

PIA TS 135
Parachute Industry Association (PIA)
TECHNICAL STANDARD 135

**PERFORMANCE STANDARDS
FOR
PERSONNEL PARACHUTE ASSEMBLIES
AND
COMPONENTS**

1. SCOPE:

This document defines the performance standards for personnel parachute assemblies (and components thereof) to be carried in aircraft for emergency use by aircrew and those reserve parachutes worn by parachutists for intentional jumping.

This document covers three types of personnel carrying parachute assemblies and the operating limitations for each:

1.1 PARACHUTE TYPES:

1.1.1 Single harness reserve parachute assembly.

1.1.2 Single harness emergency parachute assembly.

1.1.3 Dual harness reserve parachute assembly.

1.2 MAXIMUM OPERATING LIMITS, GENERAL:

1.2.1 A single harness parachute assembly (or components thereof) may be certified for any maximum operating weight and for any maximum pack opening speed equal to or greater than 150 KTAS (277.8 km/h).

1.2.2 A dual harness reserve parachute assembly (or components thereof) may be certified for any maximum operating weight greater than 500 lb (227.3 kg) (with 250 lb (113.6 kg) in each harness) and any maximum pack opening speed equal to or greater than 175 KTAS (324.1 km/h). Note that the maximum operating weight need not be the same for each harness.

PIA TS 135

1.3 LIST OF TECHNICAL STANDARDS, TABLES AND FIGURES:

Figure 1	Multiplier Factors for Structural Overload Testing
Figure 2	Functional Direct Drop Tests Required per 4.3.8.1
Table 1	Data Marking Requirements
Table 2	Human Factors and Actuation Force Tests – Primary Actuation Device/Ripcord
Table 3	Performance Test Requirements
Table 4	Performance Test Requirements for Component Qualification

2. DEFINITIONS AND GENERAL REQUIREMENTS

2.1 GENERAL DEFINITIONS:

For the purposes of this document, the following definitions are used:

- a. "Administrator" – The FAA Administrator or equivalent chief executive of the cognizant agency and/or his designated subordinate personnel and/or designated subordinate organization acting on his behalf and with his authority in the matter concerned.
- b. "Airspeed, Calibrated" (KCAS) means the indicated airspeed of an aircraft, corrected for position and instrument error. Calibrated airspeed is equal to true airspeed in standard atmosphere at sea level.
- c. "Airspeed, Equivalent" (KEAS) means the calibrated airspeed of an aircraft corrected for adiabatic compressible flow for the particular altitude. Equivalent airspeed is equal to calibrated airspeed in standard atmosphere at sea level.
- d. "Airspeed, Indicated" (KIAS) means the speed of an aircraft as shown on its pitot static airspeed indicator calibrated to reflect standard atmosphere adiabatic compressible flow at sea level uncorrected for airspeed system errors.
- e. "Airspeed, True" (KTAS) – means the airspeed relative to undisturbed air. True airspeed is equal to equivalent airspeed multiplied by $(\rho_0/\rho)^{1/2}$, where ρ_0 is the air density at standard day conditions and ρ is the air density at the local altitude.
- f. "Approved", unless used with reference to another person, means approved by the Administrator for use within the limits specified by the manufacturer and verified by compliance with the requirements of this standard.
- g. "Canopy"- The part of the parachute that opens up and fills with air and provides the lift and/or drag required to decelerate the payload to the desired value.
- h. "Certified", unless used with reference to another agency, means certified by the cognizant agency as having met the requirements of this standard.
- i. "Cognizant Agency" – The governmental agency or other organization tasked with oversight or regulation of aviation activities within a given geographical area or country. e.g. the Federal Aviation Administration (FAA) within the United States, the Joint Airworthiness Authorities (JAA) within the European Union and similar agencies worldwide. In some cases, the cognizant agency may delegate part or all of its authority to a subordinate agency such as a national aero club.
- j. "Drogue" – A small aerodynamic decelerator towed behind a falling body to slow its velocity.
- k. "Manufacturer" – The person (or business/corporate entity) who controls the design and quality of the article produced including the parts of them, and any processes or services related to them that are procured from an outside source.
- l. "Main Assisted Reserve Deployment (MARD) device" – An automatically releasable connection between the main parachute and the reserve deployment system which uses a malfunctioned main canopy to speed reserve deployment upon breakaway.

PIA TS 135

- m. "Parachute" means a device used or intended to be used to retard the fall of a body or object through the air.
- n. "Parachutist in Command" – means the person making a tandem jump who:
 - (1) Has final authority and responsibility for the operation and safety of the jump;
 - (2) Has been designated as parachutist in command before the jump; and
 - (3) Holds the appropriate rating for the conduct of the jump.
- o. "Passenger parachutist" means a person who boards an aircraft, acting as other than the parachutist in command of a tandem parachute operation, with the intent of exiting the aircraft while in-flight using the forward harness of a dual harness tandem parachute system to descend to the surface.

2.1.1 MAJOR COMPONENTS:

For purposes of this document a parachute assembly normally, but not exclusively, consists of the following major components:

- a. Deployment control device such as a sleeve, bag, diaper, or functional equivalent.
- b. Deployment initiation device (pilot chute, drogue, or functional equivalent) and bridle.
- c. Canopy(s) including suspension lines, reefing device, and connector links (if used).
- d. Riser(s), when not integral with harness and/or canopy.
- e. Stowage container(s) or stowage pack(s).
- f. Harness (es).
- g. Primary actuation device (ripcord or functional equivalent).
- h. Reserve static line.
- i. Drogue canopy and bridle (if used with reserve and/or emergency parachutes).
- j. Drogue release device (if used with reserve and/or emergency parachutes).

