Parachute Industry Association (PIA)

TECHNICAL STANDARD 136

PERFORMANCE STANDARDS FOR MILITARY PERSONNEL PARACHUTE ASSEMBLIES AND COMPONENTS

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1 SCOPE

This document defines test standards for military personnel parachute assemblies and components thereof.

1.1 PARACHUTE SYSTEM TYPES

Single harness main and reserve parachute assembly and components.

Multi-Harness main and reserve parachute assembly and components.

Single harness emergency parachute assembly and components.

1.2 GENERAL OPERATING LIMITS

1.2.1 Operating limits shall be defined for all system types as specified in Section 2.2 and noted in Table 2.

1.2.2 A parachute assembly (or components thereof) may be certified to any maximum operating weight, minimum operating weight, maximum operating altitude, and for any maximum pack opening speed.

1.3 DOCUMENTATION AND RECORD KEEPING

The Manufacturer shall generate documentation to report results of PIA TS-136 certification testing. Items to be published are described below. The Manufacturer may choose how to structure the publication of these items, whether combined as a single document, a collection of separate documents, or any combination thereof.

1.3.1 Performance Declaration

The Performance Declaration serves to summarize the results of PIA TS-136 certification testing. Data to be included is described in section 6 of this document and Table 1. A sample Performance Declaration is also provided in Appendix A, though the Manufacturer may deviate from this sample at their discretion.

1.3.2 Operating Limitations

Operating Limitations describe the limits for use of the parachute system or components. The minimum required Operating Limitations that must be published for each type of parachute system are described in Section 3.1 and Table 2. Additional information may be added to the Operating Limitations at the discretion of the Manufacturer.

1.3.3 Test Report

The Test Report contains detailed results of the PIA TS-136 certification tests. The Test Report shall include:

- Presentation of data collected during each test required in this document.

- Analysis of data sufficient to show compliance with the requirements of PIA TS-136.
- Discussion of test methods, instrumentation, and test operations sufficient to demonstrate compliance with the intent of PIA TS-136.
- Analysis sufficient to generate the Performance Declaration.

1.3.4 Technical Manual

A Technical Manual is required to support operation of the parachute system. Content of the Technical Manual may include, but is not limited to:

- Packing and/or maintenance instructions
- Maintenance and/or packing intervals
- Component and system inspection requirements
- Component and system service lifespan
- Operational procedures
- Personnel training and certification requirements
- Any other information deemed necessary by the Manufacturer

1.4 LIST OF TABLES AND FIGURES

2 DEFINITIONS AND GENERAL REQUIREMENTS

2.1 DEFINITIONS, ABBREVIATIONS AND ACRONYMS

The following definitions apply to terms used in this document:

Accessory – Any item that can be attached to the parachute system but is not a component of the system.
Airspeed, Knots Calibrated (KCAS) - 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.
Airspeed, Knots Equivalent (KEAS) - 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.
Airspeed, Knots Indicated (KIAS) - 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.

Airspeed, Knots True (KTAS) – the airspeed relative to undisturbed air. True airspeed is equal to equivalent airspeed multiplied by $(\rho_0/\rho)^{½}$ where ρ_0 is the air density at standard day conditions and ρ is the air density at the local altitude.
Altitude Loss – the altitude difference between Pack Open and the moment at which the sustained rate of descent is below 1.2 times the steady state rate of descent in the unaltered post-deployment condition.
Automatic Activation Device (AAD) – A device designed to initiate the process of opening a parachute container upon reaching a predetermined rate of descent, altitude, time or other parameters.
Average Operating Weight (AvOW) – is defined as (Maximum Operating Weight [MaxOW]/2 + Minimum Operating Weight [MinOW])
Bailout Parachute System – A parachute system intended to egress an aircraft in an emergency. Typically, a single canopy system.
Bag Lock Malfunction – A malfunction in which the container has opened and the deployment bag trails the jumper, but does not allow the parachute canopy to deploy from the bag.
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.
Certified per TS-136 - Meets the requirements of this standard.
Certified Parachute System – Consists of a harness/container system, a main canopy, a reserve canopy and an AAD (if applicable).
Design Authority - The entity that controls the design.
Drogue – An aerodynamic decelerator attached and towed behind a falling body to regulate velocity and enhance stability.
Emergency Parachute - A parachute intended for emergency use only.
Free Fall (FF)
Glide Ratio – The ratio of horizontal speed to vertical speed of a gliding parachute system. Glide ratio is measured relative to the surrounding air volume, rather than any fixed reference frame. The glide ratio in any steady-state flight mode is therefore independent of wind, altitude, and temperature.
In Accordance With (IAW)
Line Stretch – The first instant during a parachute deployment when the suspension lines have deployed to full length.
Main Parachute – The primary parachute intended for premeditated use.
Main Assisted Reserve Deployment (MARD) Device – An automatic releasable connection between the main parachute and the reserve deployment system which uses the main parachute to deploy the reserve parachute upon breakaway.
Manufacturer – The entity that produces an article and is responsible for the quality.
Material Breaking Strength – The rated breaking strength of a given material as specified in the product specification.
Maximum Demonstrated Force (MDF) - The maximum measured force during testing.
Maximum Deployment Weight (MaxDW) – the total (gross) of equipment and individuals during parachute deployment.
Maximum Exit Weight (MaxEW) – the total (gross) weight of all individuals or test dummies (mannequins) and equipment when exiting the aircraft.
Maximum Landing Weight (MaxLW) - the total (gross) weight of all individuals or test dummies (mannequins) and their equipment including the parachute assembly, excluding any items that land independently of the jumper.

