



Technical Standard Order

Subject: TSO-C70a, LIFERAFTS (REVERSIBLE AND NONREVERSIBLE)

a. Applicability.

(1) Minimum Performance Standards. This Technical Standard Order (TSO) prescribes the minimum performance standards that liferafts combinations 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 liferafts that are to be so identified and that are manufactured on or after the effective date of this TSO must meet the standards set forth in Appendix 1, "Federal Aviation Administration Standard for Liferafts" of this TSO.

(2) Environmental Standard. None.

(3) Test Methods. This TSO references Federal Test Method Standard No. 191A dated 7/20/78.

b. Marking. In addition to the marking required in Federal Aviation Regulations (FAR) § 21.607(d) (14 CFR 21.607), the part number, serial number and date of manufacture, weight and rated and overload capacities of the liferaft must be shown also. The weight of the liferaft includes any accessories required in this TSO.

c. Data Requirements. In accordance with FAR § 21.605, (14 CFR 21.605), each manufacturer shall furnish the Manager, Aircraft Certification Office (ACO), Federal Aviation Administration, having geographical purview of the manufacturer's facilities, one copy each of the following technical data:

(1) Operating instructions.

(2) Packing instructions.

(3) A complete description of the device, including detailed drawings, materials identification and specifications, and installation procedures.

(4) Manufacturer's TSO qualification test report.

(5) Applicable installation limitations, including stowage area temperatures. The manufacturer shall also provide the purchaser with such limitations.

(6) Maintenance instructions, including instructions regarding inspection, repair, and stowage of materials.

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

d. Availability of Referenced Documents.

(1) Appendix 1, "Federal Aviation Administration Standards for Liferafts," 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 the FAA Headquarters in the Office of Airworthiness, Aircraft Engineering Division (AWS-110), and at all Aircraft Certification Offices, 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 Regulations Part 21, Subpart O and Advisory 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-110), and at all regional Aircraft Certification Offices.

/S/ J. A. Pontecorvo
Acting Director of Airworthiness

APPENDIX 1. FEDERAL AVIATION ADMINISTRATION STANDARD FOR LIFERAFTS

1. Purpose. This standard provides the minimum performance standards for liferafts.

2. Scope. This standard covers the following types of liferafts:

TYPE I - For use in any category aircraft.

TYPE II - For use in nontransport category aircraft.

3. Material and Workmanship.

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.

3.1.3 The materials must not support fungus growth.

3.1.4 Coated fabrics - General. Coated fabrics, including seams, subject to deterioration used in the manufacture of the devices must possess at least 90 percent of their original physical properties after these fabrics have been subjected to the accelerated ageing test specified in paragraph 6.1 of this standard. Material used in the construction of flotation chambers and decks must be capable of withstanding the detrimental effects of exposure to fuels, oils and hydraulic fluids.

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 190 pounds/inch

Fill 190 pounds/inch

Tear Strength

Trapezoid Test: 13 X 13 pounds/inch (minimum); or

Tongue Test: 13 X 13 pounds/inch (minimum)

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

Ply Adhesion -

5 pounds/inch width at 70 ± 2 degrees F at a pull of 2.0 to 2.5 inches/minute

Coat Adhesion -

5 pounds/inch width at 70 ± 2 degrees F at 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 (Permeability Test Method) may not exceed 10 liters per 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 office 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:

Shear Strength (Seam Shear Test Method) - 175 pounds/inch width at 75 degrees F;
40 pounds/inch width at 140 degrees F

Peel Strength (Peel Test Method) -
5 pounds/inch width at 70 degrees F

3.1.6 Seam Tape. If tape is used for seam reinforcement or abrasion protection of seams or both, the tape must have minimum breaking strength (Grab Test Method) of 40 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 Canopy. Fabrics used for this purpose must be waterproof and resistant to sun penetration, and must not affect the potability of collected water, and must meet the following minimum requirements in the applicable tests prescribed in paragraph 6.1 of this standard, except that in lieu of meeting the tensile strength requirements, a fabricated canopy may be demonstrated to withstand 35-knot winds and 52-knot gusts:

Tensile Strength (Grab Test)

Warp 75 pounds/inch

Fill 75 pounds/inch

Tear Strength

Trapezoid Test: 4 x 4 pounds/inch; or

Tongue Test: 4 x 4 pounds/inch

Coat Adhesion of Coated Fabrics

3.5 pounds/inch width at 70 ± 2 degrees F at a separation rate of 2.0 to 2.5 inches/minute

3.1.8 Flammability. The device (including carrying case or stowage container) must be constructed of materials which meet FAR § 25.853 (14 CFR 25.853) in effect on May 1, 1972, as follows: Type I rafts must meet § 25.853 (b) and Type II rafts must meet § 25.853 (b-3).

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

3.3 Protection. All inflation chambers and load carrying fabrics must be protected in such a manner that nonfabric parts do not cause chafing or abrasion of the material in either the packed or the inflated condition.

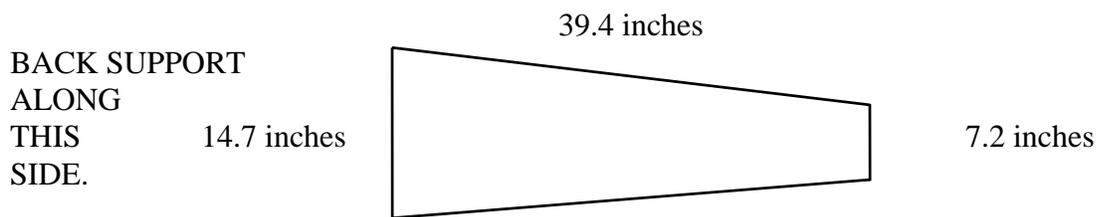
4. Design and Construction.

4.1 Capacity. The rated and overload capacities of a life raft must be based on not less than the following usable sitting areas on the deck of the life raft:

Rated Capacity	3.6 feet ² /person
Overload Capacity	2.4 feet ² /person

4.1.1 Capacity, Alternate Rating Methods. In lieu of the rated capacity as determined by paragraph 4.1 of this standard, one of the following methods may be used:

4.1.1.1 The rated capacity of a Type I or Type II liferaft may be determined by the number of occupant seating spaces which can be accommodated within the occupiable area exclusive of the perimeter structure (such as buoyancy tubes) without overlapping of the occupant seating spaces and with the occupant seating spaces located to provide each occupant with a back support of not less than 8 inches high. The occupant seating spaces may not be less than the following size:



4.1.1.2 The rated capacity of a Type I or Type II liferaft may be determined on the basis of a controlled pool or fresh water demonstration which includes conditions prescribed under paragraph 6.2.3 of this standard and the following:

4.1.1.2.1 The sitting area on the liferaft deck may not be less than 3 square feet per person.

4.1.1.2.2 The liferaft must have a back support for each occupant of not less than 14.7 inches wide and 8 inches high.

4.1.1.2.3 At least 30 percent but no more than 50 percent of the participants must be female.

4.1.1.2.4 Except as provided below, all participants must select their sitting space without outside placement assistance. Instructions, either identified on the raft or announced prior to the demonstration, may be used informing that each participant should have a back support. A raft commander, acting in the capacity of a crewmember, may direct occupant seating to the extent necessary to achieve reasonable weight distribution within the raft.

4.1.1.2.5 All participants must not have practiced, rehearsed, or have had the demonstration procedures described to them within the past 6 months.

4.2 Buoyancy. An average occupant weight of not less than 170 pounds must be used in all applicable calculations and tests specified herein. In tests, ballast in the form of sand bags or equivalent may be used to achieve the 170 pound average, provided the appropriate weight distribution within the raft is maintained.