2.1.2 SINGLE HARNESS RESERVE PARACHUTE ASSEMBLY:

A certified parachute assembly that is worn in conjunction with a main parachute assembly and used by one person for premeditated jumps. This includes, as applicable, the reserve deployment initiation device, deployment control device, canopy, risers, stowage container, harness, primary actuation device, and reserve static line.

2.1.3 DUAL HARNESS RESERVE PARACHUTE ASSEMBLY:

A certified parachute assembly used for premeditated jumps by two people: a parachutist in command and a second parachutist (each in his/her own harness), utilizing one main parachute assembly and one reserve parachute assembly. This assembly includes, as applicable, the reserve deployment initiation device, deployment control device, canopy, risers, stowage container, harness, primary actuation device, and reserve static line.

2.1.4 MAIN PARACHUTE ASSEMBLY:

A non-certified parachute assembly that is worn in conjunction with a certified reserve parachute assembly as the primary parachute (the one intended for use) for premeditated jumps. The main parachute assembly shall consist of the main container and all associated parts of the main parachute that are not permanently attached to the certificated harness assembly.

2.1.5 SINGLE HARNESS EMERGENCY PARACHUTE ASSEMBLY:

A certified parachute assembly that is worn by one person for emergency, (unpremeditated) use only. This assembly includes, as applicable, the deployment initiation device, deployment control device, canopy, risers, stowage container, harness, and primary actuation device.

PIA TS 135

2.1.6 FAILURE OF A PARACHUTE ASSEMBLY OR COMPONENT:

The term “failure” in this document shall mean any change in a component or assembly that adversely affects its airworthiness. However, the use of consumable, frangible or single use parts shall be permitted in all assemblies and shall not be considered a failure if they function as designed.

2.1.7 FUNCTIONALLY OPEN:

Functionally open shall mean a parachute sufficiently deployed and inflated to provide a rate of descent of not more than 24 ft/s (7.3m/s). This condition may be demonstrated by video, film or electronic data of the test in a manner determined by the manufacturer.

2.1.8 RESERVE STATIC LINE (RSL):

A device connected to the main parachute assembly that is capable of actuating the reserve parachute assembly following a breakaway from the main canopy.

2.1.9 MAIN PARACHUTE BREAKAWAY DEVICE:

A device used by the parachutist in command to separate the main parachute from the harness of a single or dual-harness reserve parachute assembly. The parachutist in command shall be able to operate the main parachute breakaway device for dual harness reserve parachute assemblies.

2.1.10 MAXIMUM OPERATING WEIGHT (MOW):

The maximum operating weight is the total (gross) weight of all individuals or dummies and their equipment including the parachute assembly itself. MOW is also known as the “placard weight”.

2.1.11 MAXIMUM PACK OPENING SPEED (MPOS):

The maximum pack open speed in KTAS (knots true airspeed) is the maximum speed at which the (reserve/emergency) parachute pack (container) is designed to be opened. This definition specifically allows for the wearing of parachutes in freefall and/or in aircraft at speeds higher than the maximum pack opening speed. MPOS is also known as the “placard speed”.

NOTE: In order to provide an inherently greater margin of safety without requiring that tests be conducted at all possible altitudes, all test conditions in this document are stated in KEAS and that all maximum pack opening speeds are stated in KTAS. In the event that a manufacturer elects to conduct further testing at higher altitudes, the placard limits may be changed to reflect any test conditions successfully conducted.

2.1.12 MINIMUM OPERATING WEIGHT (MinOW)

The minimum operating weight is the lowest allowed total (gross) weight of an individual or dummy (or all individuals or dummies in the case of a tandem) and their equipment including the parachute assembly itself. The **MinOW** shall be specified by the manufacturer and may be any weight demonstrated to be appropriate by the manufacturer for the system.

2.1.13 SERVICE LIFE RESTRICTED ITEMS:

Materials or products that, by design, are service life restricted for any reason (environmental, structural, chemical, etc.) may be used in any manner chosen by the manufacturer. Each such item must be marked in a manner that will allow maintenance personnel to determine the serviceable status of the part.

PIA TS 135

3. MATERIALS AND WORKMANSHIP:

Materials and workmanship shall be of a quality that documented experience and/or tests have conclusively demonstrated to be suitable for the manufacture of, and appropriate for the intended use in, personnel parachute assemblies. All materials shall remain functional for storage from -40 to +200°F (-40 to +93.3 °C), and from 0 to 100% relative humidity. All plated ferrous parts shall be treated to minimize hydrogen embrittlement.

4. DETAIL REQUIREMENTS

4.1 DESIGN AND CONSTRUCTION:

4.1.1 MATERIALS:

All materials shall be designed to support the proof loads specified in the applicable specification, drawing, or standard, without failure. In the absence of an applicable specification, drawing, or standard for a particular material, successful completion of the qualification tests listed under section 4.3 shall be considered adequate evidence of suitability.

4.1.2 STITCHING:

Stitching shall generally be of a type that will not ravel when broken. Note that this is not required for consumable or frangible parts.

4.1.3 MAIN PARACHUTE ASSEMBLY:

When installed but not deployed, the main parachute assembly shall not interfere with the proper function of the reserve parachute assembly. Ref: Table 2

4.1.4 PRIMARY ACTUATION DEVICE/RIPCORDER:

The primary actuation device/ripcorder, including all joints, shall withstand the test loads of 4.3.2 without failure. The primary actuation device/ripcorder shall meet the human-factors requirements of 4.3.3., if applicable.

4.1.5 RESERVE STATIC LINE (RSL):

The reserve static line, if used, including all joints shall withstand the test loads of 4.3.2 without failure and shall meet the functional requirements of 4.3.8.2.

4.1.6 HARNESS RELEASE:

The harness shall be so constructed that, after landing, the parachutist can separate himself from the main and reserve canopies and/or harness assembly unaided. On a dual harness, reserve parachute assembly, the parachutist in command must be able to separate himself and the second parachutist from the reserve canopy and/or harness assemblies unaided.

