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## Small craft — Permanently installed fuel systems

*Petits navires — Systèmes à carburant installés à demeure*

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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*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 464, *Small craft*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This fifth edition cancels and replaces the fourth edition (ISO 10088:2013), which has been technically revised.

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

- pressure testing requirement updated in [Annex A](#);
- permeation test limits and test procedures added as a new informative [Annex B](#) to serve as a reference for evaporative emissions.

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).

## Introduction

This document deals with the installed fuel system as a whole. Fire resistant hoses, non-fire resistant hoses and permanently installed petrol and diesel fuel tanks are dealt with by ISO 7840:2021; ISO 8469:2021 and ISO 21487:2012, respectively. These standards are applicable to these products supplied as components.

Some countries have environmental controls for evaporative emissions from petrol fuel systems, and this document includes an informative [Annex B](#) describing limits and test procedures for the control of evaporative emissions from permanently installed petrol fuel systems. The details in [Annex B](#) allow for future standardization and application of evaporative emissions on small craft.

As the international community further restricts fuel system emissions, it is anticipated that [Annex B](#) will have increased global acceptance.

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# Small craft — Permanently installed fuel systems

## 1 Scope

This document specifies the requirements for the design, materials, construction, installation and testing of permanently installed fuel systems as installed for internal combustion engines.

It applies to all parts of permanently installed diesel and petrol fuel systems as installed, from the fuel fill opening to the point of connection with the propulsion or auxiliary engine(s) on inboard- and outboard-powered small craft.

Requirements for the design and testing of petrol and diesel fuel tanks for internal combustion engines that are intended to be permanently installed in small craft are given in ISO 21487:2012.

## 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 1817:2015, *Rubber, vulcanized or thermoplastic — Determination of the effect of liquids*

ISO 7840:2021, *Small craft — Fire-resistant fuel hoses*

ISO 8469:2021, *Small craft — Non-fire-resistant fuel hoses*

ISO 8846:1990, *Small craft — Electrical devices — Protection against ignition of surrounding flammable gases*

ISO 11105:2020, *Small craft — Ventilation of petrol engine and/or petrol tank compartments*

ISO 11192:2005, *Small craft — Graphical symbols*

ISO 13297:2020, *Small craft — Electrical systems — Alternating and direct current installations*

ISO 21487:2012/Amd 1:2014/Amd 2:2015, *Small craft — Permanently installed petrol and diesel fuel tanks*

IEC 60068-2-52:2017, *Environmental testing — Part 2-52: Tests — Test Kb: Salt, cyclic (sodium chloride solution)*

## 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  
accessible**

capable of being reached for inspection, removal or maintenance without removal of permanent craft structure

Note 1 to entry: Hatches are not regarded as permanent craft structures in this sense, even if tools such as wrenches or screwdrivers are needed to open them. Hatches for inspection or maintenance of fuel tanks are permitted to be covered by uncut carpet, provided that all tank fittings can be inspected and maintained through other openings.

**3.2  
readily accessible**

capable of being reached quickly and safely for maintenance or effective use under emergency conditions without the use of tools

**3.3  
permanently installed**

securely fastened so that tools are required for removal

**3.4  
anti-siphon valve**

demand valve that can be opened only by fuel pump suction to withdraw fuel from a tank and that remains closed when the fuel pump is not operating, preventing siphon action created by a break or leakage at any point in the fuel distribution system

**3.5  
static floating position**

condition in which the craft floats in calm fresh water according to light craft mass  $m_{LC}$  with each fuel tank filled to rated capacity but excluding all non-permanently attached interior and exterior equipment

Note 1 to entry: The light craft mass  $m_{LC}$  is specified in ISO 8666:2020, 6.3.

**3.6  
petrol**

hydrocarbon fuel, or blend thereof, that is liquid at atmospheric pressure and is used in spark-ignition engines

**3.7  
diesel**

hydrocarbon fuel, or blend thereof, that is liquid at atmospheric pressure and is used in compression-ignition engines

**3.8  
spud**

rigid pipe or spigot used for the connection of pipes and hoses to tanks or components such as filters and pumps

**3.9  
swaged sleeve**

permanently attached fuel hose end fitting obtained by applying even compression to a metal sleeve or ferrule, sufficient to make the inner lining of the hose take up the shape of the insert and create a pressure seal

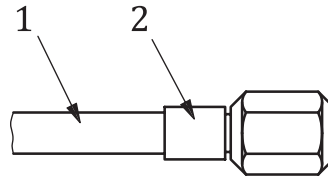
Note 1 to entry: See [Figure 1](#).

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**Key**

- 1 hose
- 2 sleeve

**Figure 1 — Swaged sleeve****3.10****sleeve and threaded insert**

permanently attached fuel hose end fitting made by screwing an insert sleeve with threads into the hose and applying even compression to a metal sleeve or ring to secure the hose in place

Note 1 to entry: This type of connection can be made with the sleeve placed on the outside of the hose and then screwing the threaded insert into the inner lining.

**3.11****compartment**

cabin or enclosure able to be closed to the outside of the craft

Note 1 to entry: Multiple compartments can be joined together as long as the total volume is closed to the outside of the craft.

**3.12****craft's ground**

ground that is established by a conducting connection (intended or accidental) with the common ground (potential of the earth's surface), including any conductive part of the wetted surface of the hull

Note 1 to entry: "Ground" is also known as "earth".

**3.13****craft****small craft**

recreational boat and other watercraft using similar equipment, of up to 24 m length of hull ( $L_H$ )

Note 1 to entry: The measurement methodology for length of hull is defined in ISO 8666.

