

Subject 402I (12402-
9,1123,1180,1191,1175,1177,1197,1517)

August 31, 2012

SUMMARY OF TOPICS

The following requirements are being proposed:

1. The first edition of the Standard for Personal Flotation Devices - Part 9: Test Methods, UL 12402-9

STP BALLOTS DUE: October 30, 2012

COMMENTS DUE: October 30, 2012

1. The first edition of the Standard for Personal Flotation Devices - Part 9: Test Methods, UL 12402-9

RATIONALE

Proposal submitted by: Samuel Wehr, Mustang Survival on behalf of International Harmonization Committee for Adoption of UL ISO based Personal Flotation Device Standards (IHC for PFDs).

The PFD community desires to replace the current standards with:

- a) A comprehensive, consolidated wearable PFD standard that serves the current needs of US and Canadian users as well as provide flexibility for innovation, future special or unusual circumstances, and increased wear rate;
- b) A new system of classification that is clear to the user and aligns with ISO standards, where practical, to facilitate international marketing and use; and
- c) Clear product markings and consumer safety information to promote proper selection and encourage use.

This proposed standard is based on the first edition of the ISO standard, published in 2006 (ISO 12402-9:2006), and the amendments published in 2010 (ISO 12402-9/Amd1:2010). The ISO text is proposed to be adopted verbatim with the exception of the National Differences (DVs) described in this Rationale document.

It should be noted that the ISO 12402 series standards are currently under systematic review by the ISO Sub-Committee on Personal protective equipment (ISO/TC188/SC1), in preparation for publication of a second edition of the standards. The proposal contains several DVs (denoted "DT" in the proposal) which have been tentatively agreed by the ISO Sub-Committee for inclusion in the next edition of the ISO standard. Additional discussions of these differences can be obtained via the US/ANSI TAG to ISO/TC188/SC1.

Additionally, the proposal includes a number of editorial DVs (denoted "DE" or, in some cases, "DT" in the proposal), which are not itemized in this Rationale document. Editorial revisions include:

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- removing redundant or conflicting statements,
- replacing references to ISO 12402 with UL 12402,
- clarifying wording or statements, and
- correcting cross-references of clauses within the UL 12402-5 and 12402-9.

Scope

1DV – A statement that all references to ISO 12402 standards are to the requirements as modified by National Differences is added to avoid an excessive number of additional DVs just to account for changes in the referenced standard(s).

Normative references

2DV.1 – The reference to ISO 12401:2004 is updated to the 2009 version so that the proper test procedures are followed.

2DV.2 – ANSI/UL 1191 standard added for use in specifying components that meet current requirements. The IHC has not fully evaluated the impact that harmonizing with ISO 12402-7 will have on the existing PFD market. This normative reference may be removed in the future if/when we adopt Part 7, be it ISO 12402-7 or UL 12402-7.

Terms and Definitions

3.11DV – Multi-chamber buoyancy systems are redefined to be compatible with the new definitions of primary and back-up inflation chambers being added to clarify and simply the requirements. This approach is the result of a working group led by the US and/or Canadian delegation and has been tentatively agreed by the ISO SC.

3.19DV – The definition of hybrid-type PFD is clarified to allow the minimal inherent buoyancy needed to ensure that inflatable PFDs float without inflation similar to current practice.

3.20DV – Bunching defined for use in limiting the displacement of buoyancy within PFDs.

3.21DV & 3.22DV – Definitions for Sheltered waters and Offshore are added to support the revised Performance levels and Classification clauses. This approach is the result of a working group led by the US and/or Canadian delegation and has been tentatively agreed by the ISO SC. (see Annex A)

3.23DV through 3.27DV – Primary and secondary inflation and primary, backup, and supplemental inflation chambers are defined to simplify the requirements for the various inflation options provided for multi-chamber buoyancy systems in the standard. This approach is the result of a working group led by the US and/or Canadian delegation and has been tentatively agreed by the ISO SC. (see 3.11DV)

3.28DV – Several terms are added to deal with in-water weight and somatotype requirements in the subject selection requirements in 5.6.1.2DV of this Part. The IHC realizes that as more data is obtained, adjustments to the limits for the various body types may be needed.

3.29DV & 3.30DV – Definitions for primary and secondary closure are added to clarify the application of the Secondary closure attachment strength test (See UL 12402-9/5.5.2.9.DV)

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3.31DV – Definition of structural component is added to clarify the application of ANSI/UL 1191 in Part 5. (See UL 12402-5/5.1DV)

3.32DV – Definition of Design inflation range is added to clarify the requirements for the inflation test (See UL 12402-5.5.3.2DV)

Sampling and Conditioning

5.2.2DV – Due to both temperature and humidity fluctuations while conducting in-water performance testing, this modification was developed to specify that only samples that are to be used for mechanical properties tests are required to be conditioned prior to testing.

5.3DV – Clause deleted since the criteria for passing and failures are already addressed within the specific test requirements.

Mechanical properties tests

Table 1DV – The purpose for these differences is to revise the table relating to the mechanical properties tests for inherently buoyant PFDs. Table 1 was revised to remove the tests relating only to inflatable PFDs. Table 1 was also revised to add tests currently conducted in the US and Canada which weren't reflected currently within Table 1. It was determined that 6 samples aren't necessary to conduct the relevant tests in Table 1, so the number of samples was reduced to 4.

5.5.1DV.1 (Table 2DV) – Table 2 for inflatable PFDs was also revised to add tests currently conducted in the US and Canada which weren't reflected currently within Table 2. Due to the addition of those tests, it was necessary to increase the minimum number of samples.

Horizontal load test

5.5.2.2 DV and 5.5.2.3.2DV – Corrections made to the figure references.

5.5.2.3.2DV.2 – A sentence is added to specify what should be measured and recorded during and after the conclusion of the Horizontal Load test, as agreed by the ISO SC.

Vertical load test

5.5.2.3.3DV.1 - The purpose for this difference is to revise the second paragraph to define the method currently used within the US and Canada regarding the Vertical Load test

Lifting loop

5.5.2.4DV and 5.5.2.4.DV.1 – Eliminated the requirement to soak the device prior to testing, to provide the option to use the test dummy prescribed by 12401 or the torso frame for this test, and to allow the dummy to be modified to prevent the device from slipping off over the head.

5.5.2.4DV.1 – Revise the paragraph to reflect editorial modifications, as well, the addition to allow the dummy or test form to be modified to prevent the device from slipping off of the neck projection during the Lifting Loop test.

Buddy line test

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5.5.2.5DV – Revised the paragraph for buddy lines to clarify how the test is to be performed. The revisions state that the load applied includes the weight of the dummy or test form. The revisions also clarify the appropriate dummy or test form to be used, and allows the dummy or test form to be modified to prevent the device from slipping off of the neck projection. This language reflects that tentatively agreed by the ISO SC.

5.5.2.6DV – 5.5.2.10DV - Added the following tests to reflect current practice: Collar handle test, Holding down device (crotch strap) test, Body strap hardware secureness test, Secondary closure attachment-strength test, and Strength of attachment test for inflatable PFDs.

Figures 3DV and 4DV – Corrected the sequence of the figures, which are incorrect in the ISO standard. This also reflects that has been tentatively agreed by the ISO SC.

Figure 5DV - Replaced the figure for the Vertical load test for vest-type PFDs with a new figure that reflects current practice. This also reflects that has been tentatively agreed by the ISO SC.

Figure 6DV - This difference replaced the figure with the torso frame which reflects current practice. This also reflects that has been tentatively agreed by the ISO SC.

Figure 7DV - This difference deleted Figure 7 since this apparatus isn't currently used. This also reflects that has been tentatively agreed by the ISO SC.

Figure 7.1DV - Added the necessary figure to demonstrate the test configuration for the hardware secureness test.

Rotating shock bin test method

5.5.3DV – The clause is re-titled to clarify that it only applies to inflatable PFDs.

5.5.3.3DV and 5.5.3.3DV.1 – The clauses are modified so that they only apply to inflatable PFDs.

5.5.3.4DV– A requirement to record and report the results is added to complete the connection between parts of the standard.

Temperature cycling test

5.5.4.1DV – The temperature cycling test is modified to apply only to inflatable PFDs and to reduce the number of samples and number of cycles to two 8-hour cycles thus making the number of samples and duration similar to current practice. The fourth and fifth paragraphs are deleted because the revised Tables 1 and 2 cover these provisions. The inflation tests at high and low temperature revised are moved from 5.5.4.2 to this clause so that 5.5.4.2 can be used for the “Results” section. Finally, the water temperature for cold and high temperature inflation is not specified since the critical low water temperature inflation is covered by ANSI/UL1191, 32.3.4

5.5.4.2DV – A requirement to examine the samples and report any damage is added to complete the connection between parts of the standard and the inflation tests at high and low temperature are moved to 5.5.4.1.

5.5.4.3DV – For inherently buoyant PFDs a resistance to temperature extremes test is added in place of the temperature cycling test per current practice.

