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Small craft — Permanently installed fuel systems

Petits navires — Systèmes à carburant installés à demeure

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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

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The committee responsible for this document is ISO/TC 188, *Small craft*.

This fourth edition cancels and replaces the third edition (ISO 10088:2009), which has been technically revised. The major changes concern 4.1.6, 4.3.2, and 5.5.4.

Small craft — Permanently installed fuel systems

1 Scope

This International Standard 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 of up to 24 m hull length.

Requirements for the design, materials, construction and testing of permanently installed fixed fuel tanks are given in ISO 21487.

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

ISO 7840:2013, *Small craft — Fire-resistant fuel hoses*

ISO 8469:2013, *Small craft — Non-fire-resistant fuel hoses*

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

ISO 10133, *Small craft — Electrical systems — Extra-low-voltage d.c. installations*

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

ISO 11192, *Small craft — Graphical symbols*

ISO 13297, *Small craft — Electrical systems — Alternating current installations*

ISO 21487, *Small craft — Permanently installed petrol and diesel fuel tanks*

3 Terms and definitions

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

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 may 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 need to be used for removal

3.4
anti-siphon valve
demand valve which can be opened only by fuel pump suction to withdraw fuel from a tank and which will remain 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
attitude in which the boat floats in calm fresh water according to light craft mass m_{LCC} with each fuel tank filled to rated capacity but excluding all non-permanently attached interior and exterior equipment

Note 1 to entry: Light craft mass m_{LCC} is specified in ISO 8666:2002[1], 6.3.

[SOURCE: ISO 13590:2003[2], 3.3, modified]

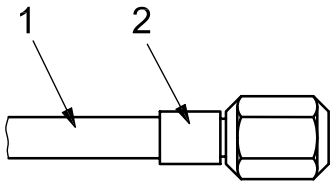
3.6
petrol
hydrocarbon fuel, or blend thereof, which is liquid at atmospheric pressure and is used in spark-ignition engines

3.7
diesel
hydrocarbon fuel, or blend thereof, which 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.



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

3.12
craft's ground
ground which 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".

4 General requirements

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.

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 − 10 °C to + 80 °C, without failure or leakage, and be capable of being stored without operation within an ambient temperature range of − 30 °C to + 80 °C, without failure or leakage.

NOTE Thermoplastic tanks and components may 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 shall have ventilation and ignition protection in accordance with ISO 11105 and ISO 8846.

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.

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 Ω.

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

4.1.7 Fuel filling systems shall be designed to avoid blowback of fuel through the fill fitting. 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 from entering the craft or the environment.

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 – shall individually, or as installed in the craft, be capable of withstanding a 2,5 min fire test as specified in ISO 7840:2013, Annex A.

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 a fuel tank level or quantity shall be provided.

4.2 Testing

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 7840:2013, 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 include all accessories intended to be attached directly to the component.

4.2.3 There shall be no blow back of fuel through 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. (see 4.1.7). 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.

4.3.4 The clearance between a petrol tank and exhaust components having a temperature exceeding 90 °C shall not be less than 250 mm, unless an equivalent thermal barrier is provided.

4.3.5 Fuel system electrical components shall be installed in accordance with ISO 10133 or ISO 13297.

4.3.6 Fuel tanks and components of petrol fuel systems shall not be installed directly above batteries unless the batteries are protected against the effects of fuel leakage.

5 Fuel pipes, hoses, connections and accessories

5.1 Fuel filling lines

5.1.1 The minimum inside diameter of the fill pipe system shall be 28,5 mm and the minimum inside diameter of fuel filling hoses shall be 38 mm.

5.1.2 Fuel filling hoses located in engine compartments shall be fire resistant, of type A1 or A2 in accordance with ISO 7840:2013. Fuel fill hoses outside engine compartments shall be of either type A1 or A2 in accordance with ISO 7840:2013, or of type B1 or B2 in accordance with ISO 8469:2013.

NOTE The 1 and 2 designations describe the level of permeation:

1 = 100g/m^2/24 h;

2 = 300 g/m^2/24 h.

5.1.3 Fuel filling lines shall be self-draining to the tank(s) when the craft is in its static floating position.

5.1.4 The fuel filling system shall be designed so that accidental fuel spillage does not enter the craft when it is in its static floating position.