4.2.1 Type I Liferaft. Buoyancy must be provided by two independent buoyancy tubes each of which, including the raft floor, must be capable of supporting the rated and overload capacities in fresh water if the other tube is deflated. The liferaft loaded to its rated capacity must have a freeboard of at least 12 inches with both buoyancy tubes at minimum operating pressure. The liferaft loaded to its rated capacity with the critical tube deflated and the remaining tube at minimum operating pressure must have a freeboard of at least 6 inches. The liferaft loaded to its overload capacity with the critical tube deflated must have a measurable freeboard.

4.2.2 Type II Liferaft. When single tube construction is used to provide the buoyancy, internal bulkheads must divide the flotation tube into at least two separate chambers such that the liferaft will be capable of supporting the rated number of occupants out of fresh water in the event that one chamber is deflated. The complete liferaft loaded to its rated capacity must have a freeboard of at least 6 inches.

4.3 Inflation. The inflation system must be arranged so that failure of one inflatable chamber or manifold will not result in loss of gas from the other chambers. The inflation equipment must be located so as not to interfere with boarding operation. Components of the inflation system must meet Department of Transportation Specification 3AA (49 CFR 178.37) or Specification 3HT (49 CFR 178.44) in effect May 30, 1976, as applicable, or an equivalent approved by the manager of the FAA office to which this TSO data is to be submitted, as required in paragraph c., Data Requirements. The inflation system must be constructed to minimize leakage due to back pressure after inflation. If an air aspirator system is used, the system must be constructed either to prevent the ingestion of foreign objects or to prevent failure or malfunction as a result of ingestion of small foreign objects. For Type I liferafts, there must be an independent inflation source for each primary flotation tube, except that there may be a single inflation source for all flotation tubes if data substantiating the reliability of the single

inflation source is approved by the manager of the FAA office to which this TSO data is to be submitted, as required in Paragraph c., Data Requirements.

4.4 Liferaft Canopy. A canopy must be packed with or attached to the raft. The erected canopy must be capable of withstanding 35-knot winds and 52-knot gusts in open water. The canopy must provide adequate headroom and must have provision for openings 180 degrees apart. Means must be provided to make the openings weathertight. If the canopy is not integral with the raft, it must be capable of being erected by occupants following conspicuously posted, simple instructions. It must be capable of being erected by one occupant of an otherwise empty raft and by occupants of a raft filled to rated capacity. For a reversible raft, attachment provisions must be installed to permit the canopy to be installed on either side of the raft.

4.5 Capsize Resistance. There must be water pockets or other means to provide capsize resistance for an empty or lightly loaded raft.

4.6 Boarding Aids. For Type I liferafts, boarding aids must be provided at two opposing positions on the raft. One boarding aid is sufficient for a Type II liferaft. Boarding aids must permit unassisted entry from the water into the unoccupied raft and must not at any time impair either the rigidity or the inflation characteristics of the raft. Puncturing of inflatable boarding aids must not affect the buoyancy of the raft buoyancy chambers. Boarding handles and/or stirrups used in conjunction with the boarding aids must withstand a pull of 500 pounds.

4.7 Righting Aids. Means must be provided to right a nonreversible liferaft if it inflates in an inverted position. The means provided for righting must be such that they may be used by one person in the water.

4.8 Lifeline. A nonrotting lifeline of contrasting color and at least 3/8-inch diameter or 3/4-inch width must encircle the liferaft on the outside periphery so that it can be easily grasped by persons in the water. The lifeline and its attachments must be capable of withstanding a minimum load of 500 pounds and must not interfere with the liferaft inflation.

4.9 Grasp Line. A grasp line, meeting the size and strength requirements for the lifeline, must be provided with sufficient slack for use by liferaft occupants to steady themselves when seated on the liferaft deck with their backs to the main flotation tube(s).

