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Personal flotation devices —

Part 7: Materials and components — Safety requirements and test methods

Équipements individuels de flottabilité —

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This draft is hereby submitted to the ISO member bodies and to the CEN member bodies for a parallel five month enquiry.

Should this draft be accepted, a final draft, established on the basis of comments received, will be submitted to a parallel two-month approval vote in ISO and formal vote in CEN.

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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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 12402-7 was prepared by Technical Committee ISO/TC 188, *Small craft*, Subcommittee SC 1, *Personal safety Equipment*.

This second edition cancels and replaces the first edition (ISO 12402-7:2006, ISO 12402-7:2006/A.1:2010), of which have been technically revised. The main changes with respect to the previous edition are listed below:

- a) Temperature of temperature cycling (4.1.6.3) was changed from $(65 \pm 2)^\circ\text{C}$ into $(60 \pm 2)^\circ\text{C}$;
- b) Compliance criteria in Table 1 Sewing thread were changed;
- c) Requirements for fabrics performance were changed (see 4.3.2 and Table 2);
- d) New chromaticity coordinates x and y and luminance factor β for yellow, orange and red non-fluorescent colours of lifejacket material were added (see Table 3);
- e) New chromaticity coordinates x and y and luminance factor β for yellow, yellow-orange, orange and orange-red fluorescent colours of lifejacket material were added (see Table 4);
- f) Compliance criteria of structural webbing (see Table 5) were modified;
- g) Compliance criteria of structural tie tape (see Table 6) were modified;
- h) New subclause "General" to structural lacing was added (see 4.5.1);
- i) Immersion of zippers, automatic and manual inflation systems in IRM 902 oil was deleted and ambient temperature replaced by $(20 \pm 2)^\circ\text{C}$ (see Tables 8, 17 and 18);
- j) Compliance criteria of webbing closures and adjusters were modified (see Table 9);
- k) Compliance criteria of lacing closures and adjusters were modified (see Table 10);
- l) Number of samples reduced for density test on foam flotation material deleted (see Table 12);
- m) Dimensional test for foam flotation material deleted;
- n) Test method for the compressibility of inherently buoyant material was modified (see 4.8.2.4);

o) Compliance criteria of inflation chamber materials were modified (see Table 15).

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

- 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: 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 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;
- 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 use. 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 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 impair 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 7: Materials and components - Safety requirements and test methods

1 Scope

This part of ISO/DIS 12402 specifies the minimum requirements for construction and performance of materials and components of personal flotation devices as well as relevant test methods.

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 105-A02, *Textiles — Tests for colour fastness — Part A02: Grey scale for assessing change in colour*
- ISO 105-E02, *Textiles — Tests for colour fastness — Part E02: Colour fastness to sea water*
- ISO 105-X12, *Textiles — Tests for colour fastness — Part X12: Colour fastness to rubbing*
- ISO 139, *Textiles — Standard atmospheres for conditioning and testing*
- ISO 188:2011, *Rubber, vulcanized or thermoplastic — Accelerated ageing and heat resistance tests*
- ISO 1302, *Geometrical Product Specifications (GPS) — Indication of surface texture in technical product documentation*
- ISO 1421:1998, *Rubber- or plastics-coated fabrics — Determination of tensile strength and elongation at break*
- ISO 1926, *Rigid cellular plastics — Determination of tensile properties*
- ISO 2062, *Textiles — Yarns from packages — Determination of single-end breaking force and elongation at break*
- ISO 2411:2000, *Rubber- or plastics-coated fabrics — Determination of coating adhesion*
- ISO 3696:1987, *Water for analytical laboratory use — Specification and test methods*
- ISO 4674-1:2003, *Rubber- or plastics-coated fabrics — Determination of tear resistance — Part 1: Constant rate of tear methods*
- ISO 4892-1:1999, *Plastics — Methods of exposure to laboratory light sources — Part 1: General guidance*
- ISO 4892-2:2013, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps*
- ISO 5470-2:2003, *Rubber- or plastics-coated fabrics — Determination of abrasion resistance — Part 2: Martindale abrader*
- ISO 6330, *Textiles — Domestic washing and drying procedures for textile testing*
- ISO 7229:1997, *Rubber- or plastics-coated fabrics — Measurement of gas permeability*

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ISO 7854:1995, *Rubber- or plastics-coated fabrics — Determination of resistance to damage by flexing*

ISO 9073-4, *Textiles — Test methods for nonwovens — Part 4: Determination of tear resistance*

ISO 9227:2012, *Corrosion tests in artificial atmospheres — Salt spray tests*

ISO/DIS 12402-2:2015, *Personal flotation devices — Part 2: Lifejackets, performance level 275 — Safety requirements*

ISO/DIS 12402-3:2015, *Personal flotation devices — Part 3: Lifejackets, performance level 150 — Safety requirements*

ISO/DIS 12402-4:2015, *Personal flotation devices — Part 4: Lifejackets, performance level 100 — Safety requirements*

ISO/DIS 12402-5:2015, *Personal flotation devices — Part 5: Buoyancy aids (level 50) — Safety requirements*

ISO/DIS 12402-6:2015, *Personal flotation devices — Part 6: Special purpose lifejackets and buoyancy aids — Safety requirements and additional test methods*

ISO 13934-1, *Textiles — Tensile properties of fabrics — Part 1: Determination of maximum force and elongation at maximum force using the strip method*

ISO 13934-2, *Textiles — Tensile properties of fabrics — Part 2: Determination of maximum force using the grab method*

