addition to complying with the conditions specified in CAR 3.195(a)(1) and (a)(2), engine mounts and their supporting structures, for turbine propeller installations, shall be designed for the limit torque corresponding with take-off power and propeller speed multiplied by a factor of 1.6 acting simultaneously with 1G level flight loads.

(b) In lieu of CAR 3.195(b): "The limit torque for turbine engines shall be obtained by multiplying the mean torque by a factor of 1.25."

2. Gyroscopic Loads. Engine mounts and their supporting structures shall be designed for the gyroscopic loads resulting during the conditions prescribed in either subparagraph (a) or subparagraph (b):

(a) the maneuvers prescribed in CAR 3.191(b) and CAR 3.216.

(b) the most critical combinations of loads due to;

(i) a yaw velocity of 2.5 radians per second,

(ii) a pitch velocity of 1.0 radian per second,

(iii) a normal load factor of 2.5, and

(iv) thrust at maximum continuous r.p.m.

3. CAR 3.245 - Level Landing.

Engine mounts, their supporting structure, the wing, and the wing-to-fuselage attaching structure shall be designed for the dynamic landing loads resulting from the aircraft landing in the two wheel level landing condition of CAR 3.245(b)(2).

4. CAR 3.311 - Flutter and Vibration.

Propeller Precessional Modes shall be evaluated to the degree necessary to assure stability. The evaluation shall include variations in the essential input parameters such as inertia, stiffness, damping or equivalent functions.

5. Aircraft Loads Due to Engine Failure.

The airplane shall be designed for the limit loads resulting from fuel flow interruption to the critical engine at all speeds between V_{mc} and V_d and for the limit loads resulting from the pilot's probable corrective action. Pilot corrective action shall be assumed to occur not earlier than two seconds after engine failure. The magnitude of the corrective action may be based on the control forces specified in CAR 3.212 except that lower forces may be assumed if it is shown by analysis or tests that such forces will control the yaw and roll resulting from the prescribed engine failure.

POWERPLANT

6. CAR 3.1 - Definitions. The following shall apply:

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

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

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

7. CAR 3.411(c) - Engine Operating Characteristics. The operating characteristics of the engine shall be investigated in flight to determine that no adverse characteristics, such as stall, surge, or flame-out are present to a hazardous degree during normal and emergency operation of the airplane within the range of the operating limitations of the airplane and of the engine.

8. CAR 3.411(d) - Engine Acceleration. Time required to accelerate the engines as installed in the airplane shall be acceptable with respect to airplane operational characteristics when the engine power level is advanced from the idle and intermediate thrust settings to takeoff thrust position.

9. CAR 3.415 - The following shall apply:

(a) Engine turbine wheel failure. The powerplant installation shall provide protection against turbine wheel failure such that wheel failure will not jeopardize the continued safe operation of the airplane, unless the engine type certificate specifies that wheel integrity meets the criteria of CAR Part 13.

(b) Engine rotor blade protection. The powerplant installation shall provide protection against rotor blade failure such that rotor blade failure will not jeopardize the continued safe operation of the airplane, unless the engine type certificate specifies that the engine is substantiated as being capable of containing damage resulting from rotor blade failure.

(c) Engine component vibration. No critical component in the engine shall be adversely affected vibrationwise when installed in the aircraft.

10. CAR 3.416 - Propeller Installation. In addition to meeting the present requirements of CAR 3.416(a), (b), and (c), the propeller installation, including blade pitch control mechanisms, emergency protective features, and devices intended to coordinate propeller and engine functions, shall be determined to be suitable for the purpose by means of analysis, component testing, flight demonstration, service testing, or a combination of these means.

11. CAR 3.418(a). Reversing systems intended for ground operation only shall be such that no single failure or malfunctioning of the system under all anticipated conditions of airplane operation will result in unwanted reverse thrust. Failure of structural elements need not be considered if occurrence of such failure is expected to be extremely remote.

12. CAR 3.418(b). On multiengine turbine powered aircraft, if engine failure or propeller malfunction during normal or emergency operation can result in sufficiently rapid increase in drag to affect airplane control to a hazardous degree, then means shall be provided to limit drag to a safe value.

13. Inflight Restarting. The inflight restarting characteristics and limitations of the engine should be demonstrated and evaluated over the operating range of the airplane. Restarting information shall be included in the Airplane Flight Manual.

14. CAR 3.429. Fuel system for turbine engine installation shall provide for continuous flow of all fuel to the engine in normal operation without interruption of fuel flow due to depletion of fuel in tanks other than the main tanks.

15. CAR 3.435 - Fuel Flow Rate. The fuel flow capacity of the airplane fuel system shall be 125% of fuel flow required to develop the standard sea level take-off power or thrust. A fuel flow rate of 100% of maximum flow required shall be obtainable with the fuel filter blocked.

