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Small craft — Permanently installed fuel systems and fixed fuel tanks

Navires de plaisance — Installations à combustible installées à demeure et réservoirs fixes correspondants

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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.

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.

International Standard ISO 10088 was prepared by Technical Committee ISO/TC 188, *Small craft*.

Annexes A and B form an integral part of this International Standard. Annexes C and D are for information only.

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Small craft — Permanently installed fuel systems and fixed fuel tanks

1 Scope

This International Standard specifies the requirements for the design, materials, construction, installation and testing of permanently installed fuel systems and fixed fuel tanks for internal combustion engines.

It applies to all parts of permanently installed diesel and petrol fuel systems and fixed fuel tanks, from the fuel fill opening to the point of connection with the propulsion or auxiliary engine on inboard- and outboard-powered small craft of less than 24 m hull length.

NOTE 1 National laws or regulations may have additional or different requirements on fuel systems from those specified in this International Standard.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 1817:1985, *Rubber, vulcanized — Determination of the effect of liquids.*

ISO 7840:—[1], *Small craft — Fire-resistant fuel hoses.*

ISO 8469:—[2], *Small craft — Non-fire-resistant fuel hoses.*

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

ISO 11192:—[2], *Small craft — Graphic symbols.*

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 accessible: Capable of being reached for inspection, removal or maintenance without removal of permanent craft structure.

NOTE 2 Hatches are not regarded as permanent craft structure 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 for operation, inspection or maintenance without removal of any craft structure or use of any tools or removal of any item of portable equipment stowed in places intended for storage of portable equipment such as lockers, drawers or shelves.

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 the 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 a craft floats in calm water, with each fuel tank filled to its rated capacity, but with no person or item of port-

1) To be published. (Revision of ISO 7840:1985)

2) To be published.

able equipment on board, with other tanks such as water and holding tanks empty and permanently installed equipment supplied by the craftbuilder in its proper place.

4 General requirements

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

4.2 All valves and other components intended to be operated or observed during normal operation of the craft or for regular service or for emergency purposes shall be readily accessible.

All other components of the system shall be accessible. Tanks need not be accessible for removal.

4.3 All electrically operated components installed in fuel systems shall be ignition-protected in accordance with ISO 8846.

4.4 There shall be no outlets for drawing fuel out from the system except:

— plugs in petrol filter bowls which are intended solely for the purpose of servicing the filter;

— plugs or valves in diesel filter bowls which are intended solely for the purpose of servicing the filter;

— drain valves and other fittings in diesel fuel tanks arranged as specified in 5.2.3.

4.5 Each metal fuel tank and metal or metal-plated component of the fuel fill system which may come into contact with fuel shall be grounded so that resistance to ground is less than 10 Ω.

Bonding wires shall not be clamped between a hose and its pipe or spud (spigot).

4.6 A means to determine fuel level or quantity in the tank shall be provided for each tank. If sounding pipes are provided they shall meet the requirements of 6.1.7 and 6.1.9.

4.7 After installation, the fuel system of every small craft shall be pressure-tested as described in annex B.

4.8 All components of the fuel system through which fuel passes shall individually or as installed in the craft withstand a 2,5 min fire test as described in annex A or ISO 7840:1985, annex A, except:

— metal fuel tanks, metal fuel lines, fittings of all-metal construction;

— diesel fuel tanks;

— fill and vent lines located outside the engine compartment;

— fill and vent external fittings;

— fill, vent, distribution and return lines for outboard motors, when these lines are located outside an engine compartment.

4.9 Copper-base alloys for fittings are acceptable for direct coupling with all tank materials listed in table 1 except aluminium. Copper-base alloy fittings may be used for aluminium tanks if a galvanic barrier is arranged between fitting and tank. Fasteners in contact with aluminium tanks shall be CrNi 18-8 stainless steel or equivalent.