Maximum Operating Weight (MaxOW) – Applicable when MaxDW, MaxEW and MaxLW are the same.
Maximum Pack Opening Speed (MPOS) - KIAS (Knots Indicated Airspeed) at which the parachute pack (container) is certified to be opened, and shall be reported at one or more altitudes and operating weights. This definition specifically allows for the wearing of parachutes in freefall and/or in aircraft at speeds higher than the maximum pack opening speed, when the intended deployment conditions are within the certified parameters. MPOS is also known as the "maximum certified speed." For multi-harness systems, if MPOS varies with harness weight distributions, MPOS vs. weight distribution limitations must be published.
Maximum Operating Altitude (MOA) – The maximum altitude at which the parachute system is certified for use.
Minimum Operating Weight (MinOW) - The minimum operating weight is the lowest allowed total (gross) weight of an individual or test dummy (or all individuals or test dummies in the case of a tandem) and equipment including the parachute assembly itself. The MinOW shall be specified by the design authority and may be any weight demonstrated to be appropriate by the designer for the system.
Minimum Pack Opening Speed (MinPOS) - The minimum pack opening speed in KIAS (Knots Indicated Airspeed) is the minimum speed at which the parachute pack (container) is certified to be opened, and shall be reported for a given altitude and operating weight.
Military Tethered Bundle (MTB) (also known as MTTB) - Equipment that can be attached to a parachute system. The MTB consists of a recovery parachute for the bundle and a tether line. The tether line connects the bundle to the jumper.
Opening Time – The time difference between Pack Open and the moment at which the rate of descent is below 1.2 times the steady state rate of descent in the unaltered post-deployment condition.
Pack Open – the point in time when the ripcord pin has been extracted from the reserve closing loop, the closing loop cut by an AAD, or other initiation method, initiating deployment.
Parachute - A device used to retard the fall of a body or object through the air.
Parachutist Drop Bag (PDB) – A ruck sack designed to carry additional equipment, which attaches to the cargo attachment points on the parachutist's harness. The PDB can be released or lowered under the parachutist during canopy flight by means of a lowering line that remains connected to the parachutist's harness until landing.
Parachutist in Command – 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.
Passenger Parachutist - A person, 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 passenger harness.
Performance Declaration – A statement of performance capabilities as declared by the Design Authority.
Positive Locking Hardware – Hardware that requires two or more actions to release.
Rate of Descent - The rate of descent shall be measured at the maximum landing weight. The measurement shall be converted to standard day sea level conditions and it shall be taken over a minimum interval of 100 ft (30.5m) with the final measurement no lower than 50 ft AGL.
Reserve Parachute – A secondary parachute in a system designed for premeditated use.
Terminal Free Fall - A free fall condition in which the drag force on the system is equal to or greater than 95% of the All Up Weight, resulting in a near-vertical trajectory.

Visually Open – A parachute is Visually Open when its shape appears to be an open parachute as defined by the design authority.
Wind Blast – Wind acting on a packed parachute system.

2.2 MAJOR COMPONENTS

A parachute assembly normally, but not exclusively, comprises the following major components:

a. Canopy(s) including main/reserve canopies, suspension lines, reefing devices and connector links
b. Harness or harnesses (for Multi-Harness systems)
c. Deployment control device such as a sleeve, bag(s), diaper, or functional equivalent
d. Deployment initiation device e.g. pilot chute, drogue, static line or functional equivalent.
e. Riser(s), when not integral with harness and/or canopy
f. Steering Toggles
g. Stowage container(s) or stowage pack(s), including closing loop(s)
h. Primary actuation device (ripcord, drogue release or functional equivalent)
i. Automatic Activation Device
j. Main Breakaway/Cutaway Handle
k. Reserve static line
l. MARD
m. Drogue canopy and bridle
n. Drogue release device
o. Military Tethered Bundle Systems

2.2.1 SINGLE HARNESS MAIN & RESERVE PARACHUTE ASSEMBLY

This includes, as applicable, the main and reserve parachutes and all necessary components for operation of the system. This harness may be equipped with multiple cargo attachment points and may be capable of carrying ancillary equipment as approved by the manufacturer. Additional equipment shall not interfere with the functional operation of the parachute system.

2.2.2 MULTI-HARNESS MAIN & RESERVE PARACHUTE ASSEMBLY (including MTTB capability)

A multi-harness capable parachute assembly used for premeditated jumps by one (1) or two (2) people: a parachutist-in-command and a second parachutist (each in their own harness), utilizing one (1) main parachute assembly and one (1) reserve parachute assembly. This assembly includes, harness(s), main parachute, reserve parachute, and all necessary components for operation of the system.

Each harness may be equipped with multiple cargo attachment points and is capable of carrying ancillary equipment (to include PDB, oxygen system, radio, weapon, K9 etc.) This additional equipment shall not interfere with the functional operation of the parachute system.

If system performance is affected by harness weight distribution, then operating limits for different weight distributions shall be defined in the performance declaration.

2.2.3 SINGLE HARNESS EMERGENCY PARACHUTE ASSEMBLY (Aircrew)

A parachute assembly that is worn by one (1) person for emergency, (unpremeditated) use only. This assembly includes, harness(s), emergency parachute, and all necessary components for operation of the system.

This harness may be equipped with multiple cargo attachment points and is capable of carrying ancillary equipment (to include oxygen system, radio etc.) This additional equipment shall not interfere with the functional operation of the parachute system.

2.2.4 MAIN PARACHUTE ASSEMBLY

A main parachute assembly used in conjunction with a reserve parachute assembly as the primary parachute assembly for a premeditated exit from an aircraft. The main parachute assembly shall consist of the main parachute and all necessary components for its operation.

2.2.5 FAILURE OF A PARACHUTE ASSEMBLY OR COMPONENT

The term “failure” 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.

2.2.6 RESERVE STATIC LINE (RSL)

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

2.2.7 PARACHUTE BREAKAWAY ASSEMBLY (also known as parachute cutaway or release)

A system used to separate a parachute from a harness.

3 DESIGN AND CONSTRUCTION

3.1 OPERATING LIMITATIONS

The manufacturer shall specify each of the operating limitations listed in Table 2. The MPOS and MaxOW shall be established by successful completion of the structural overload testing in Section 4.7. Some systems may require a different MaxEW, MaxDW, and MaxLW, which shall be reported in the Operating Limitations.

3.2 MATERIALS AND WORKMANSHIP

All materials shall be selected to support the proof loads specified in the applicable application. Successful completion of the qualification tests listed under section 4.3 shall be considered adequate evidence of suitability.

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 after exposure for

up to 16 hours to a temperature of -40 to +200°F (-40 to +93.3 °C) and normalized to ambient temperature. All plated ferrous parts shall be treated to minimize hydrogen embrittlement.

Materials shall be capable of withstanding the design operational environment.

3.3 SERVICE LIFE-RESTRICTED ITEMS

Materials or products (such as batteries, organic materials such as cotton or rubber bands, pilot chute springs, etc.) 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 have a procedure documented that will allow maintenance personnel to determine the serviceable status of the part.

3.4 MAIN PARACHUTE ASSEMBLY

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

3.5 ACTUATION DEVICES

All load bearing joints of actuation devices shall withstand the test loads of section 4.1 without failure. Actuation devices shall meet the human-factors requirements of section 4.2, if applicable.

Actuation devices/ripcords/drogue releases shall be accessible with ancillary combat equipment attached (to include PDB, rucksack, oxygen system, radio, weapon, etc.) This additional equipment shall not interfere with the functional operation of the parachute system.

3.6 RESERVE STATIC LINE (RSL)

The reserve static line, if used, including all joints, shall withstand the test loads of section 4.1 without failure and shall meet the functional requirements of section 4.3, except for sub-components designed to be frangible.

3.7 HARNESS REMOVAL

The harness shall be so constructed so that the parachutist can disengage from the harness assembly unaided. For a Multi-Harness parachute assembly, the parachutist in command must be able to separate both personnel from the harness assemblies unaided. The second parachutist must be able disengage from their harness unaided.

