CIVIL AIR REGULATIONS

PART 13—AIRCRAFT ENGINE AIRWORTHINESS

Effective March 5, 1952

CIVIL AERONAUTICS BOARD

WASHINGTON, D. C.

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PART 13—AIRCRAFT ENGINE AIRWORTHINESS

REVISION

Adopted by the Civil Aeronautics Board at its office in Washington, D. C., on the 28th day of January 1952.

The previously effective Part 13 was promulgated in 1941 and has remained substantially unchanged to date. The present revision of this part is for the purpose of making it consistent in form and language with other airworthiness parts of the Civil Air Regulations and to bring up to date certain technical provisions. The administrative rules of Subpart A have been completely rewritten for consistency with corresponding rules in other airworthiness parts. In amending these administrative rules it is not the intent of the Board to alter any of the procedures which have been consistent with the previously effective regulations. Although the present provisions with respect to eligibility for type certification under Part 13 do not make direct reference to the acceptance by the Administrator of military specifications, nevertheless such acceptance is implicit within the provisions of § 13.10 and, therefore, the revised Part 13 is not intended to imply any general change in policy in this regard.

The scope of Part 13 has also been extended to cover the certification of turbine-type engines. These rules reflect experience in turbine design during the past years and take into account certain international standards which have received general acceptance.

The provisions of revised Part 13 reflects the discussions at the annual airworthiness meeting and the subsequent comments on the notice of proposed rule making.

Interested persons have been afforded an opportunity to participate in the making of this amendment, and due consideration has been given to all relevant matter presented.

In consideration of the foregoing the Civil Aeronautics Board hereby makes and promulgates a revision of Part 13 of the Civil Air Regulations (14 CFR Part 13, as amended) effective March 5, 1952 to read as follows:

SUBPART A—GENERAL

APPLICABILITY AND DEFINITIONS

Sec.
13.0 Applicability of this part.
13.1 Definitions.

CERTIFICATION

13.10 Eligibility for type certificates.
13.11 Designation of applicable regulations.
12.12 Amendment of part.
13.13 Type certificate.
13.14 Data required.
13.15 Inspections and tests.
13.16 Required tests.
13.17 Production certificates.
13.18 Approval of materials, parts, processes, and appliances.
13.19 Changes in type design.

IDENTIFICATION AND INSTRUCTION MANUAL

13.20 Identification plate.
13.21 Instruction manual.

SUBPART B—RECIPROCATING ENGINES

DESIGN AND CONSTRUCTION

13.100 Scope.
13.101 Materials.
13.102 Fire prevention.
13.103 Vibration.
13.104 Durability.
13.110 Fuel and induction system.
13.111 Ignition system.
13.112 Lubrication system.
13.113 Engine cooling.
13.114 Engine mounting attachments.
13.115 Accessory attachments.

BLOCK TESTS

13.150 General.
13.151 Vibration test.
13.152 Calibration tests.
13.153 Detonation test.
13.154 Endurance test.
13.155 Operation test.
13.156 Teardown inspection.
13.157 Engine adjustments and parts replacements.

SUBPART C—TURBINE ENGINES

DESIGN AND CONSTRUCTION

13.200 Scope.
13.201 Materials.
13.202 Fire prevention.
13.203 Vibration.
13.204 Durability.
13.205 Surge characteristics.
13.210 Fuel and induction system.
13.211 Ignition system.
13.212 Lubrication system.
13.213 Engine cooling.
13.214 Engine mounting attachments.
13.215 Accessory attachments.

BLOCK TESTS

13.250 General.
13.251 Vibration test.
13.252 Calibration tests.
13.254 Endurance test.
13.255 Operation test.
13.256 Teardown inspection.
13.257 Engine adjustments and parts replacements.

AUTHORITY: §§ 13.0 to 13.257 issued under sec. 205, 52 Stat. 984; 49 U. S. C. 425. Interpret or apply secs. 601, 603, 52 Stat. 1007, 1009; 49 U. S. C. 551, 553.

SUBPART A—GENERAL

APPLICABILITY AND DEFINITIONS

§ 13.0 *Applicability of this part.* This part establishes standards with which compliance shall be demonstrated for the issuance of type certificates for engines used on aircraft. This part, until superseded or rescinded, shall apply to all engines for which applications for type certification are made after the effective date of this part.