5 Fuel tanks

5.1 Materials

Table 1 gives minimum material thicknesses for metal tanks required for corrosion resistance. Other materials including non-metallic materials may be used if they demonstrate equivalent corrosion resistance to materials listed.

5.2 Design and construction

5.2.1 Petrol tanks shall have no openings or fittings below the top of the tank.

5.2.2 Metal pipes, excluding vents, may be connected to the sides or ends of metal tanks provided that they are welded to the tank and reach above the top of the tank.

Table 1

Material	Minimum nominal sheet thickness for corrosion resistance mm	Remarks
Copper, internally tin-coated	1,5	Not for diesel
Aluminium alloys containing no more than 0,1 % copper	2	—
Passivated austenitic, low carbon content, chromium nickel steel alloys	1	Remove all welding deposits
Mild steel	2	Not for petrol
Mild steel externally hot-dip zinc-coated after fabrication	1,5	Not for petrol
Mild steel externally and internally hot-dip zinc-coated after fabrication	1,5	Not for diesel

5.2.3 Diesel fuel tanks may have inspection openings in the top only. Fittings in the bottom, sides or ends are allowed provided that each such connection has a shut-off valve closely coupled to the tank. The valve shall be protected against physical damage or be of at least 25 mm nominal diameter. All other openings or fittings shall be at or above the top of the tank except welded pipes complying with 5.2.2.

5.2.4 Metal tanks shall be so designed and installed that no exterior surface will trap water.

5.2.5 Rigid fuel pick-up tubes and fill pipes which extend near the tank bottom shall have sufficient clearance to prevent contact with the bottom due to flexing of the tank.

5.3 Marking

All fuel tanks shall display the following information in contrasting or embossed letters and numerals at least 3 mm high:

— manufacturer's name or trade-mark, city or equivalent, and country;

— year of manufacture (two last digits);

— capacity in litres;

— fuel or fuels in symbols for which the tank is suitable (as specified in ISO 11192);

— maximum allowable test pressure.

5.4 Testing

Each tank shall be pressure-tested in accordance with annex B.

5.5 Installation

5.5.1 Fuel tanks shall be permanently installed in such a manner that they do not support decks, bulkheads or other craft structure, unless they are designed for the purpose.

5.5.2 Petrol tanks shall not be integral with the hull.

5.5.3 Sandwich construction shall not be used for integral diesel tanks.

5.5.4 Fuel tanks shall not be mounted on engines.

5.5.5 Fuel tanks shall be installed in a manner that allows inspection and maintenance. The markings of 5.3 shall be visible during inspection.

5.5.6 Metal supports, chocks or hangers shall be separated from the surface of metal tanks by a non-metallic, non-hygroscopic, non-abrasive material or welded to the tank.

5.5.7 Non-integral metal tanks located inside the craft shall be installed with their bottom no less than 50 mm above the bilge pump inlet.

6 Fuel pipes, hoses, connections and accessories

6.1 Fuel fill lines

6.1.1 The minimum inside diameter of the fill pipe system shall be 31,5 mm and minimum inside diameter of fuel fill hoses shall be 38 mm.

6.1.2 Fuel fill hoses located in the engine compartment shall be fire-resistant type A1 or A2 according to ISO 7840[1]. Other fuel fill hoses shall be either type A1 or A2 in ISO 7840[1], or type B1 or B2 in ISO 8469.

6.1.3 Each fuel tank shall have an individual fill line.

6.1.4 Fuel fill lines shall not have valves.

6.1.5 Fuel fill lines shall be self-draining to the tank when the craft is in its static floating position.

6.1.6 Fuel fill lines shall run as directly as practicable, preferably in a straight line from the deck plate or equivalent fill point to the spud of the tank.

6.1.7 The fuel fill point shall be so located and arranged that no fuel can enter the craft when it is in static floating position and fuel overflows at a rate of 20 l/min for 5 s.