5.1.5 The distance between compartment ventilation openings and fuel fill openings shall be at least 380 mm, except where the craft's coaming, superstructure or hull creates a barrier to prevent fuel vapour entering the craft through the ventilation opening.

5.1.6 The fuel filling point shall be marked "petrol" or "diesel" and/or with a symbol specified in ISO 11192 to identify the type of fuel to be used.

5.2 Vent lines and components

5.2.1 Each fuel tank shall have a separate vent line.

5.2.2 Vent hoses located in engine compartments shall be fire resistant, of type A1 or A2 in accordance with ISO 7840:2013. Vent hoses outside engine compartments shall be of either type A1 or A2 in accordance with ISO 7840:2013, or type B1 or B2 in accordance with ISO 8469:2013.

5.2.3 Each ventilation pipe shall have a minimum inside diameter of 11 mm (95 mm^2) or a ventilation opening designed to prevent the tank pressure from exceeding 80 % of the maximum test pressure marked on the tank label when tested in accordance with ISO 21487.

5.2.4 Vent lines shall not have valves other than those that permit free flow of air and prevent flow of liquid (fluid) both in and out of the tank(s).

5.2.5 Vent lines shall be self-draining when the craft is in its static floating position.

5.2.6 The distance between compartment ventilation openings and fuel vent openings shall be at least 400 mm, except where the craft's coaming, superstructure or hull creates a barrier to prevent fuel vapour entering the craft through the ventilation opening.

5.2.7 The vent line shall be arranged to minimize intake of water without restricting the release of vapour or intake of air and shall not allow fuel or vapour overflow to enter the craft.

5.2.8 The vent-line termination or a gooseneck in the vent-line routing shall be arranged at sufficient height to prevent spillage of fuel through the vent line during filling and entry of water under normal operating conditions of the craft.

For sailing monohulls, normal operating conditions include heeling at an angle of up to 30°.

5.2.9 The vent lines on all petrol installations shall incorporate a flame arrester device that fulfils the requirements in 4.1.7 and 5.2.3.

5.2.10 For vent-line components in engine compartments, with the ability to capture fuel, the fire test requirements in 4.1.9 apply.

5.3 Fuel distribution, return and balancing lines

5.3.1 Metal fuel lines shall be made of seamless annealed copper or copper–nickel or equivalent metal with a nominal wall thickness of at least 0,8 mm. Aluminium lines may be used for diesel.

5.3.2 Rigid fuel lines shall be connected to the engine by a flexible hose section. Support shall be provided within 100 mm of the connection to the metal supply line on the rigid side of the connection.

5.3.3 Connections in rigid fuel lines shall be made with efficient screwed, compression, cone, brazed or flanged joints.

5.3.4 Flexible fuel hoses shall be used where relative movement of the craft structures supporting the fuel lines would be anticipated during normal operating conditions.

5.3.5 Flexible fuel hoses shall be accessible for inspection and maintenance.

5.3.6 Petrol hoses shall be fire-resistant, type A1 hoses in accordance with ISO 7840:2013, except hoses entirely within the splash well at the stern of the craft connected directly to an outboard engine, which shall be type B1 or B2 hoses in accordance with ISO 8469:2013 or A1 or A2 hoses in accordance with ISO 7840:2013.

NOTE Hoses according to SAE J1527 will satisfy the requirements in ISO 7840 except marking.

5.3.7 Diesel hoses shall be fire-resistant, type A1 or A2 hoses in accordance with ISO 7840:2013.

5.3.8 Fuel lines shall be properly supported and secured to the craft structure above bilge water level, unless specifically designed for immersion or protected from the effects of immersion.

5.3.9 There shall be no joints in fuel pipes or hoses other than those required to connect required fuel-line components, e.g. filters and bulkhead connections.