[SOURCE: ISO 8666:2020, 3.15, modified — Note 1 to entry has been added.]

**3.14****entering the craft**

event in which liquids or fumes enter the interior space of the craft

**3.15****evaporative emissions**

fuel emissions that result from permeation of fuel through the fuel system materials or from ventilation of the fuel system

**3.16****diurnal emissions**

*evaporative emissions* (3.15) that occur as a result of venting fuel tank vapours during daily temperature changes while the engine is not operating

**3.17****emissions class 1 craft**

craft under 8 m in length or under 2,6 m beam

**3.18**

**emissions class 2 craft**

craft greater than or equal to 8 m in length or greater than or equal to 2,6 m beam

**3.19**

**SHED**

sealed housing evaporative determination enclosure

**3.20**

**carbon canister**

container with activated carbon to absorb hydrocarbon vapours from the fuel system

**3.21**

**heeled waterline**

level of the water on the hull in the fully loaded ready-for-use  $m_{LDC}$  condition when the craft is inclined to

- 7° for motor boats and sailing multihulls; or
- 30° or immersion of the sheerline, whichever occurs first, for monohull sailing boats

Note 1 to entry: The fully loaded ready-for-use condition is defined in ISO 8666:2020, 7.3.

[SOURCE: ISO 9093:2020, 3.6]

**4 General requirements**

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**4.1 Materials and design**

**4.1.1** Individual components of the fuel system, and the fuel system as a whole, shall be designed to withstand the combined conditions of pressure, vibration, shocks, corrosion and movement encountered under normal operating conditions and storage of the craft.

**4.1.2** Each component of the fuel system, and the fuel system as a whole, shall be capable of operation within an ambient temperature range of – 40 °C to + 80 °C, without failure or leakage.

**NOTE** Thermoplastic tanks and components can be affected by high return fuel temperature. It is therefore important to read the engine installation manual for information.

**4.1.3** All materials used in the fuel system shall be resistant to deterioration by its designated fuel and to other liquids or compounds with which it may come into contact under normal operating conditions, e.g. grease, lubricating oil, bilge solvents and sea water.

**4.1.4** Petrol engine compartments and petrol tank compartments and compartments with joints or fittings in fuel lines connecting spark-ignition engines with their fuel tanks shall have ventilation and ignition protection in accordance with ISO 11105:2020 and ISO 8846:1990.

**4.1.5** The only outlets for drawing fuel from the fuel system shall be

- plugs in petrol filter bowls intended solely for the purpose of servicing the filter;
- plugs or valves in diesel filter bowls intended solely for the purpose of servicing the filter.

**NOTE** Tank openings are covered by ISO 21487:2012.

**4.1.6** Any metal or metallic plated component of a petrol tank and its filling system that is in contact with petrol shall be grounded so that its resistance to the craft's ground is less than 1  $\Omega$ .

Grounding wires shall not be installed between a hose and its clamps.

**4.1.7** Fuel filling systems shall be designed to avoid spillage of fuel during refuelling to the rated capacity. Fuel systems shall be tested in accordance with [4.2.3](#).

**4.1.8** Provision shall be made to prevent fuel overflow from the vent opening while refuelling from entering the interior of the craft or the water.

**NOTE** A substance is "entering the interior of the craft", when it gets into a place being inside the surface of the watercraft. This can be i.e. the cabin or a similar place not being open to the atmosphere having one or more closing appliances used to cover an opening in the cockpit, hull or superstructures.

**4.1.9** All fuel system components in engine compartments (e.g. filters, pumps, water separators and hoses) – excluding permanently installed fuel tanks, which are tested in accordance with ISO 21487:2012 – shall individually, or as installed in the craft, be capable of withstanding a 2,5 min fire test as specified in [Annex C](#).

Fasteners supporting metal fuel lines constitute an exception to this requirement.

**4.1.10** Copper-base alloy fittings may be used for aluminium tanks if protected by a galvanic barrier to reduce galvanic corrosion.

**4.1.11** A means to determine the level or quantity of fuel in the tank shall be provided.

## 4.2 Testing

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**4.2.1** After installation, the fuel system as a whole shall pass the pressure test specified in [Annex A](#).

**4.2.2** Small components of the fuel system (e.g. filters, pumps, water separators and hoses), required to be fire tested according to [4.1.9](#), shall be tested as specified in ISO 7840:2021, Annex A, with the lower part mounted 250 mm above the surface of liquid in a pan of which the sides extend beyond the component by 150 mm. The component to be tested shall be a complete assembly and shall include all accessories intended to be attached directly to the component.

**4.2.3** There shall be no spillage of fuel from the fill fitting when filling at a rate of 30 l/min from 25 % to 75 % of the capacity on the tank label. For fuel tanks of 100 l capacity or less, the fill rate may be reduced to 20 l/min. The test to determine compliance with this shall be performed on at least one craft or a representative installation.

## 4.3 Installation

**4.3.1** The fuel system shall be permanently installed. All component parts, except small connectors and fittings and short sections of flexible hoses, shall be independently supported.

**4.3.2** All valves and other components intended to be operated or observed during normal operation of the craft, or for emergency purposes, shall be readily accessible. All fittings and connections of the fuel system shall be readily accessible, or accessible through an access panel, port or hatch. Tanks need not be accessible for removal.

**4.3.3** The clearance between a petrol fuel tank and a combustion engine shall not be less than 100 mm unless a thermal barrier is provided.