16. CAR 3.441. For use in turbine powered airplanes, the fuel tanks as mounted in the aircraft shall be designed so as to withstand the greater of the following pressures without failure or leakage: (a) 3.5 psi; (b) 125% of the maximum air pressure developed in the tank; (c) the pressure equivalent to the hydrostatic head developed during max. limit acceleration of the aircraft with a full tank.

17. CAR 3.449. Turbine engines which do not possess a pad for directly driving a fuel pump, a reliable and independent power source for each pump shall be provided. It shall be demonstrated that the pump installations provide a reliability and durability equivalent to that intended by CAR 3.449(a) and (b).

18. CAR 3.552(a) - Fuel System Filters Ice Protection. When filters or strainers susceptible to icing are incorporated in the fuel system, a means shall be provided to automatically maintain fuel flow in the event ice particles accumulate and restrict flow by clogging the filter or screen, unless means are incorporated in the fuel system to prevent the accumulation of ice particles on the filter or strainer.

19. CAR 3.552(b) - Mesh and Capacity. The fuel strainer or filter shall be of adequate capacity, commensurate with operating limitations established to insure proper service and of appropriate mesh to insure proper engine operation with the fuel contaminated to a degree, with respect to particle size and density, which can be reasonably expected to occur in service. The degree of fuel filtering shall be not less than that established for the engine in accordance with Part 13 of this subchapter.

20. CAR 3.581 - Cooling. Tests shall be conducted to demonstrate that all powerplant components for which temperature limits have been established are cooled within those limits.

21. CAR 3.606 - Engine Ice Protection. Turbine powered aircraft shall be capable of operation throughout the flight power range without accumulation of ice in the air induction system such as to adversely affect engine operation or cause a serious loss of power and/or thrust, under icing conditions defined in CAR 4b.1(b)(7) and (8).

22. CAR 3.608. Turbine powered airplanes shall have a deicing fluid supply that is adequate for the type of operation intended for the aircraft.

23. CAR 3.611(a) - Induction System Ducts. The design of the engine air inlet duct shall be such as to assure that flammable fluids will not leak or be carried into the engine intake in case of failure of malfunctioning of any flammable fluid carrying component on or near the engine. If induction system screens are employed and fluid deicing is used to deice the induction system and screen, it shall be demonstrated that fire hazard will not occur.

24. CAR 3.611(b) - Air Inlet Protection. The engine air inlet duct(s) shall be so located or protected as to minimize the ingestion of foreign matter under normal ground or flight operating conditions.

25. CAR 3.615 - Exhaust System. The exhaust tail pipe should be so arranged or provided with drains that during an attempted start when the engine does not ignite immediately, fuel cannot accumulate within the tail pipe or in any joints in the system. The fuel should be drained rapidly and should discharge clear of the airplane in all ground and flight attitudes. It should not be possible for reversals of airflow which may occur under various flight or engine operating conditions to cause drained fuel to be drawn back into any part of the engine installation where a hazard of ignition may exist.

26. CAR 3.627(a) - Powerplant Control System. The powerplant control system shall be investigated to show that no single failure or malfunction in the aircraft installed components of this system will cause a hazardous condition which cannot be controlled safely in flight. Consideration should be given to the probability of failure of individual parts and components in determining the need for protection, duplication, or back-up devices.

27. CAR 3.632(a). Propeller reverse thrust controls shall incorporate a means to prevent their inadvertent movement to a reverse thrust position. The means provided shall incorporate a positive lock or stop at the flight idle position and shall require a separate and distinct operation by the crew in order to displace the control from the flight regime.

28. CAR 3.637 - Fire Protection. In addition to the normal Part 3 requirements, the following shall apply to turbine engines:

(a) Means shall be provided for isolating flammable fluid system components and fittings from sources of ignition. (A surface temperature of 500°F is considered a possible source of ignition.)

(b) Flammable fluids shall not be routed into or through the combustor or tailpipe zones unless protected by fireproof shrouds ventilated and drained to a suitable external point.

(c) Suitable means shall be provided to shut off the flow in all lines carrying flammable fluids into the engine compartments.

(d) All lines and fittings carrying flammable fluids into or through engine compartments, shall be of fire-resistant construction. Where lines connect parts subject to relative motion, approved type fire-resistant hose assemblies shall be used.

(e) All openings, joints, or connections in the firewall or shroud shall be sealed with fire-proof materials.

EQUIPMENT AND INSTRUMENTS

29. Powerplant Instruments. In lieu of CAR 3.655(b), the following shall be complied with:

Powerplant instruments required below shall be continuous indicating display types except where a visual warning type is specified.

a) Gas temperature (for each engine)
b) Means to enable the pilot to determine brake horsepower (for each engine)
c) Oil pressure (for each engine)
d) Oil pressure warning (for each engine)
e) Oil temperature (for each oil system in each engine)
f) Oil quantity indicator (See CAR 3.674)
g) Tachometer (to indicate the speed of the rotors for which limiting speeds have been established) (for each engine)
h) Fuel quantity (for each fuel tank)
i) Free air temperature (one required)
j) Position indicator to indicate when the blade angle is below the flight low pitch position (for each propeller)
k) A light to indicate functioning of the propeller spinner deicing system (for each propeller)
l) Fuel flow meter (for each engine)

FLIGHT

30. CAR 3.16(b) - Functional and Reliability Test. Compliance is required with the additional test requirements of CAR 3.16(b).