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Oil and water resistance tests

5.5.5DV – The oil and water resistance tests are deleted because the component testing requirements cover these characteristics as has been tentatively agreed by the ISO SC.

Water absorption test

5.5.6DV – The water absorption test is deleted because the component testing requirements cover this characteristic as has been tentatively agreed by the ISO SC.

Over-pressure test

5.5.7DV – Provisions are added to the over-pressure test to properly test PFDs that have over-pressure relief valves.

Colour

5.5.8DV – The colour requirements are deleted from this Part because Parts 1 to 4 & 6 cover these requirements as has been tentatively agreed by the ISO SC.

Measurement of buoyancy of the whole device

5.5.9.1DV– The clause is modified to include inflatable PFDs and a requirement is added to report the results to complete the connection between parts of the standard as has been tentatively agreed by the ISO SC.

5.5.9.2DV – The clause is modified to use fresh water when measuring the buoyancy as has been tentatively agreed by the ISO SC. Also, the minimum submergence depth for weighing the buoyancy test cage is reduced to 50mm, consistent with current practice (see also 5.5.9.3DV.1).

5.5.9.3DV – The buoyancy measurement is modified to test with air at a pressure consistent with what most people can achieve by oral inflation or CO₂, whichever is less.

5.5.9.3DV.1 – The minimum submergence depth for the buoyancy test is reduced to 50mm, consistent with current practice.

5.5.9.3.DV.2– A requirement is added to record the atmospheric conditions and water temperature and to repeat the test procedure on inflatable PFDs with CO₂ inflation for in a 6 hour period as tentatively agreed by the ISO SC.

5.5.9.4DV – A requirement is added to correct the buoyancy measurement results for atmospheric conditions and water temperature as tentatively agreed by the ISO SC.

5.5.9.4DV.1 – The last paragraph this clause has been deleted since the information is redundant as tentatively agreed by the ISO SC.

Inflation test

5.5.10.1DV – The provision to allow the test to be run with “normal air” is deleted because it is not consistent with current practice.

5.5.10.2.1DV – The test at two temperatures is deleted since it's covered in 5.5.4.1DV.1 and the apparatus needed for the test is added.

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5.5.10.2.2DV – The PFD performance requirement is removed from the clause; the manual pull force procedure from 5.5.10.2.3 is inserted; and specific procedure details needed to obtain consistent results for determining time to achieve minimum buoyancy are added.

5.5.10.2.3DV – The manual pull force test procedure is moved to 5.5.10.2.2DV; the PFD performance requirement is removed from the clause; and a requirement to record and report the results for comparison to the relevant part is added.

5.5.10.2.4DV – The clause is removed since the temperature testing is covered in 5.5.4.1DV and the automatic inflation buoyancy determination is covered by 5.5.10.2.2DV.

Test of the resistance to inadvertent inflation

5.5.11.2DV – A water pressure range is added to control uniform spray/mist and conform to current practice.

5.5.11.3DV – New sentence added which states to submerge the device in water to determine if the device still inflates automatically which is the current practice.

5.5.11.4DV – Adds new clause to report results of exposure and submersion of the device.

Test of the resistance to burning

5.5.12.2DV – Flame test pan dimensions modified to current practice and as tentatively agreed by the ISO SC.

Fig 10DV – Replaced flame exposure arrangement illustration, which not inconsistent with 5.5.12.2DV, with an illustration showing current practice.

5.5.12.3DV – Deletes petrol as an option to maintain consistency per current practice.

5.5.12.3DV1 – Requires inflatable devices to be inflated during the flame exposure per current practice.

5.5.12.3DV2 – Deletes strength test after flame exposure to maintain current practice.

5.5.12.4DV – Replaces the first paragraph to conform to current practice requiring the device to be allowed to burn for 6 seconds, if it is burning after exposure, and to measure buoyancy if damage may have had a negative impact on buoyancy.

5.5.13DV – Adds clause for puncture test for inflatable devices per current practice

5.5.14DV – Adds clause for the uninflated buoyancy test for inflatable devices per current practice.

5.5.15DV – Adds loss distribution test as option for devices using inherently buoyant materials to demonstrate compliance with the front/back V-factor requirements per current practice.

Human subject performance tests

Subject requirements for adults

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5.6.1.1DV.1 – Moves and modifies requirement that subjects be tested while wearing normal and heavy weather clothing for human subjects to conform with current practice. Clothing, when required, has been moved to 5.6.4.1DV. The DV also states that subjects are to be generally informed as to the nature of the testing and states they must be of sufficient health to perform the testing. This also allows for test modification for subjects 12 years and younger to ensure their safety and cooperation.

5.6.1.1DV.2 – Deletes the last paragraph of 5.6.1.1 since test sequence is now detailed in new clause 5.6.1.6 and its accompanying tables.

Table 3DV – Replaces entire table. Replaced with modified text in 5.6.1.2DV and by test sequence tables 6DV, 7DV, 8DV to conform with current practice.

5.6.1.2DV – Replaces entire clause with improved version of current practice for the selection and number of subjects to be tested in a device.

Subject requirements for children and infants

Table 4DV – Deletes entire table. Replaced with modified text in 5.6.1.3DV.

5.6.1.3DV – Replaces entire clause with improved version of current practice for the selection and number of subjects to be tested in a device.

In-water weight

5.6.1.4DV – Requirements are added for a high and a low in-water weight subject to be included in each group of test subjects used to test all devices. For younger subjects, until more data can be collected to verify the ability to collect data on these subjects and availability of subjects meeting the criteria, for level 70 PFDs and above, in-water weight requirement is optional for subjects less than or equal to 40 kg. For all sizes of Level 50 buoyancy aids, one subject in each group must meet a specific limit for high in-water weight.

Table 5DV – A table of ranges of test subject in-water weights is added for PFD testing.

Figure 10.2DV – An illustration of the in-water weight test arrangement is added to aid in understanding the in-water weight test procedure.

Sex and dress

5.6.1.5DV – Removes specific gender requirements and reference to deleted table and as tentatively agreed by ISO SC. Gender requirements now covered by subject requirements in 5.6.1.2DV. Dress/clothing covered under 5.6.4.1DV.

Human subject performance tests sequence

5.6.1.6DV – Add new clause with in-water performance sequence.

Table 6DV, 7DV, 8DV – Tables detailing in-water performance sequence for inherently buoyant, auto inflating and manual inflating PFDs per current practice.

Boarding test

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5.6.3DV – Modifies liferaft/platform boarding to be more reasonable and be more similar to current practice.

Donning test

5.6.4.1DV – Modifies donning to include clothing descriptions to conform with current practice and as has been tentatively agreed by the ISO SC.

5.6.4.1DV.1 – Adds clause for heavy weather clothing for use with SOLAS lifejackets per current practice.

5.6.4.2DV – Revises donning to conform with current practice and as tentatively agreed by ISO SC.

5.6.4.2aDV – Adds requirement and instruction to inflate for inflatable PFDs per current practice.

5.6.4.2bDV – Clarifies second donning attempt procedure to conform with current practice and to allows one subject to be replaced if he does not follow instructions

5.6.4.3DV.1 – Adds requirement to check that an inflatable PFD has inflated and opened on the subject as intended by the manufacturer, similar to current practice.

Water entry test

5.6.5.1DV and DV.1 – Deleted the redundant text regarding holding on to the PFD for the jump tests from greater than 1 m and as tentatively agreed by ISO SC. Also deleted the PFD freeboard performance requirement, which is covered in the relevant part.

5.6.5.2.1DV – The test is revised and clarified by use of a table (9VD) since there are multiple jumps required for inflatable PFDs similar to current practice in UL 1180.

5.6.5.2.1DV.1 – The tolerance on the jump test height is corrected to be consistent with current practice and as tentatively agreed to by ISO TC188 SC1 for the next edition of the standard and as has been tentatively agreed by the ISO SC.

Table 9DV – A table is inserted per 5.6.5.2.1DV and as tentatively agreed by ISO SC.

5.6.5.2.2DV – Testing of inherently buoyant buoyancy aids is deleted consistent with current practice.

5.6.5.2.3DV – The instruction to hold onto the PFD is moved to be with the relevant test and as tentatively agreed by ISO SC.

5.6.5.2.4DV – The child and infant water entry requirements are modified to be consistent with current practice.

5.6.5.3DV – Revised to clarify when freeboard measurements and other needed observations are required to be reported for the various jumps heights for the various levels of PFDs similar to current practice. Requirements are moved to the relevant parts.

Self-righting and stability test

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Section 5.6.6 general comment – Modified to correct the desired performance differences between lifejackets and buoyancy aids, to move the pass/fail requirements to the respective parts, and to test lifejackets against an appropriate reference vest (or reference test device, RTD), which allows for variation in test subject groups and variation in the way tests are carried out in different laboratories.

