



Technical Standard Order

Subject: TSO-C13f, LIFE PRESERVERS

a. Applicability.

(1) Minimum Performance Standards. This technical standard order (TSO) prescribes the minimum performance standards that life preservers must meet in order 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 (FAR) 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 I, "Federal Aviation Administration Standard for Life Preservers," as amended and supplemented by this TSO.

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

b. Marking. Each life preserver, in addition to the marking required in FAR section 21.607(d), must be marked in accordance with the requirements specified in appendix 1, section 4.2, Marking, of this TSO.

c. Data Requirements.

(1) In addition to the information specified in FAR section 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:

(i) A complete description of the life preserver, including detail drawings, material identification and specification.

(ii) Operating instructions and limitations, to include donning, retention, adjustment, and inflation instructions.

(iii) Installation instructions and limitations, including stowage area temperatures.

(iv) Packaging instructions and limitations.

(v) Maintenance instructions, including information regarding inspection, repair, stowage of materials, recommended inspection intervals and service life.

(vi) Manufacturer's TSO qualification test report.

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

(2) In addition, the manufacturer must furnish to the user one copy of the data and information specified in paragraphs c(l)(ii) through c(l)(v) of this TSO necessary for continued airworthiness and a note with the following statement:

“The conditions and test required for TSO approval of this article are minimum performance standards. It is the responsibility of those desiring to install the article either on or within a specific type or class of aircraft to determine that the aircraft installation conditions are within the TSO standards, the article may be installed only if further evaluation by the applicant documents an acceptable installation and is approved by the Administrator.”

d. Previously Approved Equipment. Effective January 3, 1985, pursuant to FAR section 21.621, each TSO authorization, to the extent it authorizes the holder to identify or mark life preservers with TSO-C13, TSO-C13a, TSO-13b, 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 FTMS No. 191A, unless otherwise noted. This test method standard 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, SW., Washington, DC 20407.

(2) Federal Aviation Regulation Part 21, Subpart O and Advisory Circular 20-110, Index of Aviation Technical Standard Orders may be reviewed at the FAA Headquarters in the Aircraft Certification Service, Aircraft Engineering Division (AIR-100), and at all ACO's.

/S/ John K. McGrath
Manager, Aircraft Engineering
Division, AIR-100

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-Small Child."
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.

3.1.1 The finished device must be clean and free from any defects that might affect its function.

3.1.2 Coated fabrics and other items, such as webbing, subject to deterioration must have been manufactured not more than 18 months prior to the date of delivery of the finished product or requalified per paragraph 5.1 Material Tests of this standard.

3.1.3 The materials must not support fungus growth.

3.1.4 Coated fabrics, including seams, subject to deterioration used in the manufacture of the devices must retain at least 90 percent of their original physical properties after these fabrics have been subjected to accelerated ageing test specified in paragraph 5.1 Material Tests of this standard.

3.1.4.1 Strength. Coated fabrics used for these applications must conform to the following minimum strengths after ageing:

Tensile Strength (Grab Test)
Warp 210 pounds/inch
Fill 180 pounds/inch

Tear Strength

- 10 x 10 pounds/inch (Tongue Test) or
- 10 x 8 pounds/inch (Trapezoid Test)

3.1.4.2 Adhesion. In addition to the requirements of 3.1.4.1, coated fabrics must meet the following minimum strength after ageing:

Coat Adhesion

- 10 pounds/inch width at 70 ± 5 degrees F at a separation rate of 2.0 to 2.5 inches/minute.

3.1.4.3 Permeability. For coated fabrics used in the manufacture of inflation chambers, the maximum permeability to helium may not exceed 5 liters/square meter in 24 hours at 77 degrees F or its equivalent using hydrogen. The permeameter must be calibrated for the gas used. 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 ACO to which this TSO data is to be submitted, as required in Paragraph c., Data Requirements.

3.1.5 Seam Strength and Adhesives. Cemented or heat sealable seams used in the manufacture of the device must meet the following minimum strength requirements.

3.1.5.1 Cemented Seams. Seams using adhesive on coated fabrics must be sealed with tape having a minimum width of 1 3/16 inches. Devices manufactured with cemented seams must meet the following minimum strength requirements:

Seam Shear Strength (Grab Test)

- 175 pounds/inch width at 75 degrees F
- 40 pounds/inch width at 140 degrees F

Peel Strength (Peel Test)

- 10 pounds/inch width at 70 degrees F

3.1.5.2 Heat Sealed Seams. The application of tape over heat sealed seams is optional. Devices manufactured with heat sealed seams used in the manufacture of the device must meet the following minimum strength requirements:

Seam Strength (Grab Test)

- 45 pounds/inch width at 70 degrees F
- 30 pounds/inch width at 140 degrees F

3.1.6 Seam Tape. If tape is used, the fabric used for the seam tape must have a minimum breaking strength (Grab Test) of not less than 50 pounds/inch width in both the warp and fill directions. When applied to the seam area, the adhesion strength characteristics must meet the seam strength requirements in paragraph 3.1.5.

