International Standard

ISO 15027-3

Immersion suits —

Part 3: Test methods

Combinaisons d'immersion —

Partie 3: Méthodes d'essai

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Foreword

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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 document 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).

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This document was prepared by Technical Committee ISO/TC 188, *Small craft*, Subcommittee SC 1, *Personal safety equipment*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 162, *Protective clothing including hand and arm protection and lifejackets*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 15027-3:2012), which has been technically revised.

The main changes are as follows:

— the terms and definitions have been revised;

— in Clause 4, the order of testing has been changed and clarified;

— in 4.3, a temperature and cycling test procedure for suits stored in sealed storage bags has been added;

— in 4.5, a test for tensile strength of seams has been added;

— in 4.7, a buoyancy test has been added;

— in 4.8, a suit strength test has been added;

— in 4.9, a lifting loop test has been added;

— in 4.12.2, the number and sizes of human test subjects have been revised;

— in 4.14.2, the use of a thermal manikin has been revised;

— Annex B "Test protocol and checklist for thermal manikin testing" has been added;

— Annex C "Thermal manikin — Means of circulated water" has been added;

— Annex D "Correlation of thermal manikin systems" has been added;

— Annex E "Thermal insulation identification for suit material — Test methods" has been added;

— Annex F “Medical fitness assessment for human thermal testing in cold water” has been added.

A list of all parts in the ISO 15027 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.

Immersion suits —

Part 3:
Test methods

1 Scope

This document specifies the test methods for constant wear suits and abandonment suits.

Requirements for constant wear suits are given in ISO 15027-1:2026.

Requirements for abandonment suits are given in ISO 15027-2:2026.

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 811:2018, *Textiles — Determination of resistance to water penetration — Hydrostatic pressure test*

ISO 12402-9:2020, *Personal flotation devices — Part 9: Evaluation*

ISO 12894:2001, *Ergonomics of the thermal environment — Medical supervision of individuals exposed to extreme hot or cold environments*

ISO 13935-2:2014, *Textiles — Seam tensile properties of fabrics and made-up textile articles — Part 2: Determination of maximum force to seam rupture using the grab method*

ISO 15027-1:2026, *Immersion suits — Part 1: Safety and performance requirements for constant wear suits*

ISO 15027-2:2026, *Immersion suits — Part 2: Safety and performance requirements for abandonment suits*

ISO 15831:2004, *Clothing — Physiological effects — Measurement of thermal insulation by means of a thermal manikin*

EN 590:2022, *Automotive fuels — Diesel — Requirements and test methods*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 15027-1:2026, ISO 15027-2:2026 and the following apply.

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

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

— IEC Electropedia: available at https://www.electropedia.org/

3.1
test panel
group of persons experienced in testing immersion suits who observe the test subject undergoing the tests

3.2
thermal manikin system
equipment for measuring thermal insulation of immersion suit systems, including a human-shaped, instrumented (temperature sensors and heaters) thermal manikin and a control system with a computer interface

4 Test methods

4.1 General

Requirements for which no special test methods are given in this document shall be tested in one of the following ways:

a) by tests referred to in ISO 15027-1:2026 and ISO 15027-2:2026; or

b) by measurement; or

c) by visual assessment; or

d) by functional test.

Prior to testing, materials and components shall be conditioned for (24 ± 0,1) h under standard atmosphere. The temperature cycling test and the rotating shock bin test shall be carried out as preconditioning before any other tests are carried out.

Annex A provides further information on uncertainty of measurement.

4.2 Sampling

Where materials and components are common to a range of suits, it is permitted to test just one sample of each material or component, unless specified otherwise by the relevant test procedure.

Samples for testing shall be taken from the original garment or from material or materials used in the finished garment.

When the number of samples to be tested is “at least [x]” or “a minimum of [x]” that number of [x] samples shall be tested.

4.3 Temperature cycling test

4.3.1 General

The temperature cycling test shall be carried out as a preconditioning before all other tests.

4.3.2 Procedure

The suit, along with any attachments, shall be subjected to the following exposures with the suit packed in accordance with the manufacturer’s instructions.

For suits supplied in a sealed storage bag, such as hermetically sealed or vacuum packed, the suit samples shall be exposed to this test in this condition, including the storage bag.

