INTERNATIONAL STANDARD

ISO 10088

Second edition
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Small craft — Permanently installed fuel systems and fixed fuel tanks

Petits navires — 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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

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

This second edition cancels and replaces the first edition (ISO 10088:1992), of which it constitutes a technical revision.

Annexes A, B and C form a normative part of this International Standard.

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 filling opening to the point of connection with the propulsion or auxiliary engine on inboard- and outboard-powered small craft of up to 24 m hull length.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 1817:1999, *Rubber, vulcanized — Determination of the effect of liquids*

ISO 7840:1994, *Small craft — Fire-resistant fuel hoses*

ISO 8469:1994, *Small craft — Non-fire-resistant fuel hoses*

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

ISO 10133:2000, *Small craft — Electrical systems — Extra-low-voltage d. c. installations*

ISO 11105:1997, *Small craft — Ventilation of petrol engine and/or petrol tank compartments*

ISO 11192:—[1)], *Small craft — Graphical symbols*

ISO 13297:2000, *Small craft — Electrical systems — Alternating current installations*

3 Terms and definitions

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

3.1
accessible
capable of being reached for inspection, removal or maintenance without removal of permanent craft structure

1) To be published.

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

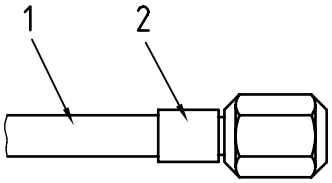
3.6
petrol
hydrocarbon fuel, or blends thereof, which is liquid at atmospheric pressure and is used in spark ignition engines

3.7
diesel
hydrocarbon fuel, or blends thereof, which is liquid at atmospheric pressure and is used in compression ignition engines

3.8
spud
term used to describe any rigid pipe or spigot used for the connection of pipes and hoses to tanks or components i.e. 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

See Figure 1.



Key

1 Hose
2 Sleeve

Figure 1 — Permanently attached end fitting

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 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

4 General requirements

4.1 Materials and design

4.1.1 Individual components of the system, and the 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 system, and the 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.

4.1.3 All materials used in fuel systems 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 Metal pipes, welded to the tank, shall be designed and installed so that bending moments at the tank connection are avoided.

4.1.5 Electrical devices located in compartments with petrol tanks or petrol fuel system connections or joints shall be ignition protected in accordance with ISO 8846.

4.1.6 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;

— drain valves and other fittings in diesel fuel tanks as specified in C.2.2 and C.2.4.

4.1.7 In any petrol fuel filling system' each metal fuel tank and metal or metal-plated component which may come into contact with fuel shall be grounded to earth with a maximum resistance of 10 Ω.

Grounding wires shall not be clamped between a hose and its pipe or spud.

4.1.8 Each tank shall be provided with a means to determine fuel level or quantity. If sounding pipes are provided, they shall meet the requirements of 6.1.6 and 6.1.8.

Sight gauges shall only be used in diesel tanks and shall be fitted with automatic shut-off valves according to C.2.5.

4.2 Testing

4.2.1 After installation, the fuel system shall pass the pressure test as specified in annex A.

4.2.2 All components in the engine compartment between the engine and the tank, (e.g. filters, water separators, etc.) shall individually, or as installed in the craft, be capable of withstanding a 2,5 min fire test as described in annex B or ISO 7840:1994, annex A.

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

4.2.3 Non-metallic petrol tanks shall be tested in accordance with the fire-resistance test specified in annex B.

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

4.3.3 Copper-base alloy fittings may be used for aluminium tanks if protected by a galvanic barrier to reduce galvanic corrosion. Any component between the fitting and tank providing a galvanic barrier may be fitted.

4.3.4 Petrol engine compartments and petrol tank compartments shall have ventilation and ignition protection in accordance with ISO 11105 and ISO 8846.

4.3.5 The clearance between a petrol fuel tank and a combustion engine shall not be less than 100 mm.

4.3.6 The clearance between dry exhaust components and a petrol tank shall not be less than 250 mm, unless an equivalent thermal barrier is provided.

4.3.7 **F**uel system electrical components shall be installed in accordance with ISO 10133 and ISO 13297.

4.3.8 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 tanks

5.1 Materials, design and marking

Materials, design and marking shall be in accordance with annex C.

5.2 Testing

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

5.2.2 Non-metallic petrol tanks shall pass the fire-resistance test in accordance with annex B.

5.3 Installation

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

5.3.2 Petrol tanks shall not be integral with the hull.

5.3.3 Each metallic tank shall be installed to allow drainage from each tank surface when the craft is in its static flotation position.

Metallic fuel tanks, installed above horizontal surfaces, shall, when full of fuel, be separated from the surfaces by at least 5 mm and the surfaces shall not trap water.

