Department of Transportation
Federal Aviation Administration
Office of Airworthiness
Washington, D.C.

TSO-C13d

Date 1/3/83

Technical Standard Order

Subject: TSO-C13d, LIFE PRESERVERS

(a) Applicability.

(1) Minimum Performance Standards. This Technical Standard Order (TSO) prescribes the minimum performance standards that life preservers must meet to be identified with the applicable TSO marking. This TSO has been prepared in accordance with the procedural rules set forth in Subpart O of the Federal Aviation Regulations Part 21. New models of life preservers that are to be so identified and that are manufactured on or after the date of this TSO must meet the standard set forth in Appendix 1, "Federal Aviation Administration Standard for Life Preservers," as amended and supplemented by this TSO.

(2) Environmental Standard. None referenced.

(3) Test Methods. This TSO references Federal Test Method Standard No. 191A dated July 20, 1978.

(b) Marking. Each life preserver must be marked in accordance with Federal Aviation Regulations (FAR) § 21.607(d) (14 CFR 21.607). The following additional information must be shown:

(1) Date of manufacture of fabric (month and year).

(2) Size category - "Adult," "Adult-Child," "Child," or "Infant," as appropriate.

(c) Data Requirements. In addition to FAR § 21.605, the manufacturer must furnish the Manager, Aircraft Certification Office (ACO), Federal Aviation Administration (FAA), having geographical purview of the manufacturer's facilities, one copy each of the following technical data:

(1) A complete description of the life preservers, including material identification and specification.

(2) Operating and donning instructions and limitations.

(3) A report of the tests conducted in accordance with this TSO for qualification and approval of the life preserver model.

(4) Maintenance instructions.

DISTRIBUTION: ZVS-326; A-W(WS)-3; A-X(FS)-3; A-FFS-1,2,3,7,8(LTD) A-FAC-1,2,3(LTD); A-X(CD)-3; AVN-1(2 copies)

(5) The functional test specification to be used to test each production article to ensure compliance with this TSO.

(d) Previously Approved Equipment. Effective January 3, 1985, pursuant to FAR § 21.621, each TSO Authorization, to the extent it authorizes the holder to identify or mark life preservers with TSO-C13, TSO-C13a, TSO-C13b, or TSO-C13c is withdrawn.

(e) Availability of Referenced Documents.

(1) Appendix 1, "Federal Aviation Administration Standard for Life Preservers," of this TSO specifies certain test methods that are contained in Federal Test Method Standard No. 191A, unless otherwise noted. Federal Test Method Standard No. 191A may be examined at any FAA ACO, and may be obtained (or purchased) from the General Services Administration, Business Service Center, Region 3, 7th and D Streets, S.W., Washington, D.C. 20407.

(2) Federal Aviation Regulation Part 21, Subpart O and Avisory Circular 20-110, Index of Aviation Technical Standard Orders may be reviewed at the FAA Headquarters in the Office of Airworthiness, Aircraft Engineering Division (AWS-130), and at all ACO's.

M. C. BEARD
Director of Airworthiness

APPENDIX 1. FEDERAL AVIATION ADMINISTRATION STANDARD FOR LIFE PRESERVERS

1. Purpose. This standard provides the minimum performance standards for life preservers.

2. Scope. This standard covers inflatable (Type I) and noninflatable (Type II) life preservers. Both Type I and Type II life preservers are divided into the following four categories: "Adult," "Adult-Child," "Child," and "Infant."

3. Materials. The materials used must be of a quality which experience and/or tests have demonstrated to be suitable for use in life preservers.

3.1 Nonmetallic Materials. All fabrics and nonmetallic components subject to deterioration must have been manufactured not more than 12 months prior to the date of delivery of the finished product.

3.1.1 Coated Fabrics. All coated fabrics used in the life preserver must retain at least 90 percent of their original physical properties after the fabrics have been subjected to accelerated ageing as provided in paragraph 5.1 of this standard.

3.1.1.1 Flotation Chamber Fabric, Type I Life Preserver. Coated fabrics used in flotation chambers must meet the following minimum specifications when tested as provided in paragraph 5.1 of this standard:

Tensile Strength
Grab Method: Warp 210 pounds per inch; fill 180 pounds per inch

Tear Strength
Tongue Method: 10 x 10 pounds per inch; or
Trapezoid Method: 10 x 8 pounds per inch

Permeability
Permeability to helium of not more than 5 liters per square meter per 24 hours at 77 degrees Fahrenheit. In lieu of this permeability test, an alternate test may be used provided the alternate test has been approved as an equivalent to this permeability test by the manager of the FAA office to which this TSO data is to be submitted, as required in Paragraph (c), Data Requirements.

Coat Adhesion
10 pounds per inch width at 2.0 to 2.5 inches per minute at 70 $\pm$ 5 degrees Fahrenheit.