4.10 Color. The color of the liferaft's surfaces, including the canopy surface, visible from the air must be an International Orange-Yellow or an equivalent high visibility color.

4.11 Placards. Suitable placarding must be provided in contrasting colors in waterproof paint which is not detrimental to the fabric, that denotes use and location of the inflation systems, raft equipment, boarding aids, and righting aids. For reversible rafts, placement of the placarding must take into account usage of either side of the raft. The letters used for such placarding must be at least 2 inches high except that details and miscellaneous instructions may be of smaller lettering. Applicable placarding must take into account persons boarding or righting the raft from the water.

4.12 Lights. One or more survivor locator lights must be provided that are approved under TSO-C85. The lights must be automatically activated upon raft inflation in the water, and visible from any direction by persons in the water.

4.13 Raft Sea Performance. The raft must meet the seaworthiness requirements in 6.2.3.2 and must be capable with its equipment of withstanding a saltwater marine environment for a period of at least 15 days.

5. Liferaft Equipment. All lines must be suitably stowed and secured to prevent entanglement during launching/inflation of a liferaft.

5.1 Mooring Line. A nonrotting mooring line at least 20 feet in length must be attached at one end to the raft, with the remainder of the line held flaked to the carrying case (See 5.2). The mooring line must be capable of keeping the raft, loaded to maximum rated capacity, attached to a floating aircraft, and not endanger the raft or cause the raft to spill occupants if the aircraft sinks. The line may be equipped with a mechanical release linkage. The breaking strength of the line must be at least 500 pounds, or 40 times the rated capacity of the raft, whichever is greater, but need not exceed 1,000 pounds.

5.2 Liferaft Launching Equipment. A parachute ripcord grip and retaining pocket must form the primary inflation control. The ripcord grip or the attached static mooring line must be provided with means for attachment to the aircraft. If the ripcord grip is designed to attach to the aircraft, its strength may not be less than that of the static mooring line. The position of the ripcord grip must be standardized. When facing the release end of the carrying case, the center line of the ripcord grip retaining pocket must lie at 45 degrees in the right upper quadrant of the end section. The outermost extremity of the ripcord grip may not extend beyond the outer margin of the carrying case. The line attached to the ripcord grip must serve both to retain the liferaft and to actuate the gas release(s). The tension required to withdraw the static mooring line and to actuate the gas release mechanism(s) must be between 20 and 30 pounds. The strength of the gas release mechanism(s), its fittings, and its attachments may not be less than 100 pounds.

5.3 Sea Anchor. A sea anchor, or anchors, or other equivalent means must be provided to maintain the raft, with rated capacity and canopy installed, on a substantially constant heading relative to the wind and have the ability to reduce the drift to 2 knots in 17 to 27-knot winds. Unless analysis and/or test data substantiating the adequacy of a lower breaking strength is approved by the manager of the FAA office to which this TSO data is to be submitted as required in paragraph c., Data Requirements, the line securing a sea anchor to the raft must have a breaking strength of 500 pounds or 40 pounds time the rated capacity of the raft, whichever is greater. The attachment of the line to the raft must be capable of withstanding a load of 1.5 times the line-rated strength without damaging the raft. The line must be at least 25 feet in length and must be protected to prevent it from being cut inadvertently by raft occupants.

5.4 Heaving-Trailing Line. At least one floating heaving-trailing line not less than 75 feet in length for Type I rafts and not less than 35 feet in length for Type II rafts, and at least 250 pounds strength, must be located on the main flotation tube near the sea anchor attachment. The

attach point of the line must withstand a pull of not less than 1.5 times the line rated strength without damage to the raft. A heaving-trailing line must be accessible in any inflated position of a reversible liferaft.

5.5 Emergency Inflation. Means readily accessible to occupants of the raft, and having a displacement of at least 32 cubic inches per full stroke, must be provided to manually inflate and maintain chambers at minimum operating pressure. Manual inflation valves, with a nonreturn opening adequate for the size and capacity of the inflation means, must be located to permit inflation of all chambers. The location must take into consideration occupancy of each side of reversible raft. The inflation means and valves must have provisions to prevent inadvertent removal and loss when either stowed or in use.