3.8 CONTROL LINE DEPLOYMENT SETTING

The manufacturer shall specify the dimension from the control line deployment setting to the top of the riser in the user manual, and note any difference from PIA TS-102 requirements.

3.9 DROGUE PARACHUTE ASSEMBLY & RELEASE

Parachute assemblies incorporating a drogue shall incorporate a drogue release system meeting the performance requirements for the drogue release as defined in section 4.3.

3.10 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.

3.11 MARKING REQUIREMENTS

TS-136 does not specify marking requirements. Marking requirements may be specified by the customer.

3.12 PACKING METHOD

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

3.13 TECHNICAL MANUAL

A technical manual must be provided to support the parachute system.

4 QUALIFICATION TESTS

The minimum performance standards listed in Table 3 through Table 7 shall be met. There shall be no failure to meet any of the requirements during any qualification tests of this section. In the event of a failure, the cause must be found, corrected, and all affected tests repeated.

4.1 PRIMARY ACTUATION DEVICE / RIPCORD TESTS

(a) The ripcord, including all joints, shall not fail under a straight tension test load of 300-lbf (1334.5 N) applied for not less than 3 seconds.

(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/bailout system is capable of being activated by a static line attached to 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.

4.2 HUMAN FACTORS TESTS

Human parachute activation operations shall be verified by a representative target anthropometric population. If a range of systems are qualified by group according to section 5.2, human factors tests must be repeated for the maximum and minimum sizes.

A diverse group of individuals, from a manufacturer-defined anthropometric size (minimum to maximum) shall be employed for all human factors tests. The body sizes used shall be reported (gender, height and weight). All individuals shall be able to operate the subject device without undue difficulty. Table 3 lists the required test conditions and number of tests for each particular component. Additional information for the component tests is listed below.

The following activation methods, as applicable, shall be verified in accordance with configurations and quantities stated in Table 3:

- Main Parachute, Hand-Deploy Pilot Chute
- Main Parachute Ripcord
- Main Parachute Release
- Drogue Throw Out
- Drogue Release
- Reserve Parachute Ripcord
- Reserve Static Line Release
- External Load Release (i.e.; MTTB)
- Any other device(s) intended to be used during a parachute jump.

Where multiple devices with the same function are installed, all shall be tested.

Under normal design operating conditions, in a fitted harness with parachutes packed and intended for use, all devices tested under this section shall result in operation of the device without delay.

NOTE: For these tests, the reserve actuation device(s) (ripcord or equivalent) shall be rigged in accordance with published packing instructions.

4.3 ACTUATION FORCE TESTS

Force measurement tests are performed separately from Human Factors Tests. Actuation force test parameters are defined in Table 4. Force requirements exist for performing critical manual parachute functions.

For all actuation force tests, failure is defined as any actuation force measurement outside the prescribed range, or any failure for the system to function without delay.

Under normal design operating conditions, in a fitted harness with parachutes packed and intended for use, all devices tested under this section shall result in the operation of the device without delay within the manufacturer's specified load range applied to the activation device. The number and configuration of tests are specified in Table 4.

Main Canopy Pilot Chute / Drogue Throw Out

a) Main pilot chutes / drogues stowed in pockets are exempt from the minimum pull force
b) The results of the pull force tests shall be reported by the manufacturer in the performance declaration.
c) Hand-Deploy pilot chutes / drogues shall remain stowed throughout wind blast conditions per section 4.5.

Main Parachute Ripcord

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 27 lbf (120 N), applied in the direction of normal design operation.*

Drogue Release

With the drogue tensioned at an equivalent (or greater) force to the drag force generated at droguefall terminal velocity at MaxOW, the release force shall be measured applied in the direction of normal design operation. This shall be performed for each drogue release according to Table 4.

A load applied at the handle of not more than 27 lbf (120 N), applied in the direction of normal design operation.*

*Deviations from this requirement must be prominently documented in the Performance Declaration and communicated to users.

Main Canopy Release

When testing this release, the following parameters must be met:

- Configuration and Weight (with additional ballast as required), according to Table 4.
- Additional weight, to equal at least twice the Maximum Operating Weight (2xMOW) is required to represent increased force on the system due to spinning malfunctions.
- Maximum Force: not more than 27 lbf (120 N), with the force applied in the direction of normal design operation

Reserve Parachute Ripcord (non-Chest Type)

- Minimum Force: 5 lbf (22.2 N) with load applied in the direction giving the lowest pull force.
- Maximum Force 27 lbf (120 N) Applied in the direction of normal design operation.

Reserve Parachute Ripcord (Chest Type)

- For chest type parachute assemblies, the maximum pull force shall be 27 lbf (120 N)
- Must remain closed throughout wind blast conditions per 4.5.

NOTE: For these tests, the reserve primary actuation device (ripcord or equivalent) shall be rigged in accordance with published packing instructions.

NOTE: Any deviation from these requirements must be prominently displayed in the Performance Declaration.

4.4 HUMAN FACTORS TESTS, HARNESS

A diverse group of individuals from the minimum anthropometric size to the maximum size shall be employed for all Human Factors tests. The body sizes used shall be reported (gender, height and weight).

Harnesses shall demonstrate that they will perform the basic function of retaining the user in a secure manner, this is demonstrated by the live jumps required in section 4.13.

4.5 WIND BLAST TESTS

Wind blast maximum airspeeds must be ≥120 KIAS to allow use at terminal freefall condition.

Wind blast testing shall expose a packed system in all primary orthogonal orientations to wind equal to or greater than the wind blast airspeed calculated according to the equation below. Testing shall demonstrate that the parachute system prevents premature deployment due to wind blast for all conditions within the operating envelope. Tests shall be repeated for all variants of deployment activation methods (for example, systems with both throw out pilot chute and ripcord activation methods.)

$$Test\ Speed\ KIAS\ =\ 1.05 \times V_{WBM}$$

Where:

V_{WBM} = Wind blast maximum airspeed in KIAS

A system can be tested with fixed dummy position or can be dynamic, as in dummy or jumper tumbling.

Test methods may consist of, but are not limited to:

- Wind Tunnel
- Towed Dummy
- Tumbling Dummy
- Freefall jumper tests
- Rocket sled tests

The manufacturer shall document the Wind Blast test method used, the duration of exposure, whether static or dynamic, test speed in KIAS, and orientations exposed. Success on wind blast tests requires that handles remain in place and are accessible and stowage containers remain closed after exposure.

4.6 ENVIRONMENTAL TESTS

Three (3) drops shall be made at 85 KIAS after subjecting the parachute assembly to the following preconditioning: (These tests may be combined with other tests.)

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

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

(c) 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 three (3) hours after removing the load.

