Department of Transportation
Federal Aviation Administration
Aircraft Certification Service
Washington, D.C.

TSO-C167

Effective
Date: *{XX/YY/ZZ}*

Proposed Technical Standard Order

Subject: Personnel Carrying Device Systems (PCDS), also known as Human Harnesses

1. PURPOSE. This Technical Standard Order (TSO) is for manufacturers of personnel carrying device systems (PCDS), who are applying for a TSO authorization or letter of design approval. In it, we (the Federal Aviation Administration, or FAA) tell you what minimum performance standards (MPS) your PCDS must first meet to obtain approval and identification with the applicable TSO marking. Hereon, we refer to a PCDS as a "human harness."

2. APPLICABILITY. This TSO affects new applications submitted after this TSO's effective date.

3. REQUIREMENTS. New models of a human harness, identified and manufactured on or after this TSO's effective date, must meet the MPS based on the following documents:

- National Fire Protection Association (NFPA) 1983, "Standard on Fire Service Life Safety Rope and System Components," 2001 edition, for a life safety harness Class III, and
- Society of Automotive Engineers (SAE) Aerospace Standard (AS) 8043, RevisionA, "Restraint Systems for Civil Aircraft," issued March 2000, as amended by appendix 1 of this TSO.

a. Functionality. This TSO's standards apply to equipment intended to transport personnel externally from a helicopter (human external cargo (HEC) operations). Note that 14 CFR ⇓ 133.45 specifies limitations for external-load operations as rotorcraft-load combination Class D, the certification requirements for HEC operations are found in 14 CFR § 27.865 or 14 CFR § 29.865, as applicable.

b. Functional Qualification. Demonstrate the required performance under the test conditions in the MPS (see APPENDIX 1 of this TSO).

c. Deviations. We have provisions for using alternative or equivalent means of compliance to the criteria in the MPS of this TSO. If you invoke these provisions, you must show that your equipment maintains an equivalent level of safety. Apply for a deviation per 14 CFR § 21.609.

4. MARKING.

a. Mark at least one major component permanently and legibly with all the information listed in 14 CFR § 21.607(d), except for:

(1) Section 21.607(d)(2). Use the name, type, and part number instead of the optional model number, and

(2) Section 21.607(d)(3). Use the date of manufacture instead of the optional serial number.

b. The label also must include the information required in NFPA 1983 Section 3.1.4.2(2) or 3.1.4.2(3), as applicable.

c. In addition, mark the following permanently and legibly with at least the manufacturer's name, subassembly part number, and the TSO number:

(1) Each component that is easily removable (without hand tools),

(2) Each interchangeable element, and

(3) Each sub-assembly of the article that you determined may be interchangeable.

5. APPLICATION DATA REQUIREMENTS. Under 14 CFR § 21.605(a)(2), you, as a manufacturer/applicant must give the FAA's Aircraft Certification Office (ACO) manager responsible for your facilities, one copy each of the following technical data to support our design and production approval:

a. Operating instructions and equipment limitations, sufficient to describe the equipment's operational capability.

b. Installation procedures and limitations, sufficient to ensure that the human harness, when installed according to the installation procedures, still meets this TSO's requirements. The limitations must identify any unique aspects of the installation. Finally, the limitations also must include a note with the following statement:

> The conditions and tests for TSO approval of this article are minimum performance standards. Those installing this article, on or in a specific type or class of aircraft, must determine that the aircraft installation conditions are within the TSO standards. TSO articles must have separate approval for installation in an aircraft.

c. Schematic drawings of the installation procedures.

d. List of the components, by part number, that make up the human harness complying with the standards in this TSO. You should include vendor part number cross-references, when applicable.

e. Instructions for Continued Airworthiness covering the periodic maintenance, calibration, and repair, for the continued airworthiness of an installed human harness. Instructions should include recommended inspection intervals and service life. Refer to APPENDIX 1, paragraph **5d**.

f. Material and process specifications list.

g. The quality control system description required by 14 CFR §§ 21.605(a)(3) and 21.143(a), including functional test specifications. These test each production article to ensure compliance with this TSO.

h. Manufacturer's TSO qualification test report.

i. Label drawing giving the information required by paragraph **4** of this TSO.

j. A list of all drawings and processes, including revision level, to define the article's design. For a minor change, you only need to make revisions to the list available on request.

6. MANUFACTURER DATA. Besides the data to be furnished directly to the FAA, each manufacturer must have the following technical data available for review by the responsible manager:

a. The functional qualification specifications for qualifying each production article to ensure compliance with this TSO.

b. Equipment calibration procedures.

c. Corrective maintenance procedures within 12 months after TSO authorization.

d. Schematic drawings.

e. Material and process specifications.

7. FURNISHED DATA. With each article manufactured under this TSO, provide one copy of the technical data and information in paragraph **5a** through **5j** and paragraph **6** of this TSO. Add any other data or information necessary for the proper installation, certification, and use, or for continued airworthiness, or both, of the human harness.

