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Specification for
Lifejackets

Spécification des brassières de sauvetage

Spezifikation für Schwimmwesten

British Standards Institution

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Foreword

This British Standard, having been prepared under the direction of the Personal Safety Equipment Standards Committee, is a revision of BS 3595 : 1969, 'Specification for life-saving jackets'.

The purpose of this standard is to provide a lifejacket with a minimum buoyancy of 155 N (35 lbf), properly distributed, for use in the conditions commonly encountered round the coasts of the British Isles, in estuaries and many inland waters, which will give a reasonable assurance of safety from drowning to a person who, for whatever reason, is no longer capable of helping himself.

A lifejacket is designed to turn and support the wearer, even though exhausted, injured or unconscious, to float at the correct attitude, with the nose and mouth clear of the water and with the trunk of the body inclined backwards. The lifejacket should also provide sufficient upthrust, properly distributed, to maintain this attitude in all but exceptionally severe weather conditions.

Lifejackets may be wholly or partially inherently buoyant or may be inflated either orally or by gas which can be manually or automatically released. Lifejackets inflated by gas may be a type operated either manually or automatically on immersion in water with facility for manual actuation.

Other personal flotation devices not covered by this standard include 'buoyancy aids'. These, usually, are of waistcoat or similar design with the necessary securing straps but they are not necessarily designed to turn and support an unconscious wearer. In certain sheltered conditions they may be considered, however, to provide adequate personal buoyancy especially when worn by users of small craft. Such craft are often themselves inherently buoyant and will provide a conscious person with additional support in, for example, a capsized situation. Whilst some buoyancy aids incorporate a collar it is not claimed that they will turn and support an unconscious wearer in the same way as a lifejacket.

The aim of this British Standard is primarily to guide manufacturers, individual users and those responsible for purchasing, prescribing or recommending equipment for clubs and associations, and for training children in

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seamanship, as to the essential performance requirements of a safe lifejacket. Whilst it has been borne in mind that lightness, lack of bulk and simplicity in use are very desirable properties, safety of life has been the foremost consideration in its preparation. Even where organized safety arrangements exist, the correct support of an exhausted or unconscious person has been the aim of this British Standard for a lifejacket. It cannot be over emphasized that dangerous conditions do exist in river estuaries and inland waters (and of course offshore) and for this reason the requirements of this standard are stringent.

This British Standard was first published in 1963 to meet the urgent need to provide increased personal safety for amateur sailors, including ocean racing yachtsmen, dinghy sailors and canoeists and for people who work on or close to water.

The first revision was undertaken in 1969 and took account of the developments in the materials field which affected lifejackets. Various points of detail were also revised in the light of the continuing experience of users and manufacturers.

This present revision takes into account numerous incidents which suggest that a collar retaining strap passing down the back of the wearer to the waist band facilitates rescue. Additionally some wearers, especially children, may benefit from an optional crotch strap to hold the lifejacket down onto the shoulders. Most importantly this revision allows for the integration of a lifejacket with a safety harness.

It is not possible to test objectively all the requirements specified in this British Standard. Subjective tests and assessments are required, and in the case of lifejackets submitted for BSI certification this will be carried out by a panel of experts appointed by BSI.

Users of this British Standard should acquaint themselves with any relevant Statutory requirements.

Certification. This British Standard provides for a product concerning personal safety. Manufacturers and purchasers are therefore urged to make use of the certification facilities of BSI.



British Standard Specification for Lifejackets

1. Scope

This British Standard specifies performance and safety requirements for lifejackets and integral lifejacket/safety harnesses for use by men, women and children.

The following three types of lifejackets are covered:

- (a) an inherently buoyant lifejacket whose buoyancy is produced solely by the incorporation of materials lighter than water;
- (b) a partially inherently buoyant lifejacket whose buoyancy is produced partly by the incorporation of materials lighter than water and partly by inflation;
- (c) an inflatable lifejacket whose buoyancy is produced solely by inflation.

