CIVIL AERONAUTICS BOARD

WASHINGTON, D. C.

CIVIL AIR REGULATIONS

14.—AIRCRAFT PROPELLER AIRWORTHINESS

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PART 14.-AIRCRAFT PROPELLER AIRWORTHINESS

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14.0 GENERAL.

14.00 PROVISION FOR RATING. Pursuant to the provisions of the Civil Aeronautics Act of 1938, as amended, empowering and requiring the Civil Aeronautics Board to prescribe such minimum standards governing the design, materials, workmanship, construction and performance of propellers as may be required in the interest of safety, and to provide for the rating of aircraft as to airworthiness, the requirements hereinafter set forth shall be used as the minimum standards for establishing such rating for propellers for use in certificated aircraft.

14.01 SCOPE.

14.010 AIRWORTHINESS REQUISITES. To show eligibility of a propeller for certification the propeller shall meet the requirements herein as to design, construction and testing. The manufacturer shall comply with the requirements by the submission of technical data and by conducting tests with suitable test equipment. The applicable requirements are set forth in §§ 14.1 through 14.4.

14.011 TYPE CERTIFICATE. The general requirements for the issuance of a type certificate are set forth in Part 01.1/ The procedure relative to type certification of propellers is set forth in § 14.5.

14.012 PRODUCTION CERTIFICATE. The requirements for the issuance of a production certificate are set forth in Part 01.1/

14.013 DEVIATIONS. When a propeller embodies a feature of design or construction which deviates from the practice in conventional screw propeller types, application shall be made to the Administrator for special rulings covering the feature in question.

14.02 HUBS AND BLADES. Interchangeable propeller hubs and blades are certificated as separate units and the word "propeller" as herein used applies, where applicable, to a propeller hub and to a blade as well as to a complete propeller.

1/ Now in Part 02.

14.03 TESTING FACILITIES. A manufacturer submitting a propeller for certification shall conduct all of the tests and supply or arrange for the testing facilities necessary to show compliance with the requirements contained herein. When, in the opinion of the Administrator, adequate and satisfactory methods of testing other than those outlined herein are available, propellers tested by such methods may be eligible for certification.

14.04 MILITARY PROPELLERS. A propeller of a type which has passed the regular endurance tests of and is approved by the United States Army Air Corps or the Bureau of Aeronautics, Navy Department, may be certificated in accordance with § 14.3.

14.05 PROPELLER OPERATION LIMITS. A certificated propeller shall not be operated at a power or propeller shaft speed, or in conjunction with an engine bore, greater than the limits assigned thereto by the Administrator. The Administrator may specify short time operation in excess of these limits for take-off purposes except that neither the power nor the speed limits will be raised by more than 10 percent without further testing.

14.06 PROPELLER IDENTIFICATION DATA. A certificated propeller, propeller blade or propeller hub shall have the following information conspicuously displayed upon it: manufacturer's name; name, model designation and serial number of the propeller; and maximum power and maximum speed for which certification has been granted. The identification data shall be permanently attached by means of a plate, stamping, engraving, etching or other such method upon a noncritical surface of the propeller blade or hub. When such data are not visible when the propeller is assembled or installed on an aircraft they shall also be painted or printed on the propeller blade or hub.

14.07 PREVICUSLY APPROVED PROPELLERS. These regulations supersede the requirements for approval of propellers set forth in previous regulations. However, propellers rated as suitable for use in approved aircraft in accordance with previous requirements may be used in certificated aircraft at the discretion of the Administrator.

14.1 DESIGN REQUIREMENTS.

14.10 Propellers shall be so designed as to operate without excessive vibration or flutter and shall be constructed of materials which are suitable for service conditions.

14.11 The surface of a propeller blade shall be smooth and the blade shall be faired with respect to the thickness and the moments of inertia about the major and minor axes, with no abrupt curvature changes or irregularities along the blade. Critical surfaces of a metal propeller hub shall be machined smooth without tool marks and any change in cross section shall be faired with as large a fillet as possible.

14.12 It is recommended that a propeller be so designed that the weakest portion of the propeller blade or hub may be inspected without disassembly and that excessive wear or a partial failure will precede a serious type of failure.

14.13 To facilitate inspection wood propellers shall be so finished that the grain of the wood is visible.

14.2 COMMERCIAL PROPELLERS.

14.20 DATA REQUIRED. In the case of a propeller of a type which has not been previously approved by the Army or Navy, and for which the manufacturer

desires the certification of the Administrator, the following information shall be submitted:

14.200 (a) Application for type certificate on a form which will be supplied for the purpose by the Administrator.