4.1.7 DROGUE PARACHUTE ASSEMBLY & RELEASE:

For reserve or emergency parachute assemblies, incorporating a drogue, the drogue release shall be tested at an equivalent force to the drag force generated at the MOW and MPOS. The human release force shall not be less than 5 lbf (22.2N) and must not exceed 22 lbf (97.9N). The release shall meet the human-factors requirements of 4.3.3.

4.1.8 DATA CARD POCKET; STOWAGE CONTAINER:

The stowage container shall be provided with a parachute data card pocket constructed such that the card will not be easily lost and will be readily accessible, when the parachute is packed in the container.

PIA TS 135

4.2 MARKING REQUIREMENTS:

Marking requirements are listed in Table 1.

NOTE: The data items listed in Table 1 need not be marked at the same location on the component as long as all of the pertinent information is permanently marked.

4.2.1 MARKING, STOWAGE CONTAINER - OPERATING LIMITS:

The minimum and maximum operating limits in Table 1 shall be marked/placarded on or attached to the outside of the parachute stowage container (pack). The marking/placard may refer to the owner's manual for the minimum operating weight. The lowest maximum operating weight of any component in the assembly (canopy, harness, etc.) and the lowest maximum pack opening speed of any component (canopy, harness, etc.) shall be marked on the outside of the stowage container (pack) in such a location as to be readily available to the user during donning of the parachute assembly and subject to a minimum of obliteration during use.

This information may alternately be placed in a pocket marked with the legend 'Operating Limitations Inside'; the pocket must be readily available to the user during donning of the parachute assembly and subject to a minimum of obliteration during use.

NOTE: The maximum pack opening speed and minimum and maximum weight markings shall be in a block typeface, in a minimum size of 0.375 inch (9.5 mm) tall (27 point type). The other information required by Table 1 may be marked in another location, if desired.

4.2.2 MARKING, CANOPY - STATEMENT OF USE:

Each certified canopy shall be marked to show its approved use as follows:

- 4.2.2.1 "Single Harness Emergency Parachute Canopy"
"Single Harness Reserve Parachute Canopy"
"Single Harness Emergency/Reserve Parachute Canopy"
"Dual Harness Reserve Parachute Canopy"

- 4.2.2.2 Each canopy (single harness types only) that has not been tested in accordance with the breakaway tests of Section 4.3.8.2 shall be marked as follows:

"**LIMITATION:** May not be used with main parachute breakaway device".

4.3 QUALIFICATION TESTS:

The minimum performance standards listed in Tables 2, 3 and 4 shall be met. There shall be no failure to meet any of the requirements during the qualification tests of this section. In case of a failure, the cause must be found, corrected, and all affected tests repeated.

4.3.1 PACKING METHOD:

The packing method must be specified and the identical packing method must be used for all of the functional and structural tests.

4.3.2 PRIMARY ACTUATION DEVICE/RIPCORD TEST:

- (a) The ripcord, including all joints, shall not fail under a straight tension test load of 300-lbf (1337.7 N) applied for not less than 3 seconds.

PIA TS 135

- (b) If the reserve is to be static line actuated by releasing the main canopy, the reserve static line, if used, must not fail under a straight tension test load of 300-lbf (1334.5 N) applied for not less than 3 seconds.
- (c) If the reserve ripcord is to be static lined from an aircraft the reserve ripcord/static line, must not fail under a straight tension test load of 600-lbf (2668.9 N) applied for not less than 3 seconds.
- (d) Rigid pins, if used, shall not yield under a load of 8-lbf (35.6 N) applied to the cable (or equivalent) perpendicular to the axis of the pin, for not less than 3 seconds. The pin shall be supported for 0.5 in (12.7-mm) maximum at the end farthest from the cable attachment. All 4.3.3 human factors tests shall be performed using a primary actuation device/ripcord that has passed this test.

4.3.3 HUMAN FACTORS AND ACTUATION FORCE TESTS:

An anthropometrically diverse group of individuals (consisting of a representative group of no less than 3 males and 3 females) from the intended user group shall be employed for all human factors tests in 4.3.3. All individuals shall be able to operate the subject device without any undue difficulty. Table 2 lists the required test conditions and number of tests for each particular component. Additional information for the component tests is listed below.

TESTS: Under normal design operating conditions, all devices tested under this paragraph shall result in a positive and quick operation of the device within the following load range applied to the handle:

- (a) a load applied at the handle of not less than 5 lbf (22.2 N), applied in the direction giving the lowest pull force,
- (b) a load applied at the handle of not more than 22 lbf (97.9 N), applied in the direction of normal design operation,
- (c) for chest type parachute assemblies, the maximum pull force shall be 15 lbf (66.7 N),
- (d) the primary actuation device shall be tested in accordance with Table 2,
- (e) the emergency/reserve drogue release (if used) shall be tested in accordance with Table 2.

NOTE: For these tests, the primary actuation device (ripcord or equivalent) shall be equipped with a tamper-indicating device (i.e. seal thread or equivalent) of the same type that will be required for production articles in service.

4.3.4 HUMAN FACTORS TESTS, HARNESS:

Harnesses shall demonstrate that they will perform the basic function of retaining the body at the end of the parachute suspension system in an inherently secure manner. This requirement shall be demonstrated by passing all live drop tests in Table 3.

4.3.5 ENVIRONMENTAL TESTS:

Three drops shall be made at 60 KEAS except that prior to the test the parachute assembly shall be subjected to the following preconditioning: (These tests may be combined with other tests.)

4.3.5.1 Precondition for 16 hours at not less than +200 °F (93.3 °C), stabilize to ambient and test drop.

4.3.5.2 Precondition for 16 h at not greater than -40 °F (-40 °C), stabilize to ambient and test drop.

PIA TS 135

4.3.5.3 Precondition for not less than 400 continuous hours with a 200 lbf (889.6 N) or greater load applied to compress the pack in a manner similar to that most likely to be encountered in actual use. Test drop within 1 hour after removing the load.