Lifejackets for children are types (a) and (b) only.

Appendix P provides guidance for those not familiar with the physiological, technical and other factors involved in designing a lifejacket and assessing its efficiency.

A testing sequence for integral lifejacket/safety harnesses is given in appendix Q.

2. References

The titles of the standards publications referred to in this standard are listed on the inside back cover.

3. Definitions

For the purposes of this British Standard the following definitions apply:

- 3.1 buoyancy.** The resultant upthrust of a lifejacket when totally submerged in fresh water with its upper part just below the surface.
- 3.2 inflatable lifejacket.** A lifejacket whose buoyancy is produced wholly by inflating it with air or other gases.
- 3.3 orally inflatable lifejacket.** A lifejacket inflatable only by mouth.
- 3.4 gas-inflatable lifejacket.** A lifejacket inflatable wholly or partially by means of compressed gas. It can also be inflated by mouth.
- 3.5 automatic gas-inflatable lifejacket.** A gas inflatable lifejacket, inflated automatically when immersed in water with facility for manual actuation. It can also be inflated by mouth.
- 3.6 inherently buoyant lifejacket.** A lifejacket whose buoyancy is produced solely by the incorporation of materials lighter than water.
- 3.7 partially inherently buoyant lifejacket.** A lifejacket whose buoyancy is produced partly by the incorporation of materials lighter than water and partly by inflation.

3.8 tare mass (commonly known as 'tare weight'). For the purpose of marking, the tare mass of disposable cylinders includes only the mass of the cylinder and any component(s) fitted permanently thereto. The tare mass of rechargeable cylinders is the mass only of the empty cylinder but complete with gas retaining closure.

3.9 minimum total mass. For the purpose of marking, the minimum total mass is the tare mass plus the minimum mass of the charge contained.

4. General requirements

Lifejackets shall be manufactured from materials and components complying with the appropriate requirements of clause 5, to meet the design and construction requirements specified in clause 6. The finished lifejackets shall comply with the appropriate performance requirements of clause 7 and shall be marked in accordance with the requirements of clause 8. All lifejackets inflated by gas shall also have arrangements for oral inflation. The lifejackets shall be accompanied by instructions complying with the appropriate requirements of clause 9. For testing, three specimens are required for each type of lifejacket to assess the completed lifejacket. The specimens shall be capable of completing the testing sequence given in appendix A. If an integral lifejacket/safety harness is manufactured to comply with the requirements of this standard then that garment shall also comply with the requirements of BS 4224 or BS 4474. An appropriate testing sequence for the combined article is given in appendix Q.

5. Materials and components requirements

5.1 Air or gas holding layer. The air or gas holding layer of material shall not be on the outside of the finished lifejacket and the base textile shall be rot-proof or shall be rot-proofed by the pentachlorophenyl laurate (PCPL) process specified in BS 2087 : Part 1.

5.2 Coated fabrics

5.2.1 General. Coated fabrics, used in the manufacture of lifejackets as an air or gas holding layer, shall be rubber (natural or synthetic), polyvinylchloride (PVC) or polyurethane (PU) coated, and shall comply with the requirements given in 5.2.2 to 5.2.4 as appropriate.

Where the textile of the coated fabric will form the outer face of the jacket, the textile shall meet also the requirements given in 5.2.2.7, 5.2.3.7 or 5.2.4.7, and clause 6(n).

5.2.2 Natural and synthetic rubber coated fabrics

5.2.2.1 Coating adhesion (dry). When tested as specified in method 9B of BS 3424 : 1973 the adhesion between

coating and fabric shall be not less than 50 N per 50 mm width.

5.2.2.2 Coating adhesion (wet). When a test piece is prepared by the method described in 38.2 of BS 3F 100 : 1975 and after immersion for 24 h in 3 % sodium chloride solution is tested wet as described in method 9B of BS 3424 : 1973, the adhesion between coating and fabric shall be not less than 45 N per 50 mm width.