8. AVAILABILITY OF REFERENCED DOCUMENTS.

a. You can buy copies of NFPA 1983 from the National Fire Protection Association, 1Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101, telephone (617) 770-3000, fax (508) 895-8301. You can get copies through the NFPA Internet website @ www.nfpa.org.

b. You can buy copies of 14 CFR part 21 Subpart O, 14 CFR part 27, 14 CFR part 29, and 14 CFR part 133 from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402-9325. Telephone (202) 512-1800, fax (202) 512-2250. You also can

get copies from the Government Printing Office (GPO), electronic CFR Internet website @ www.access.gpo.gov/ecfr/.

c. You can get Advisory Circular (AC) 20-110, "Index of Aviation Technical Standard Orders," and AC 20-36, "Index of Articles Certified under the Technical Standard Order System," from the U.S. Department of Transportation, Subsequent Distribution Office, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD 20785,telephone (301) 322-4477, fax (301) 386-5394. You also can get copies from the FAA's Regulatory and Guidance Library (RGL) @ www.airweb.faa.gov/rgl. On the RGL website, select "Advisory Circulars."

d. You can buy copies of SAE AS 8043, Revision A, from the Society of Automotive Engineers, Inc., Department 331, 400 Commonwealth Drive, Warrendale, PA 15096-0001. Telephone (724) 776-4970, fax (724) 776-0790. You can also get copies through the SAE Internet website @ www.sae.org.

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APPENDIX 1. MINIMUM PERFORMANCE STANDARD FOR A PERSONNEL CARRYING DEVICE SYSTEM (PCDS), ALSO KNOWN AS A HUMAN HARNESS

1. Purpose. This appendix prescribes the minimum performance standards (MPS) for a personnel carrying device system (PCDS). Hereon, we (the Federal Aviation Administration) refer to a PCDS as a "human harness."

2. Requirements. We base the MPS on the following standards:

- National Fire Protection Association (NFPA) 1983, "Standard on Fire Service Life Safety Rope and System Components," 2001 edition, and
- Society of Automotive Engineers (SAE) Aerospace Standard (AS) 8043, Revision A, "Restraint Systems for Civil Aircraft," issued March 2000.

3. NFPA 1983. The following sections of NFPA 1983 – on life safety harness system components, Class III – apply to this TSO:

For:	See NFPA 1983:
Definitions	**a.** Sections 1.3.1 to 1.3.30, except 1.3.8 and 1.3.26. **b.** Section 1.3.31. Replace section with the following: Life Safety Harness: A system component; materials arranged and secured on the body to support a person during human external cargo (HEC) operations. HEC is a person (or persons), who is ferried, raised, lowered, or otherwise transported external to the rotorcraft fuselage. In 14 CFR §§ 27.865 and 29.865, we define certification requirements for external loads, including HEC. We define operating limitations for HEC operations in 14 CFR § 133.45(e).
Product Labeling and User Instruction Requirements	Sections 3.1.4.2(2), 3.1.4.2(3), and 3.2.3.2.
Design and Construction Requirements	Sections 4.3.1.3, 4.3.2, 4.3.3, 4.3.4, 4.3.5, and 4.3.6.
Performance Requirements	Sections 5.3.4, 5.3.5, 5.3.6, and 5.3.9.
Testing Requirements	Sections 6.3.1, 6.3.2, 6.3.3, 6.3.4, 6.3.5, 6.3.6, and 6.5.6.

APPENDIX 1. MINIMUM PERFORMANCE STANDARD FOR A HUMAN HARNESS Continued

4. SAE AS 8043, Revision A.

a. The following sections of SAE AS 8043, Revision A, apply to this TSO:

For:	See SAE AS 8043, Revision A:
Definitions	Paragraphs 3.4, 3.4.1, 3.4.2, 3.4.3, 3.5, and 3.8.
General Requirements	Paragraphs 4.1, 4.3, 4.5, 4.6, and 4.9.
Webbing Requirements	Paragraph 5.3.
Webbing Test Procedure	Paragraphs 8, 8.2, 8.3, and 8.4.
Requirements for Adjusting Hardware Release	Paragraph 6.4.2.
Requirements for Assembly Performance	Paragraph 7.1.4.
Test Procedure for Nonmetallic Hardware	Paragraph 9.2.2.