4.3.5.4 Alternate preconditioning. The preconditioning requirements for 4.3.5.1 and 4.3.5.3 may be combined as follows: The complete test parachute assembly may be placed in a vacuum bag and preconditioned at +180 °F (82.2 °C) for 18 hours at a constant vacuum of not less than 25” Hg (0.846 bar). Stabilize to ambient and drop.

4.3.6 STRUCTURAL OVERLOAD TESTS:

No material(s) or device(s) that attenuates shock loads and is not an integral part of the parachute assembly or component being certified may be used. Tests may be conducted for either a complete parachute assembly or separate components. There shall be no evidence of material, stitch, or functional failure that will affect airworthiness. For reusable items the same items shall be used for all 4.3.6 tests. Peak opening force shall be measured on all 4.3.6 tests. The parachute must be functionally open within the number of seconds calculated for 4.3.8 tests. Parachute assemblies shall be tested in accordance with the following schedule:

- (a) Test weight = Maximum operating weight x 1.2
Test speed = Maximum pack opening speed x 1.2

-OR-

- (b) Test weight = Maximum operating weight multiplied by the factor from Figure 1
Test speed = Maximum pack opening speed multiplied by the factor from Figure 1

However, the test speed must not be less than 180 KEAS (333.4 km/h) for reserve and emergency parachute assemblies and the test weight must not be less than 264 lb. (120 kg).

For dual harness parachute assemblies the test weight must not be less than 600 lb. (272.7 kg) and the test speed must not be less than 200 KEAS (370.4 km/h).

4.3.6.1 STRENGTH TEST, COMPLETE PARACHUTE ASSEMBLY:

Three drops shall be made with weight and speed in accordance with 4.3.6. When using test method (b), in 4.3.6 a 4th drop must be added using the same parachute under the same conditions in the first three drops. Where non-positive locking hardware is used to attach the canopy or riser(s) to the harness, a cross connector must be used and one of the above drops shall be with only one attachment engaged to test the cross connector and hardware.

4.3.6.2 STRENGTH TEST, ALTERNATE MEANS OF COMPLIANCE CANOPY (ONLY):

Three drops shall be made with a gross weight and speed in accordance with 4.3.6. When using test method (b), in 4.3.6 a 4th drop must be added using the same canopy under the same conditions in the first three drops. A test vehicle (e.g., a bomb) may be used. The canopy and any required additional components (i.e., deployment device, pilot chute, and risers) shall be tested as a unit. The connector links (if used) shall be attached to the risers in the same manner as the intended use and the riser(s) should be secured to the test vehicle in a manner appropriate to the test objective. For example, if the parachute risers are to be tested on the bomb drop, it should be arranged in a manner as to duplicate the loading found on the personnel parachute harness. Where non-positive locking hardware is used to attach the canopy or riser(s) to the harness, a cross connector must be used and one of the above drops shall be with only one attachment engaged to test the cross connector and hardware.

PIA TS 135

4.3.6.3 STRENGTH TEST, ADDITIONAL MEANS OF COMPLIANCE HARNESS (ONLY):

A harness may, at the manufacturer's option, be placarded with a higher average peak opening force than what was measured in 4.3.6 tests by performing additional tower drop tests as outlined below:

The harness shall be drop tested using a torso shaped dummy, three (3) times for each of four (4) different loading conditions.

The dummy weight shall be not less than 75% of harness maximum operating weight and the drop distance shall be as necessary to generate the required forces.

Up to three (3) separate harnesses may be used; however each harness shall be subjected to a minimum of one test at each of the following four test conditions.

- (a) Test condition one – All risers loaded to a combined load of at least 100% of placard maximum load.
- (b) Test condition two – Only left side harness/canopy attachment point(s) loaded to a combined load of at least 66% of placard load.
- (c) Test condition three – Only right side harness/canopy attachment point(s) loaded to a combined load of at least 66% of placard load.
- (d) Test condition four – Each unique brake setting shall be tested to a minimum of 16.7% of placard load if applicable.

4.3.6.4 STRENGTH TESTS, ALTERNATE MEANS OF COMPLIANCE, DROGUE CANOPY (ONLY)

For parachute assemblies in which a drogue parachute canopy is an integral part of the reserve or emergency parachute assembly, the drogue may be separately tested at the conditions determined in 4.3.6. The drogue canopy itself and all related components of the drogue assembly must be tested as a functional subsystem of the parachute assembly.

4.3.7 FUNCTIONAL TESTS (Twisted Lines):

A minimum of 5 drops shall be made with a weight not more than the maximum operating weight dummy or person¹ in each harness. The airspeed at the time of pack opening shall be 60 KEAS (111.1 km/h)

Procedural Note: The suspension lines shall be twisted together (360 degrees) three times in the same direction within the upper one third of the suspension line length beginning immediately below the attachment point to the canopy. The twists shall be placed in the lines before the suspension lines are stowed.

Performance Requirement: The parachute must be functionally open within 133% of the time calculated in 4.3.8 from the time of pack opening.

4.3.8 FUNCTIONAL TESTS (Normal Pack - All Types):

Opening Time or Altitude Loss: Using the MOW in pounds and the MPOS in KTAS for all 4.3.8 tests the maximum allowable opening time and the maximum allowable altitude loss on any drop shall be determined from the following formulas..

- (a) The greater of 3.00 seconds or the value determined as follows:

¹ A person's or individual's body weight may be increased to equal the maximum operating weight by using a weight belt or similar device.