3.1.7 Materials Other Than Coated Fabrics.

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

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

3.1.8 Flammability. The device (including packaging) must be constructed of materials which are in compliance with FAR section 25.853(a) [Appendix F, Part I (a)(1)(iv)] in effect on July 20, 1990.

3.1.9 Molded Nonmetallic Fittings. Molded nonmetallic fittings must retain their physical characteristics when subjected to temperatures of -60 to +160 degrees F.

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 have one or more separate gas tight flotation chambers. Each separate flotation chamber must meet the inflation requirements of paragraph 4.1.4.

4.1.3 Protection Against Abrasion and Chafing, Type I Life Preserver. The flotation chambers must be protected in such a manner that metallic or nonmetallic parts do not cause chafing or abrasion of the material 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-small child 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-small child and child life preservers, the oral inflation means must be readily 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 0.44 pounds per square inch gage (psig). The oral inflation valve may not leak when back pressure throughout the range from 0 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 3/4 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, or person assisting a child or infant-small child wearer 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. If carbon dioxide (CO) cylinders are used, the standards of MIL-C-601G Amendment 1 dated August 31, 1972 or the equivalent are acceptable not withstanding any size or weight limitations.
- 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 or the person assisting a child or infant-small child wearer who would require adult assistance, 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. In particular, inadvertent deflation from movement of a child or infant-small child and deliberate deflation by a child or small child must be precluded.

- 4.1.6 Functional Temperature Range. The life preserver must be cable of satisfactory inflation after exposure to the temperature range from -40 to +140 degrees F for a minimum period of five minutes.

- 4.1.7 Overpressure Protection, Type I Life Preserver. A flotation chamber, when orally inflated to a operating pressure not less than 1 psig, must not burst upon subsequent discharge of the mechanical inflation system.

4.1.8 Buoyancy. The life preserver must provide a buoyant force not 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. Buoyancy 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 degrees F (pounds)
Adult	Above 90	35
Adult - Child Combination	35 and above	35
Child	35 to	25
Infant - Small Child	Under 35	20

4.1.9 Flotation Attitude.

4.1.9.1 Adult, Adult-Child, and Child Life Preservers. 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.

4.1.9.2 Infant-Small Child Life Preservers. The life preserver must prevent contact of the wearer's upper torso (i.e., from the waist up) with the water. There must be a means to confine the wearer in the proper position for utilization of the life preserver and prevent the wearer from releasing the confining means. With the wearer in the most adverse condition of weight and position attainable when the confining means are properly used, there must be no tendency of the life preserver to capsize or become unstable, take on water, or allow contact of the upper torso with water. Means must be provided to prevent the entrapment of rain or choppy water.

4.1.10 Tether Infant-Small Child Category Life Preserver. A tether not less than 72 inches in length, must be attached to the infant-small child life preserver. The attach point must be located such that the flotation attitude specified in paragraph 4.1.9.2 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-small child, 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 Life Preserver Retention and Donning Characteristics. The means of retaining the life preserver on the wearer, excluding infant-small child wearers, must require that the wearer secure no more than one attachment and make no more than one adjustment for fit. It must be demonstrated, in accordance with the donning tests specified in paragraph 5.9, that at

least 75% of the total number of test subjects and at least 60% of the test subjects in each age group specified in paragraph 5.9 can don the life preserver within 25 seconds unassisted, starting with the life preserver in its storage package. Percentage calculations may not be increased when rounded off. It must be demonstrated that an adult unassisted can install an appropriate life preserver on another adult or a child within 30 seconds. It also must be demonstrated, in accordance with the donning tests specified in paragraph 5.9, that 60% of the adult test subjects can install an infant-small child dummy in an infant-small child life preserver within 90 seconds.

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, or the person assisting a child or infant-small child wearer, while in the water.

4.1.12.3 Unobstructed view by the wearer, excluding infant-small child wearers, is allowed in both the forward and sideward directions. An observation window must be provided for viewing of an infant-small child wearer by the assisting person if the life preserver is enclosed.

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. The life preserver must be equipped with a survivor locator light which meets the requirements of TSO-C85. The light must be automatically activated. This can be accomplished upon contact with water, upon inflation or by any other means not requiring additional user action.
- 4.1.14 Life Preserver Package. A package must be provided for the life preserver for storage of the life preserver on board the aircraft. 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.
- 4.1.15 Color. The color of the life preserver must be an approved international orange-yellow or similar high visibility color. The color of the flight crew life preservers may be an approved red-orange or similar high visibility contrasting color.
- 4.2 Marking. The following information and instructions must be shown:
- 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.
- 4.2.1.1 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, or the person assisting a child or an infant-small child wearer, may read them while in the water.
- 4.2.1.2 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 foot-candle. 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).

- 4.2.2 Date of manufacture of fabric (month and year).
- 4.2.3 Size category: "Adult," "Adult-Child," "Child," or "Infant-Small Child," as appropriate and weight limitation of each category.
- 4.2.4 The life preserver package must clearly indicate that it contains a life preserver, the size category and the weight limitation of the life preserver. The package also must be marked with the life preserver TSO and part number or the information must be visible through the package.

