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**COMMISSION STAFF WORKING DOCUMENT**

**IMO - Union submission to be submitted to the 7th of the Sub-Committee on Ship Systems and Equipment (SSE 7) of the IMO in London from 2 – 6 March 2020 concerning proposed amendments to the LSA Code and Resolution MSC.81(70) to address the in-water performance of SOLAS lifejackets**

**COMMISSION STAFF WORKING DOCUMENT**  
**For the Council Shipping Working party**

**IMO - Union submission to be submitted to the 7<sup>th</sup> of the Sub-Committee on Ship Systems and Equipment (SSE 7) of the IMO in London from 2 – 6 March 2020 concerning proposed amendments to the LSA Code and Resolution MSC.81(70) to address the in-water performance of SOLAS lifejackets.**

**PURPOSE**

The document in Annex contains a draft Union submission to the 7<sup>th</sup> session of the Sub Committee on Ship Safety and Equipment (SSE 7) of the IMO, taking place in London from 2 – 6 March 2020, concerning proposed amendments to the LSA Code and Resolution MSC.81(70) to address the in-water performance of SOLAS lifejackets. It is hereby submitted to the appropriate technical body of the Council with a view to achieving agreement on transmission of the document to the IMO prior to the required deadline of 29 November 2019<sup>1</sup>.

Lifejackets are included in Commission Implementing Regulation (EU) 2018/773 of 15 May 2018 on design, construction and performance requirements and testing standards for marine equipment and repealing Implementing Regulation (EU) 2017/306. Reference is made in that Implementing Regulation to the LSA Code and to resolution MSC.81(70) in relation to item MED/1.4 as regards lifejackets. This equipment therefore falls in the scope of Directive 2014/90/EU of the European Parliament and of the Council of 23 July 2014 on marine equipment and repealing Council Directive 96/98/EC.<sup>2</sup>

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<sup>1</sup> The submission of proposals or information papers to the IMO, on issues falling under external exclusive EU competence, are acts of external representation. Such submissions are to be made by an EU actor who can represent the Union externally under the Treaty, which for non-CFSP (Common Foreign and Security Policy) issues is the Commission or the EU Delegation in accordance with Article 17(1) TEU and Article 221 TFEU. IMO internal rules make such an arrangement absolutely possible as regards existing agenda and work programme items. This way of proceeding is in line with the General Arrangements for EU statements in multilateral organisations endorsed by COREPER on 24 October 2011.

<sup>2</sup> A formal EU position under Article 218(9) TFEU is to be established in due time as regards the subject matter covered by this draft Union submission. The act which the IMO Marine Environment Protection Committee will eventually be called upon to adopt will constitute an act having legal effects. The envisaged act will be capable of decisively influencing the content of the above EU legislation. The concept of ‘acts having legal effects’ includes acts that have legal effects by virtue of the rules of international law governing the body in question. It also includes instruments that do not have a binding effect under international law, but that are ‘capable of decisively influencing the content of the legislation adopted by the EU legislature’ (Case C-399/12 Germany v Council (OIV), ECLI:EU:C:2014:2258, paragraphs 61-64).

SUB-COMMITTEE ON SHIP SYSTEMS AND  
EQUIPMENT  
7th session  
Agenda item X

SSE7/X  
29 November 2019  
ENGLISH

Pre-session public release:

**DEVELOPMENT OF AMENDMENTS TO THE LSA CODE AND RESOLUTION  
MSC.81(70) TO ADDRESS THE IN-WATER PERFORMANCE OF SOLAS LIFEJACKETS**

**Proposal for amendments to the LSA Code and Resolution MSC.81(70) to address the in-  
water performance of SOLAS lifejackets**

**Submitted by the European Commission on behalf of the European Union**

**SUMMARY**

*Executive summary:* This paper contains proposals to review the in-water performance of SOLAS lifejackets in accordance with the instruction of MSC 101.

*Strategic direction, if applicable:* Other Work

*Output:* TBD

*Action to be taken:* Paragraph XX

*Related documents:* MSC 101/21/6, MSC 101/INF.3, MSC 101/WP.1/Add.1

**Background**

1. The co-sponsors have obtained evidence indicating that the IMO requirements for the design and testing of lifejackets may not provide sufficient assurance of the in-water performance of SOLAS lifejackets in real-life situations. To address this issue the co-sponsors submitted documents MSC 101/21/6, MSC 101/INF.3 to MSC 1010 requesting the opening of a new output under the agenda of SSE.

2. The 101<sup>st</sup> session of the Committee considered documents MSC 101/21/6 and MSC 101/INF.3 (Austria et al.), proposing to review the LSA Code and resolution MSC.81(70) in respect of the in-water performance of SOLAS lifejackets; and agreed to include in the post-

biennial agenda of the Committee an output on "Development of amendments to the LSA Code and resolution MSC.81(70) to address the in-water performance of SOLAS lifejackets", with two sessions needed to complete the item, assigning the SSE Sub-Committee as the coordinating organ.

3. Notwithstanding the above decision, the Committee instructed the SSE Sub-Committee to take into account the following issues:

.1 annex 4 of the proposal should not be used as the basic document for the discussion since further detailed consideration was needed; and

.2 the approval of the output should not be interpreted to mean that the use of existing lifejackets is not safe and the retroactive application of any requirements for new equipment to existing ships should be carefully considered.

4. The Committee further agreed, in accordance with MSC.1/Circ.1481 and MSC.1/Circ.1500/Rev.1, that:

.1 the amendments to be developed should apply to lifejackets manufactured to the new standard and would apply to all new ships. Careful consideration should be made on the potential application to existing ships;

.2 the instruments to be amended are the LSA Code and resolution MSC.81(70); and

.3 the amendments to be developed should enter into force on 1 January 2024, provided that they are adopted before 1 July 2022.

## **Introduction**

5. In July 2017 the United Kingdom's Marine Accident Investigation Branch reported on the deaths of three seafarers who had drowned whilst wearing SOLAS lifejackets. The sea and environmental conditions were calm however these seafarers were found by the rescue services in a face down position.

6. A detailed review confirmed that these lifejackets held valid approval documentation and approval tests were conducted in accordance with the relevant instruments and were otherwise compliant, an investigatory group was assembled to identify the root causes affecting the in-water performance of these lifejackets. The investigatory group was chaired by the United Kingdom's Maritime & Coastguard Agency and consisted of members from the Maritime Accident Investigation Branch, the Royal National Lifeboat Institution, the International Life-saving Appliance Manufacturers' Association (ILAMA) and technical experts on human physiology and sea survival.

7. The investigatory group was primarily tasked with reviewing the capability of a SOLAS lifejacket to retain a person's airways clear of the water and the level of safety offered by existing SOLAS lifejackets. In total, the investigatory group conducted three ordered sets of in-water lifejacket tests against the requirements within the LSA Code and Resolution MSC.81(70), which included 2856 righting tests and 1060 freeboard measurements.

