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Standard Specification for Design and Performance Requirements for Powered Parachute Aircraft[1]

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1. Scope

1.1 The following requirements apply for the manufacture of Powered Parachute Aircraft. This specification includes design and performance requirements for powered parachute aircraft.

1.2 *Applicability*—This specification applies to powered parachute aircraft seeking civil aviation authority approval, in the form of flight certificates, flight permits, or other like documentation.

1.3 *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 determine the applicability of regulatory requirements prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

F 2240 Specification for Manufacturer Quality Assurance Program for Powered Parachute Aircraft[2]

F 2241 Specification for Continued Airworthiness System for Powered Parachute Aircraft[2]

F 2242 Specification for Production Acceptance Testing System for Powered Parachute Aircraft[2]

F 2243 Specification for Required Product Information to be Provided with Powered Parachute Aircraft[2]

3. Terminology

3.1 *Definitions:*

3.1.1 *gross weight* , *n*—is the total aircraft system weight at takeoff. This weight includes anything and everything that is on or a part of the powered parachute aircraft, including, but not limited to, the wing, risers, fuselage, seats, engine, instruments, wheels, fuel, oil, water, pilot, passenger, clothing, and so forth.

3.1.2 *maximum takeoff weight* , *n*—is the gross weight limit as defined by the manufacturer, proven through compliance with this specification and placarded on the aircraft as the not-to-exceed gross weight.

3.1.3 *powered parachute*, *n*—aircraft comprised of a flexible or semi-rigid wing connected to a fuselage in such a way that the wing is not in position for flight until the aircraft is in motion that aircraft has a fuselage with seats, engine, and wheels (or floats), such that the wing and engine cannot be flown without the wheels (or floats) and seat(s). Unique to the powered parachute is the large displacement between the center of lift (high) and the center of gravity (low), which is pendulum effect. Pendulum effect limits angle of attach changes, provides stall resistance and maintains flight stability.

4. Flight

4.1 *Performance Requirements*:

4.1.1 *Proof of Compliance*—Each of the following requirements shall be met at the maximum takeoff weight and most critical center of gravity (CG) position. To the extent that CG adjustment devices may be adjusted for flight, these components will be evaluated in the least favorable recommended position as it affects either performance or structural strength.

4.1.2 *General Performance*—All performance requirements apply in and shall be corrected to International Civil Aviation Organization (ICAO) defined standard atmosphere in still air conditions at sea level. Speeds shall be given in indicated (IAS) and calibrated (CAS) airspeeds in miles per hour (MPH).

4.1.2.1 *Wing Performance*—For straight-ahead flight and turns in either direction during climb, cruise, descent, and landing flare, it shall be shown that the limits of control input are less than the wing stall limitations:

(1) If a fixed wing trim is available;

(2) If adjustable wing trim is available, it shall be tested to both the most negative and most positive trim settings;

(3) If separate left wing and right wing trim devises are available, each shall be tested to both the maximum-left-and minimum-right trim settings and the minimum-left-and-maximum-right trim settings.

4.1.2.2 *Climb*—The following shall be measured:

(1) Distance to clear a 15 m (50 ft) obstacle not to exceed 213 m (700 ft) from point of liftoff.

(2) Landing—The total landing distance over a 15 m (50 ft) obstacle shall be achieved within 183 m (600 ft) total distance.

[1] This specification is under the jurisdiction of ASTM Committee F37 on Light Sport Aircraft and is the direct responsibility of Subcommittee F37.30 on Power Parachute.

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[2] *Annual Book of ASTM Standards*, Vol 15.07.

4.1.2.3 *Controllability and Maneuverability*—The aircraft shall be safely controllable and maneuverable during takeoff, climb, level flight (cruise), approach, and landing (power off and on) with primary controls of turn and throttle and the possibility of combined turn displacement for flare.

(1) Demonstrate a smooth transition between all flight conditions shall be possible without excessive pilot skills nor exceeding pilot forces of 59.1 kg (130 lb) for the rudder petal, 9.1 kg (20 lb) prolonged application.

(2) Landing—It must be shown that in the event of an engine or propeller failure that a safe decent and landing can be made. It must be shown that a pilot of normal skill can achieve landing sink rates of no more than 2.4 m/s (8ft/s).

4.1.3 *Stability and Control*:

4.1.3.1 *Longitudinal Stability*—Longitudinal stability of the aircraft will be demonstrated by performing two minutes of flight without control input for three conditions. In each case, the aircraft must not enter into dangerous or unusual attitudes. Test must be conducted at maximum gross weight, with minimum of in-flight turbulence.