§ 13.1 *Definitions.* As used in this part terms are defined as follows:

(a) *Administration*—(1) *Administrator.* The Administrator is the Administrator of Civil Aeronautics.

(2) *Applicant.* An applicant is a person or persons applying for approval of an engine or any part thereof.

(3) *Approved.* Approved, when used alone or as modifying terms such as means, devices, specifications, etc., shall mean approved by the Administrator.

(b) *General design*—(1) *Standard atmosphere.* The standard atmosphere is an atmosphere defined as follows:

(i) The air is a dry, perfect gas,

(ii) The temperature at sea level is 59° F.,

(iii) The pressure at sea level is 29.92 inches Hg,

(iv) The temperature gradient from sea level to the altitude at which the temperature equals −67° F. is −0.003566° F./ft. and zero thereabove.

(v) The density ρ_0 at sea level under the above conditions is 0.002378 lbs. sec.^{2}/ft.^{4}

(2) *Brake horsepower.* Brake horsepower is the power delivered at the propeller shaft of the engine.

(3) *Take-off power.* Take-off power is the brake horsepower developed under standard sea level conditions, under the maximum conditions of crankshaft rotational speed and engine manifold pressure approved for use in the normal take-off, and limited in use to a maximum continuous period as indicated in the approved engine specification.

(4) *Maximum continuous power.* Maximum continuous power is the brake horsepower developed in standard atmosphere at a specified altitude under the maximum conditions of crankshaft rotational speed and engine manifold pressure approved for use during periods of unrestricted duration.

(5) *Manifold pressure.* Manifold pressure is the absolute pressure measured at the appropriate point in the induction system, usually in inches of mercury.

(6) *Critical altitude.*[1] The critical altitude is the maximum altitude at which in standard atmosphere it is possible to maintain without ram, at a specified rotational speed, a specified power or a specified manifold pressure. Unless otherwise stated, the critical altitude is the maximum altitude at which it is possible to maintain, at the maximum continuous rotational speed, one of the following:

(i) The maximum continuous power, in the case of engines for which this power rating is the same at sea level and at the rated altitude.

(ii) The maximum continuous rated manifold pressure, in the case of engines the maximum continuous power of which is governed by a constant manifold pressure.

CERTIFICATION

§ 13.10 *Eligibility for type certificates.* An engine shall be eligible for type certification under the provisions of this part if it complies with the airworthiness provisions hereinafter established or if the Administrator finds that the provision or provisions not complied with are compensated for by factors which provide an equivalent level of safety: *Provided,* That the Administrator finds no feature or characteristic of the engine which renders it unsafe for use on aircraft.

§ 13.11 *Designation of applicable regulations.* (a) The provisions of this part, together with all amendments thereto effective on the date of application for type certificate, shall be considered as incorporated in the type certificate as though set forth in full.

(b) Except as otherwise provided by the Board, or pursuant to § 1.24 of this chapter by the Administrator, any change to the type design may be accomplished, at the option of the holder of the type certificate, either in accordance with the provisions incorporated by reference in the certificate pursuant to paragraph (a) of this section, or in accordance with the provisions in effect at the time the application for change is filed.

(c) The Administrator, upon approval of a change to a type design, shall designate and keep a record of the provisions of the Civil Air Regulations with which compliance was demonstrated.

§ 13.12 *Amendment of part.* Unless otherwise established by the Board, an amendment of this part shall be effective with respect to engines for which applications for type certificates are filed after the effective date of the amendment.

§ 13.13 *Type certificate.* (a) An applicant shall be issued a type certificate when he demonstrates the eligibility of the engine by complying with the requirements of this part in addition to the applicable requirements in Part 1 of this chapter.[2]

(b) The type certificate shall be deemed to include the type design (see § 13.14 (b)), the operating limitations for the engine (see § 13.16), and any other conditions or limitations prescribed by the Civil Air Regulations. (See also § 13.11 (a).)

§ 13.14 *Data required.* (a) The applicant for a type certificate shall submit to the Administrator such descriptive data, test reports, and computations as are necessary to demonstrate that the engine complies with the requirements of this part.

(b) The descriptive data required in paragraph (a) of this section shall be known as the type design and shall consist of such drawings and specifications as are necessary to disclose the configuration of the engine and all the design features covered in the requirements of this part, such information on dimensions, materials, and processes as is necessary to define the structural strength of the engine, and such other data as are necessary to permit by comparison the determination of the airworthiness of subsequent engines of the same type.