The suit shall be subjected to 10 alternating cycles of 8 h continuous exposures to temperatures of (65 ± 2) °C and (– 30 ± 2) °C. These alternating temperatures need not follow immediately after each other. On completion of the temperature cycling test, the suit shall be visually inspected for signs of degradation to the materials or construction or to any attachments.

4.4 Rotating shock bin test

4.4.1 General

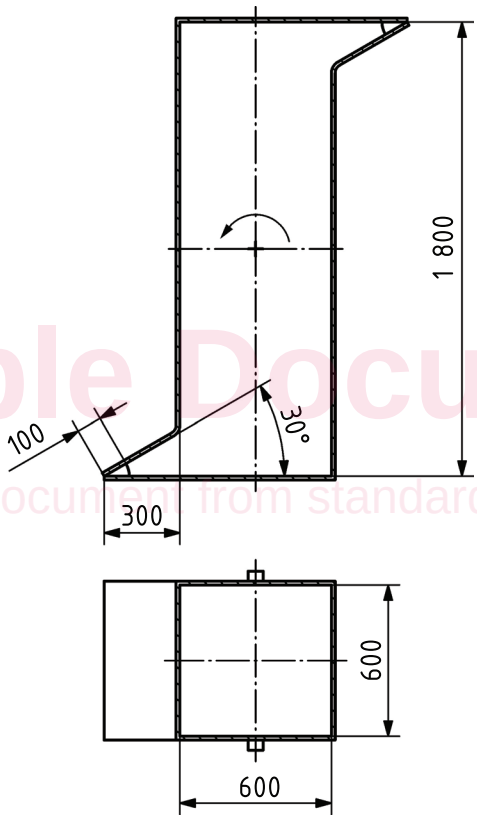
The rotating shock bin test shall be carried out as a preconditioning after the temperature cycling test in 4.3 but before all other tests.

4.4.2 Apparatus

The equipment used shall be as shown in Figure 1.

4.4.2.1 Box, of specific design made from plywood board or equivalent, the inside surface of which shall be coated with hard plastic laminate or similar. The bearing of the bin shall be in the centre of the mass and shall permit the bin to be rotated freely.

Dimensions in millimetres



NOTE In this figure, dimensions are identical once rotated 180° on its central axis.

Figure 1 — Design of rotation shock bin apparatus

4.4.3 Procedure

The suit 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^{-1}.

4.4.4 Evaluation

On completion of the revolutions, the suit shall be removed from the shock bin and examined for signs of wear and tear, and for any signs that the thermal insulation material has migrated.

4.5 Tensile strength of seams

The tensile strength of seams shall be measured on separate samples using the grab method given in ISO 13935-2:2014, using specimens of at least 60 mm width and with at least 100 mm of material on each side of the test point, with four similar seams for each type of seam including the seam between fastening devices, including zip fasteners, and fabric.

4.6 Fuel resistance test

Three samples of all exterior fabrics, typical seams, apertures and components shall be placed in a suitable container and submerged under a 100 mm head of diesel in accordance with EN 590:2022 at a temperature of (20 ± 2) °C for 24 h. After removal from the container, remove the surface diesel by wiping. Subject the samples to a hydrostatic test in accordance with ISO 811:2018 with a speed of 10 cm/min until 1 000 mm water head and then carry out a tensile seam strength test according to 4.5.

4.7 Buoyancy test

4.7.1 Principle

The buoyancy of a suit that is designed to be used without a personal flotation device (PFD) shall be measured using Archimedes' principle of weighing the submerged device in water, as specified in 4.7.3.

Any inflatable chambers required to meet ISO 15027-2:2026, 4.11.8, shall be inflated.

The buoyancy of the suit shall be measured and recorded after entrapped air has been removed, and 24 h after the initial buoyancy has been measured.

4.7.2 Apparatus

4.7.2.1 Weighted cage, with a submerged weight greater than 1,1 times its expected buoyancy value.

4.7.2.2 Tank, of fresh water, deep enough to accommodate the device horizontally with its upper surface at a depth of 100 mm to 150 mm below the water surface without contacting the sides of the tank or the bottom and supported by a calibrated load cell or balance.