5.6.6.1.1DV, 5.6.6.1.1DV.1, and 5.6.6.1.1DV.2 – Self-righting and Stability test principle is modified to correctly indicate that the clause applies to lifejackets only and to require that tests be run in comparison to appropriate reference vests. Additionally, the reference to being turned face down “by waves or other forces” is deleted since there are no tests in waves or a simulation of waves.

5.6.6.1.2DV – The reference to being turned face down “by waves or other forces” is deleted since there are no tests in waves or a simulation of waves.

5.6.6.2DV – Provision for additional reference vests appropriate for the Level 100 PFDs are added to the section similar to current practice in UL 1123.

5.6.6.3DV – The testing procedures are modified to use the reference vest comparison for all lifejackets, rather than just Part 1 (SOLAS) lifejackets.

5.6.6.3aDV – The righting test instructions are corrected to be consistent with current practice for conducting the leg release test method as has been tentatively agreed by the ISO SC.

5.6.6.3dDV – Three test procedures are added to evaluate (1) the ease of the subject to right himself in a buoyancy aid, (2) to provide an alternative to the leg release method for children as in the UL Standards, and (3) to replace the leg release method for infants as in the UL Standards

5.6.6.4.3DV – The requirement statements are removed so that they can properly be addressed in the relevant Parts and as tentatively agreed to by ISO SC, and needed Level 70 reporting is added.

5.6.6.4.4DV – The requirement to make unnecessary measurements on buoyancy aids is deleted.

Ergonomics

5.6.7.2.2DV – The clause is deleted to because it is a requirement that is being moved to the relevant parts (see UL 12042-5/5.6.2.5DV).

5.6.7.2.3DV – The oral inflation test is revised to evaluate oral tube access on deck and details of the in-water testing are added similar to current practice.

In-water stability test

5.6.8DV – The title is revised to clarify that the In-water stability test is limited to “lifejackets” only, consistent with current practice and as tentatively agreed to by ISO SC.

Retroreflective material visibility test

5.6.10 DV – A retroreflective material visibility test is added to verify that the required amount of optionally-provided material is visible. This procedure is consistent with CAN/CGSB 65.7-2007.

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Placement security evaluations

5.6.11 DV – Placement security evaluations are added to the in-water testing, including a ride-up test method similar to current practice in UL 1123 and placement security test for measurement of displacement, with provisions for yoke style PFDs (inflatable and inherently buoyant). This test is used in the evaluation of equivalencies using the aggregate performance approach.

Rearming/repacking test

5.6.12 DV – A rearming and repacking test is added similar to current practice in UL1180.

Pocket flotation stability test

5.6.13 DV – A pocket flotation stability test is added similar to current practice in UL Standards.

Classification

A.1DV – The descriptions of the three classes, “buoyancy aids”, “lifejackets”, and “special purpose devices” are revised to use consistent terminology, and improve accuracy and comprehension. The language in this section is the result of a working group led by the US and/or Canadian delegation and has been tentatively agreed by the ISO SC.

Performance levels

A.1.2DV – The descriptions of the performance levels 50, 100, 150, and 275 are revised to use consistent terminology, and improve accuracy and comprehension. The language in this section is the result of a working group led by the US and/or Canadian delegation and has been tentatively agreed by the ISO SC.

Additionally, Level 70 is added to address the “Type III PFDs” in the US and “PFDs” in Canada, which comprise a significant portion of the existing PFD market.

The National Difference Page and IEC Foreword have been provided for your reference in reviewing this document. However, they are not considered to be part of the ANSI balloted material.

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Preface (UL)

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NATIONAL DIFFERENCES

GENERAL

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There are five types of National Differences as noted below. The difference type is noted on the first line of the National Difference in the standard. The standard may not include all types of these National Differences.

DR – These are National Differences based on the **national regulatory requirements**.

D1 – These are National Differences which are based on **basic safety principles and requirements**, elimination of which would compromise safety for consumers and users of products.

D2 – These are national differences from IEC requirements based on existing **safety practices**. These requirements reflect national safety practices, where empirical substantiation (for the IEC or national requirement) is not available or the text has not been included in the IEC standard.

DC – These are National Differences based on the **component standards** and will not be deleted until a particular component standard is harmonized with the IEC component standard.

DE – These are National Differences based on **editorial comments or corrections**.

DT – These are National Differences based on

Each national difference contains a description of what the national difference entails. Typically one of the following words is used to explain how the text of the national difference is to be applied to the base IEC text:

Addition / Add - An addition entails adding a complete new numbered clause, subclause, table, figure, or annex. Addition is not meant to include adding select words to the base IEC text.

Modification / Modify - A modification is an altering of the existing base IEC text such as the addition, replacement or deletion of certain words or the replacement of an entire clause, subclause, table, figure, or annex of the base IEC text.

Deletion / Delete - A deletion entails complete deletion of an entire numbered clause, subclause, table, figure, or annex without any replacement text.

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 12402-9 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 162, *Protective clothing including hand and arm protection and lifejackets*, in collaboration with Technical Committee ISO/TC 188, *Small craft*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

ISO 12402 consists of the following parts, under the general title *Personal flotation devices*:

- Part 1: *Lifejackets for seagoing ships – Safety requirements*
- Part 2: *Lifejackets, performance level 275 – Safety requirements*
- Part 3: *Lifejackets, performance level 150 – Safety requirements*
- Part 4: *Lifejackets, performance level 100 – Safety requirements*
- Part 5: *Buoyancy aids (level 50) – Safety requirements*
- Part 6: *Special purpose lifejackets and buoyancy aids – Safety requirements and additional test methods*
- Part 7: *Materials and components – Safety requirements and test methods*
- Part 8: *Accessories – Safety requirements and test methods*
- Part 9: *Test methods*
- Part 10: *Selection and application of personal flotation devices and other relevant devices*

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Introduction

ISO 12402 has been prepared to give guidance on the design and application of personal flotation devices (hereafter referred to as PFDs) for persons engaged in activities, whether in relation to their work or their leisure, in or near water. PFDs manufactured, selected, and maintained to this standard should give a reasonable assurance of safety from drowning to a person who is immersed in water.

Requirements for lifejackets on large, commercial seagoing ships are regulated by the International Maritime Organization (IMO) under the International Convention for the Safety of Life at Sea (SOLAS). ISO 12402-1 addresses lifejackets for seagoing ships.

ISO 12402 allows for the buoyancy of a PFD to be provided by a wide variety of materials or designs, some of which may require preparation before entering the water (e.g. inflation of chambers by gas from a cylinder or blown in orally). However, PFDs can be divided into the following two main classes:

- those which provide face up in-water support to the user regardless of physical conditions (lifejackets), and
- those which require the user to make swimming and other postural movements to position the user with the face out of the water (buoyancy aids).

Within these main two classes 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. Within the different types of buoyancy allowed, inflatable PFDs either provide full buoyancy without any user intervention other than arming (i.e. PFDs inflated by a fully automatic method) or require the user to initiate the inflation. Hybrid PFDs always provide some buoyancy but rely on the same methods as inflatable PFDs to achieve full buoyancy. With inherently buoyant PFDs, the user only needs to put the PFD on to achieve the performance of its class.

PFDs that do not require intervention (automatically operating PFDs) are suited to activities where persons are likely to enter the water unexpectedly; whereas PFDs requiring intervention (e.g. manually inflated PFDs) are only suitable for use if the user believes there will be sufficient time to produce full buoyancy, or help is close at hand. In every circumstance, the user should ensure that the operation of the PFD is suited to the specific application. The conformity of a PFD to this part of ISO 12402 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 PFDs.

ISO 12402 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. Equally essential is the need for the designer to encourage the wearing of the equipment by making it comfortable and attractive for continuous wear on or near water, rather than for it to be stored in a locker for emergency use. Throwable devices and flotation cushions are not covered by this part of ISO 12402. The primary function of a PFD is to support the user in reasonable safety in the water. Within the two classes, alternative attributes make some PFDs better suited to some circumstances than others or make them easier to use and care for than others. Important alternatives allowed by ISO 12402 are the following:

- to provide higher levels of support (levels 100, 150, or 275) that generally float the user with greater water clearance, enabling the user's efforts to be expended in recovery rather than avoiding waves; or to provide lighter or less bulky PFDs (levels 50 or 100);
- 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;

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- to provide automatically operating (inherently buoyant or automatically inflated) PFDs that float users without any intervention on their part, except in initially donning the PFD (and regular inspection and rearming of inflatable types), or to provide user control of the inflatable PFD's buoyancy by manual and oral operation; and
- to assist in detection (location aids) and recovery of the user.

PFDs 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 PFD selected shall ensure 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 PFD. Users, owners and employers need to ensure that this is taken into account when selecting a PFD. Similarly, PFDs may not perform as well in extremes of temperature, although fully approved under this part of ISO 12402. PFDs 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 taking a PFD into such conditions, she/he has to be assured that the PFD will not be adversely affected. This part of ISO 12402 also allows a PFD to be an integral part of a safety harness designed to conform to ISO 12401, 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 this part of ISO 12402.