PIA TS 135

$$\text{Opening Time Allowed (sec.)} = (\text{MOW} - 250) * 0.01 + (\text{MPOS}/150 * 3.0)$$

-OR-

(b) The greater of 300 feet or the value determined as follows:

$$\text{Altitude Loss Allowed (ft)} = (\text{MOW}-250) + (\text{MPOS}/150 * 300)$$

4.3.8.1 DIRECT DROP TESTS:

There shall be a minimum of 48 tests at weights and airspeeds (at the time of pack opening) as outlined in Table 3. The test condition airspeeds are in KEAS. From the time of pack opening, the parachute canopy must be functionally open within the allowed time or altitude as calculated in 4.3.8.

- (a) The manufacturer shall specify the Maximum Operating Weight and the Minimum Operating Weight.
- (b) The Maximum Pack Opening Speed (MPOS) shall not be less than 150 knots.
- (c) The MPOS and MOW shall be established by successful completion of the structural overload testing in Paragraph 4.3.6
- (d) The manufacturer will be allowed to select whether to measure altitude loss or opening time, but within each block on the test grid the same method must be used.
- (e) The maximum allowable opening time shall be calculated using the formula in 4.3.8(a): there shall be a minimum of 4 successful tests for each block; the opening times will be averaged and presented to the Administrator in the format shown in Figure 2.
- (f) The maximum allowable altitude loss shall be calculated using the formula in 4.3.8(b): there shall be a minimum of 4 successful tests for each block; the altitude loss must be averaged and presented to the Administrator in the format shown in Figure 2.
- (g) The opening times and/or altitude loss for each test block will be averaged and published in the format shown in Figure 2 in the owner's manual or in some other readily available location.

NOTE:

If a "MARD device" option is offered, an additional 8 drops at weights and airspeeds (at the time of pack opening) must be performed as outlined in the Table 3 with the MARD attached.

4.3.8.2 BREAKAWAY DROP TESTS (systems with main canopy release):

Eight drop tests shall be made by breaking away from an open and normally functioning main parachute canopy and actuating the reserve parachute within 2 seconds of the breakaway. These tests shall be conducted by a person (or suitable other devices) weighing not more than the maximum operating weight. The initial vertical velocity shall be less than 20 ft/s (6.1 m/s) and the total velocity less than 36 ft/s at the time of breakaway. From the time of pack opening, the parachute canopy must be functionally open within the altitude or within the allowed time as calculated in 4.3.8.

NOTE:

- (a) If a reserve static line is part of the assembly, then 4 of the breakaway drops shall be made with the reserve static line actuating the reserve pack.
- (b) If a "MARD device" option is offered, an additional 16 drops at weights and airspeeds (at the time of pack opening) must be performed as outlined in the Table 3 with the MARD attached.

PIA TS 135

4.3.9 RATE OF DESCENT TESTS (METHOD 1):

Per Table 3, there shall be not less than 6 drops, with an individual and/or dummy in each harness weighing not less than the maximum operating weight². The average rate of descent shall not exceed 24 ft/s (7.3 m/s) and the total velocity shall not exceed 36 ft/s (11.0 m/s) in an unaltered post deployment configuration, corrected to standard day sea level altitude conditions. The rate of descent measurement shall be taken over a minimum interval of 100 ft (30.5 m). These tests may be combined with other tests in this section.

4.3.9.1 RATE OF DESCENT TESTS (METHOD 2):

The rate of descent corrected to standard day sea level altitude conditions shall not exceed 5 ft/sec (1.5m/sec) at touchdown with appropriate control manipulations and the average rate of descent shall not exceed 24 ft/sec (7.3 m/s) in the unaltered post deployment configuration over a minimum interval of 100 ft (30.5m). These tests may be combined with other tests in this section.

NOTE: If the total velocity exceeds 36 ft/sec at maximum certified weight, the container or harness (if integral to the container) must be marked in an area readily visible to the user: "For experienced parachutists only. The owner's manual contains experience requirements."

4.3.10 STABILITY TESTS:

Per Table 3, there shall be not less than 6 drops, at the minimum operating weight. The oscillations shall not exceed 15° from the vertical, in an unaltered post-deployment configuration. These tests may be combined with other tests in this section.

4.3.11 LIVE TESTS:

Per Table 3, there shall be a minimum of 4 live tests with an individual weighing not more than the maximum operating weight in each harness. Two drops shall include a freefall of not more than 3 seconds and 2 drops shall include a freefall of at least 20 seconds. These tests may be conducted in conjunction with functional and/or rate of descent tests when practical. The user(s) must suffer no significant discomfort from the opening shock and must be able to disengage himself (themselves) unaided from the harness after landing. For this test the standard harness may be altered to permit attachment of a certified reserve parachute assembly (less harness) provided that such alteration does not interfere with the normal operation of the parachute assembly being tested. Reserve parachute assemblies shall be tested with the main compartment(s) full and empty, with a minimum of two tests each.

NOTE: Live tests for Dual Harness Reserve Parachute Assemblies may be tested with the parachutist in command and a dummy payload in the passenger harness.

5. COMPONENT QUALIFICATIONS:

Any single component, assembly of components, group of components or group of assemblies may be certified. Table 4 lists the appropriate test paragraphs for each of the major components. Any components not listed in Table 4 shall be tested according to all applicable sections of this document based on the components function.

² A person's or individual's body weight may be increased to equal the maximum operating weight by using a weight belt or similar device.

PIA TS 135

5.1 COMPONENT COMPATIBILITY:

The component manufacturer shall provide a means of determining compatibility and shall provide specific guidance to ensure that form, fit and function of all components, as assembled, are within acceptable limits for each individual component and the assembly as a whole.

5.2 COMPONENT QUALIFICATION BY GROUP:

Components may be qualified as a group consisting of a range of scaled sizes. Separate elements of the component design may be linearly scaled at different rates as specified in the component drawings provided that fit, form, and function are not adversely affected. For canopies, the range may consist of scaled sizes to a maximum area of three times the smallest size.

