

PIA TS 135

Parachute Industry Association (PIA)

TECHNICAL STANDARD 135

MINIMUM PERFORMANCE STANDARDS FOR PERSONNEL PARACHUTE ASSEMBLIES AND COMPONENTS

1. SCOPE:

This document defines the minimum 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 (181.4 kg) (with 250 lb (90.7 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.

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1.3 LIST OF TECHNICAL STANDARDS, TABLES AND FIGURES:

Figure 1	Multiplier Factors for Structural Overload Testing
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. "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.
- b. "Administrator" – The 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.
- c. "Manufacturer" – The responsible person (or business/corporate entity) that controls the design, testing and manufacturing of a certified product.
- d. "Approved", unless used with reference to another person, means approved by the Administrator.
- e. "Certified", unless used with reference to another agency, means certified by the cognizant agency as having met the requirements of this standard.
- f. "Parachute" means a device used or intended to be used to retard the fall of a body or object through the air.
- g. "Parachutist in Command" – means the person 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. .
- h. "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 existing the aircraft while in-flight using the forward harness of a dual harness tandem parachute system to descend to the surface.
- i. "Indicated airspeed" 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.
- j. "Calibrated airspeed" 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.
- k. "True airspeed" means the airspeed of an aircraft relative to undisturbed air. True airspeed is equal to equivalent airspeed multiplied by $(\rho_0/\rho)^{1/2}$.
- l. "Equivalent airspeed" 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.

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- m. KIAS – knots indicated airspeed.
- n. KCAS – knots calibrated airspeed.
- o. KEAS – knots equivalent airspeed.
- p. KTAS – knots true airspeed.

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.
- 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. Main parachute breakaway device.
- j. Drogue canopy and bridle (if used with reserve and/or emergency parachutes).
- k. Drogue release device (if used with reserve and/or emergency parachutes).
- l. Other components identified by the manufacturer.

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, 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.

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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 drag area equal to or greater than 75% of the steady state drag area of the canopy. 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 parachute pack (container) may 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 LIFE LIMITED ITEMS:

Materials or products that, by design, are life limited 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 life status of the part.

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.

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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 environmental tests in 4.3.4 and the strength tests in paragraph 4.3.5 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 requirement may not apply to 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:

All load bearing joints of the primary actuation device/ripcorder 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. The primary actuation device (ripcorder or equivalent) shall be equipped with a tamper-indicating device (i.e. seal thread or equivalent) that is suitable for long-term use in personnel parachute assemblies.

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 4.3.7.2.

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 must not exceed 22 lbf.

A minimum of 6 ground or air tests must be done.

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4.1.8 DATA CARD POCKET; STOWAGE CONTAINER (REQUIRED):

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

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 (REQUIRED):

The maximum operating limits in Table 1 shall be marked on or attached to the outside of the parachute stowage container (pack). 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 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 (REQUIRED):

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 4.3.7.2 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.

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4.3.2 PRIMARY ACTUATION DEVICE/RIPCORD TEST:

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. The reserve static line, if used, must not fail under a straight tension test load of 300 lbf (2667.3 N) for not less than 3 seconds. The 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. The pin(s) shall be deemed to have passed this test if the primary actuation device/ripcord which it (they) is (are) a part of then passes the human-factors tests specified in Table 2.

4.3.3 HUMAN-FACTORS AND ACTUATION FORCE TESTS:

An anthropometrically diverse group of individuals (typically consisting of a representative group of no less than 6 males and 6 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.

Pass/Fail Criteria: 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).

4.3.3.1 HUMAN FACTORS TESTS, PRIMARY ACTUATION DEVICE/RIPCORD:

The primary actuation device 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.

4.3.3.2 HUMAN FACTORS TESTS, DROGUE RELEASE:

The drogue release (if used) shall be tested in accordance with Table 2.

4.3.4 ENVIRONMENTAL TESTS:

Three drops shall be made to the lowest applicable direct drop speed in 4.3.7 except that prior to the test the parachute assembly shall be subjected to the following preconditioning: (These tests may be combined with other tests.)

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

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

4.3.4.3 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.

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4.3.4.4 Alternate preconditioning. The preconditioning requirements for 4.3.4.1 and 4.3.4.3 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.

4.3.5 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 4.3.5 tests. Peak opening force shall be measured on all 4.3.5 tests. The parachute must be functionally open within the number of seconds calculated for 4.3.7 tests. Parachute assemblies shall be tested in accordance with the following schedule:

- (a) Test weight = Maximum operating weight x 1.2 or multiplier from Figure 1
- (b) Test speed = Maximum pack opening speed x 1.2 or multiplier from Figure 1

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

For dual harness parachute assemblies the test weight must not be less than 600 lb. (272.3 kg) and the test speed must not be less than 200 KEAS (370.4 km/h).