In compiling the attributes required of a PFD, consideration has also been given to the potential length of service that the user might expect. Whilst a PFD needs to be of substantial construction and material, 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. Furthermore, whilst the performance tests included are believed to assess relevant aspects of performance in real-life use, they do not accurately simulate all conditions of this. For example, the fact that a device passes the self-righting tests in swimming attire, as described herein, does not guarantee that it will self-right an unconscious user wearing waterproof clothing; neither can it be expected to completely protect the airway of an unconscious person in rough water. Waterproof clothing can trap air and further impede the self-righting action of a lifejacket.

It is essential that owners, users and employers choose those PFDs that meet the correct standards for the circumstances in which they will be used. Manufacturers and those selling PFDs have to make clear to prospective purchasers the product properties, alternative choices and the limitations to normal use, prior to the purchase.

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. More information on the selection and application is given in ISO 12402-10.

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Personal flotation devices – Part 9: Test methods

1 Scope

This part of ISO 12402 specifies the test methods for personal flotation devices.

1DV DR Addition to Clause 1 as follows:

Where references are made to ISO 12402 standards, the referenced requirements found in these standards shall apply as modified by an applicable National Differences.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 139:2005, *Textiles – Standard atmospheres for conditioning and testing*

ISO 2768-1, *General tolerances – Part 1: Tolerances for linear and angular dimensions without individual tolerance indications*

ISO 3386-1:1986, *Polymeric materials, cellular flexible – Determination of stress-strain characteristics in compression – Part 1: Low-density materials*

ISO 12401:2004, *Small craft – Deck safety harness and safety line for use on recreational craft – Safety requirements and test methods*

2DV.1 DT Modification of Clause 2 by replacing normative reference ISO 12401 as follows:

ISO 12401:2009, Small craft – Deck safety harness and safety line for use on recreational craft – Safety requirements and test methods

ISO 12402-1, *Personal flotation devices – Part 1: Lifejackets for seagoing ships – Safety requirements*

ISO 12402-2:2006, *Personal flotation devices – Part 2: Lifejackets, performance level 275 – Safety requirements*

ISO 12402-3:2006, *Personal flotation devices – Part 3: Lifejackets, performance level 150 – Safety requirements*

ISO 12402-4:2006, *Personal flotation devices – Part 4: Lifejackets, performance level 100 – Safety requirements*

ISO 12402-5:2006, *Personal flotation devices – Part 5: Buoyancy aids (level 50) – Safety requirements*

ISO 12402-6, *Personal flotation devices – Part 6: Special purpose lifejackets and buoyancy aids – Safety requirements and additional test methods*

ISO 12402-7:2006, *Personal flotation devices – Part 7: Materials and components – Safety requirements and test methods*

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ISO 12402-8:2006, *Personal flotation devices – Part 8: Accessories – Safety requirements and test methods*

ISO 12402-10, *Personal flotation devices – Part 10: Selection and application of personal flotation devices and other relevant devices*

ASTM D471-98:1999, *Standard test method for rubber property – Effect of liquids*

International Convention for the Safety of Life of Sea (SOLAS), 1974, as amended, International Maritime Organization¹⁾

2DV.2 DC Modification of Clause 2 by adding the following normative reference:

ANSI/UL 1191 Components for Personal Flotation Devices – Fourth Edition – December 12, 2008

¹⁾ IMO is an institution with domicile in London issuing regulations which are then published as laws by the member states.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 personal flotation device PFD garment or device which, when correctly worn and used in water, will provide the user with a specific amount of buoyancy which will increase the likelihood of survival

3.2 inherently buoyant material material which is permanently less dense than water

3.3 automatically operating PFD PFD in which buoyancy is provided by permanent means (inherently buoyant material) or by suitable means (gas inflation) effected by a system which automatically activates upon immersion and which, except for the inspection and rearming of inflatable types, when correctly donned requires no further action by the user

3.4 automatically inflating PFD PFD in which inflation is effected as a result of immersion without the user carrying out any action at the time of immersion

3.5 manually inflated PFD PFD in which inflation is effected as a result of the user operating a mechanism

3.6 orally inflated PFD PFD inflated by mouth to produce buoyancy

3.7 PFD with secondary donning PFD for which additional donning or adjustment is needed to place the PFD in its functioning position from the position it is normally worn

NOTE Pouch-type devices are examples of the type of PFDs which usually require such additional positioning.

3.8 vest-type PFD PFD covering the upper trunk of the user like a vest

3.9 yoke-type PFD PFD in a style worn around the back of the neck and secured by a waist strap

3.10 emergency light device which emits light so as to increase the chances of a user being located

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3.11 multi-chamber buoyancy system system that divides the buoyancy provided by an inflatable lifejacket into two or more separate compartments, such that if mechanical damage occurs to one, others can still operate and provide buoyancy so as to aid the user when immersed

3.11DV DT Modification by replacing the multi-chamber buoyancy system definition as follows:

PFD with buoyancy to meet the applicable PFD performance requirement provided by multiple sources including, for example, devices with two or more independent inflatable chambers or hybrids, for which each chamber independently provide at least the in-water performance conforming to UL 12402-5:2012. This excludes supplemental inflation chambers.

3.12 deck safety harness and safety line device that allows a user to be securely attached to a strong point on a vessel or on shore, so as to prevent him from falling into the water, or, if he does fall into the water, to prevent him from being separated from the vessel or shore

3.13 buddy line length of cord which can be tied or otherwise fixed to another person or to that person's PFD or other objects, so as to keep a user in the vicinity of that person or object with a view to making location and thus rescue easier

3.14 lifting loop device which facilitates manual recovery of a person from water

3.15 sprayhood cover brought or placed in front of the airways of a user in order to reduce or eliminate the splashing of water from waves or the like onto the airways and thereby to promote the survival of the user in rough water conditions

3.16 protective cover cover that is normally in place over the functional elements of a PFD in order to protect them from physical damage, or snagging on external objects

NOTE 1 The protective cover may be designed to provide additional properties, i.e. to make the PFDs suitable for use when the subject is exposed to additional hazards, e.g. significant abrasion, molten metal splash, flame and fire.

NOTE 2 The inflatable chamber of an inflatable PFD is an example of a functional element.

3.17 overpressure relief valve valve which may be used in an inflatable system to avoid the likelihood of destruction caused by overpressure

3.18 whistle device which, when blown by mouth, produces an audible sound which can aid in the location of the user

3.19 hybrid-type PFD PFD of combined buoyancy types, i.e. inherent and inflatable

3.19DV D1 Modification by adding the following note to the hybrid-type PFD definition:

NOTE Minimal inherent buoyance used to prevent an inflatable PFD from sinking when not inflated is not considered a hybrid-type PFD.

3.20DV DT Modification by adding bunching definition to clause 3:

bunching – curling or folding of internal buoyant material upon itself, from its original position, within the envelope

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3.21DV DT Modification by adding sheltered waters definition to clause 3:

sheltered waters – water with protection from significant breaking waves, current, or strong winds, where the possibility of being blown or carried away from shore or place of safety is minimal

3.22DV DT Modification by adding offshore definition to clause 3:

offshore – water that is unprotected and influenced by a variety of threat conditions such as waves, tide, currents, or wind, which may be at sea or on inland waters

3.23DV DT Modification by adding primary inflation definition to clause 3:

primary means of inflation – means of inflating an inflation chamber that meets the applicable PFD performance requirements and that requires the least amount of intervention by the user, generally according to the following order of precedence: automatic (easiest), manual (second), and oral (most difficult)

3.24DV DT Modification by adding secondary inflation definition to clause 3:

secondary means of inflation – alternate method of inflation which is provided in case the primary system fails

3.25DV DT Modification by adding primary inflation chamber(s) definition to clause 3:

primary inflation chamber(s) – inflation chamber(s) associated with the primary inflation system that alone meets the applicable PFD performance requirements and provides the greatest in-water performance and ease of use

3.26DV DT Modification by adding back-up inflation chamber definition to clause 3

back-up inflation chamber – inflation chamber other than the primary chamber that, when used alone, provides at least in-water performance conforming to the relevant part in case the primary inflation chamber fails to function

3.27DV DT Modification by adding supplemental inflation chamber definition to clause 3:

supplemental inflation chamber – inflation chamber other than a primary or back-up chamber that is intended for deployment after stabilization in the water, and provides enhanced features such as splash protection, higher freeboard, improved head support, additional stability, location detection, etc.

3.28DV D2 Addition of definitions as follows:

3.28.1DV somatotypes – four categories of human body types based physical characteristics: endomorphy (En), mesomorphy (Me), ectomorphy (Ec), and central (Ce). Each body type is categorized by height to mass ratio (HMR) and in-water weight to mass ratio (lwMR).