5.3.4 Fuel tanks shall not be mounted on inboard engines.

5.3.5 Fuel tanks shall be installed in a manner that allows inspection and maintenance of fittings, hoses connections, etc. The markings listed in C.3 shall be visible during inspection.

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

5.3.7 Metallic tanks other than diesel tanks integral with the hull shall be installed with the tank bottom no less than 25 mm above the top of the bilge pump inlet or the bilge pump automatic float switch.

5.3.8 Foam shall not be the sole means used to secure tanks in place. Where foam is in contact with the tank, due care should be taken to avoid corrosion.

6 Fuel pipes, hoses, connections and accessories

6.1 Fuel filling lines

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

6.1.2 Fuel filling hoses located in the engine compartment shall be fire resistant, of type A1 or A2 in accordance with ISO 7840. Other fuel fill hoses shall be of either type A1 or A2 in accordance with ISO 7840, or of type B1 or B2 in accordance with ISO 8469.

6.1.3 Each petrol tank shall have a separate fuel filling system.

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

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

6.1.6 The fuel filling point shall be so located and arranged that no overflowing fuel can enter the craft when it is in its static floating position.

The following constitute exceptions to this requirement:

— open outboard craft without accommodation spaces and other enclosed spaces and with a continuous floor that is liquid-tight to the hull interior and bilge compartments containing electrical components or batteries; or

— diesel engine powered craft, provided that the fuel filling and vent openings are above a continuous floor that is liquid-tight to the hull interior and bilge compartments containing engines, electrical components, batteries, etc. and the floor is above the fully loaded waterline and drains overboard naturally.

6.1.7 The fuel filling system shall be designed to avoid blowback of fuel through the fill fitting when filling at a rate of 30 l/min, at between 1/4 and 3/4 full of the tank capacity. For fuel tanks of 100 litres capacity or less, the fill rate may be reduced to 20 l/min.

6.1.8 The fuel filling point shall not be located within or vertically above a 400 mm horizontal radius of any ventilation opening, except where the craft's coaming, superstructure or hull creates a barrier to prevent fuel vapour entering the craft.

6.1.9 The fuel filling point shall be marked with "petrol" or "diesel" or a symbol as described in ISO 11192 to identify the type of fuel that shall be used.

6.2 Vent lines

6.2.1 Each fuel tank shall have a separate vent line.

6.2.2 Vent hoses located in the engine compartment shall be fire-resistant, of type A1 or A2 in accordance with ISO 7840. Other vent hoses shall be of either type A1 or A2 in accordance with ISO 7840, or type B1 or B2 in accordance with ISO 8469.

6.2.3 The cross-sectional area of any vent component shall not be less than 95 mm^2.

6.2.4 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.

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

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

6.2.7 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.

6.2.8 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.

On monohull sailing craft, the vent line shall be arranged to minimize the risk of fuel spillage or entry of water through the vent when sailing at an angle of 30°.

6.2.9 The vent lines on all fuel installations shall incorporate a flame arrester device, that fulfils the requirements in 6.1.7 or 6.2.3.

6.3 Fuel distribution lines and fuel return lines

6.3.1 Metal 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.

6.3.2 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.

6.3.3 Connections between rigid fuel distribution or return lines shall be made with efficient screwed, compression, cone, brazed or flanged joints.

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

6.3.5 Flexible fuel distribution and return hoses shall be accessible for inspection and maintenance.

6.3.6 All petrol distribution and return hoses shall be fire-resistant, type A1 hoses in accordance with ISO 7840, except for outboard powered craft, where fuel hoses are in the open air and where spillage drains are overboard, which shall use type B1 or B2 hoses in accordance with ISO 8469 or A1 or A2 hoses in accordance with ISO 7840.

6.3.7 All diesel fuel distribution and return hoses shall be fire-resistant, type A1 or A2 hoses in accordance with ISO 7840.

6.3.8 Fuel distribution and return 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.

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

6.3.10 Fuel distribution lines to petrol engine(s) shall be designed or installed to prevent fuel siphoning out of the tank following a failure in the system. The following examples illustrate how this may 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) at 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 in a position that is self-draining from the valve to the tank; this valve shall be capable of being closed from an indicated accessible location outside the engine compartment; or

— fitting an electrically operated valve at 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. If electrically operated valves are used, they shall be equipped with a manual emergency operating or by-passing device.

6.3.11 Fuel distribution lines to diesel engines shall either

— meet 6.3.10, or

— be fitted with a manual shut-off valve. 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.

6.3.12 Divert valves in diesel return lines shall ensure that the return line flow is not restricted.

6.4 Hose fittings and hose clamping

6.4.1 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.

6.4.2 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.

6.4.3 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, preferably 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, see [1] in the bibliography.

6.4.4 Hose connection designed for a clamp connection shall have a spud of at least 25 mm long.

6.4.5 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.

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

6.4.7 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.

Clamps shall be of the correct size and shall be fitted according to the clamp manufacturer's requirements.

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