5.3.10 Petrol line systems shall be designed or installed to prevent fuel siphoning out of the tank(s) following a failure in the system. The following examples illustrate how this can be achieved:

— routing all parts of fuel lines, from which an assumed leakage can enter the craft, above the level of the tank top when the craft is in its static floating position, including fuel-containing parts on the engine; or

— fitting an anti-siphon valve (3.4) as close as practical to the tank fittings with a rated siphon-protection head greater than that required to avoid the siphon effect; or

— fitting a manual shut-off valve as close as practical to the tank – which shall be capable of being closed from an indicated accessible location outside the engine compartment – in a position that is self-draining from the valve to the tank; or

— fitting an electrically operated valve as close as practical to the tank withdrawal fitting which is activated to open only when the engine is running or the starting device is operated. A momentary override type is acceptable for starting.

5.3.11 Diesel line systems shall be designed or installed to prevent fuel siphoning out of the tank(s) following a failure in the system. The following examples illustrate how this can be achieved:

— meet the requirements of 5.3.10, or

— be fitted with a manual shut-off valve as close as practical to the tank. This valve shall be capable of being closed from an indicated accessible location outside the engine compartment. If electrically operated valves are used, they shall be equipped with a manual emergency operating or by-passing device.

5.3.12 Diverting valves in diesel return lines shall ensure that the return line flow is not restricted.

5.4 Hose fittings and hose clamping

5.4.1 Fuel hoses shall be secured to the pipe, spud or fitting by metal hose clamps or be equipped with permanently attached end fittings such as a swaged sleeve or a sleeve and threaded insert.

5.4.2 Pipes, spuds or other fittings for hose connection with hose clamps shall have a bead, flare, series of annular grooves or serrations. The fuel-tank spud constitutes an exception to this requirement. Continuous helical threading knurls or grooves, which can provide a path for fuel leakage, shall not be used.

5.4.3 Spuds or other fittings for hose connection with hose clamps shall have a nominal outer diameter which is the same as the nominal inner diameter of the hose, and should be chosen from a series of preferred numbers, e.g. 3,2; 4; 5; 6,3; 8; 10; 12,5; 16; 20; 25; 31,5; 40; 50; 63.

5.4.4 Hose connections designed for a clamp connection shall have a spud at least 25 mm long.

5.4.5 Hose connections having a nominal diameter of more than 25 mm shall have two hose clamps. The spud shall be at least 35 mm long, to provide space for the clamps.

5.4.6 Spuds intended for hose connection shall be free from sharp edges that could cut or abrade the hose.

5.4.7 Hose clamps shall be made of CrNi 18-8 stainless steel, or equivalent, and be reusable. Clamps depending solely on spring tension shall not be used. The nominal clamp band width shall be at least 8 mm for nominal outside hose diameters up to and including 25 mm and at least 10 mm for bigger hoses. Clamps shall be of the correct size and shall be fitted according to the clamp manufacturer's requirements.

5.4.8 Clamps shall be installed to fit directly on the hose and shall not overlap each other. Clamps shall be installed behind the bead, if any, or fully on the serrations on spuds at least one clamp width from the end of the hose.

5.5 Valves and fittings

5.5.1 Manually operated valves shall be designed with positive stops in the open and closed positions or shall clearly indicate their open and closed positions.

5.5.2 The integrity and tightness of a valve shall not depend solely on spring tension.

5.5.3 Threaded valve housing covers that can be exposed to an opening torque when the valve is operated shall be secured against unintentional opening by a device that can be reused.

5.5.4 If a transparent tubular or flat glass column-type sight gauge is installed (only allowed in diesel tanks), it shall be as close as practical to the tank, protected to minimize the risk of physical damage, and shall be fitted with a self-closing valve at the bottom that can only be manually operated to open while attended. The top valve is not required to be self-closing.

5.6 Fuel filters

5.6.1 Petrol fuel systems shall be equipped with a fuel filter, which may be fitted on the engine(s).

5.6.2 Diesel fuel systems shall be equipped with at least one fuel filter and one water separator. The two functions may be combined in one unit.

5.6.3 Each filter shall be independently supported on the engine or craft structure.

5.7 Labelling

All components (e.g. filters, pumps and water separators) that fulfil the requirements of this International Standard shall be labelled or marked with the following:

— manufacturer's name or trademark;

— ISO 10088, fire resistant;

— type of fuel or fuels for which the component is suitable.

NOTE For labelling or marking of hoses see ISO 7840 or ISO 8469.