4.3.5.1 STRENGTH TEST, COMPLETE PARACHUTE ASSEMBLY:

Three drops shall be made with weight and speed in accordance with 4.3.5. 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.

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

Three drops shall be made with a gross weight and speed in accordance with 4.3.5. 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 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.

4.3.5.3 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 4.3.5 tests by performing additional tower drop tests as outlined below:

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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.

Test condition one – All risers loaded to a combined load of at least 100% of placard maximum load.

Test condition two – Only left side harness/canopy attachment point(s) loaded to a combined load of at least 66% of placard load.

Test condition three – Only right side harness/canopy attachment point(s) loaded to a combined load of at least 66% of placard load.

Test condition four – Each unique brake setting shall be tested to a minimum of 16.7% of placard load if applicable.

4.3.6 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 the time (+33%) calculated in 4.3.7 from the time of pack opening.

4.3.7 FUNCTIONAL TESTS (Normal Pack - All Types):

Opening Time or Altitude Loss: Using the MOW in pounds and the MPOS in knots, for all 4.3.7 tests the maximum allowable opening time or altitude loss shall be determined from either of the following formulas on any drop.

If MOW < 250 lb:

Maximum Allowed Opening Time (s) = $(\text{MPOS}/150)^2 \times 3.00$

Maximum Altitude loss (ft) = $(\text{MPOS}/150)^2 \times 300$

If MOW ≥ 250 lb:

Maximum Allowed Opening Time (s) = $[(\text{MOW}-250) \times 0.01] + [(\text{MPOS}/150)^2 \times 3.00]$

Maximum Altitude loss (ft) = $(\text{MOW}-250) + [(\text{MPOS}/150)^2 \times 300]$

4.3.7.1 DIRECT DROP TESTS:

There shall be a minimum of 48 drops at weights and airspeeds (at the time of pack opening) as outlined in the 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 4.3.7.

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.

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4.3.7.2 **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 4.3.7.

NOTE: If a reserve static line is part of the assembly, then four of the breakaway drops shall be made with the reserve static line actuating the reserve pack.

4.3.8 **RATE OF DESCENT TESTS:**

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. Either or both of the 4.3.8 tests may be used for compliance with this section.

4.3.8.1 **RATE OF DESCENT TESTS (Method 1):**

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 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.

4.3.8.2 **RATE OF DESCENT TESTS (Method 2):**

The average rate of descent corrected to standard sea level altitude conditions shall not exceed 5 ft/sec at touchdown with appropriate control manipulations by the user. These tests may be combined with other tests in this section.

4.3.9 **STABILITY TESTS:**

Per Table 3, there shall be not less than 6 drops, with a dummy weighing less than or equal to one half the maximum 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.

4.3.10 **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 harness⁴. 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.

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.

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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.

5.1 **COMPONENT COMPATIBILITY:**

The component manufacturer shall publish and make available a list of interchangeable components that have passed the tests listed in Table 4 in conjunction with the assembly or component(s) being certified.

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.

The canopy average peak opening shock (demonstrated in 4.3.5 tests) must not exceed the structural capacity of the harness (as demonstrated in 4.3.5 tests).

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."

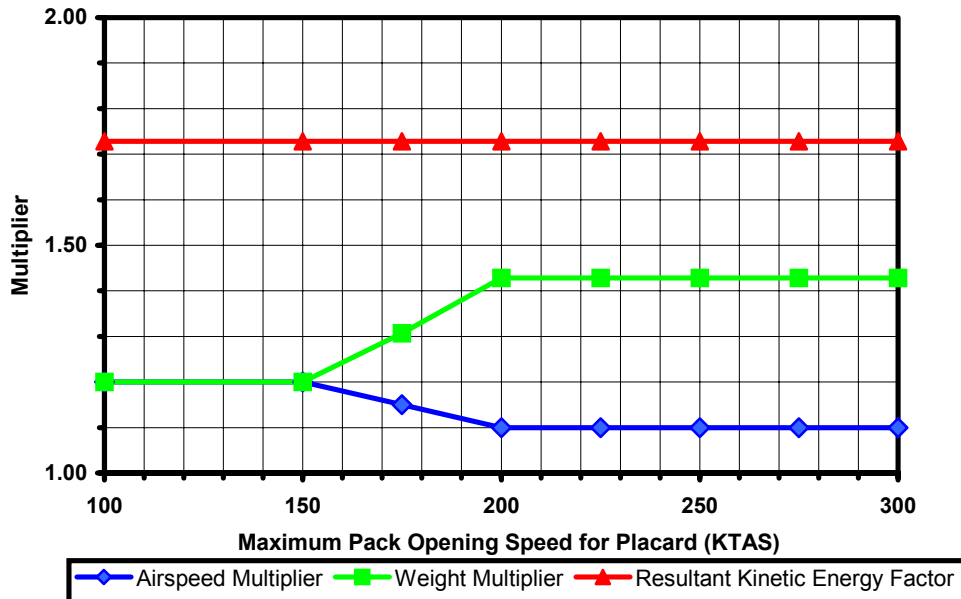
When certifying components as a group, only the largest and the smallest members of the group must be tested in accordance with the appropriate sections of this document.