6.1.8 No ventilation opening shall be located within a 400 mm horizontal radius of the fuel fill point, nor vertically below this radius, except where the vessel's coaming, superstructure or hull creates a barrier to prevent fuel vapour entering the craft.

6.1.9 The fuel fill point shall have a label or symbol as specified in ISO 11192 that clearly identifies the type of fuel to be used.

6.2 Vent lines

6.2.1 The minimum inside diameter of the vent system shall be 12,5 mm and the minimum nominal inside diameter of vent hoses shall be 16 mm. Dual vents, if installed, shall each be of this size.

6.2.2 Vent hoses located in the engine compartment shall be fire-resistant, type A1 or A2 hoses according to ISO 7840[1]. Other vent hoses shall be either type A1 or A2 in ISO 7840[1], or type B1 or B2 in ISO 8469.

6.2.3 Vent lines shall not have valves.

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

6.2.5 The vent-line termination shall be remote and not less than 400 mm from any ventilation opening through which fuel vapour may enter the craft.

6.2.6 The vent line shall have provisions to minimize intake of water without restricting the continuous release of vapour or intake of air and shall not allow fuel overflow to enter the craft.

6.2.7 The vent line connection shall be at the highest point of the tank as installed in the craft.

6.3 Fuel distribution lines and fuel return lines

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

6.3.2 Rigid fuel distribution and return 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 are acceptable for diesel fuel.

6.3.3 All petrol distribution and return hoses shall be fire-resistant, ISO 7840[1] type A1 hoses, except for installations covered under 6.3.5.

6.3.4 All diesel fuel distribution and return hoses shall be fire-resistant, ISO 7840[1], type A1 or A2 hoses, except for installations covered under 6.3.5.

6.3.5 Outboard motor petrol distribution and return hoses, located outside an engine compartment, shall be chosen as type A1, in ISO 7840[1], or B1 in ISO 8469. These hoses shall be used from the fuel tank to the last connection fitting inside the craft or the outboard motor, whichever connection is first.

Outboard motor diesel fuel distribution and return hoses, located outside an engine compartment, may be type A2 in ISO 7840[1] or B2 in ISO 8469.

6.3.6 Fuel distribution and return lines shall be properly supported and secured to the craft structure. Clips or other fasteners shall comply with the requirements in 4.7.

6.3.7 No joints are accepted in fuel distribution and return pipes or hoses other than those required to connect needed fuel line components.

6.3.8 Petrol fuel systems shall include an anti-siphon device or arrangement, which

— keeps 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,

— is an anti-siphon valve (see 3.4) at the tank fittings with a rated siphon protection head greater than required to avoid siphon effect,

— is an electrically operated valve at the tank withdrawal fitting connected to be energized to open only when the engine is running or the starter motor is operated. A momentary override type is acceptable for starting.

6.3.9 For diesel fuel systems, a shut-off valve at the tank withdrawal fitting is required, unless the entire distribution line is self-draining to the tank and meets the requirements in 6.3.8. This valve shall be capable of being closed from a readily 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.

6.4 Hose fittings and hose clamping

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

6.4.2 Pipes, spuds (spigots) or other fittings for hose connection with hose clamps shall have the same nominal outer diameter as the nominal inner diameter of the hose, preferably chosen from the series of preferred numbers (e.g. 3,2; 4; 5; 6,3; 8; 10; 12,5; 16; 20; 25; 31,5; 40; 50; 63 — see annex D).

Hose connections having a nominal diameter of more than 25 mm shall have two hose clamps instead of one.

Spuds intended for two clamps shall have a basically cylindrical portion of minimum 35 mm to provide adequate space for the clamps. For one clamp this cylindrical portion shall be a minimum of 25 mm.

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

Helical threading or knurling of fittings shall not be used to retain the fuel line on the fitting.

6.4.3 Hose clamps shall be made of stainless steel CrNi 18-8, 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.

6.4.4 Clamps shall be installed to fit directly on the hose and shall not overlap each other.

Clamps shall be installed beyond the bead, if any, or fully on the serrations and nominally at least one clamp width from the end of the hose.