4.6.1 ALTERNATE PRECONDITIONING

The preconditioning requirements for 4.6 (a) and (c) 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) with a pressure difference of at least 25.0 in Hg (0.846 bar) below ambient. Stabilize to ambient and drop.

4.7 HARNESS, RESERVE, AND EMERGENCY PARACHUTE OVERLOAD TESTING

The purpose of overload testing is to demonstrate margin in stressed materials of a parachute assembly or component.

Parachute assemblies, or components, must be tested to the overload margin factors using one of the below methods as summarized in Table 7, selected by the manufacturer. All tests may be performed with the same or separate test articles of the same size, design and construction.

4.7.1 METHOD A – OVERLOAD TESTING AT MAX ALTITUDE

Method A overload tests are performed at maximum operating altitude using increased weight and speed factors simultaneously.

The parachute system or component shall be tested three (3) times at the following conditions:

- Altitude: Maximum Operating Altitude
- Speed: Maximum Pack Opening Speed in KIAS x 1.0
- Weight: Maximum Operating Weight x 1.5

4.7.2 METHOD B – OVERLOAD TESTING AT ANY ALTITUDE

Method B overload tests may be performed at any altitude, using the calculated maximum true airspeed of the system at the maximum operating altitude. Structural margin is demonstrated using increased weight combined with the true airspeed at the system's maximum operating conditions.

The parachute system or component shall be tested three (3) times at the following conditions:

- Altitude: Any Operating Altitude
- Speed: Maximum Pack Opening Speed in KTAS at Maximum Operating Altitude
- Weight: Maximum Operating Weight x 1.5

4.7.3 METHOD C – OVERLOAD TESTING AT ANY ALTITUDE 2

Overload tests using Method C may be performed at any altitude, using increased weight at low altitude to match the kinetic energy at high altitude.

All tests may be performed with the same or separate test articles of the same size, design and construction.

Determine the low altitude test conditions:

1. Use the following input parameters:
   a. Maximum Operating Weight (MaxOW)
   b. Maximum Operating Altitude (MOA)
   c. Maximum Pack Opening Speed (MPOS)

2. Calculate the True Airspeed at MOA and MPOS
   a. Result: Test Pack Opening Speed in KTAS ($V1_{KTAS}$)

3. Select an altitude and indicated airspeed at which to execute the overload tests
   a. Test airspeed in KIAS should aim to be equal to or higher than MPOS in KIAS in order to reduce the mass increase required
   b. Calculate the True Airspeed at the chosen test speed and altitude ($V2_{KTAS}$)

4. Calculate the required test mass according to the formula:

Equation 1

$$M_{Test} = \frac{MaxOW \times V1_{KTAS}^2}{V2_{KTAS}^2}$$

5. Perform the 3 overload tests at the selected test speed in KIAS and M_{Test}.

4.7.4 METHOD D – OVERLOAD AND OVERPRESSURE TESTED SEPARATELY

Method D divides overload testing of structural materials and drag producing materials in separate tests.

For Method D structural tests, the parachute system or component shall be tested three (3) times at the following conditions:

- Altitude: Any Operating Altitude
- Speed: Maximum Pack Opening Speed in KIAS x 1.05
- Weight: Maximum Operating Weight x 1.55

For Method D pressure tests, the parachute system or component shall be tested one (1) time at the following conditions:

- Altitude: Any Operating Altitude
- Speed: Average of maximum deployment speed in KIAS at maximum altitude (V_1), and the equivalent KTAS at maximum altitude (V_2), according to the equation:

Equation 2

$$Test\ Speed\ KIAS\ = \frac{V_1 + V_2}{2}$$

Where:

$$V_2 = \frac{V_1}{\sqrt{\frac{\rho}{\rho_0}}}$$

ρ_0 = Sea level density per International Standard Atmosphere
ρ = Density at maximum operating altitude per International Standard Atmosphere

- Weight: > 75% of Maximum Operating Weight

4.7.5 METHOD E - ALTERNATIVE TO USING A WEIGHT FACTOR

Use of a peak load factor of 1.7 is permissible when peak opening forces are known for a parachute at the envelope extremes.

If opening force data is captured, and opening force measured or calculated, for a total of 5 tests performed at MPOS, MaxOW, at MOA, an alternate test method may be used by a manufacturer to demonstrate an overload test series which produces an average among 3 drops that is 1.7x the peak load measured at MPOS, MaxOW, at MOA. This method does not prescribe the weight or speed necessary to achieve these peak loads. However, separate tests to demonstrate overpressure, per Method D, are still required.

4.7.6 OVERLOAD PERFORMANCE REQUIREMENTS

No material(s) or device(s) that attenuate shock loads and is not an integral part of the parachute assembly or component being certified may be used for the overload tests. Tests may be conducted for either a complete parachute assembly or separate components. The parachute must open to a safe landing condition. There shall be no evidence of material, stitch, or functional failure that will affect airworthiness.

Peak opening force shall be measured or calculated on all tests based on recorded data Record additional data as required to verify initial conditions (speed at pack opening). The methods used shall be stated on the Performance Declaration.

Where positive locking hardware is not 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 (1) attachment engaged to test the cross connector and hardware.

4.7.7 OVERLOAD TESTING TOWER DROP OPTION (HARNESS ONLY)

At the manufacturer's option, a manufacturer may qualify a harness to a higher average peak opening force than was measured in overload testing, or to requalify a harness after a design change to a previously qualified average peak opening force. A harness demonstrates strength test requirements by successfully performing tower drop tests as outlined below:

4.7.7.1 Overload Harness Testing

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 not be less than 75% of harness maximum operating weight and the drop distance shall be as necessary to generate 100% or greater of the target maximum demonstrated load.

Up to three (3) separate harnesses may be used; however, each harness shall be subjected to a minimum of one (1) test at each of the following four (4) test conditions.

(a) Test Condition 1 – Head up orientation (+/- 20°) at the instant of first riser loading.
(b) Test Condition 2 – Head down orientation (+/- 20°) at the instant of first riser loading.
(c) Test Condition 3 – Sideways orientation (+/- 20°) at the instant of first riser loading. The peak riser loading should be at least 66% of the peak load targeted for (a) and (b).

Note: For single harness systems equipped with cross-connectors (such as chest-mounted reserves), the test series must be repeated with one side completely disconnected, relying on the cross-connector for strength.

(d) Test Condition 4 - Overload Brake Setting Testing

Each brake setting shall be tested to a minimum of:

a. 16.7% of maximum demonstrated load, OR
b. The minimum breaking strength of the steering/control line.

Note: Test Condition 4 may be performed on a load test machine.

4.8 MAIN PARACHUTE SYSTEM OVERLOAD TESTING

Strength of the main parachute system (including deployment systems and drogue, as applicable) shall be demonstrated by completing the overload tests in Table 6.