14.201 (b) A complete set of drawings descriptive of the propeller, which drawings shall be numbered and dated and shall include change letters for each revision. All details of the propeller shall be shown, including the profile and plan form of the blade, the size of blade cross sections at frequent stations, the bub design and the materials of construction. The material shall be specified on the drawings by reference to specification numbers of the Army, Navy, S. A. E., or other recognized standard whenever possible. If the manufacturer refers to his own specification numbers, details of such specifications shall be furnished the Administrator. All drawings shall be folded to a size of approximately 9 by 12 inches, with the title showing. In order to eliminate a possible source of controversy, the Administrator will not accept drawings which may be altered after approval. Blueprints, photostats or the equivalent are acceptable. If certain of the drawings required for a particular propeller are identical with drawings previously submitted and approved in connection with a prior type of propeller made by the same manufacturer, such drawings need not be again submitted.

14.202 (c) A complete parts list in duplicate, showing the drawing number, change letter and name of each component part of the propeller. The drawing numbers shall be listed in numerical order. When only one or two drawings are submitted for compliance with § 14.201, it is permissible for the manufacturer to submit these drawings in duplicate in which case a parts list is not required.

14.203 (d) A complete log certified to by the person making the test or signed by a witnessing inspector of the Administrator, at the discretion of the Administrator, describing the manufacturer's tests of the propeller in accordance with §§ 14.21 or 14.22, as the case may be. The log shall include a detailed record of the test with dates; names of persons involved; name and model number of engine, or name, model number, and identification mark of the airplane issued by the Administrator of Civil Aeronautics; and hours of testing with corresponding engine speeds. The report shall also include the results of a detailed inspection of the propeller after the test in accordance with § 14.23.

14.204 (e) A stress analysis when required by § 14.210 or when, in the judgment of the Administrator, the design is sufficiently unconventional to require it.

14.21 TESTS REQUIRED FOR PROPELLERS OTHER THAN FIXED PITCH WOOD PROPELLERS. A propeller of such type shall be subjected to a 50-hour endurance block test on an internal-combustion engine rigidly mounted and of the same characteristics as the engine or engines in conjunction with which the propeller will be certificated for use, or on another engine acceptable to the Administrator. The test shall be witnessed by an authorized inspector of the Administrator and may be run without a stop or in periods of 5 hours or more each. The cylinder bore of the engine used for the test will determine the maximum

bore of the engine with which identical propellers of this type will be certificated for use. The test shall be run at the proposed rated speed of the propeller with the propeller so adjusted as to absorb its proposed rated power. If the engine is not run at full throttle, and horsepower measurements are not possible during the test, manifold pressure readings shall be taken at frequent intervals. A suitable calibration curve shall be used to determine the power absorbed by the propeller during the test. The power rating assigned to the propeller by the Administrator may correspond to the corrected horsepower developed by the engine if the engine used for the test is of the type on which the propeller is to be certificated for use. In the case of a controllable or automatic pitch propeller, the pitch-changing mechanism shall be operated throughout the usable power range at least once for each hour of the test or the equivalent. The engine may be throttled to prevent overspeeding when changing pitch. After such 50 hours of testing, a controllable or automatic pitch propeller shall also be operated at as close to rated power and speed as possible for period of 5 minutes each at various pitch settings, i.e., at 1 degree intervals throughout the operating range when the design so permits. All variations in running characteristics of the propellers shall be recorded.

14.210 A propeller of the above type which, in the opinion of the Administrator, is sufficiently similar to a previously certificated propeller of the same manufacturer may be subjected to a 50-hour flight test in lieu of the test outlined in § 14.21 provided that its airworthiness is demonstrated to the satisfaction of the Administrator by a comparative stress analysis submitted by the manufacturer. The stress analysis shall compare the pertinent aerodynamic, centrifugal, vibration and torque impulse load differences between the respective propellers by a mathematical comparison, when possible, and by suitable curves plotted with the radius of the propeller as abscissa. Curves descriptive of the fairing of the propellers shall also be included when applicable. Such 50-hour flight test shall be conducted on an engine of equal or greater power and speed than that in conjunction with which the rating is requested. At least 5 hours of the test shall be run at the proposed rated speed of the propeller.

14.211 It is recommended that metal propellers of this type also be tested by suitable methods to determine their natural frequencies within all ranges of major vibrations which are produced by the operation of the engines in conjunction with which such propellers are to be certificated for use. Such frequencies should be determined at all blade angles within the desired operating pitch range of propellers. Data covering these tests should be submitted to the Administrator in the form of curves and tables. The type of frequency should be described and the nodes located for each frequency.