When certifying components as a group, only the largest and the smallest members of the group must be tested in accordance with the appropriate sections of this document.

5.3 MAINTENANCE REQUIREMENTS:

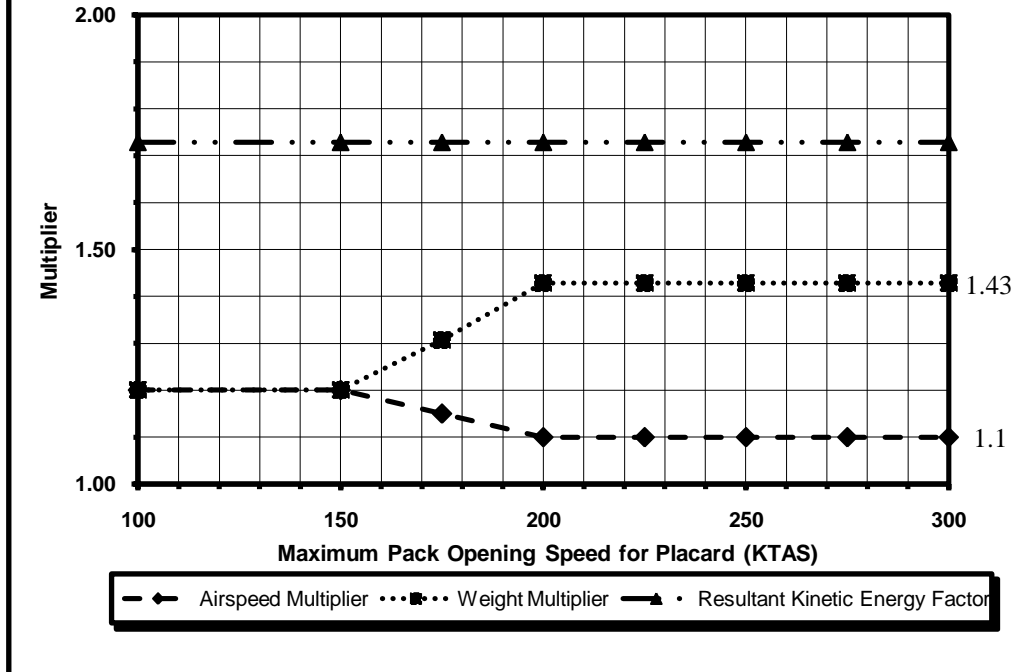
The manufacturer of each component is responsible for developing and disseminating the maintenance requirements for each component, specifically including the inspection interval, repack cycle, service life, criteria for continued airworthiness and the qualifications required of maintenance personnel.

5.4 FITTING REQUIREMENTS:

The manufacturer is responsible for developing and disseminating instructions identifying the correct method of fitting the equipment to the user.

PIA TS 135

**PIA TS-135 - Figure 1
Multiplier Factors for Structural Overload Testing
Per Paragraph 4.3.6**



**PIA TS-135 Figure 2
Direct Drop Tests
Per Paragraph 4.3.8.1**

Test Weight	Test Speed			
	60 KEAS	85 KEAS	MPOS x 80%	MPOS x 100%
Minimum Operating Weight	4	4	4	4
Averaged Operating Weight*	4	4	4	4
Maximum Operating Weight	4	4	4	4
Minimum Total (direct drop) Functional Tests Required				48

*Averaged Operating Weight is defined as (Maximum Operating Weight + Minimum Operating Weight)/2
 Average test weights shall be +/- 5%
 Minimum test weights shall be +1%/-10%.
 Maximum test weights shall be +10%/-1%

PIA TS 135

PIA-TS-135 - Table 1.												
Data Marking Requirements												
		Reference Paragraph	Deployment Initiation Device (Pilot Chute, etc.)	Deployment Control Device (d-bag, etc.)	Reserve Emergency Canopy	Stowage Container	Primary Actuation Device (Ripcord or Equivalent)	Reserve Static Line (if used)	Harness (if not integral with container)	Risers (if not integral with harness)	Reserve/Emergency Drogue Canopy & Riser (if used)	Reserve/Emergency Drogue Release Device (if used)
Marking Data Requirements												
Manufacturers Name, Code or Symbol			X	X	X	X	X	X	X	X	X	X
Part Number (w/dash numbers)			X	X	X	X	X	X	X	X	X	X
Serial or Lot Control Number			X	X	X	X	X	X	X	X	X	
Date of Manufacture (month and year minimum)			X	X	X	X	X	X	X	X	X	
Date to Be Removed from Service (if applicable)			X	X	X	X	X	X	X	X	X	
Maximum Pack Opening Speed (KEAS)	4.3.6		X		X	X			X	X		
Maximum Gross Weight (lb) if applicable	4.3.6				X					X	X	
Minimum Gross Weight (lb)	4.2				X							
Average Peak Force Measured during 4.3.6 tests	4.3.6				X					X		
Approved for Use Statement	4.2.2				X							
Statement of Authorization Under TS0-C-23e and/or (J) TSO-C-23e if applicable			X	X	X	X			X	X	X	
Operators Warning Label with Maximum Operating Limits	4.3.6				X				X			
Operators Warning Label and location for component operating limitations	4.2.1					X						
Operators Warning Label with Maximum Total Velocity for intended use (Student, Tandem, Emergency Air Crew or Other).	4.3.9				X							
Maximum Drogue deployment speed	4.3.6										X	
For ripcords, either lot control number or date of manufacture may be marked provided that tracability is maintained												
At a minimum, Maximum Operating Limitations must include maximum pack opening speed and maximum gross weight. Manufacturer may voluntarily derate operating limitations.												
Redundant marking may be eliminated for components which are permanently joined at the time of manufacture. If this is the case, the marking will be located on the most visible component, normally the container.												