- a) endomorph (En) – body type having a more rounded appearance with limited muscle definition, normal bone structure, higher body fat, and typically the waist and thigh areas carry a larger percentage of body mass than the upper chest area with an HMR less than 41.5 and the lwMR less than 8.5

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- b) mesomorph (Me) – **body type having well defined muscles, large bone structure, and low body fat with broad shoulders tapering to a defined narrower waist with an HMR less than 41.5 and lwMR greater than 10.5**
- c) ectomorph (Ec) – **lean body type with low muscle mass, light bone structure, and low body fat with a linear physique with the HMR greater than 45.5**
- d) central somatotype – **body type having no dominant endomorph, mesomorph, or ectomorph with an HMR between 41.5 and 45.5 and the lwMR between 8.5 and 10.5**
- e) height to mass ratio (HMR) – **test subject's height in centimeters divided by the cube root of mass in kilograms**
- f) in-water weight to mass ratio (lwMR) – **male test subject's in-water weight in Newtons (N), or female test subject's in-water weight in N plus 3 N, divided by the cube root of mass in kilograms**

$$lwMR_{(Male)} = IWW / m^{1/3}$$

$$lwMR_{(Female)} = (IWW + 3) / m^{1/3}$$

where:

IWW = in-water weight in Newtons (N), and

m = mass in kg

EQUATIONS may be viewed in an exact format. See UL 12402-9 Equations Document attached in CSDS under Supporting Documentation.

3.29DV D2 Modification by adding primary closure definition to clause 3:

primary closure – one or more means of securing the device onto the body so that the device can be expected to function substantially in the intended manner without the use of any other means of fastening the device onto the body

3.30DV D2 Modification by adding secondary closure definition to clause 3:

secondary closure – closure or closures not meeting the definition of a primary closure

3.31DV D2 Modification by adding structural component definition to clause 3:

structural component – component or components intended to support a structural load as demonstrated during testing

3.32DV D2 Modification by adding design inflation range definition to clause 3:

design inflation range – the range of buoyancy and pressure, as specified by the manufacturer, to which a compartment may be inflated to provide the intended in-water performance

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4 Classification of personal flotation devices

An overview of this classification is given in Annex A for information.

5 Test methods

5.1 General

Unless otherwise specified, a new sample of the PFD to be tested may be used for each of the tests.

A combination of PFD and accessories in accordance with ISO 12402-8 shall not impair the performance of either item. This shall be proved during the test required for both PFD and accessories. If necessary, the test sequence shall be arranged accordingly.

The human subject performance tests shall be witnessed by a test panel of at least 2 experts familiar with testing and the products specified in the relevant parts of ISO 12402.

5.1DV DE Modification by replacing third paragraph of clause 5.1 as follows:

The human subject performance tests shall be witnessed by a test panel of at least 2 experts familiar with testing and the products specified in the relevant parts of UL 12402.

The human subject performance tests shall be carried out under the direction of a test house's test panel that is experienced in these specific test procedures. These tests shall be observed by at least 2 experienced observers from the panel and repeated with 3 experienced observers from the panel if there is any question about the performance observed. An observer is to be qualified by having expertise in observing (or conducting under the supervision of a qualified observer) the specific test on at least 3 occasions.

NOTE 1 Specific test means, for instance, that experience with stability testing would not qualify for self-righting testing or that experience with self-righting testing of inherently buoyant PFDs would not qualify as experience with similar testing of inflatable PFDs.

NOTE 2 It is recommended that the test panel have at least one member of the test house regularly participating in experience exchanges and round robin tests.

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5.2 Sampling and conditioning

5.2.1 Sampling

At least one sample of each size of the device to be tested shall be provided, if not specified otherwise in the part of ISO 12402.

5.2.1DV DE Modification by replacing entire clause 5.2.1 as follows:

At least one sample of each size of the device to be tested shall be provided, if not specified otherwise in this part.

5.2.2 Conditioning

Prior to testing, the samples shall be conditioned for $(24 \pm 0,1)$ h under the appropriate standard atmosphere as defined in ISO 139 according to the specific fabric used for the PFD.

5.2.2DV D2 Modification by replacing the first paragraph of 5.2.2 with the following:

Prior to the mechanical properties tests, the samples shall be conditioned for $(24 \pm 0,1)$ h under the appropriate standard atmosphere as defined in ISO 139 according to the specific fabric used for the PFD.

If spelled out to be tested under wet conditions, the sample shall be soaked for at least 5 min in fresh water, or as specified by the test procedure itself.

5.3 Criteria for passing and failure

All required samples shall pass all tests specified in 5.5 for the entire device to meet the requirements of the relevant parts of ISO 12402. Due to the high variability between human subjects and the difficulty in assessing some subjective measures, for tests according to 5.6 a test subject may be disqualified if demonstrated not to perform in accordance with this standard when tested in a reference vest as described in Annex B, C or D. When a reference vest is used, the test report shall state the model of reference vest(s). Whenever a subject is disqualified from this test, another two subjects with similar weight, height and anatomic build shall be subjected to the same test and before the same test panel. If these additional tests are still not clearly passed in accordance with this standard and the part of ISO 12402 applicable to the performance level of device, the device shall be deemed to have failed.

5.3DV DE Modification by deleting clause 5.3:

Delete Clause 5.3.

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5.4 Magnetic properties testing

Place a direct-reading magnetic compass in an undisturbed magnetic area (i.e. an area in which magnetic items and d.c. electrical cables are not continually moved or switched). Check the compass to ensure that it has negligible pivot friction. This can be done by deflecting the compass card 10° by means of a magnet and then removing the deflecting force, when the card should return to within 0,5° of its original position.

Present the metal components (with any hooks closed) individually to the compass on an approximately east-to-west line, to a position where the nearest point of the component is (300 ± 10) mm horizontally from the center of the compass. Lightly tap the compass to eliminate the effect of friction. Record the angle, in degrees, of any deflection of the compass from its position before the metal components were brought near the compass.

5.5 Mechanical properties tests

5.5.1 General

The material properties tests shall be conducted in accordance with Table 1 or Table 2 on device(s) of the size that has been determined to represent the weakest construction. When different device sizes have substantially the same construction, any representative size may be tested.

Table 1 – Mechanical properties tests for inherently buoyant PFDs

Applicable tests	Applicable samples					
	A ^a	B ^b	C ^c	D ^d	E ^d	F ^d
5.5.3 Rotating shock bin test method	X	X	X	X	X	X
5.5.4 Temperature cycling test	X	X	X	X	X	X
5.5.2.3.2 Horizontal load test		X ^e				
5.5.2.3.3 Vertical load test		X ^e				
5.5.2.4 Lifting loop test		X ^e				
5.5.2.5 Buddy line test		X ^e				
5.5.7 Over-pressure test						
5.5.9 Measurement of buoyancy of the whole device	X					
5.5.10 Inflation test						
5.5.11 Test of the resistance to inadvertent inflation						
5.5.12 Test of the resistance to burning	X					
^a For each size. ^b For adult devices, this sample may be the smallest size. For child devices, the sample may be the smallest size. ^c For adult devices, this sample may be the largest size. For child devices, the sample may be the largest size. ^d When substantially the same construction is used in adult and child devices, any size may be tested. ^e An alternative sample subjected to 5.5.4 of the smallest size may be substituted for this test.						

Table 1DV D2 Modification of Table 1 by replacing with Table 1DV:

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Table 1DV – Mechanical properties tests for inherently buoyant PFDs

Applicable tests	Applicable samples			
	A ^a	B ^b	C ^c	D ^d
5.5.4.3 Resistance to temperature extremes				X
5.5.2.3.2 Horizontal load test		X ^e		
5.5.2.3.3 Vertical load test		X ^e		
5.5.2.4 Lifting loop test		X ^e		
5.5.2.5 Buddy line test		X ^e		
5.5.2.6 Collar handles test				X ^e
5.5.2.7 Holding down device test				X ^e
5.5.2.8 Body strap hardware secureness test ^f				
5.5.2.9 Secondary closure attachment-strength test ^f				
5.5.9 Measurement of buoyancy of the whole device		X		
5.5.12 Test of the resistance to burning			X	
^a For each size. ^b This sample shall be the smallest size. ^c This sample shall be the largest size. ^d When substantially the same construction is used in adult and child devices, any size may be tested. ^e An alternate sample subjected to 5.5.4 of the same size may be substituted for this test. ^f Not tested on a device and does not require the temperature test.				

Table 2 – Mechanical properties tests for inflatable PFDs

Applicable tests	Applicable samples			
	A ^a	B ^b	C ^c	D ^d
5.5.3 Rotating shock bin test method	X	X	X	X
5.5.4 Temperature cycling test	X	X	X	X
5.5.2.3.2 Horizontal load test		X ^e		
5.5.2.3.3 Vertical load test		X ^e		
5.5.2.4 Lifting loop test		X ^e		
5.5.2.5 Buddy line test		X ^e		
5.5.7 Over-pressure test			X	
5.5.9 Measurement of buoyancy of the whole device	X			
5.5.10 Inflation test		X		
5.5.11 Test of the resistance to inadvertent inflation	X			
5.5.12 Test of the resistance to burning			X	
^a For each size. ^b For adult devices, this sample may be the smallest size. For child devices, the sample may be the smallest size. ^c For adult devices, this sample may be the largest size. For child devices, the sample may be the largest size. ^d When substantially the same construction is used in adult and child devices, any size may be tested. ^e An alternative sample subjected to 5.5.4 of the smallest size may be substituted for this test.				