8. During these investigations, the group recognised that there is a strong correlation between the clothing worn by a person and the in-water performance provided by a lifejacket, and that the current IMO requirements do not consider the effects of clothing. The final set of in-water testing was performed using eight SOLAS lifejackets and 14 test subjects wearing standardised clothing. 10 out of the 14 test subjects recorded one or more test results where they would not turn to clear their airways of the water surface. Another portion of test subjects would turn in a time which exceeded the 5 second original requirement from Resolution MSC.81(70) (before adoption of the amendments to the revised recommendation on testing of life-saving appliances contained within MSC200(80)).

9. Based on this technical evidence the investigatory group concluded that the international requirements for the design and testing of lifejackets within the LSA Code and Resolution MSC.81(70) did not provide consistent assurance of the in-water performance of SOLAS lifejackets. The investigatory group developed proposals which would alleviate the issues which had been identified, including a proposal to incorporate a new in-water test with a form of standardised clothing to be worn by the test subjects. The investigatory group made formal assessments of the repeatability of the in-water tests by repeating many of the tests on two occasions and by comparing results which were obtained from previous in-water tests using the reference test device (RTD). This work concluded with verification testing of these proposals against eight SOLAS lifejackets, which showed that an acceptable performance may already be achieved by some existing SOLAS lifejackets.

### **Analysis of the Issue**

10. All SOLAS vessels are required to provide a lifejacket for every person on board which complies with the requirements of the LSA Code. Lifejackets are associated mainly with abandonment, however they are also utilised as a safety measure in many scenarios on board of SOLAS vessels; including survival craft drills, operations on a weather deck, tendering operations & crew transfer operations or any other activity where there is a greater risk of a person entering the water. If a person enters the water, there is general expectation that a SOLAS lifejacket can maintain a person's airways clear of the water surface.

11. MSC 101/INF.3 contains a timeline of events which were conducted to assess the in-water performance of SOLAS lifejackets. This evidence supports that achieving a baseline performance equivalent to that provided by the reference test device will not guarantee an acceptable level of in-water performance for a lifejacket when used in an emergency situation.

12. During the gathering of evidence and from consultations with stakeholders, the investigatory group became aware that some stakeholders believed that a lifejacket would maintain the airways clear of the water and right a person regardless of the subject's physical attributes, or anything that might be worn on their body. The IMO does not currently issue guidance with respect to the in-water performance of lifejackets, however the development of such an MSC Circular could help stakeholders to make more informed decisions regarding the safety of persons who might be expected to be immersed in water. Similar information is already presented in another international lifejacket standard.

13. The current in-water performance of SOLAS lifejackets has been the subject of detailed deliberations by the co-sponsors of this document. During these deliberations many options were considered for how to rectify the perceived issues with in-water performance of a lifejacket.

The investigatory group deemed it impossible to improve the in-water performance by simply applying a single “safety factor” to the existing requirements within the LSA Code and Resolution MSC.81(70) and hence the group concluded that a number of amendments must be established jointly. The proposal measures detailed below have been carefully considered so that collectively they achieve the necessary enhancements to lifejacket performance and to the safety of persons immersed in water.

1. To provide lifejacket end users with an enhanced understanding of the capabilities of a lifejacket, the co-sponsors believe it is necessary to introduce a new requirement for SOLAS lifejackets to be marked with important safety information and manufacturer’s details. Such information may include simple donning instructions or the proven compatibility of the lifejacket with other safety equipment. This requirement already exists within ISO 12402: Personal Flotation Devices, and such markings are common on other safety equipment.
2. The existing in-water testing requirements for turning time allow a “no-turn” result to be recorded by a lifejacket if the same test subject also recorded a “no-turn” whilst wearing the RTD (reference test device). The co-sponsors propose that this provision should no longer be permitted, and in the event that a test subject records a “no turn” in a lifejacket, a two-test subject substitution method should be employed. If either of these two test subjects also records a “no turn” then the lifejacket will have failed.
3. The co-sponsors have identified instances when a lifejacket has turned a test subject to a position where the mouth is clear of the water, however the test subject has not concluded the test in a face-up position. The co-sponsors believe that the righting test should only be deemed successful if the test subject subsequently attains the safe static balance, face-up position.
4. The in-water testing conducted by the investigatory group was conducted against the RTD and eight samples of existing SOLAS lifejackets. The RTD is used within all SOLAS in-water performance tests as a comparative testing tool for righting performance as well as freeboard and static balance measurements. The RTD has an inherent buoyancy of approximately 148 Newton however with test subjects wearing standardised clothing the RTD has shown a questionable in-water performance.
5. The eight existing SOLAS lifejackets had buoyancy values of 137, 147, 156, 173, 179, 180, 187, 191 Newton. The investigatory group concluded that there is a correlation between the buoyancy of a lifejacket and its in-water performance, and that this correlation is already the fundamental basis for performance levels within ISO 12402. Two of the tested lifejackets presented an in-water performance in clothing which achieved both the righting and static balance assessment criteria without recording no-turns. These lifejackets provided 173 Newton and 191 Newton of inherent buoyancy. After reviewing the results from the other lifejackets, the co-sponsors believe that to attain an acceptable in-water performance level for SOLAS lifejackets, it would certainly not be possible to achieve this with a buoyancy value of less than 150 Newton. In order to align with other industry standards such as ISO 12402 and so ensure that lifejacket designs are not unduly restricted, this minimum buoyancy value should be introduced.

6. As highlighted by the initial discussions of the investigatory group, the existing SOLAS in-water performance tests for lifejackets are conducted with test subjects wearing swimwear, and that this condition is not representative of a real emergency scenario. The subsequent testing by the group has repeatedly shown that the wearing of clothing has a substantial effect on the in-water righting performance of a lifejacket, and therefore the co-sponsors propose that an extra requirement is introduced for SOLAS lifejackets to turn an unconscious, face-down persons in the water to a position where the mouth is clear of the water in an average time not exceeding 5 seconds, whilst wearing standardised clothing. This test will be conducted as a new test, in addition to the current righting tests conducted against the RTD. To support this proposal, a new definition is introduced for the standardized clothing within a draft new Annex 4 to Resolution MSC.81(70).

14. The proposals detailed above, and the performance increases that they provide can be implemented using simple amendments to the existing provisions within SOLAS as shown in the Annexes to this paper. Further, these amendments were verified by the testing of eight existing SOLAS lifejackets which showed that there are lifejackets currently available on the market and currently carried on SOLAS vessels which already achieve this improved performance. It should be noted that the investigatory group considers that the proposed actions achieve the necessary improvements for in-water performance when they are applied collectively.

15. During the work of the investigatory group, attention was drawn to the general requirements for life-saving appliances within chapter 1.2 of the LSA Code which requires all life-saving appliances, "if they are to be used in a seaway, be capable of satisfactory operation in that environment." On this basis, the investigatory group highlighted two additional misalignments between the LSA Code and industry standards, one related to the fitting of spray hoods and the other fitting of retention devices. The investigatory group gathered evidence which strongly supported the introduction of these components to improve the safety level offered by SOLAS lifejackets and hence these are proposed as follows:

1. A retention device is intended to provide additional support to prevent the lifejacket riding upwards over the wearers head in a seaway and thereby promote the correct static balance position and freeboard measurement for the airways. The existing in-water tests are conducted in calm fresh water and hence the only method of currently assessing the lifejacket securing mechanism(s) is via the 1 metre jump test. A new requirement should be introduced for SOLAS lifejackets to be fitted with a retention device.