5.2.2.3 Tearing strength. The tearing strength of the coated fabric when determined by the median value tongue tear test, method 7A of BS 3424 : 1973, shall be not less than 45 N in the longitudinal and 33 N in the transverse direction.

5.2.2.4 Air permeability. There shall be no bubbles at a pressure of 27.5 kPa when tested as described in the high pressure test given in 30.1 of BS 3F 100 : 1975.

5.2.2.5 Vulcanization. The rubber shall have been satisfactorily heat cured as shown by the xylene test described in appendix R.

5.2.2.6 Resistance to copper. When the proofing is of natural rubber, it shall contain not less than 1 % by mass of copper inhibiting antioxidant based on the mass of rubber.

5.2.2.7 Dyed textiles. Where the textile forms the outer face and is dyed it shall comply with the requirements of clause 9 of BS 3F 100 : 1975 for fastness to light and water and prohibition of certain dyestuffs.

5.2.3 PVC coated fabrics

5.2.3.1 Coating adhesion (dry). See 5.2.2.1.

5.2.3.2 Coating adhesion (wet). See 5.2.2.2.

5.2.3.3 Tearing strength. See 5.2.2.3.

5.2.3.4 Air permeability. See 5.2.2.4.

5.2.3.5 Loss of mass on heat ageing. When tested as described in method 14A of BS 3424 : 1973 the loss of coating mass shall not exceed 5 %.

5.2.3.6 Degree of fusion. When tested as described in method 25 of BS 3424 : 1973 there shall be no cracking or disintegration of the coating.

5.2.3.7 Dyed textiles. See 5.2.2.7.

5.2.4 PU coated fabric

5.2.4.1 Coating adhesion (dry). When tested as described in method 9B of BS 3424 : 1973, the adhesion between coating and fabric shall be not less than 80 N per 50 mm width.

5.2.4.2 Coating adhesion (wet). When a test piece is prepared by the method described in 9.2.4 of BS 3424 : 1973 and, after immersion for 24 h in a 3 % sodium chloride solution at room temperature, is tested wet as described in method 9B of BS 3424 : 1973, the adhesion between coating and fabric shall be not less than 60 N per 50 mm width.

5.2.4.3 Tearing strength. See 5.2.2.3.

5.2.4.4 Air permeability. See 5.2.2.4.

5.2.4.5 Blocking resistance. When tested by the method described in clause 13 of BS 3424 : 1973, except that the temperature for the test shall be $70 \pm 2^\circ\text{C}$ and the

duration of time under load shall be 168 ± 1 h, the separation of the surface shall not cause the 100 g weight to be lifted.

5.2.4.6 Hydrolysis resistance. When tested as described in method 14B of BS 3424 : 1973, but with the sample suspended over a container of water, there shall be no softening or embrittlement of the PU after a period of 336 h.

5.2.4.7 Dyed textiles. See 5.2.2.7.

5.3 Foam

5.3.1 General. Foam used as inherently buoyant material shall be of the closed cell type and shall comply with the requirements given in 5.3.2 to 5.3.5.

5.3.2 Density. The density of the foam shall be not greater than 89 kg/m^3 for sheet material and not more than 129 kg/m^3 for moulded sections.

5.3.3 Water absorption. When tested as described in appendix B, the water absorption shall be not greater than 1.0 kg/m^2 of surface area.

5.3.4 Thermal stability. When tested as described in appendix C the maximum loss of volume shall be not greater than 10 %.

5.3.5 Loss of buoyancy after compression. When tested as described in appendix D, the loss of buoyancy shall be not greater than 7.5 %.

5.4 Gas cylinders

5.4.1 Construction

5.4.1.1 Rechargeable cylinders. Rechargeable gas cylinders shall comply with the requirements of BS 5045 : Part 6*.

5.4.1.2 Disposable cylinders. Disposable gas cylinders shall be constructed of suitable materials and shall be designed to withstand, without failure, an internal pressure of not less than 448 bar. This figure may be reduced to 414 bar when cylinders are of seamless construction.

