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**Personal flotation devices —**

**Part 9:  
Evaluation**

*Équipements individuels de flottabilité —  
Partie 9: Évaluation*

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document 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 12402-9:2006), which has been technically revised. It also incorporates the Amendment ISO 12402-9:2006/Amd 1:2011.

The main changes compared to the previous edition are as follows:

- a) amendment of title to make clear the need of this part for the fulfilment of the requirements in ISO 12402-2 to ISO 12402-6 to make visible the interaction and relation of the different parts of ISO 12402, and with this, its need of harmonization;
- b) new [Table 1](#) (A) Mechanical properties test for inherently buoyant PFDs (see [5.5.1](#));
- c) new [Table 2](#) (B) Mechanical properties test for inflatable PFDs (see [5.5.1](#));
- d) horizontal and vertical load test amended ([5.5.4](#));
- e) requirements on collar handles added (see [5.5.7](#));
- f) temperature cycling test amended (see [5.5.3](#));
- g) over-pressure test amended (see [5.5.14](#));
- h) air retention test deleted;
- i) requirement for the colour deleted;
- j) measurement of buoyancy of the whole device amended (see [5.5.9](#));
- k) inflation tests amended (see [5.5.13](#));
- l) strength of attachment test for inflatable chambers added (see [5.5.15](#));

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- m) human subject performance tests amended (see [5.6](#));
- n) performance levels amended (see [A.2](#));
- o) [Figures B.15](#) to [B.17](#) added.

A list of all parts in the ISO 12402 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

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## Introduction

ISO 12402 (all parts):2020 deals with personal floatation devices (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 International Standard give a reasonable assurance of safety from drowning to a person who is immersed in water. ISO 12402 (all parts):2020 does not include the following:

- requirements for lifejackets on seagoing ships, which are regulated by the International Maritime Organization (IMO)<sup>1)</sup> under the International Convention for the Safety of Life at Sea (SOLAS);
- throwable devices and flotation cushions.

ISO 12402 (all parts):2020 allows for the buoyancy of a PFD to be provided by a variety of materials or designs, some of which can require preparation before entering the water (e.g. inflation of chambers by gas from a cylinder or blown in orally). 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), which all 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, if automatic operation would result in entrapment, or if 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 the ISO 12402 series:2020 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 (all parts):2020 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. 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 provided by ISO 12402 (all parts):2020 are the following:

- to provide higher levels of support (levels 100, 150, or 275) that generally float the user with greater water clearance, when required for increasingly severe conditions; 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 accommodate the sometimes conflicting needs of reliability and durability, in-water performance, and continuous wear;

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1) The International Maritime Organization (IMO) is an institution with domicile in London issuing regulations which are then published as laws by its Member States.

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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 need to be secure when worn, in order to provide positive support in the water and to allow users to swim or actively assist themselves or others. The PFD selected ensures that the user is supported with the mouth and nose clear of the water under the expected conditions of use and the user's ability to assist.

Under certain conditions (such as rough water and waves), the use of watertight and multilayer clothing, which provide (intentionally or otherwise) additional buoyancy, or the use of equipment with additional weight (such as tool belts) can alter the performance of the PFD. Users, owners and employers need to ensure that this is taken into account when selecting a PFD. Similarly, it is possible that PFDs do not perform as well in extremes of temperature, although meeting ISO 12402 (all parts):2020 requirements. PFDs can also be affected by other conditions of use, such as chemical exposure and welding, and can require additional protection to meet the specific requirements of use. Taking a PFD into such conditions necessitates the assurance that the PFD will not be adversely affected. ISO 12402 (all parts):2020 also allows a PFD to be an integral part of a safety harness designed to conform to ISO 12401:2009, 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 expected to conform to ISO 12402 (all parts):2020.

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.

The characteristics of the product properties, alternative choices and the limitations to normal use are to be explained to potential buyers by manufacturers and distributors of PFDs prior to purchase.

Similarly, it is advised that regulators regarding the use of these garments 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 expected consequences. Requirements and recommendations for the correct selection and application of PFDs are given in ISO 12402-10:2020.



# Personal flotation devices —

## Part 9: Evaluation

### 1 Scope

This document specifies the processes for evaluation of personal flotation devices for fulfilment of the requirements in ISO 12402-2:2020 to ISO 12402-6:2020, with which this document is intended to be used.

The classification of PFDs used in the ISO 12402 series:2020 is given in [Annex A](#) for information.

### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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+Amd.1:2011, *Textiles — Standard atmospheres for conditioning and testing*

ISO 2768-1:1989, *General tolerances — Part 1: Tolerances for linear and angular dimensions without individual tolerance indications*

ISO 3386-1:1986+Amd.1:2010, *Polymeric materials, cellular flexible — Determination of stress-strain characteristics in compression — Part 1: Low-density materials*

ISO 12401:2009, *Small craft — Deck safety harness and safety line — Safety requirements and test methods*

ISO 12402-2:2020, *Personal flotation devices — Part 2: Lifejackets, performance level 275 — Safety requirements*

ISO 12402-3:2020, *Personal flotation devices — Part 3: Lifejackets, performance level 150 — Safety requirements*

ISO 12402-4:2020, *Personal flotation devices — Part 4: Lifejackets, performance level 100 — Safety requirements*

ISO 12402-5:2020, *Personal flotation devices — Part 5: Buoyancy aids (level 50) — Safety requirements*

ISO 12402-6:2020, *Personal flotation devices — Part 6: Special purpose lifejackets and buoyancy aids — Safety requirements and additional test methods*

ISO 12402-7:2020, *Personal flotation devices — Part 7: Materials and components — Safety requirements and test methods*

ISO 12402-8:2020, *Personal flotation devices — Part 8: Accessories — Safety requirements and test methods*

### 3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at <https://www.iso.org/obp>

— IEC Electropedia: available at <http://www.electropedia.org/>

**3.1  
personal flotation device**

**PFD**

garment or device which, when correctly worn and used in water, provides the user with a specific amount of buoyancy which increases the likelihood of survival

**3.2  
inherently buoyant**

permanently less dense than water

**3.3  
automatic inflation**

inflation of the *PFD* (3.1) without the user carrying out any action at the time of water immersion

**3.4  
manual inflation**

inflation of the *PFD* (3.1) resulting from the user operating a mechanism

**3.5  
oral inflation**

inflation resulting from the user blowing air into the *PFD* (3.1) by mouth

**3.6  
PFD with secondary donning**

*PFD* (3.1) for which additional donning or adjustment is needed to place the PFD in its functioning position from the position it is normally worn

**3.7  
vest-type PFD**

*PFD* (3.1) covering the upper trunk of the user like a vest

**3.8  
yoke-type PFD**

*PFD* (3.1) in a style worn around the back of the neck and secured by a waist strap

**3.9  
buddy line**

length of cord which can be tied or otherwise fixed to another person or to that person's *PFD* (3.1) 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

**3.10  
lifting loop**

device which facilitates manual recovery of a person from water

**3.11  
whistle**

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

**3.12  
hybrid PFD**

*PFD* (3.1) of combined buoyancy types, i.e. inherent and inflatable

**3.13  
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

**3.14****offshore**

water that is unprotected and influenced by threat conditions such as waves, tide, currents, or wind, at sea or on inland waters

**3.15****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)

**3.16****primary chamber**

inflation chamber associated with the *primary means of inflation* (3.15) that alone meets the applicable PFD (3.1) performance requirements

**3.17****back-up chamber**

inflation chamber other than the *primary chamber(s)* (3.16) or *supplemental chamber* (3.18) that, when used alone, provides performance in case the primary chamber fails to function

**3.18****supplemental chamber**

inflation chamber other than a *primary chamber* (3.16) or *back-up chamber* (3.17) that is intended for deployment after stabilization in the water, and provides enhanced performance such as higher freeboard, improved head support, additional stability, splash protection, location, detection

**3.19****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

**3.20****adult lifejacket**

PFD (3.1) intended for users with a body mass greater than 40 kg

**3.21****infant lifejacket**

lifejacket intended for users with a body mass less than or equal to 15 kg

**3.22****child lifejacket**

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

**3.23****child buoyancy aid**

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

**3.24****collar handle**

device on the upper back of a PFD (3.1) which facilitates getting hold of the wearer

**3.25****test panel**

group of persons, experienced in testing PFDs (3.1), who observes the *test subjects* (3.26) undergoing the tests

**3.26****test subject**

human selected to be an integral part of a test

## 4 Classification of personal flotation devices

An overview of this classification is given in [Annex A](#) for information.

## 5 Test methods

### 5.1 General

PFDs/devices that aim to fulfil the requirements and essential requirements of ISO 12402-2:2020 to ISO 12402-6:2020 shall pass the applicable procedures and sequences as specified in the following order in this part.

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

The tests shall be performed in a sequence in accordance with [Table 1](#) for inherently buoyant PFDs and [Table 2](#) for inflatable PFDs. The temperature cycling test in [5.5.3](#), and the rotating shock bin test in [5.5.2](#) shall be carried out prior to all other tests.

A combination of a PFD and accessories shall not impair the performance of either item. This shall be proved by testing the PFD and accessories in combination. If necessary, the test sequence has to be arranged accordingly. Requirements and test methods for accessories are specified in ISO 12402-8:2020.

The human subject performance tests shall be carried out under the direction of a test panel. The test panel shall consist of 2 persons.

If there is any question about the performance observed, the test shall be repeated with an additional person. The panel is to be qualified by having experience of observing or conducting the specific test (see Note 1) 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 regularly participating in experience exchanges and round robin tests.

### 5.2 Sampling and conditioning

#### 5.2.1 Sampling

One sample of each size of the device to be tested shall be provided, unless otherwise specified in this document.

#### 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 139:2005+Amd.1:2011 according to the specific fabric used for the PFD.

If testing under wet conditions is required, the sample shall be soaked for  $(5 \pm 1)$  min in fresh water, or as specified by the test procedure itself.