2. In the event that a person enters the water in a seaway and that the person successfully rights into a face-up position with adequate freeboard, the next hierarchal survival needs are for the person to be able to breathe comfortably without water ingress into their airways and for them to be able to observe their surroundings to seek rescue. Spray hoods can be a simple addition to a lifejacket and can be paramount to a person's survival when they tire and cannot prevent the natural orientation of their body to the direction of the waves. The co-sponsors propose that a new requirement is introduced for SOLAS lifejackets to be fitted with a spray hood with reference to existing industry standards.

## **Industry Standards**

16. The International Organization for Standardization produced guidance on the design and application of personal flotation devices for persons engaged in activities, whether in relation to their work or their leisure, in or near water. ISO 12402: Personal Floatation Devices provides guidance on personal flotation devices and the LSA Code already utilises a reference to Part 7 of the ISO 12402 series with regards to tests of components other than buoyancy materials and tensile strength tests.

17. The ISO 12402 series of documents openly states that personal flotation devices “manufactured, selected, and maintained to this standard should give a reasonable assurance of safety from drowning to a person who is immersed in water.” ISO 12402 also defines lifejackets as those personal flotation devices “which provide face up in-water support to the user regardless of physical conditions.”

18. When reviewing the expectation of maritime stakeholders with respect to the in-water performance of SOLAS lifejackets, the co-sponsors acknowledged that the ISO 12402 series explicitly states several of the issues, such as the wearing of heavy weather clothing, which may impact the performance of lifejackets.

19. It should also be recognised that for an adult of mass above 70kg, ISO 12402 considers 150 Newton buoyancy as being the smallest size for a lifejacket to “turn an unconscious person into a safe position and requires no subsequent action by the user to maintain this position.”

20. The proposed outputs within this paper have been considered with respect to the requirements within ISO 12402 and have been aligned to these international standards wherever possible.

21. The co-sponsors are aware that ISO 12402 includes a standard for a 275 Newton lifejacket which has a much improved in-water performance compared to the existing SOLAS lifejacket standard. Lifejackets with this volume of buoyancy are invariably of the gas inflation type. The co-sponsors acknowledge that although gas inflation lifejackets provide several benefits, including those related to in-water performance, there are some compromises such as the requirement for annual servicing and the increased complexity when compared with inherent buoyant foam lifejackets.

## **Proposals**

22. The co-sponsors propose that the following could be considered as base documents for detailed consideration by a working group::

1. Annex 1 - MSC Circular on “Guidance on the in-water performance of lifejackets and considerations for selection of a lifejacket” which contains the proposal for a Circular intended to serve as Guidance when selecting a lifejacket in relation to potential use on-board;

2. Annex 2 - Amendments to the International Life-Saving Appliance (LSA) Code, resolution MSC.48(66), as amended by MSC.368(93), MSC.320(89), MSC.81(70) and A.520(13) which contains the proposals for amendments to the LSA Code as instructed by MSC 101; and



3. Annex 3 – Amendments to Resolution MSC.81(70) (adopted on 11 December 1998), which contains proposals for amendments to the testing standards as instructed by MSC 101.

23. Annex C contains for completeness also Annex 4 Clothing to be worn during the lifejacket righting tests in standardised clothing, with a view to consider it when discussing the findings of the test as highlighted in 13.6 and not as basis for possible amendments to the MSC.81(70) at this stage.

24. [Consideration of the application to “new ships” should be addressed by the Sub-Committee only once the performance and technical requirements have be agreed.]

**Action requested of the Sub-Committee**

25. The Sub-Committee is invited to consider the proposals contained in the annexes and take action as appropriate.

## Annex 1

### **MSC Circular on “Guidance on the in-water performance of lifejackets and considerations for selection of a lifejacket”**

Requirements for lifejackets on large, commercial seagoing ships; for offshore work and emergency abandonment are regulated by the International Maritime Organization (IMO) under the International Convention for the Safety of Life at Sea (SOLAS).

SOLAS Lifejackets manufactured, selected, and maintained to this standard should give a reasonable assurance of safety from drowning and self-righting to a person who is immersed in water.

The buoyancy of a lifejacket can be provided by a wide variety of materials or designs, (e.g. inflation of chambers by gas from a cylinder or inherent buoyancy).

There are a number of levels of support, types of buoyancy, activation methods for inflatable devices, and auxiliary items (such as location aids), all of which will affect the user’s probability of survival. Hybrid lifejackets always provide some buoyancy but rely on the same methods as inflatable lifejackets to achieve full buoyancy. With inherently buoyant lifejackets, the user only needs to put the lifejacket on to achieve the performance. In every circumstance, the user should ensure that the operation of the PFD is suited to the specific application.

The conformity of a lifejacket to SOLAS does not imply that it is suitable for all circumstances.

The relative amount of required inspection and maintenance is another factor of paramount importance in the choice and application of specific lifejackets.

This Circular is intended to serve as a guide to manufacturers, purchasers, and users of such safety equipment in ensuring that the equipment provides an effective standard of performance in use.

The primary function of a lifejacket is to support the user with a reasonable degree of safety in the water. Within the different types, alternative attributes make some lifejackets better suited to some circumstances than others, or make them easier to use and care for than others. Important alternatives allowed by SOLAS are the following:

— to provide higher levels of support (e.g. buoyancy levels nearer to 275 Newton) that generally float the user with greater water clearance, when required for increasingly severe conditions; or to provide lighter or less bulky lifejackets (e.g. lifejackets with buoyancy levels nearer to 150 Newton);

— to provide the kinds of flotation (inherently buoyant foam, hybrid, and inflatable) that will accommodate the sometimes conflicting needs of reliability and durability, in-water performance, and continuous wear;

— to provide automatically operating (inherently buoyant or automatically inflated) lifejackets that float users without any intervention on their part, except in initially donning the lifejacket

(and regular inspection and rearming of inflatable types), or to provide user control of the inflatable lifejackets; and

- to assist in detection (location aids such as a light; whistle, retro-reflectors) and recovery of the user.

Lifejackets provide various degrees of buoyancy in garments that are light in weight and only as bulky and restrictive as needed for their intended use. They will need to be secure when worn, in order to provide positive support in the water and to allow the user to swim or actively assist herself/himself or others.

The lifejacket selected ensures that the user is supported with the mouth and nose clear of the water under the expected conditions of use and the user's ability to assist.

Under certain conditions (such as rough water and waves), the use of watertight and multilayer clothing, which provide (intentionally or otherwise) additional buoyancy, or the use of equipment with additional weight (such as tool belts) will likely alter the performance of the lifejacket. Users, owners and employers need to ensure that this is taken into account when selecting a lifejacket.

Similarly, lifejackets may not perform as well in extremes of temperature.

Lifejackets may also be affected by other conditions of use, such as chemical exposure and welding, and may require additional protection to meet the specific requirements of use. If the user intends exposing a lifejacket to such conditions, she/he should be assured that the lifejacket will not be adversely affected.