5.4.2 Testing. One cylinder in 500 shall be tested in the following manner and shall be discarded after testing.

(a) **Shock test.** When a correctly charged cylinder is dropped from a height of not less than 6 m on to a concrete surface, no leak shall result.

(b) **Material proving test.** All cylinders passing the shock test described in (a) shall be submitted to an internal application of pressure until the cylinder fails. If the cylinder fails at a pressure less than 448 bar, or 414 bar in the case of cylinders of seamless construction, all cylinders from the particular production batch shall be deemed not to comply with the requirements of this British Standard.

5.4.3 Filling ratio. In no circumstances shall any cylinder contain gas to more than 68 % by mass of the total distilled water capacity of the cylinder. The weighing tolerance of the gas charge shall be $\pm 1 \text{ g}$ (e.g. a cylinder designed to contain a maximum of 29 g of CO_2 shall be charged to $28 \pm 1 \text{ g}$).

5.4.4 Checking of contents. Before, and at the end of, a 21 day storage period the contents of all cylinders shall be determined by weighing. If by such weighing, or any other means of equivalent accuracy, a loss in mass is shown greater than 0.1 g, the cylinder shall not be used

*In course of preparation.

†1 bar = 10^5 N/m^2 = 100 kPa.

with lifejackets complying with the requirements of this British Standard. In the case of a rechargeable cylinder, such a mass loss shall not preclude its continued use after it has been refilled and has satisfactorily passed this test.

5.4.5 Marking. Each cylinder, or a component permanently fitted thereto, shall be indelibly marked with one of the following to the nearest 1 g:

- (a) the tare mass and the minimum mass of charge, or
- (b) the tare mass and the minimum total mass, or
- (c) the minimum mass of charge and the minimum total mass.

NOTE. For reference, tare mass and minimum total mass are defined in 3.8 and 3.9.

5.5 Metal parts. All metal parts (including metal gas cylinders) used in the construction of lifejackets shall be free from burrs and sharp edges and when tested as described in E.1, no metal part, while still affixed, shall show signs of corrosion when viewed by the unaided eye of a trained observer. No metal parts (excluding metal gas cylinders) shall deflect a typical yacht magnetic compass more than 1°, when tested as described in E.2.

5.6 Oral inflation device. A lifejacket incorporating means for oral inflation shall comply with the following requirements.

When tested as described in appendix F, the rate of flow of air through the device shall be not less than 85 litres/min. In addition, the non-return valve shall open initially at an air pressure of from 15 mbar* to 30 mbar applied at the mouthpiece.

5.7 Deflation devices. All lifejackets shall incorporate a means of deflation, which can be operated without removing the jacket, and which does not affect its ability to be re-inflated if necessary.

5.8 Whistle. All lifejackets shall be provided with a non-metallic whistle firmly secured by a lanyard and housed in a loop or small pocket on the garment.

6. Design and construction requirements

NOTE. It is recommended that assessment of compliance with the requirements of this clause is undertaken by a subjective panel.

The lifejacket shall comply with the following requirements.

- (a) It shall be light and compact and designed to be worn outside clothing. This shall be assessed as described in G.1.3.
- (b) It shall not unduly restrict the field of vision or the hearing of the wearer, nor impede his breathing. This shall be assessed as described in G.1.4.
- (c) It shall be easy to grasp, and allow the wearer to be held and pulled from the water without allowing him to slip out or to be hurt. This shall be assessed as described in G.2.6.
- (d) Neither the lifejacket, nor any part of it, shall be capable of damaging an inflatable life-raft. This shall be assessed as described in G.1.2.
- (e) It shall be simple to put on and to secure and, when assessed by the method given in G.1.2, the wearer shall don and secure it within 30 s. The means of donning shall be obvious with the aid of simple instructions for use (see clause 9).