3.1.1.2 Seam Tape. When seam tape is used, the fabric used for the seam tape must have a breaking strength (Grab Method) of not less than 50 pounds per inch in both the warp and fill directions when tested as provided in paragraph 5.1 of this standard.

3.1.2 Seam Strength. Seams using adhesive on coated fabrics must be sealed with tape having a minimum width of 1 3/16 inches. Application of tape over seams sealed by heat (without adhesive) is optional. Seams must meet the minimum specifications specified below in this subparagraph when tested as provided in paragraph 5.1 of this standard. Samples of seams must retain at least 90 percent of their original physical properties after having been subjected to accelerated aging as provided in paragraph 5.1.

Load Test (Seam Shear Strength) -
Maximum overlap = 3/4 inch and maximum width = 2 inches at not less than 75 degrees Fahrenheit, 175 pounds/inch at 12 $\pm$ 0.5 inches per minute; at not less than 140 degrees Fahrenheit, 40 pounds/inch at 12 $\pm$ 0.5 inches per minute.

Peel Test (Seam Peel Strength) -
10 pounds per inch width at not less than 70 degrees Fahrenheit at 2.0 to 2.5 inches per minute.

3.1.3 Materials Other Than Coated Fabrics.

3.1.3.1 Webbing. Webbing used to attach the life preserver to the wearer must have a minimum tensile strength of 230 pounds.

3.1.3.2 Thread. Thread used in the life preserver must be Size E nylon or equivalent with a minimum tensile strength of 8.5 pounds.

3.1.4 Molded Nonmetallic Fittings. Molded nonmetallic fittings must retain their physical characteristics when subjected to temperatures of -65 degrees to +160 degrees Fahrenheit.

3.1.5 Protection Against Fungus. All fabrics, threads, and webbing in the life preservers must be fungus-proofed or fungus resistant.

3.2 Metallic Parts. All metallic parts must be made of corrosion resistant material or must be suitably protected against corrosion.

4. Detail Requirements.

4.1 Design and Construction.

4.1.1 Reversibility. The life preserver must perform its intended function when reversed, unless the design of the preserver precludes the probability of improper donning.

4.1.2 Compartmentation, Type I Life Preserver. An inflatable life preserver may not have less than two separate gastight flotation chambers. The life preserver must support the wearer in the flotation attitude specified in paragraph 4.1.9 of this standard when no more than one-half of the flotation chambers are inflated and the other flotation chambers are fully deflated.

4.1.3 Protection Against Abrasion and Chafing, Type I Life Preserver. The flotation chambers must be protected so that metallic or nonmetallic parts must not chafe or abrade the fabric in either the packed or inflated condition.

4.1.4 Inflation, Type I Life Preserver.

4.1.4.1 Oral Inflation. A means must be provided by which the wearer, excluding child and infant wearers who would require adult assistance, without previous instruction, may inflate each flotation chamber by blowing into a mouthpiece. The mouthpiece for oral inflation must be readily available to the wearer without interfering with the wearer's face or body. For infant and child life preservers, the oral inflation means must be available to assisting persons.

4.1.4.2 Oral Inflation Valve. The opening pressure of the oral inflation valve, with no back pressure applied to the valve, may not exceed 0.6 pounds per square inch gage (psig). The oral inflation valve may not leak when back pressure throughout the range from zero psig through 10 psig is applied. The joint between the oral inflation valve and the flotation chamber may not fail when a 100-pound tensile load is applied for at least 3 seconds outwardly from and perpendicular to the surface of the flotation chamber at the point of valve attachment. To support the flotation chamber fabric during load application, an adapter having an inside diameter at least three-fourths of an inch larger than the outside diameter of the valve at the point of attachment must be used.

4.1.4.3 Manual Mechanical Inflation. A means must be provided by which the wearer, excluding child and infant wearers who would require adult assistance, without previous instruction, may inflate each flotation chamber of the life preserver by manual operation.

4.1.4.3.1 Gas Reservoir. A reservoir containing a suitable compressed gas must be provided to inflate each flotation chamber of the life preserver.

4.1.4.3.2 Pull Cord Assembly. The mechanical inflation means must have a pull cord assembly for each gas reservoir. The pull cords must be identical in length, clearly visible, and extend between 1 1/2 to 3 inches below the edge of the life preserver. The end of each pull cord assembly must be attached to a red pull knob or tab having rounded edges.

4.1.5 Deflation, Type I Life Preserver. A means by which the wearer may quickly deflate each flotation chamber must be provided. Use of the deflation means may not preclude subsequent re-inflation of the flotation chamber by either oral or mechanical inflation means. Inadvertent deflation of the flotation chamber must be precluded.

