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DATE: 2/25/69



ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION

SUBJECT: ESTABLISHMENT AND REVISION OF AIRCRAFT ENGINE OVERHAUL
AND INSPECTION PERIODS

1. PURPOSE. This advisory circular describes methods and procedures in use by the Federal Aviation Administration for the establishment and revision of overhaul periods for aircraft engines and related components used by scheduled and supplemental air carriers and commercial operators. The information in this circular also covers powerplants and components in helicopters used by such operators.
2. CANCELLATION. Advisory Circular 120-24, dated 9/1/66, is cancelled.
3. REFERENCES. Federal Aviation Regulations Parts 121 and 127 and Advisory Circulars AC 120-17 and AC 120-21.
4. BACKGROUND. Federal Aviation Regulations Sections 121.25, 121.45, and 127.13 require that time limitations or standards for determining time limitations be established for overhauls, inspections, and checks of airframes, engines, propellers, and appliances:
 - a. The agency and the airline industry recognize the need to develop better procedures for measuring engine reliability to keep pace with technical advancements in transport aircraft and in the state-of-the-maintenance-art.
 - b. As a result, various propulsion and systems reliability study programs have been proposed and evaluated over the past several years.
 - c. These joint FAA/industry efforts resulted in development and adoption of new programs and procedures for determining and assuring engine and component reliability. Because of the rapid advancement in techniques used to evaluate engine airworthiness, the agency believes it would be helpful if the various methods now in use are described.

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5. BASIC CONSIDERATIONS. In establishing or revising limitations, the agency examines: a. overall airline service experience with the type and model engine involved, b. the operator's geographical area and type of operation, c. operating procedures, d. maintenance and inspection programs, e. product improvement programs, f. the individual operator's service experience, g. manufacturers' recommendations applicable to the engines and components involved, h. shutdown rates, i. mechanical reliability reports, j. mechanical interruption summaries, and k. applicable maintenance or overhaul arrangements made by the operator with other persons. Primary consideration is given to service experience.

Emphasis is placed on trends indicative of an excessive number of malfunctions in critical areas and analysis of data from tests, inspections, or measurements performed while accumulating such service experience.

6. ESTABLISHMENT OF INITIAL LIMITATIONS. Initial time limitations are established for engines and related components in accordance with the following procedures:
- a. Maintenance Review Boards. Maintenance Review Boards (MRBs) are convened by the agency prior to the introduction of a new transport aircraft and/or powerplant into service. The MRB develops starting, interim, and basic overhaul time limitations based on the findings of a thorough investigation of the maintainability features of the new type model engine. The Board evaluates the prospective operators' proposed maintenance programs and the manufacturer's recommendations. Subsequently, an MRB report is published by the agency which describes the maintenance and sampling programs needed to substantiate the escalation of the operators' overhaul periods from the starting time to the basic overhaul period established by the MRB. MRB reports currently in effect are listed in Advisory Circular AC 121-3 (as amended).
 - b. Standard Maintenance Specifications Handbook, Advisory Circular AC 121-1. This handbook provides procedures for establishing basic overhaul periods for specific type and model engines and related components which have received substantial airline service experience. It also includes a description of the engine sampling programs designed to substantiate escalation to the established basic overhaul period. With respect to turbine engines with substantial airline experience, the agency periodically revises the overhaul periods to reflect accumulative service experience and product improvement modifications. The sampling programs contained in AC 121-1 reflect overall industry experience with the respective engines. Operators should consider the basic methods outlined in this handbook when formulating introductory maintenance programs for engines with substantial experience.

7. REVISION OF OVERHAUL TIME LIMITATIONS ABOVE BASIC OVERHAUL PERIODS.
After an engine and related components have been approved for operation at the basic overhaul period, further revision of overhaul time limitations may be governed by the procedures included in one of the programs listed below or by an equivalent program developed by the operator.
- a. Aircraft Maintenance Time Limitations, Advisory Circular AC 120-21.
Advisory Circular AC 120-21 - Aircraft Maintenance Time Limitations, provides methods and procedures for revision of maintenance time limitations. Time limitations applicable to engines and related components are normally revised on the basis of service experience at the currently approved overhaul period. Increases in engine overhaul periods are usually approved in increments of 100 hours. Increases in such time limitations may be made as often as every 90 days, providing service experience for the previous 90 days is substantive and indicates that such increase will not adversely affect the continued airworthiness of the engine.
- (1) When service records indicate that any component or subcomponent consistently requires frequent repair, adjustment, or other maintenance because of damage, wear, or deterioration within the current time limitations, the operator will be responsible for taking corrective action.
 - (2) A revision to the currently approved time limitations for the engine and related components may be approved when service experience at the current level is satisfactory, and the disassembly inspection of a representative number of sample engines reveals no condition that may prevent satisfactory operation to the proposed overhaul period.
- b. Turbine and Reciprocating Engine Time Control Programs. These programs provide procedures for the revision of overhaul time limitations for turbine and reciprocating engines and their essential accessories. Such revisions are relative to increases above the basic overhaul time limitations established by an MRB or those established in Advisory Circular AC 121-1. Revision of such time limitations is usually approved in increments of 100 hours. The "performance level" attained by an operator is used as the basis for adjusting overhaul periods. The "performance level" is a result of the final product of the operator's maintenance and inspection programs expressed in terms of engine reliability. The performance level or degree of reliability is calculated by finding the number of in-flight engine failures per 1000-engine hours flown by each type aircraft. If this calculation reflects a ratio of engine failures per 1000-engine hours that is within the limit prescribed in the program, the operator may request adjustment of overhaul time limitations every 90 days.

