



Designation: F2506 – 07

Standard Specification for Design and Testing of Fixed-Pitch or Ground Adjustable Light Sport Aircraft Propellers¹

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1. Scope

1.1 This specification covers the establishment of the minimum requirements for the design, testing, and quality assurance of fixed-pitch or ground adjustable propellers for light sport aircraft. These propellers are used on light aircraft, and could be used with engines conforming to Practice F2339.

1.2 This specification is intended for use by manufacturers of propellers for light sport aircraft.

1.3 This specification does not address the airframe installation requirements for propellers.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*²

F2339 Practice for Design and Manufacture of Reciprocating Spark Ignition Engines for Light Sport Aircraft

3. Terminology

3.1 *Definitions:*

3.1.1 *blade, n*—the aerodynamic portion of a propeller which is rotated through and acts on the air.

3.1.2 *blade root, n*—the portion of the blade that interfaces with the hub and provides retention.

3.1.3 *fixed pitch propeller, n*—a propeller with no capacity for pitch setting adjustment.

3.1.4 *ground adjustable propeller, n*—a propeller whose pitch setting is adjustable only when the aircraft is on the ground and the propeller is not rotating.

3.1.5 *hub, n*—any device that retains the blades of a propeller assembly.

3.1.6 *pitch setting, n*—the propeller blade setting as determined by the blade angle measured in a manner, and at a radius, specified by the instruction manual for the propeller.

3.1.7 *propeller, n*—a device for propelling an aircraft that has blades on an engine-driven shaft and that, when rotated, produces by its action on the air, a thrust approximately perpendicular to its plane of rotation.

4. General

4.1 Each manufacturer who claims compliance to this specification must be able to show compliance with the applicable requirements of this specification.

4.2 Manufacturers must prepare and make available a list of acceptable engine-propeller combinations.

4.3 Manufacturers must prepare and make available an operating manual or manuals containing, at minimum, the following information:

4.3.1 An overall description of the propeller and its features.

4.3.2 The mass moment of inertia of the propeller about its rotational axis.

4.3.3 Instructions for installation of the propeller.⁷

4.3.4 Instructions for operation of the propeller.

4.3.5 The maximum allowable engine power and rotational speed and any other propeller operating limitations found necessary by the manufacturer for the safe operation of the propeller.

4.3.6 For ground adjustable propellers, instructions for pitch adjustment and the minimum and maximum pitch settings allowed during operation.

4.3.7 Instructions for removal of the propeller.

4.4 Each manufacturer must prepare and make available a maintenance manual. The maintenance manual is intended to provide for continued safe and proper operation of the propeller throughout its life cycle and contains, at minimum, the following content:

4.4.1 A maintenance schedule that provides the recommended periods at which the propeller should be cleaned, adjusted, inspected, and tested.

4.4.2 The applicable damage and wear allowances.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

4.4.3 Any applicable maintenance and overhaul instructions, which include the following:

- 4.4.3.1 A list of tools needed.
- 4.4.3.2 Skills or training required for personnel performing the work.
- 4.4.3.3 Inspections required.
- 4.4.3.4 Details of repair and overhaul sequence and methods.
- 4.4.3.5 Applicable testing requirements.

4.4.4 If a manufacturer deems it necessary to set mandatory replacement intervals of propellers or propeller components, the details of this requirement shall be stated in a separate, clearly distinguishable section entitled Life Limitations.

5. Design and Construction

5.1 *Design Features*—The propeller may not have design features that have been shown to be hazardous or unreliable unless the suitability of each questionable design detail or part can be established by tests.

5.2 *Materials*—The suitability and durability of materials used in the propeller must:

5.2.1 be established on the basis of in-service experience or tests; and

5.2.2 conform to documented specifications that ensure that strength and other material properties consistently meet or exceed those used in the initial design and qualification testing.

5.3 *Durability*—Each part of the propeller must be designed and constructed with consideration of likely in-service damage and wear. The propeller must be able to operate normally between inspection and overhaul periods at the maximum damage and wear limits published in the maintenance manual.

5.4 *Ground-Adjustable Propellers*—The adjustment system of a ground-adjustable propeller must be designed such that no single failure or malfunction in that system during normal or emergency operation will result in unacceptable changes in propeller blade pitch setting. Failure of structural elements need not be considered if the occurrence of such a failure is expected to be extremely remote.

5.5 *Propeller Strength and Endurance*—Propellers must be shown to have satisfactory endurance as well as stresses that do not exceed values shown to be safe for continuous operation in accordance with the applicable requirements of Section 6, Tests and Inspections.

6. Tests and Inspections

6.1 General:

6.1.1 Each manufacturer must be able to show that the propeller concerned can complete the applicable tests and inspections of this section without evidence of failure or malfunction.

6.1.2 The minimum applicable testing and inspection requirements are outlined in **Table 1** according to propeller material type.

6.2 Strength Testing:

6.2.1 *All Propellers*—The entire propeller assembly must be tested for 1 h at a rotational speed that produces a constant centrifugal load equal to twice that which would occur at maximum rated rotational speed (as published in the operating manual). For the purpose of this requirement, an overspeed test

TABLE 1 Applicable Section 6 Paragraphs for Testing and Inspection Requirements

Propeller Blade Material Type	Strength/Fatigue Testing	Endurance Testing	Inspection/Maintenance
Wood	6.2		
Composite	6.2 or 6.3	6.4	6.5 and 6.6
Metal	6.2 or 6.3		

at least 1.41 times the maximum rated rotational speed or a static pull test are acceptable means of compliance. If a static pull test is used, the required load for each blade must be carried by at least the inner one-half of its span.

6.2.2 On propellers with detachable blades, the blade root and blade retention system must be statically tested for 1 h at a load level equal to four times the centrifugal load that would be generated by the blade weight at maximum rated rotational speed.

6.3 *Stress Measurement, Fatigue Strength, and Fatigue Analysis:*

6.3.1 The magnitude of the propeller vibration stresses, including any stress peaks and resonant conditions, throughout the operational envelope of the propeller shall be determined by direct measurement of stresses on a representative engine.

6.3.2 A full-scale fatigue test shall be performed to determine a fatigue allowable of the blade retention system.

6.3.3 Through testing or analysis, the fatigue allowable for the mid-blade and tip regions of the propeller blade shall be determined. This testing shall also account for normal in-service damage and wear.

6.3.4 Using the measured stresses and root, mid-blade, and tip fatigue allowables, a fatigue assessment shall be conducted to show that failure of the propeller will not occur between the declared propeller inspection intervals when using the declared inspection techniques.

6.4 Endurance Testing:

6.4.1 The propeller shall undergo an endurance test on the intended engine, or a vibrationally representative engine that is capable of providing the maximum rated power at the maximum rated propeller rotational speed and diameter. The propeller pitch may be adjusted as necessary to achieve maximum rated takeoff power at maximum rated takeoff RPM. Propeller pitch need not be readjusted for the remainder of the test unless necessary to avoid declared operational speed placards. The test shall be conducted according to the schedule, and in the order, shown in **Fig. 1**.

6.4.2 During the test, it is acceptable to stop the test as needed, but the test should be restarted and continued from the point in the test schedule where it was stopped.

6.5 Teardown Inspection:

6.5.1 After completion of each test prescribed in Section 5 of this specification, the propeller must be completely disassembled and a detailed inspection must be made of the propeller parts for cracks, wear, distortion, and any other unusual conditions.

6.5.2 Any unsatisfactory findings during the teardown inspection must be resolved through design changes and additional testing as necessary to establish the compliance of the propeller to this specification.