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.

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PIA TS-135 - Figure 1
Multiplier Factors for Structural Overload Testing
Per Paragraph 4.3.5



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PIA TS-135 - Table 1

Data Marking Requirements

Relevant Paragraph	Marking Data Requirements	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)
	Manufacturer's 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 (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	
4.3.5	Maximum Pack Opening Speed (KEAS)	X	X		X			X	X		
4.3.5	Maximum Gross Weight (lb) if applicable							X	X	X	
4.3.5	Average Peak Force Measured during 4.3.5 tests			X				X	X		
4.2.2	Approval for Use Statement			X							
	Statement of Authorization Under TSO-C-23e and/or (J)TSO-C-23e if applicable	X	X	X	X			X	X	X	
4.3.5	Operator's Warning Label with Maximum Operating Limits			X				X			
4.2.1	Operator's Warning Label and location for component operating limitations				X						
4.3.5	Maximum Drogue deployment speed									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 manufacturer. If this is the case, the marking will be located on the most visible component, normally the container										

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PIA TS-135 - Table 2

Human Factors and Actuation Force Tests

Primary Actuation Device / Ripcord

Line Reference	Data Required	Test Condition	Load Factor	Second Parachutist	Suspended by	Main Pack Condition	Emergency Parachute Assembly			Single Harness Reserve Parachute Assembly			Dual Harness Reserve Parachute Assembly				
							Male	Female	Dummy	Male	Female	Dummy	Male	Female	Dummy		
A1	P/F Force	Standing Upright	1 g	N/A	N/A	N/A	6	6									
A2	P/F Force	Standing Upright	1 g	N/A	N/A	Full				3	3				3	3	
A3	P/F Force	Standing Upright	1 g	N/A	N/A	Empty				3	3				3	3	
A4	P/F Force	Suspended Harness	1 g	none	Main Risers	Empty				3	3				3	3	
A5	P/F Force	Suspended Harness	1 g	none	Drogue Riser	Full	3	3		3	3				3	3	
A6	P/F Force	Suspended Harness	1 g	none	Drogue Riser	Empty				3	3				3	3	
A7	P/F Force	Suspended Harness	1 g	with	Main Risers	Empty				3	3				3	3	
A8	P/F Force	Suspended Harness	1 g	with	Drogue Riser	Full				3	3				3	3	
A9	P/F Force	Suspended Harness	1 g	with	Drogue Riser	Empty				3	3				3	3	
Total Tests Required in This Section							18	48	48	48	48	48	48	48	48	48	48

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Required Qualification Tests

