FEDERAL AVIATION AGENCY

FLIGHT STANDARDS SERVICE

[14 CFR Part 13]

[Notice 63-35; Docket No. 1925]

TWO AND ONE-HALF-MINUTE POWER RATING FOR HELICOPTER TURBINE ENGINES

Notice of Proposed Rule Making

The Federal Aviation Agency has under consideration a proposal to amend Part 13 of the Civil Air Regulations to establish a 2½-minute power rating and associated test requirements for type certification of turbine engines intended for use in multiengine helicopters. Manufacturers of engines, and manufacturers and operators of multiengine helicopters may be affected by these proposed amendments.

Interested persons are invited to participate in the making of the proposed rule by submitting such written data, views, or arguments as they may desire. Communications should identify the notice or docket number and be submitted in duplicate to the Federal Aviation Agency, Office of the General Counsel: Attention Rules Docket, Room A-103, 1711 New York Avenue, N.W., Washington, D.C. 20553. All communications received on or before November 4, 1963, will be considered by the Administrator before taking action upon the proposed rule. The proposals contained in this notice may be changed in the light of comments received. All comments submitted will be available, both before and after the closing date for comments, in the Rules Docket for examination by interested persons.

The currently effective provisions of Part 7 of the Civil Air Regulations require for Category A that the takeoff performance shall be

determined and scheduled in such a manner that, in the event of one engine becoming inoperative at any instant after the start of takeoff, it shall be possible for the rotorcraft either to return to and stop safely on the takeoff area, or to continue the takeoff climbout. For the landing approach, performance must be determined and scheduled in such a manner that, in the event of one engine becoming inoperative at any point in the approach path, it shall be possible for the rotorcraft to land and stop safely or to climbout safely. Under the present schedule of engine power ratings, takeoff power is used to show compliance with these requirements.

The Aerospace Industries Association of America, Inc., has petitioned the Administrator to issue a rule that would establish a rated power, greater than takeoff, but limited in use to two and one-half minutes to determine takeoff and approach performance when one engine of a multiengine helicopter becomes inoperative. The petitioner contends that establishment of such a rating would improve the economics of domestically built multiengine helicopters, would enhance the position of the United States manufacturers in the foreign market, and would result in no degradation of safety. In consideration of the effects of the proposed rating upon takeoff and landing performance, and pursuant to the authority vested in me by § 11.45 of the Federal Aviation Regulations [New] (27 F.R. 9585), I have concluded that the proposal made by petitioner for a two and one-half minute power rating warrants notice of proposed rule making action.

With respect to the effect of the 2 1/2-minute rating upon engine reliability, the limitations on turbine engine power and performance are determined, in a physical sense, by considerations of the cumulative turbine blade creep,

which is dependent principally upon the temperature and mechanical loads to which the blades are subjected. There has been no clear criterion for establishing the absolute power limit of a turbine engine. The power ratings that are established represent compromises intended to produce engines which have reasonable performance, a satisfactory service life, and are able to complete the endurance test program satisfactorily. When the basis for the established ratings is evaluated against the fundamental consideration of material creep, it is seen that higher temperatures and speeds than are associated with rated power levels may be attainable. To date, however, there has been no particular effort by manufacturers to exploit this capability.

To grant engine power ratings in excess of takeoff power would not be justifiable if engine reliability were adversely affected. It is recognized that there are temperatures and/or speeds for any particular engine that could result in immediate and catastrophic failure. It is also recognized that continued operation of a particular engine at temperatures and/or speeds slightly higher than its established limits would probably cause an appreciable reduction in service life. Referring, however, to the stated reasons for the industry proposal that a 2 1/2-minute power rating be introduced, it is seen that such a rating would be needed only in the event of an engine failure during takeoff or approach to landing. Service experience so far gathered with respect to multiengine helicopters indicates that this situation occurs relatively infrequently, hence, it would be expected that an engine would rarely be called upon to deliver 2 1/2-minute power. On this basis, it appears that establishment of 2 1/2-minute power would not adversely affect engine reliability by

subjecting turbine blades to prolonged operations at elevated temperatures or speeds. A definition of the power is proposed as a new § 13.1(b)(5). The format of the definition differs from that in the currently effective regulations. It is consistent with that of a rated power and properly does not include limitations. Similar revisions to the existing definitions of the various power and thrust ratings are being considered.