4.7.3 Procedure

The suit shall be enclosed in a weighted cage (4.7.2.1).

The cage shall be suspended from the load cell in fresh water at a temperature of (20 ± 5) °C so that the upper surface of the horizontally positioned suit is submerged at 100 mm to 150 mm below the surface. The combined immersed weight shall be recorded as A.

The assembly shall remain immersed for $\left(24,0^{+0,5}_{-0}\right)$h , after which time the combined immersed weight shall again be recorded as B.

The suit shall finally be removed from the cage. The weighted cage (4.7.2.1) shall again be immersed and the result again recorded as C.

The water temperature, air temperature and atmospheric pressure shall be recorded at the start of each test and then after completion of each test.

4.7.4 Results

The buoyancy values shall be corrected to a water temperature of 20 °C and an atmospheric pressure of 101,325 kPa.

The initial buoyancy is obtained by subtracting A from C. The final buoyancy is obtained by subtracting B from C. The buoyancy lost during immersion is obtained by subtracting the final buoyancy from the initial buoyancy.

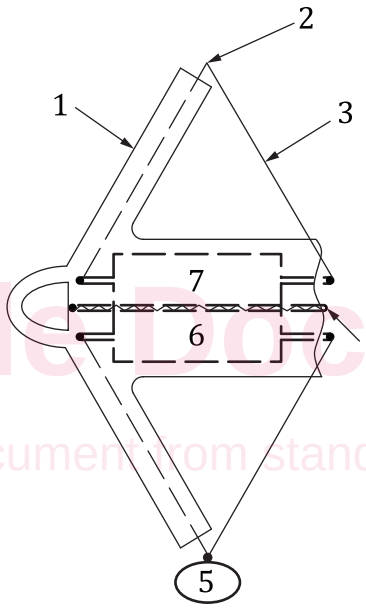
4.8 Suit strength test

4.8.1 Principle

The suit shall be subject to tension via its integral structure, such as waist belt or harness arrangement, by means of a specified load.

4.8.2 Apparatus

4.8.2.1 Horizontally suspended upper cylinder, of diameter (50 ± 5) mm for child suits, or of diameter (125 ± 10) mm for adult suits. The length of the test cylinder shall be sufficient to accommodate the full width of the portion of the suit under test, as shown in Figure 2.



Key

1	immersion suit	5	weight
2	suspension point	6	bottom cylinder
3	rope or cable	7	top cylinder
4	suit closure (closed)		

Figure 2 — Suit strength test

4.8.3 Procedure

The suit shall withstand a load of 1 350 N for 30 min, without tearing, seams ripping, parts breaking or other damage that permits water entry or otherwise affects the intended performance of the suit. One sample of the suit shall be tested. Prior to the application of the load, the suit shall be immersed in water for at least 2 min. The suit shall be placed in the test apparatus immediately after the immersion.

The load shall be applied by means of two cylinders (4.8.2.1), as illustrated in Figure 2.

With the suit supported by the top cylinder and the primary suit closures closed and adjusted to simulate use, a weight shall be attached to the bottom cylinder by means of ropes or cables to apply the required load

to the suit. When required, to accommodate the test apparatus, the suit shall be cut at the wrists or waist, or holes shall be cut into the suit.

4.8.4 Results

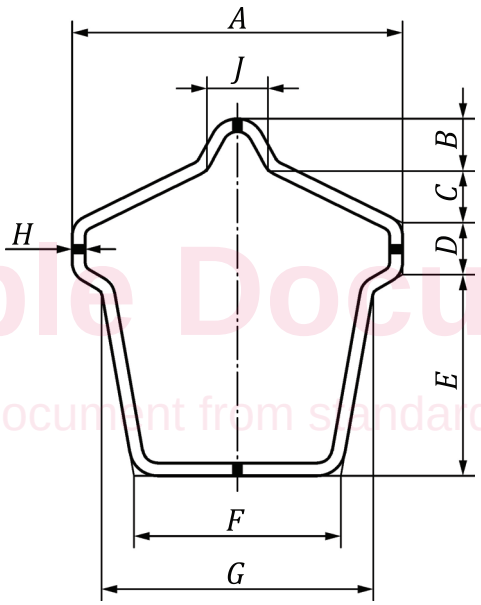
The suit shall be examined for any failures resulting in functional damage of the suit.