§ 13.15 *Inspections and tests.* Inspections and tests shall include all those found necessary by the Administrator to insure that the engine complies with the applicable airworthiness requirements and conforms to the following:

(a) All materials and products are in accordance with the specifications in the type design.

(b) All parts of the engine are constructed in accordance with the drawings in the type design.

(c) All manufacturing processes, construction, and assembly are such that the design strength and safety contemplated by the type design will be realized in service.

§ 13.16 *Required tests.* The block tests prescribed in this part shall be conducted to establish the engine operating limitations, as chosen by the applicant, and the reliability of the engine to operate within those limitations. The provisions of paragraphs (a) through (d) of this section shall be applicable.

(a) The applicant shall furnish all testing facilities, including equipment and competent personnel, to conduct the prescribed block tests.

(b) An authorized representative of the Administrator shall witness such of the block tests as are necessary to verify the test report.

(c) The Administrator shall establish engine operating limitations determined on the basis of the engine operating conditions demonstrated during the block tests. Such operating limitations shall include those items relating to power, speeds, temperatures, pressures, fuels, and oils which he finds necessary for safe operation of the engine.

(d) It shall be permissible to use separate engines of identical design and construction in the vibration, calibration, detonation (if applicable), endurance, and operation tests prescribed in subparts B and C of this part, except that if a separate engine is used for the endurance test it shall be subjected to a calibration check before starting the endurance test.

§ 13.17 *Production certificates.* (For requirements with regard to production certificates see Part 1 of this chapter.)

§ 13.18 *Approval of materials, parts, processes, and appliances.* (a) Materials, parts, processes, and appliances shall be approved upon a basis and in a manner found necessary by the Administrator to implement the pertinent provisions of the Civil Air Regulations. The Administrator may adopt and publish such specifications as he finds necessary to administer this regulation, and shall incorporate therein such portions of the aviation industry, Federal, and military specifications respecting such materials, parts, processes, and appliances as he finds appropriate.

NOTE: The provisions of this paragraph are intended to allow approval of materials, parts, processes, and appliances under the system of Technical Standard Orders, or in conjunction with type certification procedures for an engine, or by any other form of approval by the Administrator.

(b) Any material, part, process, or appliance shall be deemed to have met the requirements for approval when it meets the pertinent specifications adopted by the Administrator, and the manufacturer so certifies in a manner prescribed by the Administrator.

§ 13.19 *Changes in type design.* (For requirements with regard to changes in type design see Part 1 of this chapter.)

IDENTIFICATION AND INSTRUCTION MANUAL

§ 13.20 *Identification plate.* A fireproof identification plate shall be securely attached to the engine in a location which will be readily accessible when the engine is installed on an aircraft. The identification plate shall contain the identification data required by § 1.50 of this chapter.

§ 13.21 *Instruction manual.* The applicant shall prepare and make available an approved manual containing instructions for the installation, operation, servicing, maintenance, repair, and overhaul of the engine.

NOTE: It is not intended to limit the form of the manual to a single document.

SUBPART B—RECIPROCATING ENGINES

DESIGN AND CONSTRUCTION

§ 13.100 *Scope.* The provisions of this subpart shall apply to reciprocating engines.

(a) The engine shall not incorporate design features or details which experience has shown to be hazardous or unreliable. The suitability of all questionable design details or parts shall be established by tests.

(b) The design and construction provisions of this subpart shall be applicable

[1] These definitions may not apply in the case of less conventional engines such as compound, variable discharge turbine, etc.

[2] Prior to approval for use of a type certificated engine on a certificated aircraft, the engine will be required to comply with pertinent provisions of the applicable aircraft airworthiness parts of the Civil Air Regulations.

to the engine when it is installed, operated, and maintained in accordance with the instruction manual prescribed in § 13.21 and when fitted with an appropriate propeller.

§ 13.101 *Materials.* The suitability and durability of all materials used in the engine shall be established on a basis of experience or tests. All materials used in the engine shall conform to approved specifications which will insure their having the strength and other properties assumed in the design data.

§ 13.102 *Fire prevention.* The design and construction of the engine and the materials used shall be such as to minimize the possibility of occurrence and spread of fire because of structural failure, overheating, or other causes.

§ 13.103 *Vibration.* The engine shall be designed and constructed to function throughout its normal operating range of crankshaft rotational speeds and engine powers without inducing excessive stress in any of the engine parts because of vibration and without imparting excessive vibration forces to the aircraft structure.