(f) It shall be easily adjustable and shall be a good and secure fit on the wearer when assessed as described in G.2.5.

(g) It shall allow the wearer freedom of action and movement when assessed as described in G.2.4.

(h) It shall be simple to maintain and service and shall be capable of repeated use in water subject to simple servicing not involving the use of specifically designed tools unless these are provided, with full instructions, with the lifejacket by the manufacturer.

It shall be capable of being fully serviced by the test subject within 30 min according to the manufacturer's instructions and shall be tested to demonstrate this.

(i) The lifejacket stole and its outer cover, where one is fitted, shall be made from soft pliant materials that cannot cause the wearer discomfort owing to chafing or rigidity.

(j) The lifejacket† shall provide lateral and occipital support of the wearer's head so that the mouth of an exhausted or unconscious person is held well clear of the water with the trunk of the body inclined backwards from the vertical position at an angle between 30° and 60°, when assessed as described in G.2.3.

(k) The lifejacket shall automatically turn an exhausted or unconscious person into the position required by (j) within 5 s (10 s for automatically inflated lifejackets only tested as described in G.2.1) when that person either:

- (1) has fallen into the water (as in G.2.1), or
- (2) is lying face down in the water (as in G.2.2).

The lifejacket shall allow the wearer to make progress through the water, but in no circumstances shall it allow an inert wearer to remain floating face downward or horizontally.

(l) The lifejacket shall be fitted with a rot-resisting harness incorporating a lifting becket. The becket shall be positioned centrally and be conspicuous when the wearer is floating. It shall be so designed that it stands open and clear of the lifejacket.†

(m) The harness shall incorporate a webbing back strap connecting the collar to the waistband to prevent the collar of the lifejacket from accidentally slipping over the head of the wearer.

(n) The lifejacket shall be yellow or orange in colour and shall be conspicuous by day both when saturated with water and when dry.

NOTE. For use at night, a light can be provided or retro-reflective strips used.

(p) The lifejacket shall be provided with a whistle (see 5.8) firmly secured by a lanyard and housed in a loop or small pocket on the garment.

(q) A partially inherently buoyant lifejacket in its uninflated state shall support the trunk of the wearer at an angle inclined backwards from the vertical, when assessed as described in G.2.3, but uninflated.

(r) A lifejacket with a manually operated or automatic inflation head shall comply with the following requirements.

- (1) The means of operation of the triggering device shall be obvious and readily accessible to either hand.

*1 mbar = 10² N/m² = 100 Pa.

†Inflatable and partially inherently buoyant lifejackets are assessed in the inflated state.

(2) It shall be capable of operation by either hand but shall not require both hands.

(3) The device shall be guarded against 'snagging' (i.e. cords shall be sleeved, triggers guarded, etc.).

(s) A crotch strap may also be included in a lifejacket if desired.

(t) If the lifejacket incorporates means for oral inflation this shall embody an automatic non-return valve. The action required to make it ready for use shall be simple and shall require the use of one hand only. The mouthpiece shall be readily accessible to the mouth and to either hand with the jacket uninflated or fully inflated. Compliance with this requirement shall be demonstrated by the test subject. The mouthpiece shall be non-metallic with a smooth finish free from burrs and sharp edges, and shall be fitted with a watertight cap.

7. Performance requirements

7.1 Cold conditioning. The lifejacket is conditioned, folded as supplied, for 16 h at a temperature of $-10 \pm 2^\circ\text{C}$. The time taken to reach the conditioning temperature from room temperature shall be not more than 1 h. Inflatable lifejackets are then subjected to the following treatment.

90 s after removal from the conditioning temperature an internal air pressure of 205 mbar is applied through the oral inflation tube and maintained for a period of 10 min. Then carry out the hot conditioning treatment as detailed in 7.2.