A lifejacket can also be an integral part of a safety harness, or an integral part of a garment with other uses, for example to provide thermal protection during immersion, in which case the complete assembly as used is required to conform to SOLAS and be appropriate for the selected end use.

In considering the attributes required of a lifejacket, consideration should also be given to the potential length of service and level of wear that the user might expect. Whilst a lifejacket needs to be of substantial construction and materials, its potential length of service often depends on the conditions of use and storage, which are the responsibility of the owner, user and/or employer. Appropriate procedures should be in place to verify the condition of lifejackets and the need for repair or replacement.

Furthermore, the tests included in the SOLAS requirements assess relevant aspects of lifejacket in-water performance. However, it is not possible to capture every scenario a lifejacket may encounter during approval testing. For example, the fact that a lifejacket passes the self-righting tests in a test environment does not mean that it will allow for the form, shape, density, build & structure of every user it will be worn by or every combination of clothing that will be worn with the lifejacket

Waterproof or buoyant clothing, such as oil skins; floatation suits; dry suits; immersion suits, can trap air and further impair the self-righting action of a lifejacket.

It is essential that owners, users and employers choose those lifejackets that meet the correct performance level for the circumstances in which they will be used, and it may be deemed necessary to conduct in-water tests with individuals wearing their normal working attire such as clothing, personal protective equipment and tools. Changes to the operational use of a lifejacket may require a reassessment of the in-water performance.

Owners, employers and users should consult maritime administrations, manufacturers and those selling lifejackets for advice regarding the product properties, alternative choices and the limitations to normal use, prior to the purchase of such lifejackets.

Similarly, those framing legislation regarding the use of these garments should consider carefully which class and performance levels are most appropriate for the foreseeable conditions of use, allowing for the higher risk circumstances. These higher risk circumstances should account for the highest probabilities of occurrence of accidental immersion and the expected consequences in such emergencies.

## Annex 2

**Amendments to the International Life-Saving Appliance (LSA) Code, resolution MSC.48(66), as amended by MSC.368(93), MSC.320(89), MSC.81(70) and A.520(13).**

### **2.2 Lifejackets**

#### *2.2.1 General requirements for lifejackets*

2.2.1.1 Lifejackets shall maintain a minimum buoyancy of 150 Newton for the duration of the buoyancy test as detailed in the recommendations of the Organization.

2.2.1.2 A lifejacket shall not sustain burning or continue melting after being totally enveloped in a fire for a period of 2 s.

2.2.1.3 Lifejackets shall be marked with the following information:

- .1 Identification of the manufacturer or representative and their mailing address;
- .2 The size range of the lifejacket, e.g. range of chest girth and user's body mass;
- .3 The buoyancy provided in Newton;
- .4 Simple instructions for use, including donning and adjustment instructions;
- .5 The manufacturer's model, designation, serial number, and month and year of manufacture. NOTE Months are given as Arabic numerals (1 to 12), starting from 1st January.
- .6 Pictograms or words indicating other risks catered for or not provided for;
- .7 The text "Do not use as a cushion";
- .8 The text "Train yourself in the use of the device";
- .9 A space where servicing dates can be marked,
- .10 Compatibility with the intended safety harnesses, clothing or additional equipment as relevant - specific equipment to be listed;
- .11 The text "Full performance may not be achieved using waterproof clothing or in other circumstances. Refer to the leaflet";
- .12 Storage, care, cleaning and maintenance instructions in brief;

2.2.1.4 In addition to the requirements of 2.2.1.3, inflatable lifejackets shall also be marked with the following information:

- .1 a statement that it is not a lifejacket until fully inflated;
- .2 the correct filled gas mass of the cylinder (in g). This information shall appear near the place where the cylinder is actually fitted;
- .3 a warning that gas cylinders are dangerous goods, and that they shall be kept away from children and not misused;
- .4 The text "WARNING. Freezing temperatures will affect the performance of the lifejacket and oral top up may be required after the gas cylinders have been discharged. Refer to leaflet".

2.2.1.25 Lifejackets shall be provided in three sizes in accordance with table 2.1. If a lifejacket fully complies with the requirements of two adjacent size ranges, it may be marked with both size ranges, but the specified ranges shall not be divided. Lifejackets shall be marked by either weight or height, or by both weight and height, according to table 2.1.

**Table 2.1 – Lifejacket sizing criteria**

Lifejacket marking	Infant	Child	Adult
User's size:			
Weight (kg)	less than 15	15 or more but less than 43	43 or more
Height (cm)	less than 100	100 or more but less than 155	155 or more

2.2.1.36 If an adult lifejacket is not designed to fit persons weighing up to 140 kg and with a chest girth of up to 1,750 mm, suitable accessories shall be available to allow it to be secured to such persons.

2.2.1.47 The in-water performance of a lifejacket shall be evaluated by comparison to the performance of a suitable size standard reference lifejacket, i.e. reference test device (RTD) complying with the recommendations of the Organization.<sup>3</sup>

2.2.1.58 An adult lifejacket shall be so constructed that:

- .1 at least 75% of persons who are completely unfamiliar with the lifejacket can correctly don it within a period of 1 min without assistance, guidance or prior demonstration;
- .2 after demonstration, all persons can correctly don it within a period of 1 min without assistance;

<sup>3</sup> Refer to the Revised Recommendation on testing of life-saving appliances (resolution MSC.81(70)), as amended.

- .3 it is clearly capable of being worn in only one way or inside-out and, if donned incorrectly, it is not injurious to the wearer;
- .4 the method of securing the lifejacket to the wearer has quick and positive means of closure that do not require tying of knots;
- .5 it is comfortable to wear; and
- .6 it allows the wearer to jump into the water from a height of at least 4.5 m while holding on to the lifejacket, and from a height of at least 1m with arms held overhead, without injury and without dislodging or damaging the lifejacket or its attachments.

2.2.1.69 When tested according to the recommendations of the Organization on at least 12 persons, adult lifejackets shall have sufficient buoyancy and stability in calm fresh water to:

- .1 lift the mouth of exhausted or unconscious persons by an average height of not less than the average provided by the adult RTD minus 10 mm;
- .2 turn the body of unconscious, face-down persons in the water to a position where the mouth is clear of the water in an average time not exceeding that of the RTD plus 1 s. , with the number of persons not turned by the lifejacket no greater than that of the RTD; The person should finish in a face-up position.
- .3 incline the body backwards from the vertical position for an average torso angle of not less than that of the RTD minus 10°;
- .4 lift the head above horizontal for an average faceplane angle of not less than that of the RTD minus 10°; and
- .5 return at least as many wearers to a stable face-up position after being destabilized when floating in the flexed foetal position<sup>4</sup> as with the RTD when tested on the wearers in the same manner.
- .6 turn the body of unconscious, face-down persons in the water to a position where the mouth is clear of the water in an average time not exceeding 5 seconds whilst wearing standardised clothing according to the recommendations of the Organization. The person should finish in a face-up position.

2.2.1.710 An adult lifejacket shall allow the person wearing it to swim a short distance and to board a survival craft.

2.2.1.811 An infant or child lifejacket shall perform the same as an adult lifejacket except as follows:

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<sup>4</sup> Refer to the illustration on page 9 of the *IMO Pocket Guide for Cold Water Survival*, 2010 Edition, and to the Revised Recommendation on testing of life-saving appliances (resolution MSC.81(70), as amended).