PIA TS 135

PIA-TS-135 - Table 2

Human Factors and Actuation Force Tests

Primary Actuation Device / Ripcord

	Data Required	Test Condition	Load Factor	Second Parachutist	Suspended by	Pack Condition	Emergency Parachute Assembly		Single Harness Reserve Parachute Assembly		Dual Harness Reserve Parachute Assembly		
							Male	Female	Male	Female	Male	Female	
Primary Actuation Device / Ripcord	P/F Force	Standing Upright	N/A	N/A	N/A	N/A	6	6					
	P/F Force	Standing Upright	N/A	none/with	N/A	Full			3	3	3/3	3/3	
	P/F Force	Standing Upright	N/A	none/with	N/A	Empty			3	3	3/3	3/3	
	P/F Force	Suspended Harness	1g	none	Main Risers	Empty			3	3	3	3	
	P/F Force	Suspended Harness	1 g	with	Main Risers	Empty					3	3	
	Additional tests if emergency/reserve drogue is used:												
	P/F Force	Suspended Harness	4.1.7	N/A	Drogue	N/A	6	6					
	P/F Force	Suspended Harness	4.1.7	none	Drogue	Full			3	3	3	3	
	P/F Force	Suspended Harness	4.1.7	none	Drogue	Empty			3	3	3	3	
	P/F Force	Suspended Harness	4.1.7	with	Drogue	Full					3	3	
	P/F Force	Suspended Harness	4.1.7	with	Drogue	Empty					3	3	
	Total Tests Required in This Section (drogue / no drogue)							24/12		30/18		60/36	
4.1.7 - The drogue release shall be tested at an equivalent (or greater) force to the drag force generated at the MOW and MPOS.													

Notes:

1. All tests must be conducted with a reserve/emergency canopy assembly packed for intended use.
2. N/A = Not Applicable
3. P/F = Pass/Fail

PIA TS 135

PIA TS-135 Table 3

Required Qualification Tests

Notes on Data Required	Test Description	Reference Paragraph	Speed at Pack Opening (KEAS)	Test Weight	Main Pack Condition	Emergency Parachute Assemblies		Single or Dual Harness Reserve Parachute Assembly		
						Dummy	Live	Dummy	Live	
1, 8, 5	Primary Actuation Device/Ripcord Test	4.3.2	IAW 4.3.2 (a) through (d)							
1,2,5	Human Factors and Actuation Force Tests	4.3.3	IAW Table 2 and as described in paragraphs 4.3.3(a) through (e)							
	Human Factors Tests, Harness	4.3.4	Demonstrated by successful completion of live jumps per paragraph 4.3 .11							
	Environmental Tests	4.3.5								
1, 3, 5	Precondition to +200 F	4.3.5.1	60 KEAS	<= MaxOW		1		1		
1, 3, 5	Precondition to -40 F	4.3.5.2	60 KEAS	<= MaxOW		1		1		
1, 3, 5	Precondition - compressed pack	4.3.5.3	60 KEAS	<= MaxOW		1		1		
1, 3, 5	Precondition - alternate to 4.3.5.1 & 4.3.5.3	4.3.5.4	60 KEAS	<= MaxOW		1		1		
	Structural Overload Tests	4.3.6								
1,2,3,5	Complete Assemblies	4.3.6.1	Fig. 1	Fig. 1	N/S	3	N/A	3	N/A	
1,2,3,5	Alternate Means of Compliance, Canopy Only	4.3.6.2	Fig. 1	Fig. 1	N/S	3		3		
1,2,3,5	Alternate Means of Compliance, Harness Only	4.3.6.3	Fig. 1	Fig. 1	N/S	3		3		
1,2,3,5	Drogue (if applicable)	4.3.6.4	Fig. 1	Fig. 1	N/S	3		3		
1, 3 (or 4), 5,	Functional Tests, Twisted Lines	4.3.7	60 KEAS	<= MOW	N/S	5		5		
1, 3 (or 4), 5,	Functional Tests, (Normal Pack all types)	4.3.8	Opening Time allowed shall be calculated IAW paragraph 4.3.8 (a). Opening Altitude allowed shall be calculated IAW paragraph 4.3.8 (b)							
1, 3 (or 4), 5,	Direct Drop	4.3.8.1	60 KEAS	MinOW	Empty	4		2		
1, 3 (or 4), 5,	Direct Drop	4.3.8.1	60 KEAS	AvOW	Full	N/A		2		
1, 3 (or 4), 5,	Direct Drop	4.3.8.1	60 KEAS	MaxOW	Empty	4		2		
1, 3 (or 4), 5,	Direct Drop	4.3.8.1	60 KEAS	MinOW	Full	N/A		2		
1, 3 (or 4), 5,	Direct Drop	4.3.8.1	60 KEAS	AvOW	Empty	4		2		
1, 3 (or 4), 5,	Direct Drop	4.3.8.1	60 KEAS	MaxOW	Full	N/A		2		
			Total Drops at 60 KEAS				12		12	
1, 3 (or 4), 5,	Direct Drop	4.3.8.1	85 KEAS	MinOW	Empty	4		2		
1, 3 (or 4), 5,	Direct Drop	4.3.8.1	85 KEAS	AvOW	Full	N/A		2		
1, 3 (or 4), 5,	Direct Drop	4.3.8.1	85 KEAS	MaxOW	Empty	4		2		
1, 3 (or 4), 5,	Direct Drop	4.3.8.1	85 KEAS	MinOW	Full	N/A		2		
1, 3 (or 4), 5,	Direct Drop	4.3.8.1	85 KEAS	AvOW	Empty	4		2		
1, 3 (or 4), 5,	Direct Drop	4.3.8.1	85 KEAS	MaxOW	Full	N/A		2		
			Total Drops at 85 KEAS				12		12	
1, 3 (or 4), 5,	Direct Drop	4.3.8.1	80% MPOS	MinOW	Empty	4		2		
1, 3 (or 4), 5,	Direct Drop	4.3.8.1	80% MPOS	AvOW	Full	N/A		2		
1, 3 (or 4), 5,	Direct Drop	4.3.8.1	80% MPOS	MaxOW	Empty	4		2		
1, 3 (or 4), 5,	Direct Drop	4.3.8.1	80% MPOS	MinOW	Full	N/A		2		
1, 3 (or 4), 5,	Direct Drop	4.3.8.1	80% MPOS	AvOW	Empty	4		2		
1, 3 (or 4), 5,	Direct Drop	4.3.8.1	80% MPOS	MaxOW	Full	N/A		2		
			Total Drops at 80% MPOS				12		12	