ISO 13937-2, *Textiles — Tear properties of fabrics — Part 2: Determination of tear force of trouser-shaped test specimens (Single tear method)*

ISO 13938-1, *Textiles — Bursting properties of fabrics — Part 1: Hydraulic method for determination of bursting strength and bursting distension*

ISO 13938-2, *Textiles — Bursting properties of fabrics — Part 2: Pneumatic method for determination of bursting strength and bursting distension*

EN 590, *Automotive fuels — Diesel — Requirements and test methods*

EN 10088-1, *Stainless steels — Part 1: List of stainless steels*

CIE publication No. 15.2, *Colorimetry*

ASTM D 412-98, *Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers — Tension*

ASTM D 471-98, *Standard Test Method for Rubber Property-Effect of Liquids*

ASTM D 882-02, *Standard Test Method for Tensile Properties of Thin Plastic Sheeting*

ASTM D 1683, *Standard Test Method for Failure in Sewn Seams of Woven Apparel Fabrics*

ASTM D 2061, *Standard Test Methods for Strength Tests for Zippers*

ASTM D 2062, *Standard Test Methods for Operability of Zippers*

ASTM D 5034-95, *Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)*

FTMS 191A, *Federal Test Method Standard*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12402-1-2 to ISO 12402-5 and the following apply.

3.1

coated fabric

flexible material composed of a textile fabric and an adherent polymeric material

3.2

design inflation range

range of buoyancy and pressure, as specified by the manufacturer, to which a chamber is capable of being inflated to provide the intended in-water performance

3.3

filling density

mass of the gas charge for gas-filled cylinders or other inflation-medium containers, in kilograms, divided by the volume of the inflation-medium container, in litres

3.4

foam flotation material

closed-cell (cells not interconnecting) foamed polymeric material

3.5

full inflation

chamber or chambers inflated to any value within the design inflation range

3.6

inflation system

means of inflating one or more chambers to make the PFD buoyant or more buoyant on demand, either actively or passively with respect to the user's action

3.7

initial jaw separation

distance between the bottom of the top clamp and the top of the bottom clamp of a tensile test machine prior to testing

3.8

multi-eyelet guide

polymeric part designed to be sewn into a PFD and having a series of holes to insert lacing for adjustment of the fit of a PFD

3.9

status indicator

part or parts of an inflation system which provide user feedback to assist in keeping an inflatable PFD in an armed and ready condition

EXAMPLES single-point status indicator, multi-point status indicator, cylinder seal indicator

3.10

polymeric foam coating

coating applied to flotation foam in place of a fabric covering to protect and strengthen the finished PFD

3.11

selvage

uncut edge portion of a fabric

3.12

serviceability

ease with which the inflation system mechanism is properly rearmed

3.13

serviceable

capable of continued use, i.e. exhibits no signs of functional deterioration, broken or deformed hardware, non-functional indicators, blocked or detached oral inflation tube, or detached manual inflator trigger

3.14

adult PFD

PFD intended for users with a mass greater than (or equal to) 40 kg

3.15

child lifejacket

lifejacket intended for users with a mass greater than (or equal to) 15 kg and less than 40 kg

3.16

child buoyancy aid

buoyancy aid intended for users with a mass greater than (or equal to) 25 kg and less than 40 kg

3.17

structural parts, materials and components

parts, materials, or components that are integral to the device and that are essential for its correct function and performance

3.18

ride-up prevention system

system that helps to secure the PFD in its functional position on the body and prevent the PFD from riding up the body towards the head.

4 Materials and components

4.1 General

4.1.1 Principles

All structural materials and components of personal flotation devices shall meet the requirements specified in this part of ISO/DIS 12402:2015.

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/DIS 12402:2015.

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 experience of observing (or conducting under the supervision of a qualified observer) the specific test on at least 3 occasions.

NOTE 1 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.

4.1.2 Sampling

Two samples (one from each end of the range) of materials and components common to a range of products may be presented and the results used to cover the full range of products.

4.1.3 Pass or fail criteria

All required samples shall pass all objective tests for the component or material to meet the requirements of this part of ISO/DIS 12402. For any test identified as subjective or which uses human test subjects, because of the high variability between subjects and the difficulty in assessing some subjective measures, a component may be accepted on the basis of the following additional testing. If a component does not completely meet the requirements of a test for a particular measurement or does so but with only one test subject, another two samples or subjects (within similar physical characteristics, if applicable) shall be subjected to the same test and before the same test personnel. Such subjective tests shall be witnessed by a test panel of at least two experts familiar with testing the products specified in the series of ISO/DIS 12402:2015 and repeated with three experts if there is any question about the performance observed. If this additional test is still not clearly passed in accordance with this part of ISO/DIS 12402:2015, then the component or material shall be deemed to have failed. The test panel should deem that the component or material has passed the test only if it has now fulfilled the test requirements completely.

4.1.4 Units of measurement

Units of measurement shall be in accordance with ISO 31.

4.1.5 Material

4.1.5.1 Non-metallic components and fabrics

Non-metallic components and fabrics shall not be damaged when tested in accordance with the relevant Tables of this standard.

4.1.5.2 Corrosion of metal components

When tested in accordance with ISO 9227 for a minimum of 160 h, metal components shall not be significantly affected by corrosion when tested in accordance with the relevant Tables of this standard.

No metallic component shall affect a magnetic compass of a type commonly used in small boats by more than 1° when placed 500 mm from the compass.

4.1.5.3 Innocuousness

The foam flotation material shall not contain CFC or HCFC.