4.1.6 Functional Temperature Range. The life preserver must function after exposure to the temperature range from -40 degrees to +140 degrees Fahrenheit.

4.1.7 Overpressure Protection, Type I Life Preserver. A flotation chamber when orally inflated to design operating pressure must not burst upon subsequent discharge of the mechanical inflation system.

4.1.8 Buoyancy. The life preserver must not provide a buoyant force less than that shown in Table I, Minimum Buoyant Force. The buoyant force of the life preserver is equal to the weight of the volume of fresh water displaced by the life preserver when totally submerged. Bouyancy must be demonstrated using the standard gas reservoirs described in 4.1.4.3.1 without further oral inflation, starting from a vacuumed flat unit.

TABLE I, MINIMUM BUOYANT FORCE

Category of preserver	Weight of wearer (pounds)	Minimum buoyant force in fresh water at 70±5° F (pounds)
Adult	Above 90	35
Adult-Child combination	35 and above	35
Child	35 to 90 inclusive	25
Infant	Under 35	20

4.1.9 Flotation Attitude. The life preserver must, within 5 seconds, right the wearer, who is in the water in a face-down attitude. The life preserver must provide lateral and rear support to the wearer's head such that the mouth and nose of a completely relaxed wearer is held clear of the water line with the trunk of the body inclined backward from the vertical position at an angle of 30 degrees minimum.

4.1.10 Tether Infant Category Life Preserver. A tether not less than 72 inches in length, must be attached to the infant life preserver. The attach point must be located such that the flotation attitude specified in paragraph 4.1.9 is maintained when the line is under sufficient tension to remove the slack as when held by an adult in the water. With the life preserver on the infant, there must be provisions for stowing or securing the tether in a manner that it remains readily accessible and will not dangle loosely so as to pose a hazard during an emergency evacuation.

4.1.11 Donning. It must be demonstrated that an adult, after receiving only the customary preflight briefing on the use of life preservers, can don the life preserver within 15 seconds unassisted while seated. It must be demonstrated that an adult can install the life

preserver on another adult, a child, or an infant within 30 seconds unassisted. The donning demonstration is begun with the unpackaged life preserver in hand.

4.1.12 Comfort, Fit, and Adaptability. The design of the life preserver must be such that:

4.1.12.1 After donning, inadvertent release by the wearer is not likely.

4.1.12.2 Adjustment may be made by the wearer while in the water.

4.1.12.3 Unobstructed view by the wearer is allowed in both the forward and sideward directions.

4.1.12.4 Blood circulation of the wearer is not restricted.

4.1.12.5 The wearer's breathing is not restricted.

4.1.13 Survivor Locator Light. When the installation of a survivor locator light is required by operating regulations, refer to TSO-C85 for requirements for the light.

4.1.14 Life Preserver Package. If a package is provided with the life preserver which is intended for use in storage of the life preserver on board the aircraft, the package must clearly indicate that it contains a life preserver and the size category of the life perserver. The means of opening the package must be simple and obvious, and must be accomplished in one operation without the use of any tool or excessive physical force.

4.2 Marking and Instructions.

4.2.1 Pictorial Presentation. The proper donning procedure and other operational instructions on the use of the life preserver must be simple, obvious, and presented primarily pictorially with minimum use of words.

4.2.2 Orientation of Instructions. Instructions pertaining to operations which would normally be accomplished after the life preserver has been donned must be oriented so that the wearer may read them while in the water.

4.2.3 Readability in Emergency Lighting Conditions. Size, position, and contrast of instructions must be such that the pictorial descriptions and written instructions are easily distinguishable and readable in low level illumination. The markings and instructions must be readable by a person having 20/20 vision at a minimum viewing distance of 24 inches with illumination no greater than 0.05 footcandle. For written instructions, an acceptable means of complying with this requirement is by use of bold lettering approximately .22 inch (5.6 mm) high with a stroke width of .047 inch (1.2 mm).

4.2.4 Color. The color of the life preserver must be an approved international rescue color.

5. Tests.

5.1 Material Tests. The material properties specified in paragraph 3 of this standard must be determined in accordance with the following test method or approved equivalent methods:

TABLE II, TEST METHODS

Test Required (1)	Federal Test Method Standard No. 191A	Other Test Method
Accelerated Age (2)	Method 5850	
Tensile Strength (Grab Method)	Method 5100	
Tear Strength (Tongue Method)	Method 5134	
Tear Strength (Trapezoid Method)	Method 5136(6) (Alternate to Tongue Method. Refer to 3.1.1.1.)	
Ply Adhesion	Method 5960	
Coat Adhesion	Method 5970	
Permeability	Method 5460(6)	
Seam Shear Strength (3)		As noted
Seam Peel Strength (4)	Method 5960	
Fire Protection		
Horizontal Burn Rate (5)		FAR 25.853(b-2)

NOTES:

(1) Standard atmospheric conditions must be as described in Section 4 of Federal Test Method Standard No. 191A, except for fire protection.