4.9 Lifting loop test

4.9.1 Procedure

The suit shall be fitted to the appropriately sized dummy such as that shown in ISO 12401:2009, 5.2.2.2, or the appropriately sized test form (see Figure 3) according to the manufacturer's donning and adjustment instructions.

A cylinder, (50 ± 5) mm in diameter, shall be put through the loop and a load of 3 200 N shall be applied steadily until the suit is hanging freely. The load shall be maintained for 30 min and shall include the mass of the dummy or test form (see Figure 3).



Key

Dimensions in millimetres

Size	A	B	C	D	E	F	G	H	I
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

NOTE General tolerances ISO 2768-1:1989, tolerance level "v".

Figure 3 — Test form for vertical load test, lifting loop and buddy lines

4.9.2 Results

The suit and lifting loop shall be examined for any failures resulting in functional damage of the suit.

4.10 Flammability test

4.10.1 Principle

The suit system, excluding a separate PFD, is passed over a test pan with burning test fuel to determine if the suit system burns or continues to melt after removal.

4.10.2 Apparatus

4.10.2.1 Test pan, (300 ± 20) mm × (350 ± 20) mm × (65 ± 5) mm.

4.10.2.2 Test fuel: petrol or n-heptane.

4.10.3 Sampling

One suit system, excluding a separate PFD, shall be subjected to the flammability test

4.10.4 Procedure

Place a test pan (4.10.2.1) in a draught-free area so that the suit system travels freely across the diagonal distance of the test pan.

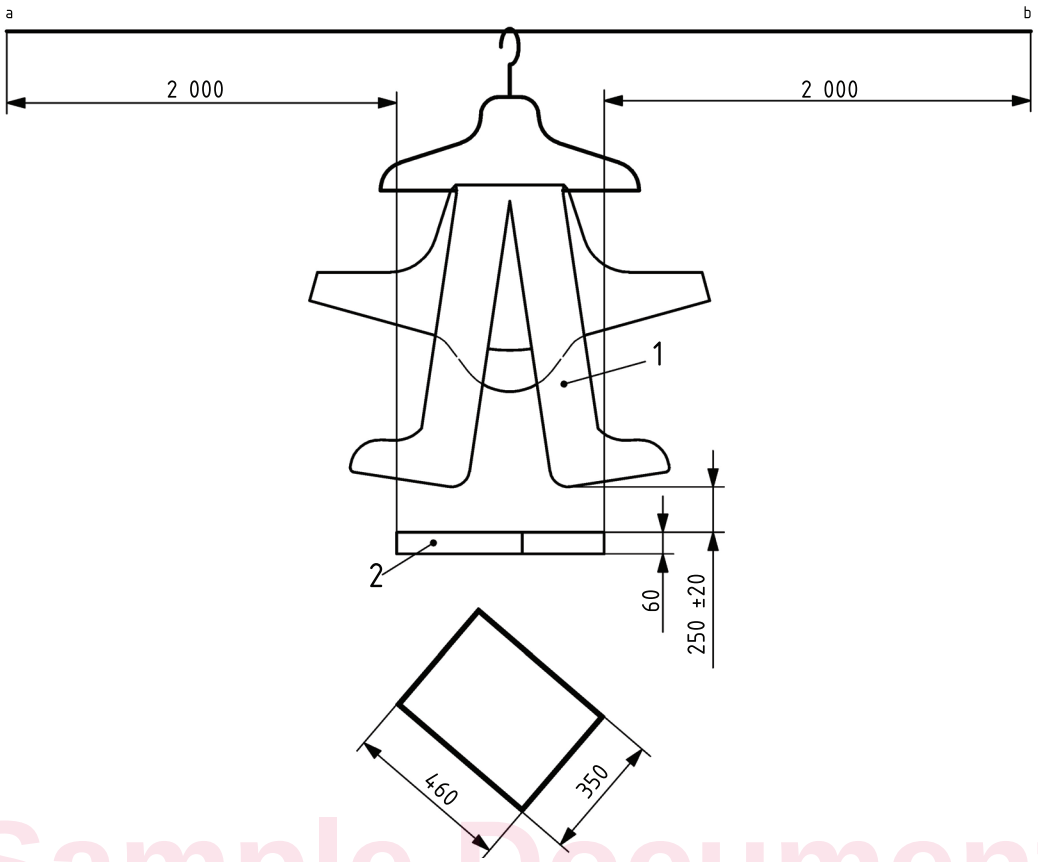
Fill the test pan (4.10.2.1) with water to a depth of 10 mm, followed by enough petrol or n-heptane to make a minimum total depth of 40 mm.