4.1.3.2 The three conditions are:

(1) Maximum power setting climb,

(2) Zero power descent, and

(3) Cruise setting power level flight.

4.1.3.3 *Lateral and Directional Stability*:

(1) Lateral stability will be demonstrated by maintaining the controls in a neutral position, which will initially give an unaccelerated level flight condition. The aircraft must not enter into a dangerous attitude during the 2 min that the flight controls are fixed. Test must be conducted at maximum takeoff weight, with minimum of in-flight turbulence

(2) Directional stability will be demonstrated by a separate and full deflection of each directional flight control for three full turns of 360° without the aircraft entering any dangerous flight attitude during the maneuver. Test must be conducted at minimum flight weight, with minimum of in-flight turbulence. The demonstrated turn rate shall not be less than 12° per second (30 s for a 360° turn) in either direction.

4.1.3.4 *Parachute Re-inflation*—Chute re-inflation may be conducted detached from the cage, or on a suitable test apparatus.

(1) Ground Roll Chute Collapse—The chute manufacturer shall demonstrate techniques that recover tip and wing collapse conditions as documented in the POH (F37.34).

(2) In-flight Collapse—At least one type of in-flight chute collapse and recovery shall be demonstrated.

5. Structure

5.1 *Loads*—Unless otherwise specified, all requirements are specified in terms of limit load.

5.1.1 Ultimate loads are limit loads multiplied by the factor of safety defined below.

5.1.1.1 Loads shall be redistributed if the deformations affect them significantly.

5.1.2 *Factors of Safety*—The factor of safety is 1.5, except as shown in the following:

5.1.2.1 3.0 on castings,

5.1.2.2 1.8 on fittings,

5.1.2.3 6.67 on control surface hinges,

5.1.2.4 3.3 on push-pull control systems, and

5.1.2.5 2.0 on cable control systems.

5.1.3 *Strength and Deformation*:

5.1.3.1 The structure must be able to support limit loads without permanent deformation of the structure.

5.1.3.2 The structure must be shown by analysis, test or analysis supported by test, to be able to withstand ultimate loads without failure.

5.1.3.3 The structure shall be able to withstand ultimate loads for three (3) s without failure when proof is by static test. When dynamic tests are used to demonstrate strength, the three-second requirement does not apply. Local failures or structural instabilities between limit load and ultimate load are acceptable if the structure can sustain the required ultimate load for three seconds.

5.2 *Proof of Structure*—Each critical load requirement shall be investigated either by conservative analysis or tests or a combination of both.

5.2.1 *Proof of Strength-Wings*—Test the wing design for a Powered Parachute Aircraft to verify the critical Ultimate Loads. The wing designer shall provide the wing and risers design load capability to the point of attachment of the risers. The wing designer shall provide the Factor of Safety demonstrated in wing and riser tests to the fuselage designer.

NOTE 1—Advisory information—Wing designer information provided to the fuselage designer shall be known as "pass-through" information.

5.2.2 *Load Factor*:

5.2.2.1 *Positive*—$n = 2.25$ (comprised of a 1.5 maneuvering load multiplied by a 1.5 gust load factor). The maneuvering load must be increased for any conditions for which the following equation indicates a g loading higher than 1.5 g's. The calculated g load shall then be used as the maneuvering load. Maneuvering Load Factor: $N = 1/\cos(B)$, where $B = \arctan(RT \times V/1255)$, where RT is turning rate in degrees per second, and V is true airspeed in mph. Example: $V = 26$ mph, $RT = 60°$ per second (360° turn in 6 s), $N = 1.595$. $N > 1.5$ and the maneuvering load factor rises to 1.595. As a result, the limit load is $1.5 \times 1.595 = 2.393$ gs. See Fig. 1 for a reference graph.

5.2.2.2 *Negative*—$n = 0$.

5.2.3 *Fuselage Loads*—The airframe must be capable of supporting all lifting forces created by the parachute, any propulsive device, systems, persons, and landing loads.

5.2.4 *Control Surface Loads*—Control surface loads on a powered parachute are related through the turn lines and shall be evaluated at loads defined in flight tests of the wing by the wing manufacturer.

5.2.5 *Ground Gust Conditions*—A powered parachute wing is not inflated for normal ground conditions. As a result, classical ground gust load concerns do not exist. Rolling gust loads for takeoff or landing are considered as part of the landing ground load conditions.

5.2.6 *Control System and Supporting Structure*—The control system structure shall be designed to withstand maximum forces and in the case of dual controls the relevant system shall be designed for the pilots operating in opposition, if greater than the control system forces.