§ 13.104 *Durability.* All parts of the engine shall be designed and constructed to minimize the development of an unsafe condition of the engine between overhaul periods.

§ 13.110 *Fuel and induction system.* (a) The fuel system of the engine shall be designed and constructed to supply an appropriate mixture of fuel to the cylinders throughout the complete operating range of the engine under all flight and atmospheric conditions.

(b) The intake passages of the engine through which air or fuel in combination with air passes for combustion purposes shall be designed and constructed to minimize the danger of ice accretion in such passages. The engine shall be designed and constructed to permit the use of a means for ice prevention.

§ 13.111 *Ignition system.* All spark ignition engines shall be equipped with either a dual ignition system having at least two spark plugs per cylinder and two separate electrical circuits with separate sources of electrical energy, or with an ignition system which will function with equal reliability in flight.

§ 13.112 *Lubrication system.* (a) The lubrication system of the engine shall be designed and constructed so that it will function properly in all flight attitudes and atmospheric conditions in which the airplane is expected to operate.

(b) In wet sump engines the provision of paragraph (a) of this section shall be complied with when only one-half of the maximum lubricant supply is in the engine.

(c) The lubrication system of the engine shall be designed and constructed to permit the installation of a means for cooling of the lubricant.

§ 13.113 *Engine cooling.* The engine shall be designed and constructed to provide the necessary cooling under conditions in which the airplane is expected to operate.

§ 13.114 *Engine mounting attachments.* The mounting attachments and structure of the engine shall have sufficient strength, when the engine is mounted on an aircraft, to withstand the loads arising from the loading conditions prescribed in the airworthiness parts of the Civil Air Regulations applicable to the aircraft involved.

§ 13.115 *Accessory attachments.* Accessory drives and mounting attachments shall be designed and constructed so that the engine will operate properly with the accessories attached. The design of the engine shall incorporate provisions for the examination, adjustment, or removal of all essential engine accessories.

BLOCK TESTS

§ 13.150 *General.* The engine, including all essential accessories, shall be subjected to the block tests and inspections prescribed in §§ 13.151 through 13.157.

§ 13.151 *Vibration test.* A vibration survey shall be conducted to investigate crankshaft torsional and bending vibration characteristics over the operational range of crankshaft rotational speed and engine power normally used in flight (including low-power operation), from idling speed to either 110 percent of the desired maximum continuous speed rating, or 103 percent of the desired take-off speed rating, whichever is higher. The survey shall be conducted with a representative propeller. If a critical speed or speeds are found to be present in the operating range of the engine, changes in design of the engine shall be made for their elimination prior to the conduct of the endurance test specified in § 13.154, or the endurance test shall include operation under the most adverse vibration condition for a period sufficient to establish the ability of the engine to operate without fatigue failure.

§ 13.152 *Calibration test.* The engine shall be subjected to such calibration tests as are necessary to establish its power characteristics and the conditions for the endurance test specified in § 13.154. The results of such tests shall constitute the basis for establishing the characteristics of the engine over its entire operating range of crankshaft rotational speeds, manifold pressures, fuel/air mixture settings, and altitudes. Power ratings shall be based upon standard atmospheric conditions. (See also § 13.16 (d).)

§ 13.153 *Detonation test.* A test shall be conducted to establish that the engine can function without detonation throughout its range of intended conditions of operation.

§ 13.154 *Endurance test.* The endurance test of an engine with a representative propeller shall include a total of 150 hours of operation, consisting of the individual runs specified in paragraphs (a) through (c) of this section. The runs shall be performed in such periods and order as are found appropriate by the Administrator for the specific engine. During the endurance test the engine power and the crankshaft rotational speed shall be controlled within ±3 percent of the specified values.

(a) *90-hour run.* A 90-hour run shall be made at maximum continuous crankshaft rotational speed and engine power unless a take-off rating greater than the maximum continuous rating is to be established, in which case the conditions of subparagraph (1) of this paragraph shall apply, or unless a maximum continuous rating at altitude differing from the sea level maximum continuous rating is to be established, in which case the conditions of subparagraph (2) of this paragraph shall apply.

(1) If a take-off rating greater than the maximum continuous rating is to be established, a 10-hour run at the take-off rating shall be substituted for an equal number of hours of the 90 hours at the maximum continuous rating. The run at take-off rating shall be the basis for the establishment of a take-off rating, except that the rating shall not specify a duration greater than 5 minutes.