14.22 TESTS REQUIRED FOR FIXED PITCH WOOD PROPELLERS. A propeller of such type shall be subjected to a 10-hour endurance block test on an internal-combustion engine, or to a 50-hour flight test. The testing shall be witnessed by an authorized inspector of the Administrator at the discretion of the Administrator. In the case of a block test the entire test shall be run at the proposed rated speed of the propeller. In the case of a flight test at least 5 hours shall be run at the proposed rated speed of the

propeller. Such flight test shall be conducted with an engine of equal or greater power and speed than that in conjunction with which the propeller is to be certificated for use.

14.23 INSPECTION OF A TESTED PROPELLER. As prescribed in § 14.203, the log of the flight or block test shall include the results of a detailed inspection of the propeller after the test. Photographs of any failures or suspected failures shall be included. A propeller which fails during the testing is not eligible for certification unless the failure is of a nature such that the strength of the propeller is not impaired and a minor modification to the propeller will preclude the probability of future failures of the same type. Aluminum-alloy propellers shall be etched at all critical portions and then examined for minute cracks with a magnifying glass. Steel propellers shall be subjected to both a magnetic and visual inspection for signs of failure.

14.230 A failure of a metal propeller is defined as actual breakage, cracking or permanent set of any part of any blade, hub, bolt, lock nut, spline or keyway; slipping of a blade in its clamping socket; seizing or pitting of any bearing; or jamming of an automatic or controllable pitch mechanism. A wood propeller will be deemed to have failed if the tipping pulls or cracks, if a glue joint opens, or if there is any local failure or crushing around the hub or a bolt. Similar considerations will apply to propellers of any patented composition or of other than conventional wood or metal construction.

14.3 MILITARY PROPELLERS. In the case of a propeller of a type which has previously been approved by the Army or Navy and for which the manufacturer desires certification by the Administrator, the following data shall be submitted:

(a) An application as described in § 14.200.

(b) A copy of the official Army or Navy endurance test report which was the basis for the military approval, signed by the Army or Navy representative who witnessed the test. It is not necessary for the manufacturer to submit this report when such report has been previously forwarded to the Administrator through official channels. When the report is being prepared by the military agency the Administrator, to expedite approval, may in the interim accept a copy of the official letter of approval of the propeller which letter shall include the military rating, the length of test, and the output and model designation of the test engine.

(c) Drawings as described in § 14.201.

14.4 MODIFIED PROPELLERS. When a manufacturer desires the certification by the Administrator of a propeller which embodies only minor modifications of a certificated propeller of the same manufacturer, data shall be submitted as follows:

(a) An application as described in § 14.200.

(b) Drawings as described in § 14.201.

(c) Technical data which demonstrate conclusively that the airworthiness of the modified propeller is at least equal to that of the certificated propeller.

14.5 PROCEDURE RELATIVE TO TYPE CERTIFICATION.

14.50 GENERAL. The procedure and general requirements for the issuance of a type certificate shall be as prescribed in Part 01.2/

14.51 SEALED DRAWING LIST. When a type certificate is granted, a drawing list representative of the certificated propeller is impressed with the seal of the Administrator of Civil Aeronautics and is returnd to the manufacturer. Sealed copies of the drawings may be used for this purpose in lieu of a drawing list. Inspectors of the Administrator may call for, and must have access to, the sealed drawing list or drawings together with any other pertinent drawings when making an inspection of the manufacturer's plant to determine whether the propellers as built conform to the approved data.

14.52 MAJOR CHANGES. Any major change from the approved drawings must be approved in advance by the Administrator. A change will be deemed major within the meaning of these regulations if it adversely affects the reliability or airworthiness of the propeller. In general, a change will be deemed major when it decreases the airworthiness of a part the failure of which might prevent the aircraft from continuing flight. In all doubtful cases the decision of the Administrator shall establish the category within which a specific change will be included.

14.520 Information accompanying a request for approval of a change to a certificated propeller shall include technical data, including (when necessary) stress analyses and reports of tests sufficient to demonstrate to the satisfaction of the Administrator that the changed propeller is airworthy. The report shall be signed and certified to by the responsible representative of the manufacturer. If the change is to a difference blade shank size, engine shaft size, blade airfoil or propeller material, application shall be made for a new type certificate.

14.53 MINOR CHANGES. On January 1 and July 1 of each year the holder of a propeller type certificate shall submit, for approval and file, drawings pertaining to all the minor changes made to the propeller during the preceding 6-month period.

14.54 REDUCTIONS IN DIAMETER. A type certificate may provide for reduction in diameter from that of the propeller tested, provided that no increase in rating is involved. The diameter of a propeller blade may be reduced by cutting off the tip of a blade and fairing the immediate vicinity or by telescoping the outer sections of the blade. The drawings submitted shall show the details of each blade smaller in radius by 6-inch steps, which details may be shown superimposed on a drawing of the original blade.

2/ Now in Part 02.

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