



## PIA – TS-135 Advisory Letter Rev 1

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

**Date:** March 10, 2023

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

**Revised Items:** 4, 9, 10 and 12-13 Added

### **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.

### **Items:**

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

Based on how it was originally presented on the Advisory letter it would appear we were changing from KEAS TO KTAS, when in reality the original document section 2.1.11 always read KTAS (i.e. NOTE was always on the original document, it was not a clarification added on the Advisory).

-----ORIGINAL TEXT AS APPROVED BY THE FAA ON TSO C23(f)-----

**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	Reference Paragraph	Deployment Initiation Device (Pilot Chute, etc.)	Deployment Control Device (d-bag, etc.)	Reserve Emergency Canopy	Storage Container	Primary Actuation Device (Ripcord or Equivalent)	Reserve Static Line (if used)	Harness (if not integral with container)	Risers (if not integral with harness)	Reserve/Emergency Drogue Canopy & Riser (if used)	Reserve/Emergency Drogue Release Device (if used)
Marking Data Requirements											
Maximum Pack Opening Speed <del>(KEAS)</del> (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	<b>PRIMARY ACTUATION DEVICE/RIPCORDER TEST:</b>	Applicable Section Shown Only
(a) The ripcord, including all joints, shall not fail under a straight tension test load of 300-lbf 1334.5 N <del>(1337.7 N)</del> 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.		

## 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, <del>9</del> 13	Functional Tests, Breakaway "MARD device"	4.3.8.2		<= MaxOW	Empty	N/A		4	
1, 3, 5, <del>9</del> 14	Functional Tests, Breakaway "MARD device"	4.3.8.2		<= MaxOW	Empty	N/A		4	
1, 3, 5, <del>9</del> 15	Functional Tests, Breakaway "MARD device"	4.3.8.2		<= MaxOW	Empty	N/A		4	
1, 3, 5, <del>9</del> 12, 16	Functional Tests, Breakaway "MARD device"	4.3.8.2		<= MaxOW	Empty	N/A		4	
Notes on Test Criteria									
	1 Record Pass/Fail								
	2 Record Riser Force								
	3 Record Opening Time								
	4 Record Altitude Loss								
	5 Video Record								
	6 Record Oscillation Angle								
	7 Record Rate-of-Descent								
	8 Record Ripcord Pull Force								
	9 If an RSL used, then half of the cutaway test shall be conducted with the RSL - a total of 8 tests is required								

## 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.

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	<del>3</del> 12		<del>3</del> 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:

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

-OR-

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

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

### 4.3.8.2 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

## 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, 9	Functional Tests, Breakaway	4.3.8.2	< 20 f/s Vv	<= MaxOW	Empty	N/A		8	

Notes on Test Criteria

- Record Pass/Fail
- Record Riser Force
- Record Opening Time
- Record Altitude Loss
- Video Record
- Record Oscillation Angle
- Record Rate-of-Descent
- Record Ripcord Pull Force
- If an RSL used, then half of the cutaway test shall be conducted with the RSL - a total of 8 tests is required

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



## 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.

Also, Pack Opening Speed was correctly noted in section 4.3.11 but incorrectly stated in Table 3.

### 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	< 3 SEC FF	<= MaxOW	Empty		2		1
1, 3, 5, 11	Live Jumps	4.3.11	< 3 SEC FF	<= MaxOW	Full				1
1, 3, 5, 12	Live Jumps	4.3.11	> 20 SEC FF	<= MaxOW	Empty				1
1, 3, 5, 12	Live Jumps	4.3.11	> 20 SEC FF	<= MaxOW	Full		2		1

This same Pack Opening Speed was also noted in AS8015 REV B:

4.3.9 Live Drop Tests, All Types: There shall be a minimum of 4 live drop tests with an individual weighing not more than the maximum operating weight in each harness<sup>4</sup>. Two drops shall include a freefall of not more than 3 s and 2 drops shall include a freefall of at least 20 s. 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 certificated 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, except dual harness reserve parachute assemblies.

10. TS-135 makes no reference to using calibrated equipment, but all tests should be conducted using instruments calibrated for the range and sensitivity required for parachute testing. Calibration of instruments should be documented in the test report. It is advisable to provide your Cognizant Agency a detailed test plan prior to beginning any testing.

#### 11. 4.3.6.3 STRENGTH TEST, ADDITIONAL MEANS OF COMPLIANCE HARNESS (ONLY)

Clarification on the test method:

TS-135 specifies that for conditions b and c, 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.

#### 12. Page 16, Table 3

Note #2- "Recording Riser Forces" for test number 4.3.3 is a typographical error.

PIA-TS-135 - Table 3									
Applicable Section Shown Only									
Notes on Data Required	Test Description	Reference Paragraph	Speed at Pack Opening (KEAS)	Test Weight	Main Pack Condition	Emergency Parachute Assemblies		Single or Dual Harness Reserve Parachute Assembly	
						Dummy	Live	Dummy	Live
1, 8, 5	Primary Actuation Device/Ripcord Test	4.3.2	IAW 4.3.2 (a) through (d)						
1-2, 5	Human Factors and Actuation Force Tests	4.3.3	IAW Table 2 and as described in paragraphs 4.3.3(a) through (e)						
	Human Factors Tests, Harness	4.3.4	Demonstrated by successful completion of live jumps per paragraph 4.3.11						
Notes on Test Criteria									
	1 Record Pass/Fail								
	2 Record Riser Force								
	3 Record Opening Time								

### 13. Page 16-17, Table 1

a. We can see the marking of limitations are only requested on Risers when not integral with harness. Those 2 limitations require to be marked as well on stowage container or harness (if not integral with container).

**b. 4.3.6 and 4.2: Maximum Gross Weight and Minimum Gross Weight are not the terms define and use in TS135. The terms use are Maximum Operating Weight (MOW) and Minimum Operating Weight (MinOW)**

[illegible]

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

**PIA - Parachute Certification Standards Committee- (PCSC)**  
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