APPENDIX 1. MINIMUM PERFORMANCE STANDARD FOR A HUMAN HARNESS Continued

b. We modified the following SAE AS 8043, Revision A, paragraphs, which also apply to this TSO:

SAE AS 8043, Revision A:	Replace with:
Paragraph 3.1 (Definitions)	PCDS (also called "Human Harness"): A device or system that has the structural capability and features needed for safely transporting occupants externally during human external cargo (HEC) operations. These systems include, but are not limited to, life safety harnesses.
Paragraph 5.2 (Webbing Requirements)	Breaking Strength: The webbing in a human harness must have a breaking strength not less than 22kN (5,000 lbs), when tested by the procedure in Paragraph 8.2. Breaking strength after the abrasion tests of Paragraph 10.5 must be not less than 16.7 kN (3,750 lbs), when tested by the procedure in Paragraph 8.2.
Paragraph 5.4 (Webbing Requirements)	Resistance to Light: The webbing in a human harness, after testing by the procedure in Paragraph 8.4, must have a breaking strength not less than 13.3 kN (3,000 lbs).
Paragraph 6.1 (Metallic Hardware)	Corrosion Resistance: Metallic hardware parts of a human harness must not corrode, after subjected to the conditions in Paragraph 9.1. Metallic adjusting devices must not fail, gall, or wear to an extent that impairs normal adjustment. A buckle must not separate when a force of not more than 0.22 kN (5 lbs) causes it partially to engage.
Paragraph 9 (Test Procedure for Metallic Hardware)	Test Procedure for Hardware: Use three samples of hardware for each test, unless otherwise specified.
Paragraph 9.1 (Test Procedure for Metallic Hardware)	Corrosion Resistance: Test hardware using conditions in ASTM B117-73[2], Standard Method of Salt Spray (Fog) Testing. The test must consist of 24-hour exposure to salt spray, followed by 1 hour of drying. In a salt spray test chamber, place samples in a position most likely to develop corrosion on the larger areas. At the end of the test, wash the hardware with water to remove the salt. After drying, examine the hardware for corrosion.

APPENDIX 1. MINIMUM PERFORMANCE STANDARD FOR A HUMAN HARNESS Continued

SAE AS 8043, Revision A:	Replace with:
Paragraph 6.2.1 (Nonmetallic Hardware)	Temperature Resistance: Nonmetallic hardware parts of a human harness, when subjected to the conditions in Paragraph 9.2.1, must not warp or otherwise deteriorate to cause the assembly to operate improperly.
Paragraph 6.2.2 (Nonmetallic Hardware)	Solvent Resistance: Nonmetallic hardware parts of a human harness, when subjected to the conditions in Paragraph 9.2.2, must not deteriorate to cause the assembly to operate improperly.
Paragraph 9.2.1 (Test Procedure for Nonmetallic Hardware)	Temperature Resistance: Subject nonmetallic hardware to the conditions in Procedure D of ASTM D756-78[2], Standard Methods of Test for Resistance of Plastics to Accelerated Service Conditions. Disregard the measurements in Paragraph 7 of that procedure.
Paragraph 6.4.1 (Adjusting Hardware Release)	Release Force: Any adjusting release hardware of a human harness must release when a force of not more than 0.13 kN (30 lbs) is applied to a pull or lift release mechanism. Release mechanisms requiring a twisting or torsional motion must release with a force equal to 0.13 kN (30 lbs) applied at the appropriate moment arm relative to the axis of rotation, when tested as prescribed in Paragraph 9.4.
Paragraph 10.5 (Test Procedure for Assembly Performance)	PCDS (or Human Harness), Abrasion Conditioning Procedure: Test the webbing breaking strength on an area of webbing conditioned using the procedure in Paragraph 8.2. Use the adjustment hardware and webbing combination that best represents the human harness' hardware and webbing. The combination must not show wear before conditioning. Use test equipment that provides the conditions of Figure 4 of SAE AS 8043, Revision A, with a length of stroke of 152-203 mm (6-8 inches) and a cycle rate of 16-18 cycles per minute. One cycle consists of one lengthening stroke and one shortening. **NOTE:** Condition the webbing for 4 hours at 21 ± 1 degree C (70 ± 3 degrees F) and 65 ± 2 percent relative humidity. Test samples within 1 hour after conditioning.

APPENDIX 1. MINIMUM PERFORMANCE STANDARD FOR A HUMAN HARNESS Continued

5. Additional Requirements. The following requirements also apply to this TSO:

a. The *maximum operating weight* for harnesses approved under this TSO is 450 pounds. The maximum operating weight is the total weight of the individual and all equipment supported by the harness.

b. Construct the harness with *stitching* that will not unravel when broken.

c. Load-bearing Hardware.

(1) Construct all load-bearing hardware (D-rings, buckles, links, and so on) using forged, machined, or cast metal. Castings must meet Class I, Grade A requirements of SAE-AMS-STD-2175 (formerly MIL-STD-2175A), Classification and Inspection of Castings. All hardware parts must lack burrs and sharp edges, and must be designed and installed to minimize injury to the occupant.

(2) The load-bearing hardware must meet the *fatigue* requirements of 14 CFR § 27.571 or 14 CFR § 29.571 as applicable, and the *corrosion resistance* requirements of NFPA 1983 Paragraph 6.5.6.

d. The manufacturer must prepare Instructions for Continued Airworthiness (ICA) per 14 CFR § 27.1529 or 14 CFR § 29.1529, as applicable. The ICA must include at least the information required by NFPA 1983 Paragraph 3.2.3.2.