For parachute assemblies which incorporate a drogue, alternate drogues may be separately tested by repeating the main parachute live jumps in Table 6.

4.9 FUNCTIONAL TESTS (Normal Pack - All Types)

Record time from Pack Opening until jumper / dummy has achieved a rate of descent below 1.2 times the steady state rate of descent for the system.
System (harness/container with canopies): Record Altitude Loss and Opening Time.

The Altitude Loss and Opening Time shall be separately reported in the Performance Declaration for each of the following set of tests, if applicable:

a) Cutaway
b) Terminal with drogue
c) Terminal without drogue
d) Bailout

For each set of tests, the reported values shall be the average Altitude Loss and Opening Times at Standard Day Sea Level equivalent elevation, with a tolerance determined by a 2σ statistical calculation. A summary of the results shall be provided in the Performance Declaration, formatted as presented in Appendix A.

4.9.1 TWISTED LINES (Reserve Parachutes)

A minimum of five (5) drops shall be made at a weight not more than the maximum operating weight. Report Opening Time and Altitude Loss.

The suspension lines shall be twisted together (360 degrees) three (3) 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.

4.9.2 RESERVE PARACHUTE QUALIFICATION TESTS

There shall be a minimum of 46 tests as defined in Table 5. Record Altitude Loss and Opening Time. Record performance metrics per Performance Declaration.

NOTE: If a MARD device is offered, an additional eight (8) drops at weights and airspeeds (at the time of pack opening) must be performed as outlined in Table 5 with the MARD attached.

4.9.3 ALTITUDE LOSS TESTS

For free-fall systems, at least eight (8) drops at greater than Average Operating Weight must be performed where deployment is initiated at terminal free-fall speed in the vertical direction.

For bailout and static-line systems, at least an additional eight (8) drops at greater than Average Operating Weight must be performed where deployment is initiated within two (2) seconds after aircraft exit. The aircraft Indicated Airspeed may be used as the reported airspeed for these tests.

For static-line systems that are not qualified for free-fall, the free-fall tests are not required.

These may be combined with live jumps required in section 4.13.

4.9.4 AAD INTERFACE TESTS

The following tests shall be conducted in which the AAD activates the reserve parachute. Record altitude loss, opening time and video. These tests may be combined with other required tests as applicable.

Four (4) tests shall be performed at any weight, main container full, terminal speed. For systems with a drogue, two (2) tests with a fully inflated drogue in tow at minimum weight, drogue terminal speed.

4.9.5 BREAKAWAY TESTS (systems with main canopy release)

For systems equipped with main canopy release intended for inflight use, eight (8) drop tests shall be made by breaking away from an open, normally functioning main parachute on a nominal flight condition, and actuating the reserve parachute within two (2) seconds of the breakaway. These tests shall be conducted by an individual/dummy or suitable device weighing not more than the maximum operating weight.

These tests can be combined with main parachute deployment tests in section 4.13.

NOTE:

(a) If a reserve static line is incorporated, four (4) of the breakaway drops shall be made with the reserve static line actuating the reserve pack.
(b) If a MARD device is incorporated, an additional 16 drops at weights and speeds must be performed as described in sections 4.9.5.1 through 4.9.5.4 with the MARD attached.

4.9.5.1 MARD Breakaway Tests – Nominal Main

Four (4) breakaway tests shall be performed with the MARD connected. These test shall be at or below the MaxOW, breaking away from a normally flying main parachute.

4.9.5.2 MARD Breakaway Tests – Forward Spinning Main

Four (4) breakaway tests shall be performed with the MARD connected, breaking away from a forward spinning main parachute. These tests shall be at or below the MaxOW. A common technique is for the test jumper to release one brake toggle after main deployment, and allow the system to develop a stable spin before initiating the cutaway.

4.9.5.3 MARD Breakaway Tests – Backward Spinning Main

Four (4) breakaway tests shall be performed with the MARD connected, breaking away from a backward spinning main parachute. These tests shall be at or below the MaxOW. A common technique is for the test jumper to hook the main up backward and release one (1) brake toggle after main deployment and allow the system to develop a stable spin before initiating the cutaway.

4.9.5.4 MARD Breakaway Tests – Bag Lock Malfunction

Four (4) breakaway tests shall be performed with the MARD connected, breaking away from a bag lock malfunction. These tests shall be at or below the MaxOW and shall include >20 seconds of freefall time under the bag lock malfunction before cutaway.

4.10 RATE OF DESCENT TESTS

Per Table 5, there shall be not less than five (5) drops, at not less than the MaxOW. The average rate of descent shall be measured and not exceed 24 ft/s (7.3 m/s) in an unaltered post deployment configuration. Rate of descent measurements shall be averaged over a minimum altitude interval of 100 ft (30.5 m). Rate of descent shall be corrected to standard sea level altitude conditions. Record data in the Performance Declaration.

4.11 GLIDE RATIO TESTS

Glide Ratio measurements taken at not less than 70% of MaxOW shall be averaged over a minimum altitude interval of 500 ft (152.5 m). The average of at least five (5) jumps/drops shall be recorded in the Performance Declaration. The reported glide ratio shall be corrected for any local atmospheric effects, such as winds or thermals.

4.12 STABILITY TESTS

There shall be not less than three (3) drops at the minimum and three (3) drops at the maximum operating weights. Oscillation shall not exceed 15° from vertical in an unaltered post-deployment configuration.

4.13 LIVE TESTS

Reserve Parachutes

There shall be a minimum of four (4) live tests at not more than the maximum operating weight. Two jumps shall include a freefall of not more than three (3) seconds and two jumps shall include a freefall of no less than twenty (20) seconds. The user(s) must suffer no significant discomfort from the opening shock and must be able to remove the harness unaided 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.

NOTE: Live tests for Multi-Harness Reserve Parachute Assemblies may be tested with the Parachutist in Command and a dummy payload in place of the passenger harness.

Main Parachutes

The main parachute shall be jumped a minimum of 46 times across a range of weights and speeds according to Table 6. The user(s) must suffer no significant discomfort from the opening shock and must be able to disengage unaided from the harness after landing.

Harness / Containers

Each main parachute deployment method must be demonstrated (pilot chute, drogue, static line, etc.) a minimum of 46 times across a range of weights and speeds. Any of these deployment method tests may be combined with the required Main Parachute tests in Table 6.

NOTE: Live tests for Dual Harness Tandem Main Parachute Assemblies must be tested with the Parachutist in Command in the main harness and a Passenger Parachutist 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 component's function.

5.1 COMPONENT COMPATIBILITY

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

Ancillary components shall not interfere with the normal operation of the system. Additionally, these components shall not prevent the user from being able to remove the harness unaided.