5.6 Accessory Case Tiedowns. Provisions must be made for tiedowns to hold any accessory case. Each accessory case tiedown must withstand a pull of 250 pounds.

5.7 Carrying Case. A carrying case which meets the flammability requirement of this standard and which properly fits the packed liferaft must be provided. Carrying case materials must be of a highly visible color, be fungus proof, and be resistant to aircraft fuels and other fluids. The carrying case must provide chafe protection to the liferaft. The carrying case must be provided with easily distinguishable handles so that it may be carried by one person, carried by two persons in tandem, or dragged by either end; none of these carrying operations must tend to pull the carrying case open. Each handle must be easily grasped and its strength must be at least four times the total weight of the liferaft and case. Conventional zippers may not be employed for closure. Location of and instructions for use of the inflation handle must be clearly identified and marked on the carrying case surface.

5.8 Knife. A hook type knife secured by a retaining line must be sheathed and attached to the raft adjacent to the point of mooring line attachment.

6 Tests.

6.1 Material Tests. The material tests required in paragraph 3.0 of this standard must be determined in accordance with the following test method or other approved equivalent methods:

<u>Tests Required</u>	<u>Test Method</u>	
	Federal Test Method Standard No. 191A dated July 20, 1978	<u>Notes</u>
Accelerated Age	Method 5850	Per Note (1)
Tensile Strength (Grab Test)	Method 5100	
Tear Strength(Trapezoid Test)	Method 5136 (4)	
Tear Strength (Tongue Test)	Method 5134	
	(Alternate to Trapezoid Test See 3.1.4.1)	
Ply Adhesion	Method 5960	
Coat Adhesion	Method 5970	

Test Method

<u>Tests Required</u>	Federal Test Method Standard No. 191A <u>dated July 20, 1978</u>	<u>Notes</u>
Permeability	Method 5460 (4)	
Seam Shear Strength		Per Note (2)
Seam Peel Strength	Method 5960	Per Note (3)

NOTES:

(1) Samples for the accelerated aging tests must be exposed to a temperature of 158 ± 5 degrees Fahrenheit for 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 3.1 of this standard.

(2) Each sample shall consist of two strips 2 inches maximum width by 5 inches maximum length bonded together with an overlap $3/4$ inches 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 as required to provide adequate strength to ensure against premature material failure.

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

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

6.2 Liferaft Tests.

6.2.1 Pressure Retention. Under static conditions and when inflated and stabilized at the nominal operating pressure, the pressure in each inflatable chamber must not fall below the minimum operating pressure in less than 24 hours. The minimum operating pressure is the pressure required to meet the minimum design buoyancy requirements of paragraph 4.2 of this standard.

6.2.2 Overpressure Tests.

6.2.2.1 The device must be shown by test to withstand a pressure at least 1.5 times the maximum operating pressure for at least 5 minutes without sustaining damage.

6.2.2.2 At least one specimen of the inflatable device model must be shown by test to withstand a pressure at least 2 times the maximum operating pressure without failure. Devices so tested must be clearly identified.

6.2.3 Functional Tests. Each liferaft model must pass the following tests:

6.2.3.1 Water Tests. In either a controlled pool or fresh water, the liferaft capacity and buoyancy must be demonstrated as follows:

6.2.3.1.1 Both rated and overload capacities established in accordance with the requirements of paragraph 4.1 of this standard must be demonstrated with inflation tubes at minimum operating pressure and with the critical buoyancy chamber deflated. The resultant freeboard in each case must meet the requirements of paragraph 4.2 of this standard.

6.2.3.1.2 Persons used in the demonstration must have an average weight of not less than 170 pounds. Ballast in the form of sand bags or equivalent may be used to achieve proper loading provided the appropriate weight distribution within the raft is maintained.