- .1 donning assistance is permitted for small children and infants;
- .2 the appropriate child or infant RTD shall be used in place of the adult RTD;
- .3 assistance may be given to board a survival craft, but wearer mobility shall not be reduced to any greater extent than by the appropriate size RTD.
- .4 for infants the jump and drop tests shall be exempted;
- .5 for children, five of the nine subjects shall perform the jump and drop tests; and
- .6 in lieu of paragraph 2.2.1.8-511.5, manikins may be substituted for human test subjects.

2.2.1.912 With the exception of freeboard and self-righting performance, the requirements for infant lifejackets may be relaxed, if necessary, in order to:

- .1 facilitate the rescue of the infant by a caretaker;
- .2 allow the infant to be fastened to a caretaker and contribute to keeping the infant close to the caretaker;
- .3 keep the infant dry, with free respiratory passages;
- .4 protect the infant against bumps and jolts during evacuation; and
- .5 allow a caretaker to monitor and control heat loss by the infant.

2.2.1.4013 In addition to the markings required by paragraph 1.2.2.9, an infant or child lifejacket shall be marked with:

- .1 the size range in accordance with paragraph 2.2.1.2; and
- .2 an “infant” or “child” symbol as shown in the “infant’s lifejacket” or “child’s lifejacket” symbol adopted by the Organization.<sup>5</sup>

2.2.1.4114 A lifejacket shall have buoyancy which is not reduced by more than 5% after 24 h submersion in fresh water.

2.2.1.4215 The buoyancy of a lifejacket shall not depend on the use of loose granulated materials.

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<sup>5</sup> Refer to Symbols related to life-saving appliances and arrangements, adopted by the Organization by resolution A.760(18), as amended.



2.2.1.4316 Each lifejacket shall be provided with means of securing a lifejacket light as specified in paragraph 2.2.3 such that it shall be capable of complying with paragraphs 2.2.1.5.6 and 2.2.3.1.3.

2.2.1.4417 Each lifejacket shall be fitted with a whistle firmly secured by a lanyard.

2.2.1.4518 Lifejacket lights and whistles shall be selected and secured to the lifejacket in such a way that their performance in combination is not degraded.

2.2.1.4619 A lifejacket shall be provided with a releasable buoyant line or other means to secure it to a lifejacket worn by another person in the water.

2.2.1.4720 A lifejacket shall be provided with a suitable means to allow a rescuer to lift the wearer from the water into a survival craft or rescue boat.

2.2.1.21 In addition to the requirements for securing arrangements in 2.2.1.5.4, a lifejacket shall be provided with a retention device to minimise displacement of the lifejacket from the original fitted position on the wearer when subject to dynamic forces such as waves.

2.2.1.22 A lifejacket shall be provided with a spray hood complying with the requirements of an international standard acceptable to the Organization.<sup>6</sup>

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<sup>6</sup> Refer to the recommendations of the International Organization for Standardization, in particular publication ISO 12402-8:2006+A1:2011 Personal flotation devices – Part 8: Accessories -Safety requirements and test methods.

## Annex 3

**Resolution MSC.81(70) (adopted on 11 December 1998)**

**As amended by MSC.200(80), MSC.226(82), MSC.274(85), MSC.295(87), MSC.321(89), MSC.323(89), MSC.378(93)**

### **2 LIFEJACKETS**

#### **2.1 Temperature cycling test**

A lifejacket should be subjected to the temperature cycling as prescribed in 1.2.1 and should then be externally examined. If the buoyancy material has not been subjected to the tests prescribed in 2.7, the lifejacket should also be examined internally. The lifejacket materials should show no sign of damage such as shrinking, cracking, swelling, dissolution or change of mechanical qualities.

#### **2.2 Buoyancy test**

The buoyancy of the lifejacket should be measured before and after 24 h complete submersion to just below the surface in fresh water. The difference between the initial buoyancy and the final buoyancy should not exceed 5% of the initial buoyancy. Both buoyancy measurements should be greater than 150 Newtons.

#### **2.3 Fire test**

A lifejacket should be subjected to the fire test prescribed in 1.5. The lifejacket should not sustain burning for more than 6 s or continue melting after being removed from the flames.

#### **2.4 Tests of components other than buoyancy materials**

All the materials, other than buoyancy materials, used in the construction of the lifejacket, including the cover, tapes, seams and closures should be tested to an international standard acceptable to the Organization<sup>7</sup> to establish that they are rot-proof, colour-fast and resistant to deterioration from exposure to sunlight and that they are not unduly affected by seawater, oil or fungal attack.

#### **2.5 Strength tests**

##### *Body or lifting loop strength tests*

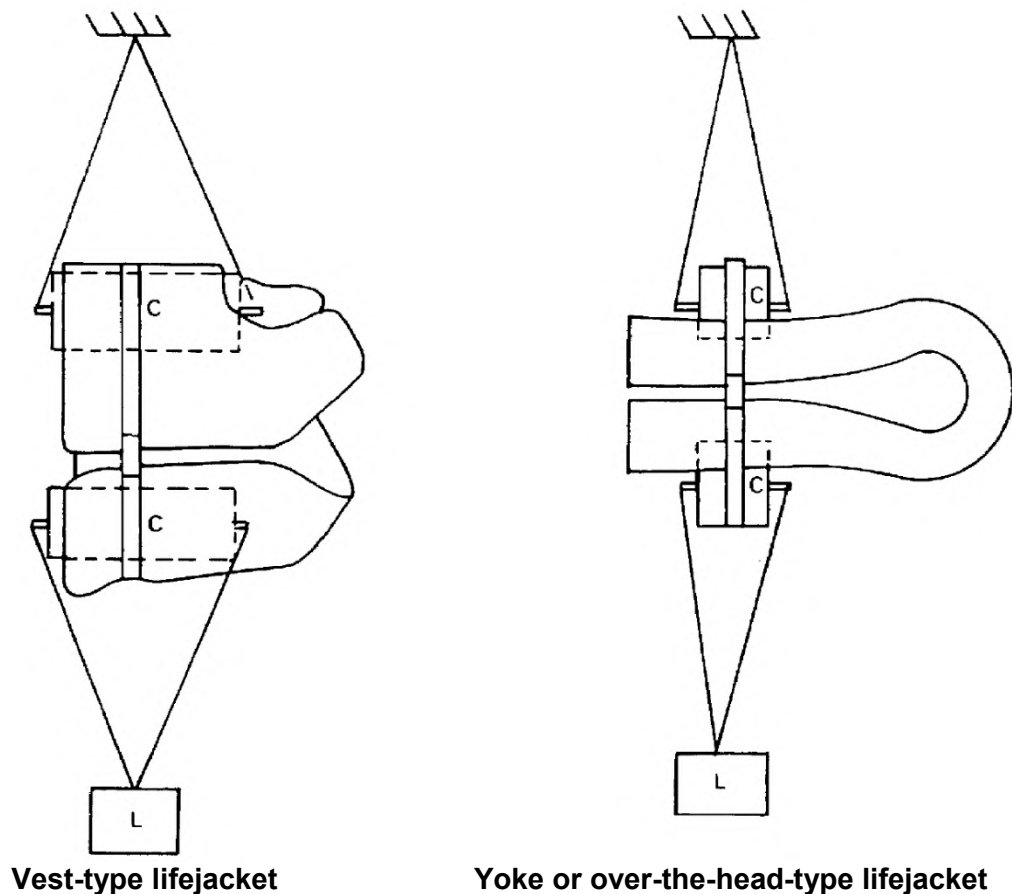
**2.5.1** The lifejacket should be immersed in water for a period of 2 min. It should then be removed from the water and closed in the same manner as when it is worn by a person. A force of not less than 3,200 N (2,400 N in the case of a child or infant-size lifejacket) should be applied for 30 min to the part of the lifejacket that secures it to the body of the wearer (see figure 1) and separately to the lifting loop of the lifejacket. The lifejacket should not be damaged as a result of this test. The test should be repeated for each encircling closure.