6.5 Valves

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

6.5.2 Electrically operated petrol shut-off valves shall be connected to be energized to open only when the engine is running. A momentary override type may be provided.

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

6.5.4 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.

6.6 Fuel filters

6.6.1 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.

6.6.2 Each filter shall be independently supported on the engine or hull structure.

Annex A
(normative)

Fire resistance testing

A.1 General

A.1.1 Larger components shall be tested independently or as installed.

A.1.2 Fuel system components that are small enough, such as fuel valves, shall be tested as described in ISO 7840:—[1], annex A.

A.1.3 The component to be tested shall be a complete assembly and include all details intended to be attached directly to the component.

A.2 As-installed fire test

A.2.1 The component to be tested shall be installed in an actual or simulated hull section of sufficient size to simulate fire conditions aboard the craft. All bulkheads, supports, floors and other surfaces in the test hull section shall be of the same material and dimensions as in the craft.

A.2.2 A component intended for use in a series of crafts of similar size and design may be tested in one hull section only provided that the chosen hull section gives the most severe fire exposure to the component of the hull sections in the series.

A.2.3 The test method described in A.3 shall be used.

A.3 Test method

A.3.1 The area in which the test is to be conducted shall be free from draughts but shall have provision for a free inflow of air during the test.

A.3.2 Perform a pressure test according to annex B. The component to be tested shall show no leakage. Release the test pressure.

A.3.3 Components which, according to 4.8, do not need to be capable of withstanding the fire test may be left out from the test setup. If this is done, open connections in the fuel may be equipped with hoses or pipes with open ends outside the fire area.

A.3.4 Fill the component or components to be tested to 25 % of its rated or full capacity with petrol.

A.3.5 Pour *n*-heptane into all crevices and liquid traps beneath the components and into all crevices within a 75 mm horizontal distance out from a vertical projection of the outmost parts of the components.

A.3.6 The heptane in the simulated hull section shall be ignited and permitted to burn for a continuous period of 2,5 min.

A.3.7 At the end of the 2,5 min test period, any continued burning shall be extinguished.

A.3.8 Examine the sample components for leakage. Drain the components. Pressure-test the components with a slowly increased air or inert gas pressure up to 2 kPa.

The components shall show no evidence of leakage when checked with methods other than the pressure drop method (see clause B.4).

Annex B
(normative)

Pressure testing

B.1 When testing a separate component of a fuel system, the test pressure shall be 20 kPa or 1,5 times the highest hydrostatic pressure to which the component may be subjected in service, whichever is greater.

B.2 When testing a separate component containing non-metallic parts in contact with fuel or fuel vapour, the component shall be filled with test liquid C in accordance with ISO 1817 immediately before a pressure test and stored 28 days ± 2 h at a temperature of 23 °C ± 2 °C.

B.3 When testing a complete fuel system as installed in the craft, the test pressure shall be 20 kPa.

B.4 Pressure testing shall be performed with the component or system filled with air or inert gas. For separate components, including tanks, and for joints and gaskets in complete fuel systems, a leak-detection method other than the pressure drop method shall be used. Submerging in water or the use of soapy water shall be preferred.

WARNING — Do not use solutions containing ammonia.

For complete systems as a whole, the pressure drop method shall be used. In addition, each fitting, joint and connection shall be examined using a leak-detection method other than the pressure drop method. The time during which the system is exposed to the pressure shall then be at least 1,5 s per litre tank capacity or 5 min, whichever is greater, up to a maximum of 30 min.

When pressure-testing complete systems, fuel-fill deck plates and vent-line through-hull fittings may be replaced by plugs. The fuel connection at the fuel feed pump of the engine shall be disconnected and sealed. Anti-siphon valve and other fuel valves shall be open.

B.5 A component or fuel system shall show no leakage under testing.