PIA – TS-135 Advisory Letter

To: ***All Manufacturers Testing to TS-135 v1.4***

Date: ***February 02, 2019***

Subject: ***TS-135 Document Issues Recently Noted***

Background

Several manufacturers, who are using TS-135 as guidance during their recent testing, have noted typographical errors and other issues that should be documented and evaluated.

Objective

The purpose of this letter is to ensure that all manufacturers are notified of these issues in a prompt and organized manner. Additionally, TS-135 will be revised as necessary to ensure its effectiveness during use. Please take note of the following information that may be incorporated into v1.5 at a future date.

Item:

1. **Page 14, Table 1.**
   Statement of Authorization should be TSO-C23f (not TSO-C23e) and is a typographical error, already mentioned in C23f Appendix 1.

PIA-TS-135 - Table 1.

Data Marking Requirements

Applicable Section Shown Only Marking Data Requirements	Reference Paragraph	Deployment Initiation Device (Pilot Chute, etc.)	Deployment Control Device (d-bag, etc.)	Reserve Emergency Canopy	Stowage Container	Primary Actuation Device (Ripcord or Equivalent)	Reserve Static Line (if used)	Harness (if not integral with container)	Risers (if not integral with harness)	Reserve/Emergency Drogue Canopy & Riser (if used)	Reserve/Emergency Drogue Release Device (if used)
Manufacturers Name, Code or Symbol		X	X	X	X	X	X	X	X	X	X
Part Number (w/dash numbers)		X	X	X	X	X	X	X	X	X	X
Serial or Lot Control Number		X	X	X	X	X	X	X	X	X	
Date of Manufacture (month and year minimum)		X	X	X	X	X	X	X	X	X	
Date to Be Removed from Service (if applicable)		X	X	X	X	X	X	X	X	X	
Maximum Pack Opening Speed (KEAS)	4.3.6	X		X	X			X	X		
Maximum Gross Weight (lb) if applicable	4.3.6			X					X	X	
Minimum Gross Weight (lb)	4.2			X							
Average Peak Force Measured during 4.3.6 tests	4.3.6			X					X		
Appoved for Use Statement	4.2.2			X							
Statement of Authorization Under TS0-C-23e and/or (J) TSO-C-23e if applicable		X	X	X	X			X	X	X	

2. **Page 14, Table 1**
   Maximum Gross Weight (lb.), "if applicable" is a typographical error.

PIA-TS-135 - Table 1.

Data Marking Requirements

Applicable Section Shown Only

Marking Data Requirements	Reference Paragraph	Deployment Initiation Device (Pilot Chute, etc.)	Deployment Control Device (d-bag, etc.)	Reserve Emergency Canopy	Stowage Container	Primary Actuation Device (Ripcord or Equivalent)	Reserve Static Line (if used)	Harness (if not integral with container)	Risers (if not integral with harness)	Reserve/Emergency Drogue Canopy & Riser (if used)	Reserve/Emergency Drogue Release Device (if used)
Manufacturers Name, Code or Symbol		X	X	X	X	X	X	X	X	X	X
Part Number (w/dash numbers)		X	X	X	X	X	X	X	X	X	X
Serial or Lot Control Number		X	X	X	X	X	X	X	X	X	
Date of Manufacture (month and year minimum)		X	X	X	X	X	X	X	X	X	
Date to Be Removed from Service (if applicable)		X	X	X	X	X	X	X	X	X	
Maximum Pack Opening Speed (KEAS)	4.3.6	X		X	X			X	X		
Maximum Gross Weight (lb) ~~if applicable~~	4.3.6			X					X	X	

3. **Page 14, Table 1**
   Typographical error note "Reserve Emergency Canopy" should be changed to "Reserve/Emergency Canopy". Notice how this is done in the last two columns "Reserve/Emergency Drogue..."

PIA-TS-135 - Table 1.

Data Marking Requirements

Applicable Section Shown Only

Marking Data Requirements	Reference Paragraph	Deployment Initiation Device (Pilot Chute, etc.)	Deployment Control Device (d-bag, etc.)	Reserve/Emergency Canopy	Stowage Container	Primary Actuation Device (Ripcord or Equivalent)	Reserve Static Line (if used)	Harness (if not integral with container)	Risers (if not integral with harness)	Reserve/Emergency Drogue Canopy & Riser (if used)	Reserve/Emergency Drogue Release Device (if used)

4. **Page 14, Table 1**
   Section 2.1.11 states MPOS as being defined in “KTAS”. “KEAS” is a typographical error.

