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installation on the engine must be established and recorded.

[Amdt. 36–6, 39 FR 35468, Oct. 1, 1974]

§ 33.83 Vibration test.

(a) Each engine must undergo vibration surveys to establish that the vibration characteristics of those components that may be subject to mechanically or aerodynamically induced vibratory excitations are acceptable throughout the declared flight envelope. The engine surveys shall be based upon an appropriate combination of experience, analysis, and component test and shall address, as a minimum, blades, vanes, rotor discs, spacers, and rotor shafts.

(b) The surveys shall cover the ranges of power or thrust, and both the physical and corrected rotational speeds for each rotor system, corresponding to operations throughout the range of ambient conditions in the declared flight envelope, from the minimum rotational speed up to 103 percent of the maximum physical and corrected rotational speed permitted for rating periods of two minutes or longer, and up to 100 percent of all other permitted physical and corrected rotational speeds, including those that are overspeeds. If there is any indication of a stress peak arising at the highest of those required physical or corrected rotational speeds, the surveys shall be extended sufficiently to reveal the maximum stress values present, except that the extension need not cover more than a further 2 percentage points increase beyond those speeds.

(c) Evaluations shall be made of the following:

(1) The effects on vibration characteristics of operating with scheduled changes (including tolerances) to variable vane angles, compressor bleeds, accessory loading, the most adverse inlet air flow distortion pattern declared by the manufacturer, and the most adverse conditions in the exhaust duct(s); and

(2) The aerodynamic and aeromechanical factors which might induce or influence flutter in those systems susceptible to that form of vibration.

(d) Except as provided by paragraph (e) of this section, the vibration stresses associated with the vibration characteristics determined under this section, when combined with the appropriate steady stresses, must be less than the endurance limits of the materials concerned, after making due allowances for operating conditions for the permitted variations in properties of the materials. The suitability of these stress margins must be justified for each part evaluated. If it is determined that certain operating conditions, or ranges, need to be limited, operating and installation limitations shall be established.

(e) The effects on vibration characteristics of excitation forces caused by fault conditions (such as, but not limited to, out-of balance, local blockage or enlargement of stator vane passages, fuel nozzle blockage, incorrectly schedule compressor variables, etc.) shall be evaluated by test or analysis, or by reference to previous experience and shall be shown not to create a hazardous condition.

(f) Compliance with this section shall be substantiated for each specific installation configuration that can affect the vibration characteristics of the engine. If these vibration effects cannot be fully investigated during engine certification, the methods by which they can be evaluated and methods by which compliance can be shown shall be substantiated and defined in the installation instructions required by § 33.5.

[Doc. No. 28107, 61 FR 28433, June 4, 1996]

§ 33.84 Engine overtorque test.

(a) If approval of a maximum engine overtorque is sought for an engine incorporating a free power turbine, compliance with this section must be demonstrated by testing.

(1) The test may be run as part of the endurance test requirement of § 33.87. Alternatively, tests may be performed on a complete engine or equivalent testing on individual groups of components.

(2) Upon conclusion of tests conducted to show compliance with this section, each engine part or individual groups of components must meet the requirements of § 33.93(a)(1) and (a)(2).

(b) The test conditions must be as follows:

(1) A total of 15 minutes run at the maximum engine overtorque to be approved. This may be done in separate runs, each being of at least 2½ minutes duration.

(2) A power turbine rotational speed equal to the highest speed at which the maximum overtorque can occur in service. The test speed may not be more than the limit speed of take-off or OEI ratings longer than 2 minutes.

(3) For engines incorporating a reduction gearbox, a gearbox oil temperature equal to the maximum temperature when the maximum engine overtorque could occur in service; and for all other engines, an oil temperature within the normal operating range.

(4) A turbine entry gas temperature equal to the maximum steady state temperature approved for use during periods longer than 20 seconds when operating at conditions not associated with 30-second or 2 minutes OEI ratings. The requirement to run the test at the maximum approved steady state temperature may be waived by the FAA if the applicant can demonstrate that other testing provides substantiation of the temperature effects when considered in combination with the other parameters identified in paragraphs (b)(1), (b)(2) and (b)(3) of this section.

[Doc. No. 2007–28502, 74 FR 45310, Sept. 2, 2009]

§ 33.85 Calibration tests.

(a) Each engine must be subjected to those calibration tests necessary to establish its power characteristics and the conditions for the endurance test specified § 33.87. The results of the power characteristics calibration tests form the basis for establishing the characteristics of the engine over its entire operating range of speeds, pressures, temperatures, and altitudes. Power ratings are based upon standard atmospheric conditions with no airbleed for aircraft services and with only those accessories installed which are essential for engine functioning.

(b) A power check at sea level conditions must be accomplished on the endurance test engine after the endurance test and any change in power characteristics which occurs during the endurance test must be determined. Measurements taken during the final portion of the endurance test may be used in showing compliance with the requirements of this paragraph.

(c) In showing compliance with this section, each condition must stabilize before measurements are taken, except as permitted by paragraph (d) of this section.

(d) In the case of engines having 30-second OEI, and 2-minute OEI ratings, measurements taken during the applicable endurance test prescribed in § 33.87(f) (1) through (8) may be used in showing compliance with the requirements of this section for these OEI ratings.

[Doc. No. 3025, 29 FR 7453, June 10, 1964, as amended by Amdt. 33–6, 39 FR 35468, Oct. 1, 1974; Amdt. 33–18, 61 FR 31328, June 19, 1996]

§ 33.87 Endurance test.

(a) *General.* Each engine must be subjected to an endurance test that includes a total of at least 150 hours of operation and, depending upon the type and contemplated use of the engine, consists of one of the series of runs specified in paragraphs (b) through (g) of this section, as applicable. For engines tested under paragraphs (b), (c), (d), (e) or (g) of this section, the prescribed 6-hour test sequence must be conducted 25 times to complete the required 150 hours of operation. Engines for which the 30-second OEI and 2-minute OEI ratings are desired must be further tested under paragraph (f) of this section. The following test requirements apply:

(1) The runs must be made in the order found appropriate by the Administrator for the particular engine being tested.

(2) Any automatic engine control that is part of the engine must control the engine during the endurance test except for operations where automatic control is normally overridden by manual control or where manual control is otherwise specified for a particular test run.

(3) Except as provided in paragraph (a)(5) of this section, power or thrust, gas temperature, rotor shaft rotational speed, and, if limited, temperature of external surfaces of the engine must be