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 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 square footage of three (3) times the smallest size. For containers and other deployment components; the range may consist of scaled sizes to a maximum factor of three (3) times the smallest canopy size accommodated. Dimensions of a harness may be changed without repeat structural testing as long the structural materials and joint construction are not changed.

When certifying components as a group, only the largest and smallest members of the group must pass the tests of Table 5 and Table 6, provided that MaxOW is scaled directly with reserve canopy size. Any change in structure (for example a change in strength of suspension lines or reinforcement tapes) requires repeat of the overload tests in Table 7.

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 providing instructions identifying the correct method of fitting the equipment to the user. These instructions shall be published by the manufacturer.

6 PERFORMANCE DECLARATION

Parachute assemblies or components have operating limits based on observed performance during testing. A Performance Declaration shall be created according to Table 1, and a sample Performance Declaration is included for reference in Appendix A.

Declarations of the following shall be made for the main parachute, reserve parachute, or component:

- Altitude Loss
    - Result from the drop test with greatest Altitude Loss for each type listed
    - Overload tests are excluded from reporting altitude loss in the Performance Declaration because the tests occur outside the Operating Limits of the system.
- Opening Time
    - Result from the drop test with greatest Opening Time
    - Overload Test opening times are excluded from the Performance Declaration because the test parameters are outside the Operating Limits of the system.
- Maximum inflation load among the Overload Tests
    - Demonstrate highest structural load applied to the system
    - Overload tests are outside the operating limits of the system, so loads demonstrated on these tests are for reference only and would not be expected to occur in normal operation of the system.
    - Maximum inflation load is reported in force units (lbf or N)
- Range, Average, and Standard Deviation of loads on the MPOS tests
    - Demonstrate expected loads on jumpers at maximum speed for various weights
    - These loads shall be reported as acceleration in Gs
- Range, Average, and Standard Deviation of altitude loss for direct drops and or live jumps, for each deployment method
    - Allow comparison of deployment methods
- Max weight for main harness
- Max weight for passenger harness
- Harness weight distribution limits, if applicable
    - Any limits of harness weight ratios, if applicable
- Minimum and Maximum demonstrated Opening Speed
- Minimum and Maximum anthropometric size limits demonstrated during testing

Table 1 – Performance Declaration Requirements

		Main Parachute	Reserve Parachute	Deployment System	Harness
Maximum Altitude Loss, Cutaway Tests			X		
Maximum Altitude Loss, Terminal with Drogue		X	X		
Maximum Altitude Loss, Terminal without Drogue		X	X		
Maximum Altitude Loss, Bailout		X	X		
Opening Time		X	X		
Maximum Load, Overload Tests			X		X
Range, Avg and Std Dev of Max Loads, MPOS tests		X	X		
Maximum Load Measurement Method		X	X		X
Range, Avg and Std Dev of Altitude Loss for direct drops and/or live jumps, for each deployment method		X	X		
Max Weight for main harness					X
Max Weight for passenger harness, if applicable					X
Harness weight distribution limits, if applicable					X
Demonstrated opening speed	Minimum	X	X	X	
	Maximum	X	X	X	
Anthropometric Size	Minimum				X
	Maximum				X

Table 2 – Operating Limitations

	System Type		
	Single Harness Main & Reserve Parachute Assembly (2.2.1)	Multi Harness Main & Reserve Parachute Assembly (2.2.2)	Single Harness Emergency Parachute Assembly (2.2.3)
Maximum Operating Weight (MaxOW)	X	X	X
Minimum Operating Weight (Min OW)	X	X	X
Maximum Operating Altitude (MOA)	X	X	X
Maximum Pack Opening Speed (Max POS) in KIAS	X	X	X
Wind Blast Speed in KIAS	X	X	X
Maximum weight for the main harness	X	X	X
Anthropometric size (minimum to maximum) limits for the main harness	X	X	X
Maximum weight of attachable equipment, for each attachment point	X	X	X
Maximum weight for the passenger harness	X	X	X
Anthropometric size (minimum to maximum) limits for the passenger harness		X	
Maximum weight for the MTTB system, if applicable		X	
Any other limitations that may apply	X	X	X

Table 3 – Human Factors Tests

					Emergency Parachute Assembly		Single Harness Reserve Parachute Assembly		Multi-Harness Reserve Parachute Assembly	
Operation	**Load Factor**	**Second Parachutist**	**Jumper Pose**	**Main Pack Condition**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Main Parachute BOC Throw Out	NA	NA	Standing, arching	Full	-	-	6	6	-	-
Main Parachute Rip Cord	NA	NA	Standing, arching	Full	-	-	6	6	-	-
Main Canopy Release	1g	NA	Suspended by main risers	Empty	-	-	6	6	-	-
	1g	with (dummy ok)	Suspended by main risers	Empty	-	-	-	-	6	6
Drogue Throw Out	NA	NA / None	Standing, arching	Full	-	-	6	6	-	-
Drogue Release	Per 4.3	NA	Suspended by drogue	Full	6	6	-	-	-	-
		none	Suspended by drogue	Full	-	-	3	3	3	3
		none	Suspended by drogue	Empty	-	-	3	3	3	3
		with	Suspended by drogue	Full	-	-	-	-	3	3
		with	Suspended by drogue	Empty	-	-	-	-	3	3
Reserve Parachute Activation	NA	NA	Standing, upright	NA	6	6	-	-	-	-
	NA	none/with	Standing, arching	Full	-	-	3	3	3 / 3	3 / 3
	NA	none/with	Standing, arching	Empty	-	-	3	3	3 / 3	3 / 3
	1g	none/with	Suspended by main risers	Empty	-	-	3	3	3	3
	1g	with	Suspended by main risers	Empty	-	-	-	-	3	3

Table 4 – Actuation Force Tests

Operation	Load Factor	Second Parachutist	Jumper Pose	Main Pack Condition	Emergency Parachute Assembly	Single Harness Reserve Parachute Assembly	Multi-Harness Reserve Parachute Assembly
Main Ripcord	NA	NA	Standing, arching	Full	-	5	-
Drogue Release	Per 4.3	w/o	Suspended by drogue	Full	-	5	5
Drogue Release	Per 4.3	with	Suspended by drogue	Full	-	-	5
Main Canopy Release	NA	w/o	Standing, arching	Full	-	5	5
	2xMOW	with	Suspended by main risers	Empty	-	-	5
	2xMOW	w/o	Suspended by main risers	Empty	-	5	-
Reserve Ripcord	NA	w/o	Standing, arching	Full	-	5	5
	NA	with	Standing, arching	Empty	-	-	5
	NA	w/o	Standing, arching	Empty	5	5	5