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

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

PIA-TS-135 - Table 1.
Data Marking Requirements

Applicable Section Shown Only

Marking Data Requirements	Reference Paragraph	Deployment Initiation Device (Pilot Chute, etc.)	Deployment Control Device (d-bag, etc.)	Reserve Emergency Canopy	Stowage Container	Primary Actuation Device (Ripcord or Equivalent)	Reserve Static Line (if used)	Harness (if not integral with container)	Risers (if not integral with harness)	Reserve/Emergency Drogue Canopy & Riser (if used)	Reserve/Emergency Drogue Release Device (if used)
Maximum Pack Opening Speed ~~(KEAS)~~ (KTAS)	4.3.6	X		X	X			X	X		

5. **Section 4.3.2 (a) Primary Actuation Device/Ripcord Test**
   1337.7 N is a typographical error, 300-lbf = 1334.5 N.

4.3.2 PRIMARY ACTUATION DEVICE/RIPCORD TEST:

(a) The ripcord, including all joints, shall not fail under a straight tension test load of 300-lbf 1334.5 N ~~(1337.7 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 ripcord is to be static lined from an aircraft the reserve ripcord/static line, must not fail under a straight tension test load of 600-lbf (2668.9 N) applied for not less than 3 seconds.

(d) Rigid pins, if used, shall not yield under a load of 8-lbf (35.6 N) applied to the cable (or equivalent) perpendicular to the axis of the pin, for not less than 3 seconds. The pin shall be supported for 0.5 in (12.7-mm) maximum at the end farthest from the cable attachment. All 4.3.3 human factors tests shall be performed using a primary actuation device/ripcord that has passed this test.

6. **Page 17, Table 3**

References to “9” from notes at section 4.3.8.2 on data required are a copy-and-paste misprint.

Applicable Section Shown Only

PIA TS-135 Table 3
Required Qualification Tests

Notes on Data Required	Test Description	Reference Paragraph	Speed at Pack Opening (KEAS)	Test Weight	Main Pack Condition	Emergency Parachute Assemblies		Single or Dual Harness Reserve Parachute Assembly	
						Dummy	Live	Dummy	Live
1, 3 (or 4), 5, 10, 11	Direct Drop "MARD device"	4.3.8.1	60 KEAS	<= MaxOW	Full	N/A		4	
1, 3 (or 4), 5, 12	Direct Drop "MARD device"	4.3.8.1		<= MaxOW	Full	N/A		4	
1, 3, 5, 9	***Functional Tests, Breakaway***	4.3.8.2	< 20 fps Vv	<= MaxOW	Empty	N/A		8	
1, 3, 5, ~~9,~~ 13	Functional Tests, Breakaway "MARD device"	4.3.8.2		<= MaxOW	Empty	N/A		4	
1, 3, 5, ~~9,~~ 14	Functional Tests, Breakaway "MARD device"	4.3.8.2		<= MaxOW	Empty	N/A		4	
1, 3, 5, ~~9,~~ 15	Functional Tests, Breakaway "MARD device"	4.3.8.2		<= MaxOW	Empty	N/A		4	
1, 3, 5, ~~9,~~ 12, 16	Functional Tests, Breakaway "MARD device"	4.3.8.2		<= MaxOW	Empty	N/A		4	

Notes on Test Critera	
1	Record Pass/Fail
2	Record Riser Force
3	Record Opening Time
4	Record Altitude Loss
5	Video Record
6	Record Oscillation Angle
7	Record Rate-of-Descent
8	Record Ripcord Pull Force
9	If an RSL used, then half of the cutaway test shall be connducted with the RSL - a total of 8 tests is required

7. **Page 17 Table 3**

The number of Dummy tests for the 4.3.6.3 is 12, not 3, as this is a typographical error.

4.3.6.3 STRENGTH TEST, ADDITIONAL MEANS OF COMPLIANCE HARNESS (ONLY):
A harness may, at the manufacturer’s option, be placarded with a higher average peak opening force than what was measured in 4.3.6 tests by performing additional tower drop tests as outlined below:

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

Applicable Section Shown Only

PIA TS-135 Table 3
Required Qualification Tests

Notes on Data Required	Test Description	Reference Paragraph	Speed at Pack Opening (KEAS)	Test Weight	Main Pack Condition	Emergency Parachute Assemblies		Single or Dual Harness Reserve Parachute Assembly	
						Dummy	Live	Dummy	Live
	Structural Overload Tests	4.3.6							
1,2,3,5	Complete Assemblies	4.3.6.1	Fig. 1	Fig. 1	N/S	3	N/A	3	N/A
1,2,3,5	Alternate Means of Compliance, Canopy Only	4.3.6.2	Fig. 1	Fig. 1	N/S	3		3	
1,2,3,5	Alternate Means of Compliance, Harness Only	4.3.6.3	Fig. 1	Fig. 1	N/S	~~3~~ 12		~~3~~ 12	
1,2,3,5	Drogue (if applicable)	4.3.6.4	Fig. 1	Fig. 1	N/S	3		3	

8. **Page 17 Table 3, Section 4.3.8.2**
Breakaway drop tests, it is written "From the time of pack opening, the canopy must be functionally open within the altitude or allowed time as calculated in 4.3.8.". Per Table 3 the data required for 4.3.8.2 Functional Tests, Breakaway are "1, 3, 5, 9". 3 being the record of the Opening time, Criteria 4 = Record Altitude Loss is missing in the Table 3.