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<sup>7</sup> Refer to the recommendations of the International Organization for Standardization, in particular publication ISO 12402-7:2006 *Personal flotation devices - Part 7: Materials and components - Safety requirements and test methods*.

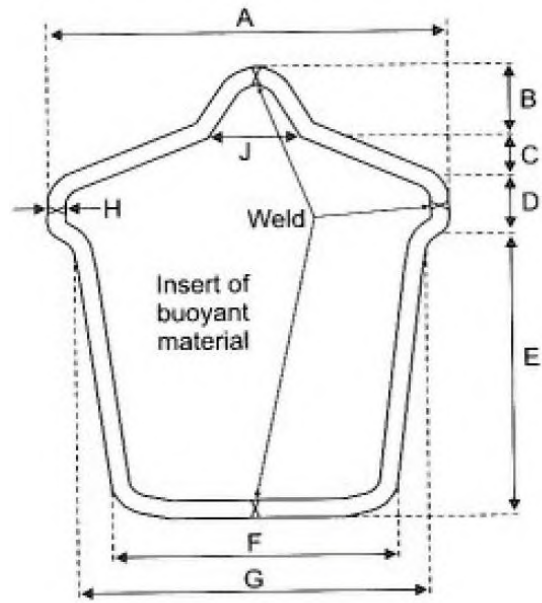
*Shoulder lift test*

**2.5.2** This test shall be conducted both with and without the ride-up prevention system correctly fitted. The lifejacket should be immersed in water for a period of 2 min. It should then be removed from the water and closed on a form as shown in figure 2, in the same manner as when it is worn by a person. A force of not less than 900 N (700 N in the case of a child- or infant-size lifejacket) should be applied for 30 min across the form and the shoulder section of the lifejacket (see figure 3). The lifejacket should not be damaged as a result of this test. The lifejacket should remain secured on the form during this test.



C - Cylinder  
125 mm diameter for adult sizes  
50 mm diameter for child sizes  
L - Test load

**Figure 1 - Body strength test arrangement for lifejackets**



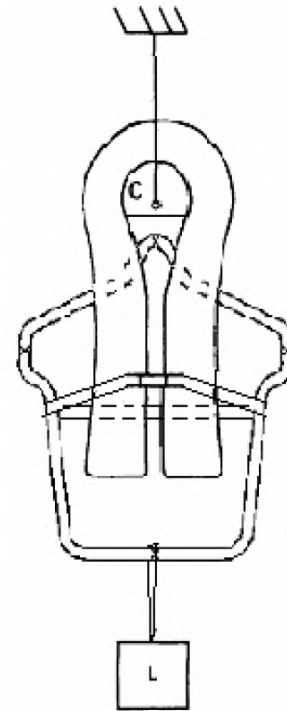
Dimensions in mm

Size	A	B	C	D	E	F	G	H	J
Adult	610	114	76.2	127	381	432	508	25.4	178
Child	508	102	76.2	102	279	330	406	22.2	152
Infant	305	63.5	38.1	63.5	191	203	241	19.1	76.2

**Figure 2 - Test form for shoulder lift test for lifejackets**



Vest-type lifejacket



Yoke or over-the-head-type

lifejacket

C - Cylinder  
 125 mm diameter for adult sizes  
 50 mm diameter for child sizes  
 L - Test load

**Figure 3 - Shoulder lift test arrangement for lifejackets**

## 2.6 Tests for lifejacket buoyancy material

The tests specified in 2.6.1 to 2.6.7 should be carried out on eight specimens of each lifejacket-buoyancy material. A further four specimens of each lifejacket-buoyancy material should be prepared for the test specified in 2.6.8. The specimens should be at least 300 mm square and be of the same thickness as used in the lifejacket. In the case of kapok, the entire lifejacket should be subjected to the test. The dimensions should be recorded at the beginning and end of these tests. Where multiple layers of materials are used to achieve the total thickness desired for the lifejacket, the specimens should be of the thinnest material used.

### *Test for stability under temperature cycling*

**2.6.1** Six specimens should be subjected to temperature cycling as prescribed in 1.2.1.

**2.6.2** The dimensions of the specimens (except kapok) should be recorded at the end of the last cycle. The specimens should be carefully examined and should not show any sign of external change of structure or of mechanical qualities.

**2.6.3** Two of the specimens should be cut open and should not show any sign of internal change of structure.

**2.6.4** Four of the specimens should be used for compression and water absorption tests, two of which should be so tested after they have also been subjected to the diesel oil test as prescribed in 1.4.

#### *Tests for compression and water absorption*

**2.6.5** The tests should be carried out in fresh water and the specimens should be immersed for a period of seven days under a 1.25 m head of water.

**2.6.6** The tests should be carried out:

- .1 on two specimens as supplied;
- .2 on two specimens which have been subjected to the temperature cycling as prescribed in 2.6.1; and
- .3 on two specimens which have been subjected to the temperature cycling as prescribed in 2.6.1 followed by the diesel oil test as prescribed in 1.4.

**2.6.7** The results should state the buoyant force in N which each specimen exerts when submerged in water after one and seven days' immersion. The reduction of buoyancy should not exceed 10% for specimens which have been exposed to the diesel oil conditioning and must not exceed 5% for all other specimens. The specimens should show no sign of damage such as shrinking, cracking, swelling, dissolution or change of mechanical qualities.

#### *Tensile strength test*

**2.6.8** The tensile strength at break of the material should be measured before and after the combined exposure described in 2.6.6.3. When tested according to an international standard acceptable to the Organization<sup>8</sup>, the materials should have a minimum tensile strength of 140 kPa before exposure, which should not be reduced by more than 25% following the combined exposures. In the case of kapok, the protective cover should have a minimum breaking strength of 13 kPa before exposure, which should not be reduced by more than 25% following the combined exposures.

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<sup>8</sup> Refer to the recommendations of the International Organization for Standardization, in particular publication ISO 12402-7:2006, Personal flotation devices – Part 7: Materials and components – Safety requirements and test methods.