Table 2DV D2 Modification of Table 2 by replacing with the following Table 2DV

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Table 2DV – Mechanical properties tests for inflatable PFDs

Applicable tests	Applicable samples				
	A ^a	B ^b	C ^c	D ^d	E ^d
5.5.3 Rotating shock bin test method	X	X	X	X	
5.5.4 Temperature cycling test	X	X	X	X	
5.5.2.3.2 Horizontal load test		X ^e			
5.5.2.3.3 Vertical load test		X ^e			
5.5.2.4 Lifting loop test		X ^e			
5.5.2.5 Buddy line test		X ^e			
5.5.2.6 Collar handles test				X ^e	
5.5.2.7 Holding down device test				X ^e	
5.5.2.8 Body strap hardware secureness test ^f					
5.5.2.9 Secondary closure attachment-strength test ^f					
5.5.2.10 Strength of attachment test for inflatable PFDs		X ^e			
5.5.7 Over-pressure test			X		
5.5.9 Measurement of buoyancy of the whole device	X				
5.5.10 Inflation test		X ^e			
5.5.11 Test of the resistance to inadvertent inflation	X				
5.5.12 Test of the resistance to burning			X		
5.5.13 Puncture Resistance test					X
^a For each size. ^b This sample shall be the smallest size. ^c This sample shall be the largest size. ^d When substantially the same construction is used in adult and child devices, any size may be tested. ^e An alternate sample subjected to 5.5.3 and 5.5.4 of the same size may be substituted for this test. ^f Not tested on a device and does not require the temperature test.					

5.5.2 Horizontal and vertical load tests

5.5.2.1 Principles

The PFD shall be subject to tension via its integral structure, such as waist belt or harness arrangement, by means of a specified load. The tests shall be carried out in the following order and be applied to the same PFD sample:

horizontal load test wet;

vertical load test wet.

NOTE Test houses may use other test arrangements as described in 5.5.2.3, i.e. by means of a hydraulic jig, if the load maintained and the same accuracy of results can be achieved.

5.5.2.1DV DE Modification by replacing “Note” under clause 5.5.2.1 as follows:

NOTE Test houses may use other test arrangements as described in 5.5.2.3DV, i.e. by means of a hydraulic jig, if the load maintained and the same accuracy of results can be achieved.

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5.5.2.2 Apparatus

The apparatus consists of a horizontally suspended upper cylinder, of diameter (50 ± 5) mm for PFD user masses less than 40 kg, or of diameter (125 ± 10) mm for PFD user masses of 40 kg and above, to which the PFD is fitted. The length of the test cylinder shall be sufficient to accommodate the full width of the portion of the PFD under test.

For the horizontal load test shown in Figures 2 and 4, an additional lower test cylinder of similar size to the upper cylinder shall be placed in the PFD in the position indicated. The axes of the upper and lower cylinders shall be regarded as the datum positions A1-A2 and B1-B2, respectively, shown in Figures 2 and 4.

For the horizontal load test shown in Figures 2 and 4, a pre-load is required. The total pre-load shall be (20 ± 2) N.

For the vertical load tests shown in Figures 3 and 5, the lower apparatus shall have the dimensions as indicated in Figures 6 and 7. The diameter of the tube shown in Figure 7 shall be (50 ± 5) mm for PFD user masses less than 40 kg and (125 ± 10) mm for user masses of 40 kg and above.

5.5.2.2DV DE Modification by replacing paragraphs 2 through 4 of clause 5.5.2.2 as follows:

For the horizontal load test shown in Figures 2 and 3DV, an additional lower test cylinder of similar size to the upper cylinder shall be placed in the PFD in the position indicated. The axes of the upper and lower cylinders shall be regarded as the datum positions A1–A2 and B1–B2, respectively, shown in Figures 2 and 3DV.

For the horizontal load test shown in Figures 2 and 3DV, a pre-load is required. The total pre-load shall be (20 ± 2) N.

For the vertical load tests shown in Figures 4DV and 5DV, the apparatus shall have the dimensions as indicated in Figures 6DV.

For all load tests, any load from the test fixtures applied to the device shall be included in the test load.

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5.5.2.3 Procedure

5.5.2.3.1 General

The webbing or movable part of the assembly shall be marked at each point of adjustment prior to application of each test load. This includes tie tapes, draw cords, and lacing, as well as webbing-hardware adjustments.

A different sample is acceptable to test each configuration. Except for hardware closures on buoyancy aids, the tests shall be repeated on each closure independently. For buoyancy aids, all closures shall be fastened and adjusted to the mid-range to approximate even loading.

5.5.2.3.2 Horizontal load test

The PFD shall be fitted (if inflated by its primary means of inflation (30 ± 5) min prior the test being carried out) to the upper test cylinder, in the manner shown in Figure 2 for halter types or Figure 4 for vest types. If inflatable, it shall be tested both when uninflated and when inflated by its primary means of inflation. The PFD shall be attached to the cylinders such that all adjustment devices are tested. The position of the webbing relative to the adjustment devices it passes through shall be marked.

5.5.2.3.2DV DE Modification by replacing the first paragraph of clause 5.5.2.3.2 as follows:

The PFD shall be fitted to the upper test cylinder in the manner shown in Figure 2 for yoke types or Figure 3DV for vest types. If inflatable, it shall be tested both when uninflated and when inflated by its primary means of inflation (30 ± 5) min prior the test. The PFD shall be attached to the cylinders such that all adjustment devices are tested.

The lower test cylinder shall be fixed in the appropriate positions shown in Figures 2 and 4. The specified pre-load shall be added and the test arrangement shall be adjusted such that the axes A1-A2 and B1-B2 of the upper and lower test cylinders are substantially parallel and horizontal.

The additional test load shall be applied steadily until the PFD is hanging freely. The load shall be maintained for 30 min, if not specified otherwise. For buoyancy aids (level 50), the load is maintained for 5 min only, see ISO 12402-5:2006, 5.3.3.2.

5.5.2.3.2DV.1 DE Modification by replacing the third paragraph of clause 5.5.2.3.2 as follows:

The additional test load shall be applied steadily until the PFD is hanging freely. The load shall be maintained for 30 min, if not specified otherwise. For buoyancy aids the load is maintained for 5 min only.

The PFD shall be examined for any failures resulting in functional damage of the PFD.

5.5.2.3.2DV.2 Modification by adding a sentence to the last paragraph of clause 5.5.2.3.2:

Measure and record any adjustment device slippage.

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5.5.2.3.3 Vertical load test

The PFD shall be fitted to the upper test cylinder, in the manner shown in Figure 3 for halter types or Figure 5 for vest types. If inflatable, it shall be tested both when uninflated and when inflated by its primary means of inflation.

5.5.2.3.3DV DT Modification by replacing first sentence in the first paragraph of clause 5.5.2.3.3 as follows:

The PFD shall be fitted to the upper test cylinder, in the manner shown in Figure 4DV for yoke types or Figure 5DV for vest types.

For halter types, adjust the harness to fit the test body according to Figure 6. For vest types, fasten the PFD in such a way that any adjustment devices are tested. Mark the position of the webbing relative to any adjustment devices it passes through.

5.5.2.3.3DV.1 DE Modification of clause 5.5.2.3.3 by replacing second paragraph with the following:

Adjust the device to fit the test form according to Figure 6DV.

Attach the load suspension cord to the PFD in the appropriate positions shown in Figures 3 and 5. Apply the test load steadily without jerking. Maintain the test load for the specified period. Remove the test load and examine the PFD for any resultant failures. Measure any adjustment device slippage.

5.5.2.4 Lifting loop test

All PFDs equipped with a lifting loop shall be soaked in fresh water for a period of 5 min. The PFD shall then be fitted to the appropriate test dummy according to the manufacturer's donning and adjustment instructions. If inflatable, the lifejacket shall be inflated prior to load application.

5.5.2.4DV D2 Modification by replacing second sentence in the first paragraph of clause 5.5.2.4 as follows:

The PFD shall then be fitted to the appropriately sized dummy such as that shown in ISO 12401, 5.2.2.1 or the appropriately sized test form (see Figure 6DV) according to the manufacturer's donning and adjustment instructions.

Then apply the loads F_1 or F_2 (see Figure 1) to the lifting loop using the lower attachment point of the dummy (in accordance with ISO 12401:2004, 5.2.2.1). Lift the dummy by means of a cylinder of (50 ± 5) mm in diameter, which is put through the loop without jerking until it is suspended freely.