To establish that the introduction of 2 1/2-minute power will not involve temperatures or speeds that would immediately impair engine reliability, and otherwise to establish that a satisfactory level of overall reliability exists when the selected 2 1/2-minute rating is used, it is necessary that the endurance test schedule be modified for engines to be granted this rating. It is proposed to revise the endurance test schedule of § 13.254 to require that during the 150-hour endurance test the engine be operated at 2 1/2-minute power during 50 periods of 2 1/2 minutes duration. It is considered that this procedure will establish the reliability of the engine with a 2 1/2-minute rating when operated in service under the conditions proposed for this rating.

This proposal is subject to the FAA Recodification Program announced in Draft Release 61-25 (26 F.R. 10698). The final rule, if adopted, may be in the recodified form; however, the recodification itself will not alter the substantive contents proposed herein.

These amendments are proposed under the authority of sections 313(a), 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354, 1421, 1423).

In consideration of the foregoing, it is proposed to amend Part 13 of the Civil Air Regulations (14 CFR Part 13, as amended) as follows:

1. By amending § 13.1(b) by redesignating subparagraphs (5), (6), (7), and (8) as (6), (7), (8), and (9), and by adding a new subparagraph (5) to read as follows:

13.1 Definitions.

* * * * *

(b) General design.

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(5) Two and one-half-minute power for helicopter turbine engines. Two and one-half-minute power for helicopter turbine engines is the brake horsepower developed statically in standard atmosphere at sea level, or at a specified altitude, for one-engine-out operation of multiengine helicopters for two and one-half-minutes at rotor shaft rotational speed and gas temperature established for this rating.

2. By amending § 13.254 by adding a new paragraph (c) to read as follows:

13.254 Endurance test. * * *

(c) Helicopter engines for which 2 1/2-minute and 30-minute power ratings are desired.

(1) Takeoff, 2 1/2-minute power, and idling. One hour of alternate 5-minute periods of engine operation shall be conducted at takeoff power and thrust and at idling power and thrust except that, during the third and sixth takeoff power periods, only 2 1/2 minutes will be conducted at takeoff power and the remaining 2 1/2 minutes will be conducted at 2 1/2-minute power. The developed powers and thrusts at takeoff, 2 1/2-minute, and idling conditions and their corresponding rotor speed and gas temperature conditions shall be as established by the power control(s) in accordance with the schedule established by the manufacturer. It shall be permissible to control manually during any one period the rotor speed and power and thrust while taking data to check performance. For engines with augmented takeoff ratings which involve increases in turbine inlet temperature, rotor speed, or shaft power, this period of running at rated takeoff power shall be at the augmented rating. In changing the power setting after or during each period, the power control lever shall be moved in the manner prescribed in subparagraph (5) of this paragraph.

(2) Thirty-minute power. Thirty minutes of engine operation shall be conducted at 30-minute power, or thrust, or both.

(3) Maximum continuous power and thrust. Two hours of engine operation shall be conducted at the maximum continuous power and thrust.

(4) Incremental cruise power and thrust. Two hours of engine operation shall be conducted at the successive power lever positions

corresponding with not less than 12 approximately equal speed and time increments between maximum continuous engine rotational speed and ground or minimum idle rotational speed. For engines operating at constant speed, it shall be permissible to vary the thrust and power in lieu of speed. In the event significant peak vibrations exist anywhere between ground idle and maximum continuous conditions, the number of increments chosen shall be altered to increase the amount of running conducted while being subjected to the peak vibrations up to an amount not exceeding 50 percent of the total time spent in incremental running. (See also § 13.251).

(5) Acceleration and deceleration runs. Thirty minutes of engine operation shall be conducted of accelerations and decerlations consisting of 6 cycles from idling power and thrust to takeoff power and thrust and maintaining at the takeoff power lever position for 30 seconds and at the idling power lever position for approximately 4 1/2 minutes. In complying with the provisions of this subparagraph, the power-control lever shall be moved from one extreme position to the other in not more than one second except that, where different regimes of control operations are incorporated necessitating scheduling of the power-control lever motion in going from one extreme position to the other, a longer period of time shall be acceptable but in no case shall this time exceed 2 seconds.

(6) Starts. One hundred starts shall be made, of which 25 starts shall be preceded by at least a 2-hour engine shutdown. Ten starts shall be false engine starts pausing for the applicant's specified minimum fuel drainage time before attempting a normal start. Ten starts shall be normal restarts, each performed not more than 15 minutes after engine shutdown. It shall be acceptable to make the remaining starts after completion of the 150 hours of endurance testing.

(7) Maximum temperatures. The limiting maximum hot gas and oil inlet temperatures shall be substantiated by operation at these limits during all the takeoff, 2½-minute power, 30-minute power, and maximum continuous running of the endurance test.

Acting Director,
Flight Standards Service

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