## 2.7 Donning test

**2.7.1** To minimize the risk of incorrect donning by uninitiated persons, often in adverse conditions, lifejackets should be examined for the following features and tested as follows:

- .1 fastenings necessary for proper performance should be few and simple, and provide quick and positive closure that does not require tying of knots;
- .2 adult lifejackets should readily fit various sizes of adults, both lightly and heavily clad; and
- .3 all lifejackets should be capable of being worn inside-out, or clearly in only one way.

### *Test subjects*

**2.7.2** These tests should be carried out with at least 12 able-bodied persons who are completely unfamiliar with the lifejacket and selected according to the heights and weights in table 2.1 and the following:

- .1 small test subjects need not be adults;
- .2 at least 1/3, but not more than 1/2 of test subjects should be females, including at least 1 per height category but excluding the tallest height;
- .3 at least one male should be from the lowest and highest weight group and one female should be from the lowest weight group and one female should be more than 80 kg and 1.8 m;
- .4 at least one subject should be selected from each cell containing a .1.; and
- .5 enough additional subjects should be selected from cells containing a "X" to total the required number of test subjects, with no more than one subject per cell. A uniform distribution across weight ranges should be maintained.

**Table 2.1** – Test subject selection for adult lifejackets

Height range (m)	Weight range – kg							
	40 - 43	43 - 60	60 - 70	70 - 80	80 - 100	100 - 110	110 - 120	>120
< 1.5	1	X	X	X				
1.5 - 1.6	X	1	1	X	X			
1.6 - 1.7		X	X	1	X	X		
1.7 - 1.8			X	X	1	X	X	X
1.8 - 1.9			X	X	X	1	1	X
> 1.9					X	X	X	1

### *Clothing*

**2.7.3** Each test subject should be tested wearing the clothing specified for the test and appropriate to their size as follows:

- .1 *Normal clothing* means normal indoor clothing, which would not normally interfere with the donning of a lifejacket; and
- .2 *Heavy-weather clothing* means the attire appropriate for a hostile environment, including a hooded arctic parka and warm cotton gloves.

**2.7.4** Each test should be timed from when the order is given until the test subject declares that donning is complete. For assessment purposes donning is considered complete when the subject has donned and securely adjusted all methods of securing the lifejacket to the extent needed to meet the in-water performance requirements, including inflation, if needed.

#### *Test without instruction*

**2.7.4.1** The test subjects may be tested individually or as a group. Wearing normal clothing, the first attempt should be with no assistance, guidance or prior demonstration. The lifejacket, with closures in the stored condition, should be placed on the floor, face up, in front of the test subject. The instruction provided should be identical for each subject and should be equivalent to the following: .PLEASE DON THIS LIFEJACKET AS QUICKLY AS POSSIBLE AND ADJUST IT TO A SNUG FIT SO YOU CAN ABANDON SHIP.. The lifejacket should be capable of being donned by at least 75 % of the subjects, and within 1 min. If a subject dons the lifejacket substantially correctly but fails to secure and/or adjust all closures, the jump test in 2.8.8 and in-water performance tests in 2.8.5 and 2.8.6 should be performed with the lifejacket as donned to establish whether the performance is acceptable and the donning is successful.

#### *Test after instruction*

**2.7.4.2** For each subject whose first attempt exceeds 1 min or is incomplete, after demonstration or instruction to familiarize the subject with the donning procedure, the test subject should then don the lifejacket without assistance while wearing normal clothing, using the same instruction and timing method as in 2.7.4.1. Each subject should correctly don the lifejacket within a period of 1 min.

#### *Heavy-weather clothing test*

**2.7.4.3** Each subject should then don the lifejacket without assistance while wearing heavy-weather clothing, using the same instruction and timing method as in 2.7.4.1. Each subject should don the lifejacket correctly within a period of 1 min.

## **2.8 Water performance tests**

**2.8.1** This portion of the test is intended to determine the ability of the lifejacket to assist a helpless person or one in an exhausted or unconscious state and to show that the lifejacket does not unduly restrict movement. The in-water performance of a lifejacket is evaluated by comparison to the performance of a suitable size standard reference lifejacket, i.e. Reference Test Device (RTD) as specified in appendices 1 to 3. All tests should be carried out in fresh



water under still conditions. Each test for a candidate lifejacket and the relevant RTD should be conducted on the same day.

### *Test subjects*

**2.8.2** These tests should be carried out with at least 12 persons as described in 2.7.2. Only good swimmers should be used, since the ability to relax in the water is rarely otherwise obtained.

**2.8.3** In the event that a “no turn” is recorded by a candidate lifejacket during righting tests within 2.8.6 or 2.8.9, the test subject which incurred the “no turn” may be replaced with two additional test subjects from the same height and weight category and in accordance with 2.7.2. No further “no turn” shall be recorded by any test subject. This provision for the replacement of a test subject may be applied on one occasion only. A no-turn is a turning time greater than 10s for the mouth of the test subject to come clear of the water during the righting tests.

### *Clothing*

~~**2.8.3** Subjects should wear only swimming costumes.~~

### *Preparation for water performance tests*

**2.8.4** The test subjects should be made familiar with each of the tests set out below, particularly the requirement regarding relaxing and exhaling in the face-down position. The test subject should don the lifejacket, unassisted, using only the instructions provided by the manufacturer. Prior to taking the measurements in 2.8 and 2.9, the proper fit, donning, and fastening of the RTD on the subject should be checked and corrected as necessary. After entering the water, care should be taken to ensure that there is no significant amount of air unintentionally trapped in the lifejacket or swimming costume.

### *Righting tests in swimwear*

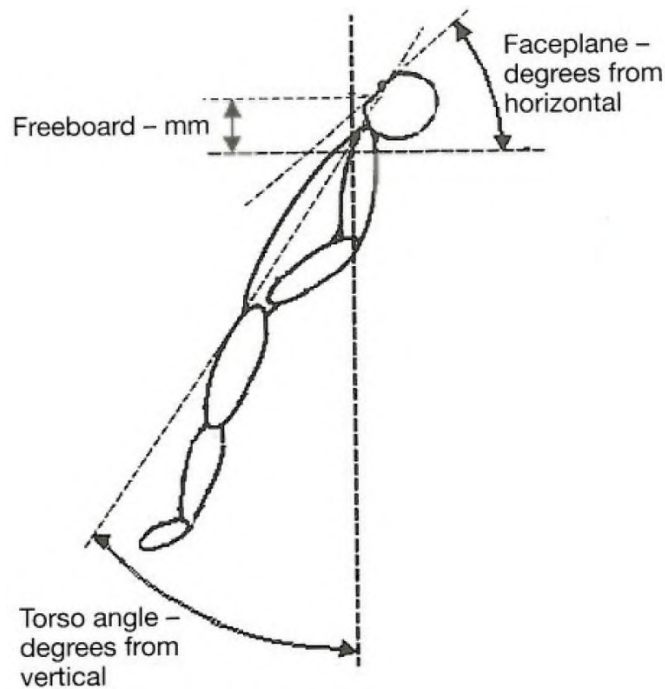
~~**2.8.5** Subjects should wear only swimming costumes.~~

**2.8.56** Each test subject should assume a prone, face down position in the water, but with the head lifted up so the mouth is out of the water. The subject’s feet should be supported, shoulder width apart, with the heels just below the surface of the water. After assuming a starting position with the legs straight and arms along the sides, the subject should then be instructed in the following sequence to allow the body to gradually and completely relax into a natural floating posture: allow the arms and shoulders to relax; allow the legs to relax; and then the spine and neck, letting the head fall into the water while breathing out normally. During the relaxation phase, the subject should be maintained in a stable face down position. Immediately after the subject has relaxed with the face in the water, simulating a state of utter exhaustion, the subject’s feet should be released. The period of time until the mouth of the test subject comes clear of the water should be recorded to the nearest 1/10 of a second, starting from when the subject’s feet are released. The above test should be conducted for a total of six times, and the highest and lowest times discarded. The test should then be conducted for a total of six times in the RTD and the highest and lowest times discarded.