5.5.2.4DV.1 D2 Modification by replacing second paragraph of clause 5.5.2.4 as follows:

Attach the load F_1 or F_2 , which includes the weight of the dummy (see Figure 1) or test form, to the lifting loop using the lower attachment point of the dummy or test form. Lift the assembly without jerking until it is suspended freely by means of a cylinder (50 ± 5) mm in diameter, which is put through the loop. The dummy or test form may be modified to prevent the device from slipping off of the neck projection, if needed for a valid test.

Maintain the load for $(1 \pm 0,1)$ min.

See also 5.5 in the relevant parts of ISO 12402.

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5.5.2.4DV.2 DE Modification by replacing last paragraph of clause 5.5.2.4 as follows:

See also 5.5 in the relevant parts of UL 12402.

5.5.2.5 Buddy line test

If a buddy line is attached to a PFD, a load of 750 N shall be applied for $(1,0 \pm 0,1)$ min perpendicular to the PFD, whilst the PFD is fitted to a torso in accordance with ISO 12401. No damage shall occur to the buddy line or to the PFD.

5.5.2.5DV DT Modification by replacing first paragraph of clause 5.5.2.5 as follows:

If a buddy line is attached to a PFD, a load of 750 ± 5 N, which includes the weight of the dummy or test form, shall be applied for the specified time perpendicular to the PFD, whilst the PFD is fitted to an appropriately sized dummy such as that shown in ISO 12401, 5.2.2.1 or the appropriately sized test form (see Figure 6DV for this Part). Record if damage occurs to the buddy line or to the PFD. The dummy or test form may be modified to prevent the device from slipping off of the neck projection, if needed for a valid test.

5.5.2DV D2 Modification of adding 5.5.2.6DV – 5.5.2.10DV to Clause 5.5.2:**5.5.2.6DV Collar handles test**

The PFD shall be fitted to an appropriate test form to suspend the PFD vertically in the inverted position. A 50 ± 10 mm wide strap and a having 6 ± 2 mm thick foam covering shall be looped through the collar handle strap and the vertical test load specified. The test load shall be raised slowly until supported by the collar handle strap. Maintain the load for $5,0 \pm 0,1$ minutes. Examine PFD for any damage that might endanger the function of the PFD.

5.5.2.7DV Holding down device test

The PFD shall be fitted to an appropriate test form to suspend the PFD vertically in the upright position. The holding down device, such as crotch strap, shall be laced or fastened and adjusted to mid-range. The holding down device shall be connected to the vertical test load specified using a looped strap 50 ± 10 mm wide strap and having 6 ± 2 mm thick foam covering. The test load shall be raised slowly until supported by the holding down device. Maintain the load for $5,0 \pm 0,1$ minutes. Measure webbing slippage and examine PFD for any damage that might endanger the function of the PFD.

5.5.2.8DV Body strap hardware secureness test**5.5.2.8.1DV Principle**

The principle is to determine that hardware necessary for the performance of the device will not be inadvertently lost.

NOTE This test only applies to the hardware that is not mechanically secured to the device, webbing, or lacing.

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5.5.2.8.2DV Procedure

5.5.2.8.2.1DV With the retention means on webbing or lacing located as close as possible to the adjustable hardware, the force specified in Figure 7.1DV shall be slowly applied to the end of the webbing without the retention means, with the adjustable hardware rigidly mounted perpendicular to the direction of the force applied, as shown in Figure 7.1DV.

NOTE The hardware shall be tested at an angle different than perpendicular to the force if it is determined that it will produce more slippage through the hardware.

5.5.2.8.2.2DV If a t-tab construction is used, the tab shall be placed against the webbing to allow for a greater possibility of unthreading, as shown in Figure 7.1DV.

5.5.2.8.2.3DV Results

Report if the free end completely separates from the hardware.

5.5.2.9DV Secondary closure attachment-strength test

5.5.2.9.1DV Six samples of the closure/fabric combination that represent the weakest combination of components, three with the attachment sewn parallel to the direction of greater thread count and three in the direction of lesser thread count, are to be prepared. The closure shall be attached, centered, using the intended securing means, such as a box X or bar tack stitch, on fabric cut (100 ± 5) mm wide and of sufficient length to be clamped for testing.

5.5.2.9.2DV Each sample is to be placed, in turn, in a tensile test machine by clamping the closure in the fixed jaws, aligning the cover fabric centered parallel with the direction of closure, and then securing the cover fabric portion in the moving jaws (50 ± 5) mm from the attachment point. The moving jaw shall be at least as wide as the width of the closure attachment to the cover fabric. The jaws are to be separated at a constant rate of (300 ± 10) mm per minute. Record the breaking force for each sample.

5.5.2.10DV Strength of attachment test for inflatable PFDs

5.5.2.10.1DV The sample is to be mounted on the test form illustrated in Figure 6DV in the uninflated condition. Each compartment is to be inflated to the maximum pressure of the design inflation range. A supported load of 220 ± 5 N is to be attached to each inflation system, in turn, by means of a clamp, lacing, or the like as close as possible to the point of attachment to the device. The test form is to be freely supported from the top, and is then to be slowly raised until the inflation system completely supports the load, and is to be maintained in this position for $5 \pm 0,1$ min.

5.5.2.10.2DV For an inflation system having an additional joint or coupling other than at the connection to the compartment, this procedure is to be repeated with the weight attached at a point beyond the joint or coupling. Any tubes or hoses are to be evaluated by adjusting the point of attachment to the location(s) most critical for the specific design being evaluated.

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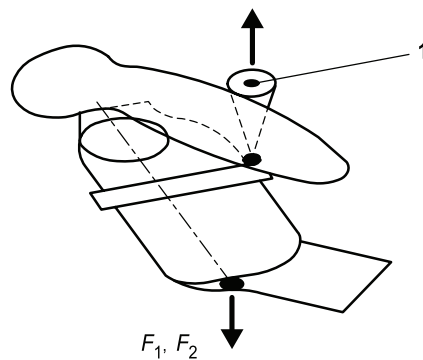
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5.5.2.10.3DV For an inflatable device having other identifiable attachments to the gas holding portion of the inflatable chamber, such as loop for accessories (for example a personal marker light), the procedure detailed above is to be repeated using a load of 135 ± 5 N applied to the attachment points.

5.5.2.10.4DV The same device tested above is to be deflated and the tests are to be repeated with a supported load of 135 ± 5 N.

5.5.2.10.5DV For each attachment, record whether the load was supported without causing loss of function.



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F_1 load for adult size (according to 5.5 in the relevant part of ISO 12402, mass of the dummy included)

F_2 load for child size (according to 5.5 in the relevant part of ISO 12402, mass of the dummy included)

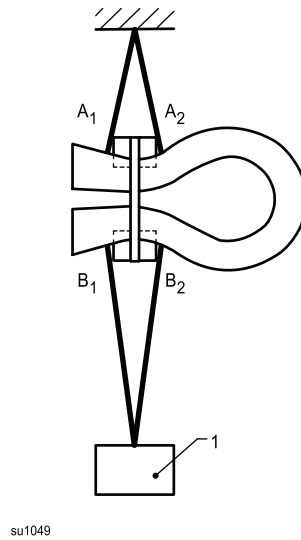
1 test load

Figure 1 – Test dummy

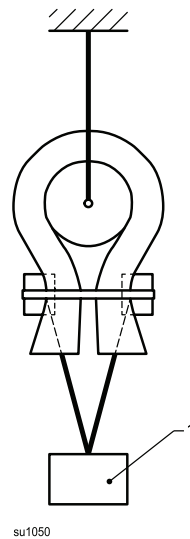
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**Key**

1 test load

Figure 2 – Horizontal load test of yoke-type PFD**Key**

1 test load

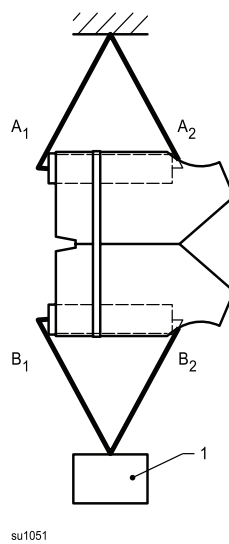
Figure 3 – Vertical load test of yoke-type PFD

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Figure 3DV DT Modification of Figure 3 by replacing with the following:



Key

1 test load

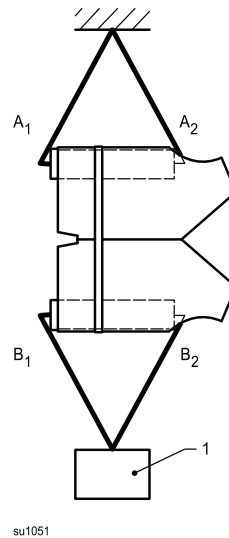
Figure 3DV.1 — Horizontal load test of vest-type PFD

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**Key**

1 test load

Figure 4 – Horizontal load test of vest-type PFD

Figure 4DV *DT Modification by replacing Figure 4 with new Figure 4DV.*

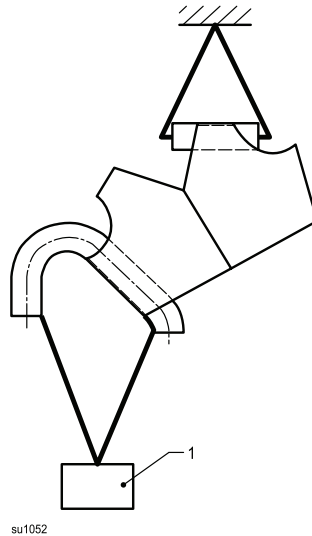
Note: Figure 4DV may be viewed by accessing the graphics document, UL 12402-9 ND Graphics, which is attached under Supporting Documentation in CSDS.

