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Standard Specification for Airframe Emergency Parachutes[1]

This standard is issued under the fixed designation F2316; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers minimum requirements for the design, manufacture, and installation of parachutes for airframes. Airframe emergency parachutes addressed in this specification refer to parachute systems designed, manufactured, and installed to recover the airframe and its occupants at a survivable rate of descent. This specification is not applicable to deep-stall parachutes, spin recovery parachutes, drogue parachutes, or other airframe emergency aerodynamic decelerators not specifically intended for safely lowering the airframe and occupants to the ground. The specification is applicable to these types of parachutes if they are an integral part of an airframe emergency parachute system designed to recover the airframe and occupants at a survivable rate of descent.

1.2 The values stated in SI units are to be regarded as standard. There may be values given in parentheses that are mathematical conversions to inch-pound units. Values in parentheses are provided for information only and are not considered standard.

1.2.1 Note that within the aviation community mixed units are appropriate in accordance with International Civil Aviation Organization (ICAO) agreements. While the values stated in SI units are regarded as standard, certain values such as airspeeds in knots and altitude in feet are also accepted as standard.

1.3 *Airframe emergency parachute recovery systems have become an acceptable means of greatly reducing the likelihood of serious injury or death in an in-flight emergency. Even though they have saved hundreds of lives in many different types of conditions, inherent danger of failure, even if properly designed, manufactured and installed, remains due to the countless permutations of random variables (attitude, altitude, accelerations, airspeed, weight, geographic location, etc.) that may exist at time of usage. The combination of these variables may negatively influence the life saving function of these airframe emergency parachute systems. They are designed to be a supplemental safety device and to be used at the discretion of the pilot when deemed to provide the best chance of survivability.*

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, health, and environmental practices and determine the applicability of regulatory requirements prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 There are currently no referenced documents in this specification.

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *ballistic device, n*—may include rocket motor, mortar, explosive projectile, spring, or other stored energy device.

3.1.2 *completely opened parachute, n*—the parachute has reached its maximum design dimensions for the first time.

3.1.3 *parachute deployment, n*—process of parachute activation and inflation.

4. Materials and Manufacture

4.1 *Materials*—Materials used for parts and assemblies, the failure of which could adversely affect safety, must meet the following conditions:

4.1.1 Materials shall be suitable and durable for the intended use.

4.1.2 Design values (strength) must be chosen so that no structural part is under strength as a result of material variations or load concentration, or both.

4.1.3 The effects of environmental conditions, such as temperature and humidity, expected in service must be taken into account.

5. Reserved

5.1 This section is being used as a placeholder to maintain the previous section numbers.

[1] This specification is under the jurisdiction of ASTM Committee F37 on Light Sport Aircraft and is the direct responsibility of Subcommittee F37.70 on Cross Cutting.

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6. Parachute System Design Requirements

6.1 *Strength Requirements:*

6.1.1 Strength requirements are specified in terms of limit loads (the maximum loads to be expected in service) and ultimate loads (limit loads multiplied by a prescribed factor of safety).

6.1.1.1 Unless otherwise provided, prescribed loads are limit loads.

6.1.1.2 Unless otherwise provided, an ultimate load factor of safety of 1.5 must be used.

6.1.2 System evaluation by analysis must use an accepted computational method that has been verified through testing. In other cases, load testing must be conducted.

6.1.3 System evaluation by testing must be supported with instrument calibration verified by an applicable weights and measures regulatory body, for example, state and federal governments.

6.2 *System Design*—The following minimum performance standards for the basic parachute system shall be met.

6.2.1 *Parachute Strength Test*—A minimum of three successful drop tests of the parachute assembly shall be conducted under ultimate load conditions to demonstrate the parachute's strength. The maximum parachute opening force measured in the three tests will be the ultimate parachute opening load. A new parachute assembly may be used for each test. The weight of the parachute assembly is included in the test weight. Data acquisition shall be performed for each test and shall include recordings of inflation loads as a function of time.