Ignite the petrol or n-heptane and allow to burn freely for 30 s.

Drape the suit system over a suitable hanger, folded at the waist with the front outward. The bottom of the suit shall be (250 ± 20) mm from the top edge of the test pan (4.10.2.1), see Figure 4. Secure loose parts above the lower part of the suit.

Then expose the suit system at a constant speed that allows the suit system to be exposed to the flames for (2 ± 0,1) s. The suit system shall start and finish the test 2 m away from the closest edge of the test pan (4.10.2.1).

Dimensions in millimetres



Key

1	suit	a	Start.
2	test pan	b	Finish.

Figure 4 — Flammability test

4.10.5 Evaluation

It shall be reported if the suit system, excluding a separate PFD, is destroyed by the flames. It shall be reported whether the suit sustains burning or continues melting 6 s after being removed from the flames.

4.11 Cleaning

Suit samples shall be cleaned in accordance with the manufacturer's cleaning instructions to condition them prior to testing. Five cleaning cycles shall be undertaken.

4.12 Human test subjects

4.12.1 Instruction and selection

All human test subjects shall be familiar with the use of the suit under test. They shall be informed and instructed on the potential hazards of the tests.

4.12.2 Number and sizes of human test subjects

Where tests call for the use of human test subjects, unless otherwise specified, six people shall be used, each wearing a suit of the appropriate size for the test subject, fitted in accordance with the stated height and chest size of the suit. Their body sizes shall be within the values for height and mass shown in Table 1.

When selecting test subjects, care should be taken to achieve an evenly spaced range of subject height and body mass.

If certain subject sizes in Table 1 are not applicable for the specific suit sizing, then subjects within the size range of the suits shall be selected, for a minimum of six subjects. The sizes of the subjects should be evenly distributed as much as possible to cover the range appropriate for the suit.

Table 1 — Human test subject sizes

Subject category	Height mm	Mass kg
1	1 400 to 1 600	1 person under 60
2	1 400 to 1 600	1 person over 60
3	1 601 to 1 800	1 person under 70
4	1 601 to 1 800	1 person over 70
5	> 1 800	1 person under 80
6	> 1 800	1 person over 100
NOTE Size categories relate to the size of test subjects only and do not relate to the size ranges of the suit products.		

4.12.3 Gender of human test subjects

At least one and not more than three of the persons should be female.

If the suit is gender specific, all subjects shall be of the specific gender.

4.12.4 Fitness of human test subjects

The persons conforming to the criteria given in 4.12.1 shall:

— be capable of relaxing when in water out of their depth; and

— be able to swim for 20 min and cover a distance of 350 m with the aid of an approved PFD as recommended by the manufacturer and, after sufficient rest, board the life raft or platform specified in 4.16.6.

4.12.5 Dress of human test subjects

Throughout the tests given in 4.13 to 4.16, unless otherwise specified, the underclothing specified by the manufacturer or, if not specified by the manufacturer, the standard underclothing according to 4.14.2.2, shall be worn by each human test subject.

4.12.6 Pass/fail criteria

Due to the high variability between human test subjects and the difficulty in assessing some subjective measures, it is permitted that a device does not completely meet the requirements of the subjective tests given in 4.13 to 4.16 in a single sample and in no more than one human test subject. Two other human test subjects within the same body mass category and with the same gender, wearing the same size of suit, shall be subjected to the same test and before the same test panel. If this additional test is still not clearly passed, then the device is deemed to have failed, while if it is clearly passed by the additional two subjects, the test panel may deem that the device has passed the test overall.

NOTE For the purposes of this clause, “subjective tests” includes all tests that require the participation of human test subjects.