Table 5 – Required Reserve Parachute Qualification Tests

Notes on Data Required	Test Description	Reference Paragraph	Speed at Pack Opening	Test Weight	Main Pack Condition	Emergency Parachute Assemblies	Single or Dual Harness Reserve Parachute Assembly
1	Actuation Device / Ripcord Test	4.1	IAW 4.1 (a) through (d)				
1	Human Factors Tests	4.2	IAW Table 3				
8	Actuation Force Tests	4.3	IAW Table 4				
1, 5, 11	Wind Blast Tests	4.5	IAW 4.5		Full		
	Environmental Tests	4.6					
1, 3, 4, 11	Precondition to -40 F	4.6 (a)	85 KEAS	≤MaxOW	N/S	1	1
1, 3, 4, 11	Precondition to +200 F	4.6 (a)	85 KEAS	≤MaxOW	N/S	1	1
1, 3, 4, 11	Precondition - compressed	4.6 (c)	85 KEAS	≤MaxOW	N/S	1	1
1, 3, 4, 11	Precondition - alternate to 4.6 (a) and 4.6 (c)	4.6.1	85 KEAS	≤MaxOW	N/S	1	1
1, 2	Structural Overload Tests	4.7	IAW Table 7 as described in 4.7.1 - 4.7.7				
	Functional Tests	4.9					
1, 3, 4, 11	Twisted Lines	4.9.1	85 KEAS	≤MaxOW	N/S	5	5
3, 4, 5	Direct Drop	4.9.2	85 KEAS	MinOW	Empty	6	3
3, 4, 5	Direct Drop	4.9.2	85 KEAS	AvOW	Full	N/A	2
3, 4, 5	Direct Drop	4.9.2	85 KEAS	MaxOW	Empty	6	3
3, 4, 5	Direct Drop	4.9.2	85 KEAS	MinOW	Full	N/A	3
3, 4, 5	Direct Drop	4.9.2	85 KEAS	AvOW	Empty	4	2
3, 4, 5	Direct Drop	4.9.2	85 KEAS	MaxOW	Full	N/A	3
					Total Drops at 85 KEAS	16	16
3, 4, 5	Direct Drop	4.9.2	120 KEAS	MinOW	Empty	4	2
3, 4, 5	Direct Drop	4.9.2	120 KEAS	AvOW	Full	N/A	2

Notes on Data Required	Test Description	Reference Paragraph	Speed at Pack Opening	Test Weight	Main Pack Condition	Emergency Parachute Assemblies	Single or Dual Harness Reserve Parachute Assembly
3, 4, 5	Direct Drop	4.9.2	120 KEAS	MaxOW	Empty	4	2
3, 4, 5	Direct Drop	4.9.2	120 KEAS	MinOW	Full	N/A	2
3, 4, 5	Direct Drop	4.9.2	120 KEAS	AvOW	Empty	4	2
3, 4, 5	Direct Drop	4.9.2	120 KEAS	MaxOW	Full	N/A	2
					Total Drops at 120 KEAS	12	12
2, 3, 4, 5	Direct Drop	4.9.2	MPOS	MinOW	Empty	6	3
2, 3, 4, 5	Direct Drop	4.9.2	MPOS	AvOW	Full	N/A	3
2, 3, 4, 5	Direct Drop	4.9.2	MPOS	MaxOW	Empty	6	3
2, 3, 4, 5	Direct Drop	4.9.2	MPOS	MinOW	Full	N/A	3
2, 3, 4, 5	Direct Drop	4.9.2	MPOS	AvOW	Empty	6	3
2, 3, 4, 5	Direct Drop	4.9.2	MPOS	MaxOW	Full	N/A	3
					Total Drops at MPOS	18	18
					Total Direct Drop Tests	**46**	**46**
1, 5, 11	Direct Drop – MARD Device	4.9.2	≤ 85 KEAS	≤MaxOW	Full	N/A	4
1, 5, 11	Direct Drop – MARD Device	4.9.2	FF ≥ 20 sec	≤MaxOW	Full	N/A	4
2, 3, 4, 5, 11	Altitude Loss	4.9.3	Terminal	≥AvOW	Full	8	8
2, 3, 4, 5, 11	AAD Interface Tests Systems without drogue	4.9.4	Terminal	Any	Full	4	4
2, 3, 4, 5, 11	AAD Interface Tests Systems with drogue	4.9.4	Terminal	Any	Full	N/A	2 with 2 without
2, 3, 4, 5, 9, 11	Breakaway Tests	4.9.5	Nominal Main	≤MaxOW	N/A	N/A	8
2, 3, 4, 5, 9, 11	Breakaway w/MARD	4.9.5.1	Nominal Main	≤MaxOW	N/A	N/A	4
2, 3, 4, 5, 9, 11	Breakaway w/MARD	4.9.5.2	Forward Spin	≤MaxOW	N/A	N/A	4
2, 3, 4, 5, 9, 11	Breakaway w/MARD	4.9.5.3	Backward Spin	≤MaxOW	N/A	N/A	4
2, 3, 4, 5, 10, 11	Breakaway w/MARD	4.9.5.4	Main Bag Lock	≤MaxOW	N/A	N/A	4
7	Rate of Descent Tests	4.10	Any	MaxOW	Any	5	5
7, 9, 11	Glide Ratio Tests	4.11	Any	≥70% MaxOW	Any	5	5
1, 6	Stability Tests 1	4.12	Any	MinOW	Any	3	3
1, 6	Stability Tests 2	4.12	Any	MaxOW	Any	3	3
1, 11	Live Jumps	4.13	FF ≤ 3 sec	≤MaxOW	Full	2	2
1, 11	Live Jumps	4.13	FF ≥ 20 sec	≤MaxOW	Full	2	2

Notes on Test Criteria

1	Record Pass/Fail	7	Record Rate of Descent
2	Record Deployment Load	8	Record Pull Force
3	Record Opening Time	9	Record Glide Ratio
4	Record Altitude Loss	10	If an RSL used, half of the cutaway tests shall be conducted with the RSL connected
5	Video Record	11	May be combined with other tests in this table
6	Record Oscillation Angle		

Table 6 - Main Parachute Tests

Data Required	Test Type	Test Description	Speed at Pack Opening	Test Weight	Number of Tests	
					Freefall Systems	Static Line Systems
1, 2, 5	Dummy or Live	Overload Test	MPOS (KIAS)	≥1.1 MaxOW	**3**	**3**
2, 3, 4, 7	Live	Low Weight Low Speed	85 KEAS	≤115% MinOW	**8**	**11**
2, 3, 4, 7	Live	High Weight Low Speed	85 KEAS	≥75% MaxOW	**8**	**12**
2, 3, 4, 7	Live	Low Weight Terminal	FF≥ 20 sec	≤115% MinOW	**12**	**-**
2, 3, 4, 6, 7, 9	Live	High Weight Terminal	FF≥ 20 sec	≥75% MaxOW	**12**	**-**
2, 3, 4, 7	Live	Low Weight MPOS	MPOS (KIAS)	≤115% MinOW	**3**	**11**
2, 3, 4, 7	Live	High Weight MPOS	MPOS (KIAS)	≥75% MaxOW	**3**	**12**
Total Main Parachute Live Jumps					**46**	**46**
Total Live Jumps for Systems with Optional Static Line Deployment					**92**	