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- (1) A revision to the time limitations for the engine and essential accessories may be approved when:
 - (a) The performance level for the previous 90-day period reflects a failure rate that is not greater than the rate prescribed in the program for the make and model engine.
 - (b) The operator and assigned FAA inspector have determined that no condition exists in the engine or essential engine accessories that may prevent satisfactory operation to the proposed overhaul period. This determination is made by inspection of engines during routine overhaul and by inspection of a representative number of engines as specified in the particular program which have operated in a satisfactory manner for the maximum time permissible under the currently approved time limitations.
- c. Propulsion System Reliability Program, Advisory Circular AC 120-17, Exhibit D. This program presents a means for measuring in-flight reliability of propulsion systems and may be used to substantiate revisions to time limitations for these systems. The propulsion system components, as referred to in this program, are those systems generally outlined in Chapters 61 and 70 through 83 of the ATA Specification 100.
 - (1) Reliability Measurement Procedures. An alert value is established by the program for each airframe/engine combination used in airline service. The alert values are based upon performance data compiled from the experience of the airline industry over an extended period of time. A reliability index based on the number of propulsion system in-flight shutdowns per 1000-engine hours is calculated on a monthly basis for each airframe/engine combination. The index, when compared with the pertinent alert value, indicates the relative level of propulsion system reliability and the effectiveness of the operator's maintenance and operating procedures.
 - (a) Listings are prepared which show the cause for shutdowns and are used to pinpoint problem areas which require corrective action.
 - (b) A summary of the technical and statistical information compiled by the program is disseminated by the agency to all participants for their analysis and application to improve the reliability of propulsion systems.

(2) Revision of Overhaul Time Limitations. The procedures and data used in measuring propulsion system reliability may be used to substantiate revisions to overhaul time limitations. The data made available to the agency on a continuing basis for evaluation will show satisfactory service experience at the current overhaul period or it will indicate the existence of any condition that could cause the propulsion system to become unreliable at the proposed overhaul period. The data will also show initiation of timely and effective corrective action to improve the reliability of propulsion systems operating at or above the alert value and for all critical failures. Revision of propulsion system overhaul periods up to the maximum increment (i.e., 200 hours for basic engine) as specified by the program may be approved when:

- (a) Service experience at the current level is satisfactory.
- (b) A representative number of sample engines as specified by the program receive a teardown inspection after operating to within 100 hours of the current overhaul period.
- (c) No known condition exists that may adversely affect in-flight reliability during operation to the proposed overhaul period.
- (d) Such revision does not conflict with a reliability corrective action program currently in effect.

d. Maintenance Control by Reliability Methods, Advisory Circular AC-120-17. This circular provides guidance material for the development of a maintenance program management system to monitor and control engine operating performance and adjustment of time limitations by reliability methods. In essence, such programs are designed to provide statistical indications to guide airline management and the agency in seeking improvements to the operational reliability of engines:


(1) Reliability Measurement Procedures. A numerical reliability value is established by the operator in terms of confirmed system or component failures per 1000 hours of aircraft operation, number of landings, operating cycles, or the ratio of such failures to other exposure factors. This established reliability value is based on the operator's service experience supplemented by and relative to other appropriate industry experience. Once established, the reliability value provides the minimum standard to be met. It is, therefore, the low point in operating reliability below which action or additional study to determine corrective action becomes necessary. This standard is not fixed, but is subject to adjustment as reliability changes. Procedures to make adjustments to performance standards should be included in the program.

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(a) The program establishes a reliability "band" which is the area of reliability acceptable for continuing existing maintenance controls but is unacceptable for increases in overhaul periods or other similar maintenance control actions unless appropriate corrective action is taken. The results of corrective action should become evident by an improved trend in reliability within a reasonable length of time. The time permitted would be commensurate with the scope of the problem and the character of the corrections required.

(2) Revision of Overhaul Time Limitations. The procedures and data used in measuring reliability may be used to substantiate revisions to overhaul periods. The data compiled by the program and made available to the agency will show satisfactory experience at the current overhaul period including existence of any condition that could have an adverse effect on reliability during operation to the proposed overhaul period. This information will also show the effectiveness of corrective action taken to improve the reliability of components or systems operating beyond the reliability value and the status of product improvement programs.

8. SUMMARY. The programs described herein have been developed in light of experience which shows that no single program of maintenance control satisfies the maintenance needs of all airline operators. While the foregoing programs are considered to meet current demands, the FAA is continuing its efforts to improve these programs and to develop new programs offering more specific response to safety in airline operations. Further, the FAA envisions such new programs which will take advantage of advances in the state-of-the-art of design, maintainability features, and maintenance support programs pertaining to propulsion systems. Thus, the FAA is receptive to ideas or suggestions which can lead to the development of new and better means of maintenance control to maintain or improve in-flight reliability.


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