31. CAR 3.80 - Performance Requirements. Irrespective of CAR 3.80, compliance shall be shown with CAR 3.84, 3.85, 3.86, and 3.112(a)(2)(ii).

32. CAR 3.82, 3.83 - Stalling Speeds. Since zero thrust may not be obtainable with the throttles closed at flight idle position, the following shall be complied with: Stalling speed shall not be less than that which would be obtained with zero thrust at the stall.

33. CAR 3.84 - Takeoff. In addition to the present requirement of CAR 3.84(b) the speed at a height of 50 feet above the level take-off surface shall not be less than the speed at which compliance with CAR 3.85(a) is shown.

34. CAR 3.85(a) - Normal Climb. In addition to meeting the present requirements of CAR 3.85(a) at standard temperature, the airplane shall meet a steady angle of climb of at least 1:25 at standard temperature plus 40°F at a pressure altitude of 5,000 feet.

35. CAR 3.85(b) - Inoperative Engine Climb. In addition to the present requirement of CAR 3.85(b) the following shall apply.

The climb performance capability shall be determined for the following combinations of weight, altitude, and ambient temperatures. For takeoff at altitudes of 5000 feet and below, the maximum takeoff weight shall be limited to that which provides a minimum steady rate of climb at a pressure altitude of 5000 feet of:

(a) $0.02\ V_{so}^{2}$ at standard temperature (41°F).

(b) $0.01\ V_{so}^{2}$ at standard temperature plus 40°F (81°F).

(c) The variation between the rates of climb at (a) and (b) above shall vary linearly.

The applicant shall provide sufficient information in the airplane flight manual so that the above requirements can be met.

36. CAR 3.85(c) - Balked Landing Condition. In addition to meeting the present requirements of CAR 3.85(c) at standard temperature, with a climb speed not in excess of $1.4\ V_{so}$, the steady climb performance shall not be less than zero at standard temperature plus 40°F at a pressure altitude of 5,000 feet, and with a climb speed not in excess of $1.4\ V_{so}$.

37. CAR 3.86 - Landing.

a. In addition to meeting the present requirements, the landing distances shall be obtained in accordance with procedures established by the applicant. Such procedures shall include all changes in the airplane configuration, i.e., power, speed, drag devices, etc. Allowances shall be made for time delays in the execution of the procedures as may be reasonably expected to occur during service.

b. Add the following to the present requirements: "In addition to, or in lieu of wheel brakes, the use of other braking means shall be acceptable in determining the landing distances, provided such braking means shall have been proven to be safe and reliable."

c. If the characteristics of a device (e.g., the propellers) dependent upon operation of any of the engines noticeably increase the landing distances when the landing is made with an engine inoperative, the landing distance shall be determined with the critical engine inoperative.

38. CAR 3.109(a)(1), 3.109(c), 3.110(a)(1), 3.110(b)(2) - Longitudinal Control and Lateral & Directional Control - In lieu of present requirements regarding maximum continuous power: "Maximum continuous power selected by the applicant as an operating limitation for use during climb." (CAR 3.744)

39. CAR 3.112(a)(2)(i). In lieu of present requirement: "During a climb with maximum continuous power as selected by the applicant as an operating limitation at a speed between V_x and 1.4 V_{s1}.

40. CAR 3.112(b)(1). In lieu of present requirement: "The other engine operating at maximum continuous power as selected by the applicant as an operating limitation."

41. CAR 3.115(b) - Climb Stability. The airplane shall comply with CAR 3.115(b)(4) at maximum power selected by the applicant as an operating limitation for use during climb.

42. CAR 3.115(c) - Cruising Stability. The airplane shall comply with CAR 3.115(c)(1)(iv) at 75 percent of maximum continuous power or the maximum cruising power selected by the applicant as an operating limitation whichever is the greater, except that the power need not exceed that required at V_{no}.

The airplane shall comply with CAR 3.115(c)(1)(v) with the airplane trimmed for level flight and with the power specified above.

43. CAR 3.745 - Maximum Operating Altitude. In addition to the present operating limitations, the following special condition will apply: "A maximum operating altitude to which operation is permitted as limited by flight, structural, powerplant, functional, or equipment characteristics."

44. CAR 3.777 - Airplane Flight Manual. Airplane Flight Manual shall be furnished in accordance with CAR 3.777(a).

45. A reliable accurate means should be provided to indicate power output of the engine.