5. Tests.

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

Accelerated Age	Method 5850(9)(1)
Tensile Strength (Grab Test)	Method 5100(9)(7)
Tear Strength (Trapezoid Test)	Method 5136(9)(5)
Tear Strength (Tongue Test)	Method 5134(9) (Alternate to Trapezoid Test see 3.1.4.1)
Ply Adhesion	Method 5960(9)(3)
Coat Adhesion	Method 5970(9)(8)
Permeability	Method 5460 (5)(6)
Seam Shear Strength	(9)(2)
Seam Peel Strength	Method 5960(9)(3)
Flammability	FAR Part 25, Appendix F, Part I(b)(5), Horizontal Burn Rate (4)

(1) Samples of coated fabric and seams for the accelerated ageing tests must be exposed to a temperature of 158 ± 5 degrees F for not less than 168 hours. After exposure, the samples must be allowed to cool to 70 ± 2 degrees F for neither less than 16 hours nor more than 96 hours before determining their physical properties in accordance with paragraph 3.1 of this standard.

- (2) Samples must consist of two strips of material 2 inches maximum width by 5 inches maximum length. Strips must be bonded or heat sealed together along the width with an overlap of 3/4 inch maximum. Heat sealed seams must have a $1/8 \pm 1/32$ inch width minimum heat seal bead with the heat seal 1/4 inch from each end. The free ends must be placed in the testing machine described in FTMS 191A, Method 5100 and separated at a rate of 12 ± 0.5 inches/minute. The average value of two samples must be reported. Samples may be multilayered to ensure against premature material failure. Samples may be gripped across the full two inches of width.

- (3) Separation rate must be 2.0 to 2.5 inches/minute. Sample shall be one inch.

- (4) The material must meet the flammability requirements of FAR section 25.853(a) [Appendix F, Part I (a) (1) (iv)] in effect July 20, 1990

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

- (6) ASTM Method D1434-82, Procedure V, approved July 30, 1982, is an acceptable alternate method.

- (7) Use of pneumatic grips, for holding test samples, is an acceptable alternate to the mechanical grips described in Method 5100.

- (8) The sample shall be prepared using the adhesive and construction methods used to manufacture the life preserver. Separation rate must be 2.0 to 2.5 inches/minute.

- (9) Federal Test Method Standard No. 191A dated July 20, 1978.

- 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 F 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 F 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 F.

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 minimum tension load of 60 pounds is applied to the cord for at least 3 seconds. If the pull cord is designed to separate from the mechanical inflation means when operated, the pull cord shall be capable of withstanding a minimum tension load of 30 pounds for 3 seconds without failure.
- 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 psig air pressure and may not lose more than .5 psig when subjected to 40 psig air pressure. 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 $\frac{3}{4}$ inch larger than the outside diameter of the valve at the point of attachment must be used.

5.7 Jump Test.

- 5.7.1 Adult, Adult-Child or Child. An inflated adult, adult-child, or child Type I or Type II life preserver, excluding infant-small child life preservers, 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.

- 5.7.2 Infant-Small Child. An infant-small child life preserver must remain inflated and undamaged and the infant-small child dummy, specified in paragraph 5.9.1, must remain properly secured when an adult holding the dummy, with the preserver installed on the dummy, jumps into the water from a height above the water of at least 5 feet. The adult must be wearing an inflated life preserver for the test.

5.8 Fire Protection Test. Materials used in the life preserver and the storage package for the life preserver must be tested by the horizontal burn rate test prescribed in paragraph 5.1 of this standard.

5.9 Donning Test.

- 5.9.1 Test Subjects. There must be a minimum of 25 test subjects. There must be a minimum of five test subjects in each of the following age groups: 20-29 years; 30-39 years; 40-49 years; 50-59 years; and 60-69 years. Not more than 60% of the test subjects in any age group may be of the same sex. The number of test subjects in any age group may not exceed 30% of the total number of test subjects. Infant-small child donning tests must be performed by a minimum of 5 adult test subjects of both sexes between the ages of 20-40. Tests must be performed using an articulating infant-small child dummy, as described below. Adult test subjects must have no prior experience in donning tests of life preservers.
- 5.9.2 Infant-Small Child Test Dummy. The dummy to be used in the donning tests must have the basic physical characteristics for a composite 50th percentile unisex child of 24 months with a height of 34 inches and weighing 27.2 pounds. The dummy shall have articulating joints and, if used for water testing, must not absorb water. The anthropometric values for the dummy are presented in Table II. These data are considered valid for the stated chronological age plus or minus three months and are representative of U.S. children, as reported by the University of Michigan from 1975-1985.

information other than a typical preflight briefing and donning demonstration on the use of life preservers.

5.9.4 Test Procedure. The donning test must be begun with the life preserver contained in the storage package required by paragraph 4.1.14, and the package held in the test subject's hand. Separate timing must be kept for each test subject. Timing starts on signal when the test subject has both hands on the packaged life preserver and stops when the life preserver is properly donned, secured, and adjusted for fit. During the test, the test subject may release the seat belt and rise from the seat but may not move to any extent from the area immediately in front of the seat.