(2) If a maximum continuous rating at altitude differing from the sea level maximum continuous rating is to be established, half of the 90 hours at maximum continuous rating shall be made at the maximum power obtainable at the critical altitude with the maximum continuous manifold pressure and crankshaft rotational speed.

(b) *40-hour run.* A 40-hour run shall be made in five periods of 8 hours each at 50, 60, 65, 70, and 75 percent, respectively, of the maximum continuous rating.

(c) *20-hour run.* A 20-hour run shall be made at the maximum weak-mixture power or at the maximum recommended cruising power.

§ 13.155 *Operation test.* The operation test shall include all testing found by the Administrator to be necessary to demonstrate backfire characteristics, starting, idling, acceleration, overspeeding, functioning of propeller and ignition, and any other operational characteristic of the engine.

§ 13.156 *Teardown inspection.* After completion of the endurance test the engine shall be completely disassembled and a detailed inspection shall be made of the engine parts to check for fatigue and wear.

§ 13.157 *Engine adjustments and parts replacements.* During the block tests servicing and minor repairs of the engine shall be permissible. If major repairs or replacement of parts are found necessary during the tests or in the teardown inspection, the parts in question shall be subjected to such additional tests as are found by the Administrator to be necessary.

SUBPART C—TURBINE ENGINES

DESIGN AND CONSTRUCTION

§ 13.200 *Scope.* The provisions of this subpart shall apply to turbine engines.

(a) The engine shall not incorporate design features or details which experience has shown to be hazardous or unreliable. The suitability of all question-

able design details or parts shall be established by tests.

(b) The design and construction provisions of this subpart shall be applicable to the engine when it is installed, operated, and maintained in accordance with the instruction manual prescribed in § 13.21 and when fitted with an appropriate propeller (if used).

§ 13.201 *Materials.* The suitability and durability of all materials used in the engine shall be established on a basis of experience or tests. All materials used in the engine shall conform to approved specifications which will insure their having the strength and other properties assumed in the design data.

§ 13.202 *Fire prevention.* The design and construction of the engine and the materials used shall be such as to minimize the possibility of occurrence and spread of fire because of structural failure, overheating, or other causes.

§ 13.203 *Vibration.* The engine shall be designed and constructed to function throughout its normal operating range of rotational speeds and engine powers without inducing excessive stress in any of the engine parts because of vibration and without imparting excessive vibration forces to the aircraft structure.

§ 13.204 *Durability.* All parts of the engine shall be designed and constructed to minimize the development of an unsafe condition of the engine between overhaul periods.

§ 13.205 *Surge characteristics.* The engine shall be free of detrimental surge throughout its operating range in the minimum ambient air temperature in which it is to be operated.

§ 13.210 *Fuel and induction system.* (a) The fuel system of the engine shall be designed and constructed to supply an appropriate mixture of fuel to the combustion chamber(s) throughout the complete operating range of the engine under all flight and atmospheric conditions.

(b) The intake passages of the engine through which air or fuel in combination with air passes for combustion purposes shall be designed and constructed to minimize the danger of ice accretion in such passages. The engine shall be designed and constructed to permit the use of a means for ice prevention.

§ 13.211 *Ignition system.* All engines shall be equipped with an ignition system for starting the engine on the ground and in flight.

§ 13.212 *Lubrication system.* The lubrication system of the engine shall be designed and constructed so that it will function properly in all flight attitudes and atmospheric conditions in which the airplane is expected to operate.

§ 13.213 *Engine cooling.* The engine shall be designed and constructed to provide the necessary cooling under conditions in which the airplane is expected to operate.

§ 13.214 *Engine mounting attachments.* The mounting attachments and structure of the engine shall have sufficient strength, when the engine is mounted on an aircraft, to withstand the loads arising from the loading conditions prescribed in the airworthiness parts of the Civil Air Regulations applicable to the aircraft involved.

§ 13.215 *Accessory attachments.* Accessory drives and mounting attachments shall be designed and constructed so that the engine will operate properly with the accessories attached. The design of the engine shall incorporate provisions for the examination, adjustment, or removal of all essential engine accessories.

BLOCK TESTS

§ 13.250 *General.* The engine, including all essential accessories, shall be subjected to the block tests and inspections prescribed in §§ 13.251 through 13.257. In addition, throughout the tests, unless otherwise chosen by the applicant, the controlled air extraction shall be zero.