Data Required	Test Description	Reference Paragraph	Comments	Speed at Pack Opening (KEAS)	Test Weight	Main Pack Condition	Emergency Parachute Assemblies		Single Harness Reserve Parachute Assembly		Dual Harness Reserve Parachute Assembly	
							Male	Female	Dummy	Male	Female	Dummy
P/F, Force, Video	Primary Actuation Device/Ripcord	4.3.2	Use Paragraph 4.3.2	N/A	N/A							
P/F, Force, Video	Human Factors Tests	4.3.3	Use Table 2	N/A	N/A							
P/F, Video	Environmental Tests	4.3.4		N/A	N/A		3				3	
P/F, Force, Time, Video	Structural Overload Tests	4.3.5	For placard speeds in excess of 150 KEAS, the multipliers in Figure 2 may be used instead of 1.2	1.2 * MPOS	1.2 * MOW	N/S						
P/F, Force, Time, Video	Complete Assemblies	4.3.5.1		Fig 1	N/S		0	3	0	3	0	3
P/F, Force, Time, Video	Canopy, Alternate	4.3.5.2		N/A	N/A							
P/F, Force, Time, Video	Harness, Alternate	4.3.5.3		N/A	N/A							
P/F, Time, Video	Functional Tests, Twisted Lines	4.3.6		60	<= MOW	N/S	5		5		5	
P/F, Video, Time, or Alt. Loss	Functional Tests, Normal Pack	4.3.7	Empty/Full pack indications are not applicable to emergency parachute assemblies.									
P/F, Video, Time, or Alt. Loss	Direct Drop	4.3.7.1		60	<= MOW	Empty	14	2	7	2	7	2
P/F, Video, Time, or Alt. Loss	Direct Drop	4.3.7.1		60	<= MOW	Full	at MOW	at MOW	7	at MOW	7	at MOW
P/F, Video, Time, or Alt. Loss	Direct Drop	4.3.7.1		85	<= MOW	Empty	14	2	7	2	7	2
P/F, Video, Time, or Alt. Loss	Direct Drop	4.3.7.1	Measurement of the altitude loss along a vertical trajectory is an approved alternate test.	85	<= MOW	Full	at MOW	at MOW	7	at MOW	7	at MOW
P/F, Video, Time, or Alt. Loss	Direct Drop	4.3.7.1		110	<= MOW	Empty	14	2	7	2	7	2
P/F, Video, Time, or Alt. Loss	Direct Drop	4.3.7.1		110	<= MOW	Full	at MOW	at MOW	7	at MOW	7	at MOW
P/F, Time, Video	Functional Tests, Breakaway	4.3.7.2	See Note 6.	Note 9	<= MOW	Empty	0		8		8	
P/F, Video, ROD	Rate of Descent Tests	4.3.8	Either method may be used by either dummy or live jumpers.									
P/F, Video, ROD	Method 1	4.3.8.1		N/A	MOW	N/S				5		5
P/F, Video, ROD	Alternate, Method 2	4.3.8.2		N/A	MOW	N/S						
P/F, Oscillation angle, Video	Stability Test	4.3.9	Dummy Use Only	N/A	0.5 * MOW	N/S		6				6
P/F, Time, Video	Live Jumps	4.3.10										
P/F, Time, Video	Less 3 second delay	4.3.10		60	<= MOW		2	0	2	0	2	0
P/F, Time, Video	More than 20 second delay	4.3.10		> 85	<= MOW		2	0	2	0	2	0
Notes:							74		82		82	
1. P/F = Pass/Fail												
2. MPOS = Maximum Operating Speed (Placard Speed)												
3. MOW = Maximum Operating Weight (Placard Weight)												
4. ROD = Rate Of Descent												
5. N/S = Not Specified												
6. If an RSL is used, then four of the breakaway tests will be conducted with the RSL.												
7. Within the matrix, a block that covers more than one smaller block indicates that any of the covered conditions may be used for compliance with the paragraph.												
8. Dummy tests specified to be done at the maximum operating weight may be done at or above the maximum operating weight.												
9. The initial vertical velocity shall be less than 20 FPS (6.1 m/s) and the total velocity less than 36 FPS at the time of breakaway and the reserve parachute activated within 2 seconds of the breakaway.												

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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 (d-bag, etc.)	Canopy, lines, links and reefing device (if used)	Stowage Container	Primary Actuation Device (Ripcord or Equivalent)	Reserve Static Line (if used)	Harness	Risers (if not integral with harness)	Main Parachute Breakaway Device (if used)	Drogue Canopy & Riser (if used)	Drogue Release Device (if used)
Ripcord strength tests	4.3.2	X					X	X					
Human Factors	4.3.3	X				X	X				X	X	X
Environmental	4.3.4	X	X	X	X	X						X	X
Strength Tests - Assembly	4.3.5.1	X	X	X	X	X			X	X	X	X	X
Strength Tests - Canopy Alternate	4.3.5.2												
Strength Tests - Harness Alternate	4.3.5.3												
Strength Tests - Drogue Canopy and Bridle	4.3.5											X	
Strength Tests - Deployment Devices	4.3.5		X	X									
Functional Tests - Twisted Line	4.3.6	X		X	X								
Functional Tests - Normal Pack, Direct Drop	4.3.7.1	X	X	X	X	X	X	X				X	X
Functional Tests - Normal Pack, Breakaway	4.3.7.2	X	X	X	X	X	X	X					
Rate of Descent	4.3.8.1	X			X								
Rate of Descent - Alternate	4.3.8.2												
Stability	4.3.9	X			X								
Live Drops	4.3.10	X	X	X	X	X	X	X	X	X	X	X	X