6.2.1.1 For a successful drop test the parachute system must be able to support the ultimate loads demonstrated during the drop test. No detrimental permanent deformations or damages may occur that prevent the system from serving its purpose. The parachute shall:

(1) Maintain a descent rate at or below its designed rate of descent for a given weight and altitude.

(2) Have completely opened within its designed parameter of time.

6.2.1.2 An ultimate load factor of safety of 1.5 is achieved by conducting the parachute strength test as follows:

(1) Parachute Strength Test with Aircraft in Flight—If the parachute is strength tested while attached to an aircraft in flight, the following test parameters shall be applied:

Min. Test weight = 1.25 × Aircraft Maximum Gross Takeoff Weight

Min. Test Speed = 1.1 × Aircaft's Maximum Intended Parachute Deployment Speed

NOTE 1—In this test variant, the factor of safety is considered applicable to the energy of the aircraft. However, it is not permissible to scale test results by using an energy equation approach.

(2) Parachute Strength Test with "Dead Weight" Payload—If the parachute is strength tested while attached to a "dead" weight (dense mass—sand, metal chains, water, etc. and limited volume), the following test parameters shall be applied:

Min. Test weight = Aircraft Maximum Gross Takeoff Weight

Min. Test Speed = Aircaft's Maximum Intended Parachute Deployment Speed

NOTE 2—This test method is by nature conservative, as a dead weight does not show any pitching or rotation tendency that absorbs energy during the parachute opening thrust, as a real aircraft always does. Therefore, test with maximum weight and speed results in ultimate loads.

6.2.2 *Rate of Descent*—Rate of descent data shall be recorded for all tests in 6.2.1. This data may be corrected for the variation in test vehicle weight to determine the rate of descent at the gross weight of the specific aircraft. Descent rate data from parachute canopies shall be corrected to 1500 m (5000 ft) density altitude and standard temperature. Aircraft manufacturer and parachute manufacturer shall coordinate that serious injury to occupants is unlikely while landing under parachute.

6.2.3 *Staged Deployment*—The parachute assembly shall be designed to stage the deployment sequence in an orderly manner to reduce the chances of entanglements or similar malfunctions.

6.2.4 *Environmental Conditions*—The system must be evaluated for operations in temperature conditions of −40 °C to 48.9 °C (−40 °F to 120 °F).

6.3 *Installation Design*—A specific Parachute Installation Manual (PIM) for the installation of a particular parachute system into each aircraft model must be created. The PIM must provide sufficient information to ensure correct installation of the parachute system to the specific airframe.

6.3.1 *Coordination*—Airframe and parachute manufacturers must coordinate and jointly approve the PIM for correctness. Design or configuration changes that impact the parachute installation, performance, or operability require re-evaluation relative to the requirements of this specification. Both airframe and parachute manufacturer shall coordinate these anticipated changes before implementation. These changes shall be documented in a revised PIM.

6.3.2 *Weight and Balance*—The installation of the parachute system must be accounted for in the design data of weight and balance limits of the airframe.

6.3.3 *System Mounting*—The hardware used to install the parachute system shall not become loosened or detached as a result of normal wear and tear.

6.3.4 *Extraction Performance*—Airframe and parachute manufacturers must coordinate and show that the extraction device will cleanly penetrate any covering or remove the parachute system's cover, if any, and extract the parachute assembly to full suspension line stretch (lines that connect the parachute canopy to the harnesses) without inhibiting or damaging the parachute upon egress. While it is recognized that the aircraft configuration is unpredictable in an emergency situation (for example, broken parts creating debris), all due care must be taken to provide a path of least resistance assuming an extremely rapid rate of departure.

6.3.5 *Parachute Attachment to the Airframe*—The parachute assembly must be attached to the primary structure of the airframe with an airframe attachment harness that may be composed of a single harness section or a series of harness sections. The airframe and parachute manufacturers must coordinate and agree to ensure that the parachute attachment to the subject airframe complies with the following conditions:

6.3.5.1 Parachute deployments induce unique load distributions to the airframe, largely due to geometric locations of the harness attachment points. The airframe attachment points and