PIA TS 135

PIA TS-135 Table 3 continued

Required Qualification Tests

1, 3 (or 4), 5,	Direct Drop	4.3.8.1	100% MPOS	MinOW	Empty	4	2
1, 3 (or 4), 5,	Direct Drop	4.3.8.1	100% MPOS	AvOW	Full	N/A	2
1, 3 (or 4), 5,	Direct Drop	4.3.8.1	100% MPOS	MaxOW	Empty	4	2
1, 3 (or 4), 5,	Direct Drop	4.3.8.1	100% MPOS	MinOW	Full	N/A	2
1, 3 (or 4), 5,	Direct Drop	4.3.8.1	100% MPOS	AvOW	Empty	4	2
1, 3 (or 4), 5,	Direct Drop	4.3.8.1	100% MPOS	MaxOW	Full	N/A	2
Total Drops at 100% MPOS						12	12
Total Direct Drop Tests						48	48

1, 3 (or 4), 5, 10, 11	Direct Drop "MARD device"	4.3.8.1	60 KEAS	<= MaxOW	Full	N/A	4
1, 3 (or 4), 5, 12	Direct Drop "MARD device"	4.3.8.1		<= MaxOW	Full	N/A	4
1, 3, 5, 9	Functional Tests, Breakaway	4.3.8.2	< 20 fps Vv	<= MaxOW	Empty	N/A	8
1, 3, 5, 9, 13	Functional Tests, Breakaway "MARD device"	4.3.8.2		<= MaxOW	Empty	N/A	4
1, 3, 5, 9, 14	Functional Tests, Breakaway "MARD device"	4.3.8.2		<= MaxOW	Empty	N/A	4
1, 3, 5, 9, 15	Functional Tests, Breakaway "MARD device"	4.3.8.2		<= MaxOW	Empty	N/A	4
1, 3, 5, 9, 12, 16	Functional Tests, Breakaway "MARD device"	4.3.8.2		<= MaxOW	Empty	N/A	4
1, 5, 7	Rate of Descent Tests	4.3.9	N/A	MaxOW	N/S	6	6
1, 5, 6	Stability Test	4.3.10	N/A	MinOW	N/S	6	6
1, 3, 5, 11	Live Jumps	4.3.11	< 60 knots	<= MaxOW	N/S	2	2
1, 3, 5, 12	Live Jumps	4.3.11	> 120 knots	<= MaxOW	N/S	2	2

Abbreviations used above:

IAW	In accordance with
MPOS	Maximum pack opening speed
MaxOW	Maximum operating weight
AvOW	Average operating weight
MinOW	Minimum operating weight
N/A	Not Applicable
N/S	Not Specified

Notes on Test Criteria

1	Record Pass/Fail
2	Record Riser Force
3	Record Opening Time
4	Record Altitude Loss
5	Video Record
6	Record Oscillation Angle
7	Record Rate-of-Descent
8	Record Ripcord Pull Force
9	If an RSL used, then half of the cutaway test shall be conducted with the RSL - a total of 8 tests is required
10	Jumps may be performed concurrently with similar direct drops outlined in table 3
11	Shall include a freefall of not more than 3 seconds
12	Shall include a freefall of at least 20 seconds
13	Breakaways from stable main
14	Breakaways from forward spinning main. Half left spin, half right spin
15	Breakaways from BACKWARDS spinning main. Half left spin, half right spin
16	Breakaways from bag lock malfunction

PIA TS 135

PIA-TS-135 - Table 4.

Performance Test Requirements for Component Qualification

Description of Test	Reference Paragraph for PIA-TS-135	Complete Parachute Assembly	Deployment Initiation Device (Pilot Chute, etc.)	Deployment Control Device, (dbag, etc.)	Canopy, lines, links, and reefing device (if used)	Stowage Container	Primary Actuation Device (Ripcord or Equivalent, Except Static Line)	Primary Actuation Device (Static Line)	Reserve Static Line (if used)	Harness	Risers (if not integral with harness)	Drogue, Canopy & Riser (if used)	Drogue Release Device (if used)	MARD (if used)
Ripcord Strength Tests	4.3.2	X					X	X	X				X	
Human Factors	4.3.3	X				X	X					X	X	X
Environmental	4.3.5	X	X	X	X	X				X	X	X	X	X
Structural Overload Test	4.3.6	X	X	X	X	X				X	X	X	X	*1
Functional Tests - Twisted Line	4.3.7	X		X	X									
Functional Tests - Normal Pack, Direct Drop	4.3.8.1	X	X	X	X	X						X	X	
Functional Tests - Normal Pack, Breakaway	4.3.8.2	X	X	X	X	X	X		X					X
Rate of Descent	4.3.9	X			X									
Stability	4.3.10	X			X									
Live Drops	4.3.11	X	X	X	X	X	X	X	X	X	X	X	X	X

*1 MARD installation shall not degrade strength or tensile loads on any reserve deployment devices or subassemblies on which it is installed. The manufacturer shall prove equivalent strength between similar devices or subassemblies with and without the MARD installed. This can be done with a bench/pull test or tensile test. For example, the strength of a free bag bridle with MARD parts installed but not hooked up should not be less than a bridle without a MARD installation.