Figure 4DV – Vertical load test of yoke-type PFD

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**Key**

1 test load

Figure 5 – Vertical test of vest-type PFD

Figure 5DV *DT Modification by replacing Figure 5 with new figure 5DV.*

Note: Figure 5DV may be viewed by accessing the graphics document, UL 12402-9 ND Graphics, which is located under Supporting Documentation in CSDS.

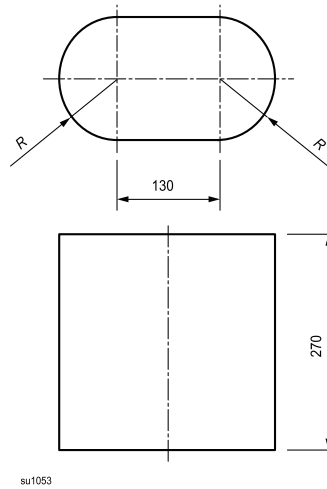
Figure 5DV – Vertical load test of vest-type PFD

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Dimensions in millimetres



Key

$R = 155 \text{ mm}$

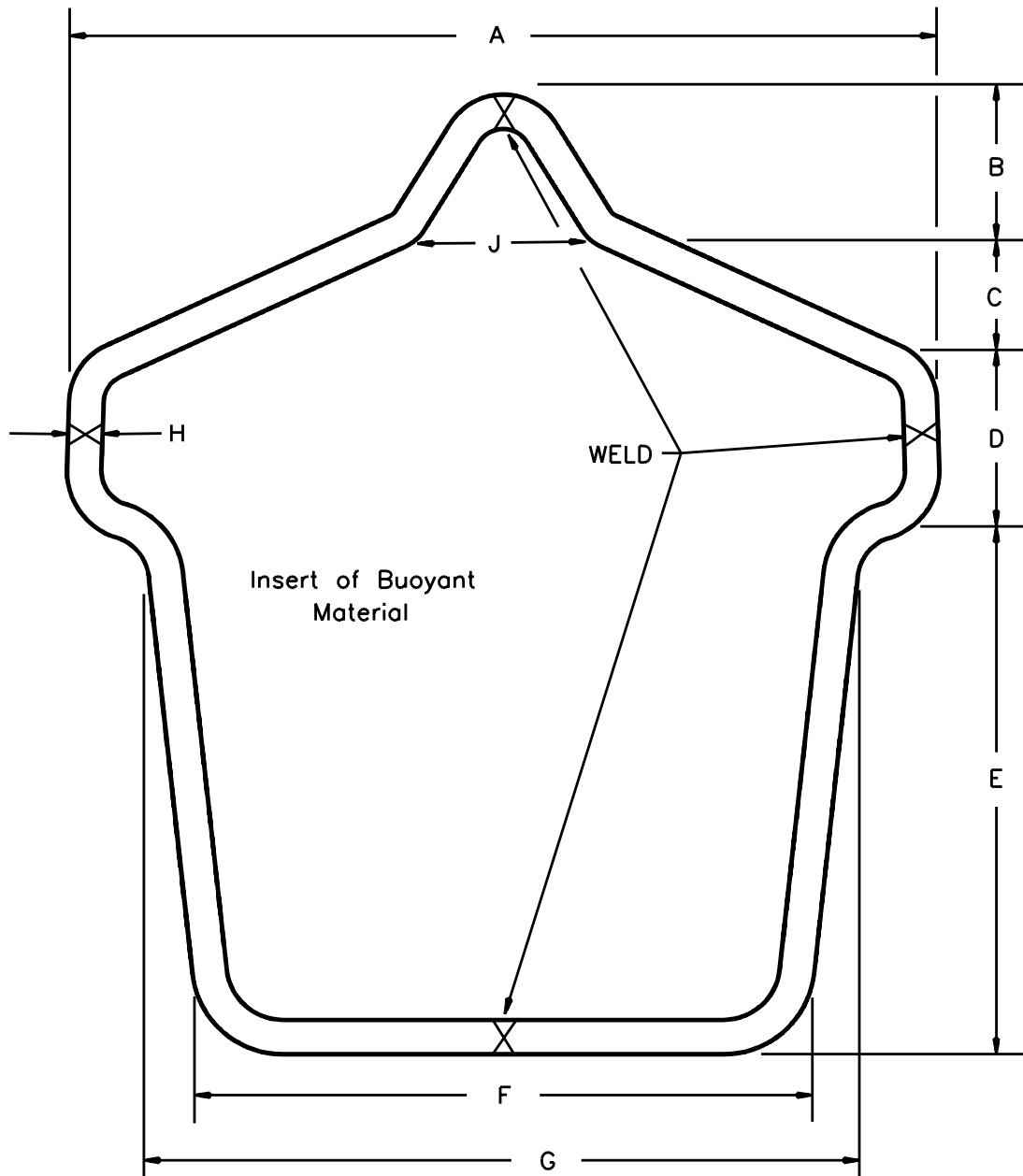
Figure 6 – Body for vertical load test (general tolerances ISO 2768-1, v)

Figure 6DV DT Modification by replacing Figure 6 with new Figure 6DV:

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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 6DV – Test form for vertical load test, lifting loop and buddy lines
(general tolerances ISO 2768-1, v)

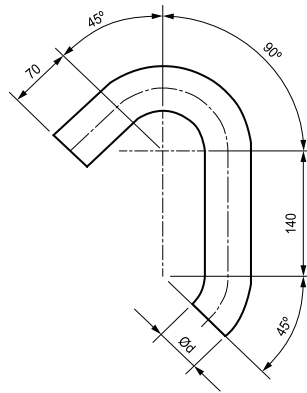
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Dimensions in millimetres



su1054

Key

$\varnothing = (125 \pm 10)$ mm for adult size

$\varnothing = (50 \pm 10)$ mm for child size

Figure 7 – Bent tube for vertical load test (general tolerances ISO 2768-1, v)

F7DV DT Modification by deleting Figure 7

Figure 7DV.1 D2 Modification by replacing Figure 7 with new Figure 7DV.1.

Note: Figure 7DV.1 may be viewed by accessing the graphics document, UL 12402-9 ND Graphics, which is located under Supporting Documentation in CSDS.

Figure 7DV.1 – Hardware secureness test configuration

5.5.3 Rotating shock bin test method

5.5.3DV D2 Modification by replacing the title of clause 5.5.3 as follows:

Rotating shock bin test method for inflatable PFDs

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5.5.3.1 Principle

The PFD shall provide a minimum resistance against wear and tear.

5.5.3.2 Apparatus

The equipment used shall be that shown in Figure 8, and consists of a box made from plywood board, the inside surface of which shall be coated with a hard plastic laminate or similar. The bearing of the bin shall be in the center of its mass, as shown in Figure 8, and permit the bin to be rotated freely.

5.5.3.3 Procedure

The PFD shall be exposed to this test in the condition "ready for use", i.e. unpacked and un-inflated, if inflatable, buckles closed but not tightened or wrapped around.

5.5.3.3DV DE Modification by replacing the first paragraph of clause 5.5.3.3 as follows:

The PFD shall be exposed to this test unpacked and un-inflated, buckles closed but not tightened or wrapped around.

The test specimen shall be placed in the bin through a flush panel in one of its faces, which shall then be closed and secured. The bin shall then be rotated for a total of 150 revolutions at a steady rate of 6 rev/min.

On completion of the rotations, the specimen shall be removed. The device, if inflatable, shall be inflated for $(5,0 \pm 0,1)$ min then examined for damage and checked for leaks under water. Perform the functional test according to the relevant performance level if damage is detected.

5.5.3.3DV.1 DE Modification by replacing the second sentence in the third paragraph of clause 5.5.3.3 as follows:

The device shall be inflated to 13.8 kPa or the maximum of the design inflation range whichever is greater, then examined for damage and checked for leaks under water.

5.5.3.4DV DE Modification by adding a clause to 5.5.3 as follows:

5.5.3.4DV Results

Report whether damage and/or leakage was observed and whether any functional tests were performed and their results.

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