### Static balance measurements

**2.8.67** At the conclusion of the righting tests without making any adjustments in body or lifejacket position, measurements should be made with the subject floating in the relaxed face-up position of static balance resulting from the preceding tests. The following measurements should be made (see figure 4):

- .1 freeboard – the distance measured perpendicularly from the surface of the water to the lowest point of the subject's mouth where respiration may be impeded, if the mouth were not held shut. The lowest side of the mouth should be measured if the left and right sides are not level;
- .2 faceplane angle – the angle, relative to the surface of the water, of the plane formed between the most forward part of the forehead and the chin;
- .3 torso angle – the angle, relative to vertical, of the line formed by the forward points of the shoulder and hipbone (ilium portion of the pelvis); and
- .4 list angle – the angle relative to the surface of the water and a line between the left and right shoulder or a line through the ears if only the head is tilted.



**Figure 4 - Static balance measurements**

### Righting tests in standardised clothing

**2.8.8** Subjects should wear the standardised clothing as defined in Annex 4.

**2.8.9** Each test subject should perform the righting test defined in 2.8.5.

#### *Assessment*

**2.8.710** After the water tests described in 2.8.56 and 2.8.9 above:

- .1 *Turning time in swimwear:* The average turn time for all subjects in the candidate lifejacket should not exceed the average time in the RTD plus 1 s, and the number of “no turns”, if any, should not exceed the number in the RTD; and at the end of each righting test each test subject should attain a face-up position;
- .2 *Freeboard:* The average freeboard of all the subjects should not be less than the average for the RTD minus 10 mm;
- .3 *Torso angles:* The average of all subjects. torso angles should be not less than the average for the RTD minus 10°;
- .4 *Faceplane (head) angles:* The average of all subjects. faceplane angles should be not less than the average for the RTD minus 10°;
- .5 *Lifejacket light location:* The position of the lifejacket light should permit it to be visible over as great a segment of the upper hemisphere as is practicable.
- .6 *Turning time in standardised clothing:* The average turn time for all subjects in the candidate lifejacket should not exceed 5 s, and at the end of each righting test each test subject should attain a face-up position.

#### *Jump and drop tests*

**2.8.811** Without readjusting the lifejacket, the test subject should jump vertically into the water, feet first, from a height of at least 1 m while holding the arms over the head. Upon entering the water, the test subject should relax to simulate a state of utter exhaustion. The freeboard to the mouth should be recorded after the test subject comes to rest. The test should be repeated from a height of at least 4.5 m but, when jumping into possible injury. Upon entering the water, the test subject should relax to simulate a state of utter exhaustion. The freeboard to the mouth should be recorded after the test subject comes to rest. The lifejacket and its attachments should be examined for any damage. If injury is believed likely from any jump or drop test the lifejacket should be rejected or the test delayed until tests from a lower height or with additional precautions demonstrate that the risk from the required test is acceptable.

#### *Assessment*

**2.8.912** Following the drop test, the lifejacket should:

- .1 surface the test subject in a face up position with an average freeboard for all the subjects of not less than the average determined for the RTD after the turning test in accordance with 2.8.6 minus 15 mm;
- .2 not be dislodged or cause harm to the test subject;

- .3 have no damage that would affect its in-water performance or buoyancy; and
- .4 have no damage to its attachments.

#### *Stability test*

**2.8.4013** The test subject should attain a relaxed face-up position of static balance in the water. The subject should be instructed to assume a foetal position as follows: .place your elbows against your sides, your hands on your stomach, under the lifejacket if possible, and bring your knees up as close to your chest as possible.. The subject should be rotated clockwise around the longitudinal axis of the torso by grasping the subject's shoulders or upper areas of the lifejacket so that the subject attains a  $55 \pm 5$  degree list. The subject should then be released. The subject should return to a stable face-up position. The test should then be conducted with the subject rotated counter-clockwise. The entire test should then be repeated with the test subject wearing the RTD. The candidate lifejacket should not roll any subject face down in the water. The number of subjects who are returned to the stable face-up foetal position in the candidate lifejacket should be at least equal to the number who are returned to the stable face-up foetal position in the RTD.

#### *Swimming and water emergence test*

**2.8.4114** All test subjects, without wearing the lifejacket, should attempt to swim 25 m and board a liferaft or a rigid platform with its surface 300 mm above the water surface. All test subjects who successfully complete this task should perform it again wearing the lifejacket. At least two thirds of the test subjects who can accomplish the task without the lifejacket should also be able to perform it with the lifejacket.

## Annex 4

### *Clothing to be worn during the lifejacket righting tests in standardised clothing*

#### 1. Standardised clothing shall consist of:

##### .1 underwear (short sleeved, short legged);

Composition: 100 % cotton, single jersey  
Weight: greater than 210 g/m<sup>2</sup>  
Thickness: greater than 1 mm

##### .2 shirt (long sleeved);

Composition: 100 % cotton, single jersey  
Weight: greater than 220 g/m<sup>2</sup>  
Thickness: greater than 1 mm

##### .3 trousers (not woollen);

Composition: 100 % cotton, single jersey  
Weight: greater than 450 g/m<sup>2</sup>  
Thickness: greater than 1.2 mm

##### .4 athletics shoes

Composition: 100 % cotton, single jersey  
Weight: greater than 210 g/m<sup>2</sup>  
Thickness: greater than 1 mm

##### .5 woollen sweater;

Composition: at least 75% wool, at least 15% acrylic (2x2 knit)  
Weight: greater than 640 g/m<sup>2</sup>  
Thickness: greater than 4 mm

##### .6 waterproof jacket; and

Composition: exterior shell – polyester/polyamide/polyurethane  
Inner lining - polyester  
Weight: greater than 500g/m<sup>2</sup>  
Thickness: greater than 2mm

##### .7 woollen socks;

Composition: at least 75% wool, at least 15% polyamide, at least 2% elastane (knit)  
Weight: greater than 210 g/m<sup>2</sup>  
Thickness: greater than 1 mm

2. The long sleeved shirt, woollen jumper, trousers, woollen socks, waterproof jacket and training shoes shall each be provided in a full range of sizes to appropriately fit the individual sizes of test subjects in accordance with Table 2.1, such that the test subject is comfortable and is not restricted in their manoeuvrability. Clothing of different sizes shall be comparable in design and construction.