7.2 Hot conditioning. The lifejacket is conditioned for 16 h at a temperature of $60 \pm 2^\circ\text{C}$. The time taken to reach the conditioning temperature shall be not less than 30 min and not more than 1 h. Inflatable jackets are then subjected to the following treatment.

90 s after removal from the conditioning temperature an internal air pressure of 205 mbar is applied through the oral inflation tube and maintained for a period of 10 min. During the 90 s period immediately after removal from the conditioning temperature, the inflation valve is tested in the manner described in M.2. The oral inflation valve shall not be removed by a force of up to 90 N.

7.3 Buoyancy. The minimum total buoyancy shall be 155 N for adults' lifejackets and 90 N for young children's lifejackets initially and after immersion, when tested by the method described in appendix H.

In addition, in the case of partially inherently buoyant lifejackets, the minimum effective buoyancy of the lifejacket shall be not less than 60 N for adults' jackets and not less than 45 N for young children's jackets, when prepared by the method described in H.2.2 and tested by the method described in H.3.*

7.4 Harness strength. After being tested by the method described in appendix J, the lifejacket shall be inspected. There shall be no damage to the buoyancy compartments or their attachment to the harness, and the harness shall

not be so damaged as to allow a wearer to slip out of it.

7.5 Resistance to oil and water. After being tested by the method described in appendix K, the lifejacket shall still comply with the requirements for total buoyancy specified in 7.3.

7.6 Resistance to crushing. After being tested by the method described in appendix L, the lifejacket shall reveal no damage on visual inspection.

7.7 Resistance to bursting

7.7.1 Production proof test. Each lifejacket manufactured with buoyancy depending wholly or partly on inflation, shall be proof tested by inflation to a pressure of 205 mbar for 1 min.

7.7.2 Design proof test. In addition to the production proof test, when carrying out a design test each tested lifejacket with buoyancy depending wholly or partly on inflation, shall withstand, without damage, inflation to a pressure of 410 mbar.

7.8 Resistance to the oral inflation device to pulling. When tested by the method described in appendix M, the inflation valve shall not be removed by a force of up to 90 N.

7.9 Operation of gas inflation heads. A lifejacket with manually or automatically operated inflation head shall meet the following requirements.

(a) When mounted uninflated on a test dummy with a steady force applied to the triggering device of the operating head in the manner described in the manufacturer's instructions, the inflation device shall operate at a force of not more than 65 N. It shall discharge fully into the lifejacket within 5 s when tested as described in N.1.1. After the device has fired, the force exerted shall be increased to 220 N and the triggering device shall not fracture.

In addition, a lifejacket with automatically operated inflation head shall meet the following requirements.

(b) The inflation device shall operate within 5 s of immersion in water, when tested as described in N.1.2, and shall discharge fully into the lifejacket within a further 5 s.

(c) The inflation device shall be tested for resistance to inadvertent operation as described in N.2 and after 15 min the inflation device shall not have operated.

7.10 Strength of attachment of inflation head. In the case of inflation heads outside the buoyancy chamber, when tested as described in N.3, the lifejacket shall show no signs of deflation.

8. Marking

8.1 Marking on lifejackets. Each lifejacket shall be clearly and indelibly marked with the following particulars using ink that is non-injurious to any of the lifejacket materials, such as, for example, the ink specified in DTD Specification 537Et.

(a) The number of this British Standard, i.e. BS 3595†.

*Inflatable and partially inherently buoyant lifejackets are tested in the inflated state.

†DTD Specification 537E 'Proofed fabric and tape for inflatable liferaft equipment' published by the Ministry of Defence.

‡Marking BS 3595 on or in relation to a product is a claim by the manufacturer that the product has been manufactured in accordance with the requirements of the standard. The accuracy of such a claim is therefore solely the manufacturer's responsibility. Enquiries as to the availability of third party certification to support such claims should be addressed to the Director, British Standards Institution, Maylands Avenue, Hemel Hempstead, Herts HP2 4SQ in the case of certification marks administered by BSI or to the appropriate authority for other certification marks.