6.2.3.1.3 Persons used in the demonstration must wear life preservers with at least one chamber inflated.

6.2.3.1.4 The required liferaft equipment, including one emergency locator transmitter or a weight simulating a transmitter, must be aboard the liferaft.

6.2.3.1.5 It must be demonstrated that the raft is self-righting, or can be righted by one person in water, or while inverted can be boarded and provide flotation for the normal rated capacity.

6.2.3.1.6 It must be demonstrated that the boarding aids are adequate for the purpose intended and that it is possible for an adult wearing an inflated life preserver to board the raft unassisted.

6.2.3.2 Sea Trials. The liferaft must be demonstrated by tests or analysis, or a combination of both, to be seaworthy in an open sea condition of 17 to 27-knot winds and waves of 6 to 10 feet. In tests, ballast in the form of sand bags or equivalent may be used to achieve proper loading provided the appropriate weight distribution within the raft is maintained. If analysis is used, the analysis must be approved by the manager of the FAA office to which the TSO data is to be submitted as required in paragraph c., Data Requirements. For this seaworthiness demonstration, the following apply:

6.2.3.2.1 The liferaft must be deployed to simulate deployment from an aircraft under the most adverse wind direction and wave condition. If the liferaft is an aspirated inflated type, it must be demonstrated that water ingested during inflation will not cause the raft to fail to meet the requirement for buoyancy under rated capacity in 4.2.

6.2.3.2.2 All required equipment must be aboard and the proper functioning of each item of equipment must be demonstrated.

6.2.3.2.3 The canopy must be erected for a sufficient time to assess its resistance to tearing and the protection it affords. The method of erection must be

shown to be accomplished by one occupant of an otherwise empty raft, and by occupants of a raft filled to rated capacity.

6.2.3.2.4 The stability of the raft must be demonstrated when occupied at normal rated capacity and at 50 percent rated capacity.

6.2.3.3 Liferaft Drop Test. A complete liferaft package must be dropped or thrown from a height of 5 feet onto a hard surface floor after which it must be inflated and meet the pressure retention requirements of paragraph 6.2.1 of this standard.

6.2.3.4 Portability Test. If the liferaft is to be manually deployed, it must be demonstrated that the complete liferaft package can be moved from a typical stowage installation by no more than two persons and then deployed at another suitable exit.

6.2.3.5 Carrying Case. It must be demonstrated at least 10 times that the carrying case will open satisfactorily and cause no delay in the deployment and inflation of the liferaft.

6.2.3.6 Gas Cylinder Releases. It must be demonstrated that pulling the ripcord grip from any position will actuate the primary gas release(s).

6.2.5 Temperature Exposure and Inflation. The manufacturer shall determine the minimum temperature at which the complete liferaft assembly with its inflation bottles, will be "rounded out" (i.e., attain its design shape and approximate dimension) so that the liferaft will be able to receive and to support the first occupant within one minute after the start of inflation. Thereafter, the rate of inflation must progress in such a manner and rate as to ensure a serviceable and rigid liferaft for boarding by the remainder of the occupants. Similarly, a maximum environmental temperature to which the liferaft assembly may be exposed and still remain in a seaworthy condition upon inflation must be determined. The temperature limitations must be submitted to the FAA and liferaft purchaser in accordance with the data requirements of this TSO.

6.2.5.1 Test Procedure. The packed liferaft assembly with its inflation bottles installed must be exposed to each of the above temperatures for not less than 24 hours and must be inflated within 5 minutes after removal from such temperatures. The liferaft must be allowed to return to a temperature of approximately 70 ± 5 degrees Fahrenheit before being deflated, repacked, and subjected to a second exposure. After the above tests have been completed, the liferaft must be able to pass tests required by paragraphs 6.2.1 and 6.2.2 of this standard.