4.3.8 FUNCTIONAL TESTS (Normal Pack - All Types):
Opening Time or Altitude Loss: Using the MOW in pounds and the MPOS in KTAS for all 4.3.8 tests the maximum allowable opening time and the maximum allowable altitude loss on any drop shall be determined from the following formulas..

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

Opening Time Allowed (sec.) = (MOW – 250) * 0.01 + (MPOS/150 * 3.0)

-OR-

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

Altitude Loss Allowed (ft) = (MOW-250) + (MPOS/150 * 300)

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

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

Applicable Section Shown Only

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PIA TS-135 Table 3
Required Qualification Tests

Notes on Data Required	Test Description	Reference Paragraph	Speed at Pack Opening (KEAS)	Test Weight	Main Pack Condition	Emergency Parachute Assemblies		Single or Dual Harness Reserve Parachute Assembly	
						Dummy	Live	Dummy	Live
1, 3, 5, 9	***Functional Tests, Breakaway***	**4.3.8.2**	< 20 fps Vv	<= MaxOW	Empty	N/A		8	

Should Read 1, 3 (or 4), 5, 9

Notes on Test Critera	
1	Record Pass/Fail
2	Record Riser Force
3	Record Opening Time
4	Record Altitude Loss
5	Video Record
6	Record Oscillation Angle
7	Record Rate-of-Descent
8	Record Ripcord Pull Force
9	If an RSL used, then half of the cutaway test shall be connducted with the RSL - a total of 8 tests is required

9. Page 17 Table 3, Section 4.3.11

Live Tests require the main compartment to be tested in both full and empty conditions, this is missing in Table 3 and should be tested in these conditions as noted below.

4.3.11 LIVE TESTS:

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

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

Applicable Section Shown Only

PIA TS 135

PIA TS-135 Table 3
Required Qualification Tests

Notes on Data Required	Test Description	Reference Paragraph	Speed at Pack Opening (KEAS)	Test Weight	Main Pack Condition	Emergency Parachute Assemblies		Single or Dual Harness Reserve Parachute Assembly	
						Dummy	Live	Dummy	Live
1, 3, 5, 11	***Live Jumps***	**4.3.11**	< 60 knots	<= MaxOW	N/S		2		2
1, 3, 5, 12	***Live Jumps***	**4.3.11**	> 120 knots	<= MaxOW	N/S		2		2

Should be:

1, 3, 5, 11	***Live Jumps***	**4.3.11**	< 60 knots	<= MaxOW	Empty		2		1
1, 3, 5, 11	***Live Jumps***	**4.3.11**	< 60 knots	<= MaxOW	Full				1
1, 3, 5, 12	***Live Jumps***	**4.3.11**	< 120 knots	<= MaxOW	Empty		2		1
1, 3, 5, 12	***Live Jumps***	**4.3.11**	< 120 knots	<= MaxOW	Full				1

10. TS-135 makes no reference to using calibrated equipment, but all test should be conducted using equipment calibrated to NIST or equivalent standards. For loads and/or acceleration, the data should be of sufficient resolution to accurately capture the peak magnitude. A minimum of 500 samples per second data recording is recommended. Altitude measurements for rate of descent calculations can be recorded with a pressure sensor with a recommended minimum sampling rate of 10 samples per second.

11. **4.3.6.3 STRENGTH TEST, ADDITIONAL MEANS OF COMPLIANCE HARNESS (ONLY).**
Clarification on the test method:
TS-135 specifies that for conditions two and three, only the left/right side of the harness/canopy attachment point(s) shall be loaded to a combined load of 66% of placard load. The intent of this test is to load one side or the other to 66% prior to loading the opposite side. It is neither intended nor desired to completely disconnect the opposite side, as the resulting harness geometry is unrealistic. It is acceptable to extend the opposite riser or connect it to a lower point (i.e. lines attachment to base ring on non-functional riser) to ensure the rest geometry of the harness remains as designed.

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

4.3.6.3 STRENGTH TEST, ADDITIONAL MEANS OF COMPLIANCE HARNESS (ONLY):
A harness may, at the manufacturer's option, be placarded with a higher average peak opening force than what was measured in 4.3.6 tests by performing additional tower drop tests as outlined below:

The harness shall be drop tested using a torso shaped dummy, three (3) times for each of four (4) different loading conditions.
The dummy weight shall be not less than 75% of harness maximum operating weight and the drop distance shall be as necessary to generate the required forces.
Up to three (3) separate harnesses may be used; however each harness shall be subjected to a minimum of one test at each of the following four test conditions.

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

~~~~~~ End of Advisory ~~~~~~

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