§ 13.251 *Vibration test.* A vibration survey shall be conducted to investigate the vibration characteristics of the engine over the operational range of rotational speed and engine power. If critical vibration is found to be present in the operating range of the engine, changes in design of the engine shall be made for its elimination prior to the conduct of the endurance test specified in § 13.254, or the endurance test shall include operation under the most adverse vibration condition for a period sufficient to establish the ability of the engine to operate without fatigue failure.

NOTE: The vibration survey usually need consist of external measurements only, unless the Administrator finds that internal measurements are necessary in a particular case.

§ 13.252 *Calibration tests.* (a) The engine shall be subjected to such calibration tests as are necessary to establish its power characteristics and the conditions for the endurance test specified in § 13.254. The results of such tests shall constitute the basis for establishing the characteristics of the engine over its entire operating range of speeds, pressures, temperatures, and altitudes. Power ratings shall be based upon standard atmospheric conditions. (See also § 13.16 (d).)

(b) Prior to the endurance test the power control(s) shall be adjusted to produce the maximum allowable gas temperatures and rotor speeds at take-off operating conditions. Such adjustment shall not be changed during the relevant calibration tests and the relevant runs of the endurance test.

§ 13.254 *Endurance test.* The endurance test of an engine with a representative propeller (if applicable) shall include a total of 150 hours of operation, consisting of 30 periods of 5 hours each as specified in this section. It shall be permissible to conduct each run of the endurance test, except the runs prescribed in paragraphs (a) and (f) of this section, with one predetermined engine variable (i. e., speed or gas temperature) held constant and with the position of the power lever(s) recorded. The runs shall be performed in such order as is found appropriate by the Administrator for the specific engine. Each period of the 150-hour endurance test shall be conducted as follows:

(a) *Take-off and idling.* One hour of alternate 5-minute periods shall be conducted at maximum take-off power and/or thrust and at idling power and/or thrust. The developed powers and/or thrusts at take-off 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 speed and power and/or thrust while taking data to check performance.

(b) *91 percent take-off power and/or thrust.* Thirty minutes shall be conducted at the power lever position corresponding with either 91 percent take-off power and/or thrust or maximum continuous power and/or thrust, whichever is the greater.

(c) *Maximum continuous power and/or thrust.* One hour and 30 minutes shall be conducted at the power lever position corresponding with maximum continuous power and/or thrust.

(d) *90 percent maximum continuous power and/or thrust.* One hour shall be conducted at the power lever position corresponding with 90 percent maximum continuous power and/or thrust.

(e) *75 percent maximum continuous power and/or thrust.* Thirty minutes shall be conducted at the power lever position corresponding with 75 percent maximum continuous power and/or thrust.

(f) *Acceleration and deceleration runs.* Thirty minutes shall be conducted of accelerations and decelerations consisting of five cycles from idling power and/or thrust to take-off power and/or thrust and maintained at the take-off power and/or thrust for approximately 30 seconds and at the idling power and/or thrust for approximately 5 minutes.

(g) *Starts.* Seventy-five starts shall be made of which 30 starts shall be preceded by a 2-hour shutdown. It shall be acceptable to make the remaining starts after the completion of the 150 hours of endurance testing.

§ 13.255 *Operation test.* The operation test shall include all testing found by the Administrator to be necessary to demonstrate starting, idling, acceleration, overspeeding, functioning of propeller (if applicable) and ignition, and any other operational characteristic of the engine.

§ 13.256 *Teardown inspection.* After completion of the endurance test the engine shall be completely disassembled and a detailed inspection shall be made of the engine parts to check for fatigue and wear.

§ 13.257 *Engine adjustments and parts replacements.* During the block tests servicing and minor repairs of the

engine shall be permissible. If major repairs or replacement of parts are found necessary during the tests or in the teardown inspection, the parts in question shall be subjected to such additional tests as are found by the Administrator to be necessary.

By the Civil Aeronautics Board.

[SEAL] M. C. MULLIGAN,
Secretary.

[F. R. Doc. 52-1424; Filed, Feb. 4, 1952; 8:51 a. m.]

NOTICE

Advise the Civil Aeronautics Board, Washington 25, D. C., that you have purchased this Part of the Civil Air Regulations and that agency will supply you with copies of amendments which have been issued since this printing. Be sure to specify the number of this Part, otherwise your request cannot be filled.

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