* For systems with alternate drogue options per section 4.8, MinOW and Max OW may be adjusted as appropriate

1	Record Pass/Fail	5	Video Record
2	Record Deployment Load	6	Record Oscillation Angle
3	Record Opening Time	7	Record Rate of Descent
4	Record Altitude Loss	9	Record Glide Ratio

Table 7 – Overload Test Methods

Method	Title	Altitude	Speed	Weight	# Drops
A	Max Altitude	MOA	≥ MPOS x 1.0	≥ MOW x 1.5	3
B	Any Altitude	Any	Max KTAS at MOA	≥ MOW x 1.5	3
C	Any Altitude 2	Any	Section 4.7.3	Equation 1	3
D	Structural	Any	≥MPOS x 1.05	≥ MOW x 1.55	3
	Pressure	Any	Equation 2	> 75% MOW	1
E	Alternative	1.7 times previously characterized peak load at MPOS, MOA, MOW			3

Table 8 – Anthropometric Definition of 5th/95th Percentile Male and Female

	Percentile values in cm (in)			
	5th percentile		95th percentile	
	Male	Female	Male	Female
Weight, kg (lbs)	65.3 (143.7)	52.6 (115.8)	97.2 (213.8)	80.7 (177.6)
1. Stature	166.3 (65.5)	161.2 (63.5)	187.8 (73.9)	176 (69.3)
2. Eye height (standing)	154.5 (60.8)	150.1 (59.1)	175.6 (69.1)	164.2 (64.6)
3. Shoulder (acromiale) height	135.9 (53.5)	123 (48.4)	155.3 (61.2)	144.6 (56.9)
4. Chest (nipple) height*	119.5 (47.1)	115 (45.2)	136.9 (53.9)	128.3 (50.5)
5. Elbow (radiale) height	100.8 (39.7)	97.5 (38.4)	116 (45.7)	108.8 (42.8)
6. Fingertip (dactylion) height	59.1 (23.3)	55.1 (21.7)	72.4 (28.5)	67 (26.4)
7a. Waist (iliocristale) height	99.8 (39.3)	91.1 (35.9)	116.1 (45.7)	107.1 (42.2)
7b. Waist (omphalion) height	97.7 (38.5)	90.3 (35.6)	114.7 (45.1)	107.1 (42.2)
7c. Waist (natural indentation) height	105.2 (41.4)	103.1 (40.6)	121.2 (47.7)	114.3 (45)

8. Crotch height	77.5 (30.5)	68.1 (26.8)	91.5 (36)	84.6 (33.3)
9. Gluteal furrow height	74.9 (29.5)	66.4 (26.1)	88.5 (34.8)	81.7 (32.2)
10. Knee (mid-patella) height	46.4 (18.2)	44.7 (17.6)	54.7 (21.5)	50.2 (19.8)
11. Calf height	32 (12.6)	27.8 (10.9)	38.4 (15.1)	35.7 (14.1)
12. Functional (thumbtip) reach	71.7 (28.2)	67.7 (26.7)	88.6 (34.9)	80.5 (31.7)
13. Functional reach, extended	80.5 (31.7)	73.5 (28.9)	94.2 (37.1)	92.3 (36.3)

NOTE: *Bustpoint height for women

Table 9 – Tolerances

	Min	Max
MinOW	-10%	+1%
AvOW	-10%	+10%
MaxOW	-1%	+10%
Airspeed, KIAS	-5%	+5%
Anthropometric tests, dimensions	-3.8 cm -1.5 in	+3.8 cm +1.5 in
Anthropometric tests, mass	-5%	+5%
Harness drop, angle	-20°	+20°

7 Appendix A

Sample Performance Declarations

PIA TS-136 SAMPLE Performance Declaration	
Date	6 December, 1941
Manufacturer	Parachute Company, Inc.
Item Name	PCS 365 Main Parachute
Maximum Altitude Loss, Drogue Terminal	760 ft
Maximum Altitude Loss, Terminal Freefall	650 ft
Maximum Altitude Loss, Bailout	500 ft
Greatest Opening Time	8.3 s
Range of Max Loads, MPOS Tests	5.6g – 7.3g
Average of Max Loads, MPOS Tests	6.3g
Std. Deviation of Max Loads, MPOS Tests	0.95g
Maximum Load Measurement Method	Accelerometer, 200 Hz with 40 ms filter
Range of Altitude Loss	425 – 760 ft
Average Altitude Loss	565 ft
Std. Deviation of Altitude Loss	90 ft
Minimum Demonstrated Opening Speed	60 KIAS
Maximum Demonstrated Opening Speed	210 KIAS

PIA TS-136 SAMPLE Performance Declaration	
Date	6 December, 1941
Manufacturer	Parachute Company, Inc.
Item Name	PCS 365 Reserve Parachute
Maximum Altitude Loss, Drogue Terminal	720 ft
Maximum Altitude Loss, Terminal Freefall	610 ft
Maximum Altitude Loss, Bailout	460 ft
Greatest Opening Time	7.6 s
Maximum Load, Overload Tests	4600 lbf
Range of Max Loads, MPOS Tests	6.5g – 8.2g
Average of Max Loads, MPOS Tests	7.3g
Std. Deviation of Max Loads, MPOS Tests	0.95g
Maximum Load Measurement Method	Accelerometer, 200 Hz with 40 ms filter
Range of Altitude Loss	405 – 740 ft
Average Altitude Loss	545 ft
Std. Deviation of Altitude Loss	90 ft
Minimum Demonstrated Opening Speed	60 KIAS
Maximum Demonstrated Opening Speed	210 KIAS

PIA TS-136 SAMPLE Performance Declaration	
Date	6 December, 1941
Manufacturer	Parachute Company, Inc.
Item Name	PCS 365 Parachute Harness/Container
Maximum Load, Overload Tests	4600 lbf
Maximum Load Measurement Method	Accelerometer, 200 Hz with 40 ms filter
Max Weight for Main Harness	295 lb
Max Weight for Passenger Harness	285 lb
Harness Weight Distribution Limit	Main Weight ≥ 0.9 X Passenger Weight
Minimum Demonstrated Opening Speed	60 KIAS
Maximum Demonstrated Opening Speed	210 KIAS
Minimum Demonstrated Anthropometric Size	135 lb, 64 in, Female
Maximum Demonstrated Anthropometric Size	265 lb, 75 in, Male