### 5.3 Criteria

All required samples of the PFD shall pass all tests specified in [5.5](#) for the entire device to meet the requirements of the relevant parts of the ISO 12402 series:2020.

## 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 by 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 all 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  $(500 \pm 10)$  mm horizontally from the centre 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 mechanical properties of the PFD shall be tested to determine if the device:

- provides resistance against wear and tear;
- remains functional after extreme temperatures;
- remains functional after external loads are applied; and
- remains functional after exposed to flames.

The mechanical properties tests shall be conducted in the sequence in accordance with [Table 1](#) or [Table 2](#) on device(s) of the required size(s). The samples in [Tables 1](#) and [Table 2](#) shall follow the test sequence defined.

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**Table 1 — Property tests for inherently buoyant PFDs**

Tests	Samples			
	A <sup>a</sup>	B <sup>b</sup>	C <sup>c</sup>	D <sup>b</sup>
<a href="#">5.5.3</a> Temperature cycling test	X	X	X	X
<a href="#">5.5.2</a> Rotating shock bin test	X	X	X	X
<a href="#">5.5.4</a> Horizontal load test		X	X	
<a href="#">5.5.4</a> Vertical load test		X	X	
<a href="#">5.5.5</a> Lifting loop test		X <sup>d</sup>		
<a href="#">5.5.6</a> Buddy line test		X <sup>d</sup>		
<a href="#">5.5.7</a> Collar handles		X <sup>d</sup>		
<a href="#">5.5.8</a> Body strap hardware secureness test		X <sup>d</sup>		
<a href="#">5.5.10</a> Measurement of buoyancy of the whole device	X			
<a href="#">5.5.12</a> Buoyancy test for inherently buoyant material <sup>e</sup>	X			
<a href="#">5.5.13</a> Test of the resistance to burning			X	
<a href="#">5.5.15</a> Strength test of attachment points				X
<p><sup>a</sup> For each size.</p> <p><sup>b</sup> This sample shall be the smallest size for end user mass group.</p> <p><sup>c</sup> This sample shall be the largest size for each user group.</p> <p><sup>d</sup> A different sample is allowed to be used for this test, however, the samples shall be tested in accordance with <a href="#">5.5.2</a> and <a href="#">5.5.3</a> prior to testing.</p> <p><sup>e</sup> This buoyancy test is only applicable for PFDs where the inherently buoyant material is qualified according to ISO 12402-7:2020, 4.8.2.5</p>				

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Table 2 — Property tests for inflatable PFDs

Tests	Samples			
	A <sup>a</sup>	B <sup>b</sup>	C <sup>c</sup>	D <sup>b</sup>
<a href="#">5.5.3</a> Temperature cycling test	X	X	X	X
<a href="#">5.5.2</a> Rotating shock bin test	X	X	X	X
<a href="#">5.5.4</a> Horizontal load test		X		
<a href="#">5.5.4</a> Vertical load test		X	X	
<a href="#">5.5.5</a> Lifting loop test		X <sup>d</sup>		
<a href="#">5.5.6</a> Buddy line test		X <sup>d</sup>		
<a href="#">5.5.7</a> Collar handles		X <sup>d</sup>		
<a href="#">5.5.8</a> Body strap hardware secureness test		X <sup>d</sup>		
<a href="#">5.5.14</a> Over-pressure test			X	
<a href="#">5.5.11</a> Uninflated buoyancy test	X			
<a href="#">5.5.10</a> Measurement of buoyancy of the whole device	X			
<a href="#">5.5.9</a> Inflation tests		X		
<a href="#">5.5.16</a> Test of the resistance to inadvertent inflation		X		
<a href="#">5.5.13</a> Test of the resistance to burning			X	
<a href="#">5.5.15</a> Strength test of attachment points				X <sup>d</sup>
<p><sup>a</sup> For each size.</p> <p><sup>b</sup> This sample shall be the smallest size for each user mass group.</p> <p><sup>c</sup> This sample shall be the largest size for each user group.</p> <p><sup>d</sup> A different sample is allowed to be used for this test, but the samples shall be submitted to <a href="#">5.5.2</a> and <a href="#">5.5.3</a> prior to testing.</p>				

## 5.5.2 Rotating shock bin test

### 5.5.2.1 Principle

The PFD shall provide a resistance against wear and tear.

The test shall be conducted after the temperature cycling test in [5.5.3](#) for all samples prior to conducting any other property tests.

The PFD shall meet the requirements in the relevant product standard after being submitted to this test.

### 5.5.2.2 Apparatus

The equipment used shall be that shown in [Figure 1](#), and consist 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 centre of its mass, as shown in [Figure 1](#), and permit the bin to be rotated freely.

### 5.5.2.3 Procedure

The PFDs specified by [Tables 1](#) or [2](#) shall be exposed to this test in the condition “ready for use”. Buckles shall be closed, and webbing straps shall not be tightly wrapped around the device. Inflatables shall be packed and armed.

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 min<sup>-1</sup>.