(2) Samples of coated fabric and seams used in the life preserver must be exposed to a temperature not lower than 158 ± 5 degrees Fahrenheit

for a period of not less than 168 hours. After exposure, the samples must be allowed to cool to 70 ± 2 degrees Fahrenheit for neither less than 16 hours nor more than 96 hours before determining their physical properties in accordance with paragraph 3.1.1 of this standard.

(3) Samples must consist of two strips of 2 inches maximum width by 5 inches maximum length bonded together with an overlap of 3/4 inch maximum. The free ends must be placed in the testing machine described in Method 5100 and separated at a rate of 12 ± 0.5 inches per minute. The average value of two samples must be reported. Samples may be multilayered to ensure against premature material failure, provided the test seam is not altered in a manner which increases it strength.

(4) Separation rate must be 2.0 to 2.5 inches per minute.

(5) The material must meet FAR § 25.853(b-2) (14 CFR 25.853) in effect May 1, 1972.

(6) Federal Test Method Standard No. 191 in effect December 31, 1968.

5.2 Leakage Test, Type I Life Preserver. The life preserver may not lose more than 1/2 psig per flotation chamber after each flotation chamber has been inflated to not less than 2 psig and hung in a rack for at least 12 hours.

5.3 Overpressure Test, Type I Life Preserver. Each flotation chamber of the life preserver must withstand an inflation pressure of not less than 10 psig for at least 5 minutes.

5.4 Submersion Test. The life preserver must be submerged in fresh water at 72 ± 5 degrees Fahrenheit so that no part of it is less than 24 inches below the surface. The buoyancy of the preserver must not be less than the value specified in paragraph 4.1.8 of this standard. Submersion must continue for at least 8 hours, except that the test may be discontinued in less than 8 hours if buoyancy measurements taken at four successive 30-minute intervals show that the buoyancy of the preserver has stabilized at a value at least equal to the value specified in paragraph 4.1.8 of this standard.

5.5 Salt Spray Test.

5.5.1 Salt Spray Test Procedure. All metal parts must be placed in an atomized salt solution spray for a period of not less than 100 hours. The solution must be atomized in the chamber at a rate of 3 quarts per 10 cubic feet of chamber volume per each 24-hour period. The temperature in the chamber must be maintained at 95 ± 2 degrees Fahrenheit throughout the test.

5.5.2 Salt Spray Solution. The salt used must be sodium chloride or equivalent containing not more than 0.2 percent of impurities on the dry weight basis. The spray solution must be prepared by dissolving 20 ± 2 parts by weight of salt in 80 ± 2 parts by weight of water containing not more than 200 parts per million of solids. The spray solution must be kept from exceeding this level of solids throughout the test. The spray solution must be maintained at a specific gravity of from 1.126 to 1.157 and a pH between 6.5 and 7.2 when measured at 95 ± 2 degrees Fahrenheit.

5.6 Inflator Test, Type I Life Preserver.

5.6.1 Operating Force. The force necessary to operate the mechanical inflation means may not exceed 15 pounds when applied through the pull cord.

5.6.2 Pull Cord Strength. The pull cord may not fail or separate from the mechanical inflation means when a tension load of not less than 100 pounds is applied to the cord for at least 3 seconds.

5.6.3 Proof Pressure. The mechanical inflation means must withstand a hydrostatic pressure of not less than 1,500 psig without deformation or leakage. The mechanical inflation means may not leak when subjected to 2 and 40 psig air pressure, respectively. Each test pressure must be applied for not less than 30 seconds.

5.6.4 Mechanical Inflation Valve. The mechanical inflation valve must allow a minimum flow of 4 liters of air per minute at 40 psig inlet pressure. The valve may not leak when subjected to a vacuum of 12 inches of water applied so as to reduce the seating spring pressure and with atmospheric pressure on the opposite side. The joint between the valve and the flotation chamber may not fail when a 250-pound load is applied, for at least 3 seconds, outwardly from and perpendicular to the surface of the flotation chamber at the point of valve attachment. To secure the joint during application of the load, an adapter having an inside diameter at least three-fourths of an inch larger than the outside diameter of the valve at the point of attachment must be used.

5.7 Jump Test. An inflated Type I or a Type II life preserver must remain attached and not cause injury to the wearer when the wearer jumps into the water at any attitude from a height above the water of at least 5 feet. There must not be any damage to the preserver following the jump. Minor skin chafing is not considered an injury in this respect.

5.8 Fire Protection Test. Materials used in the life preserver and the package or container for the life preserver, if a package or a container is provided, must be tested by the horizontal burn rate test prescribed in paragraph 5.1 of this standard.