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Small craft — Personal watercraft — Construction and system installation requirements

Navires de plaisance — Motos aquatiques — Exigences de construction et d'installation des systèmes

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Contents

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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 13590 was prepared by Technical Committee ISO/TC 188, *Small craft*.

Annex A of this International Standard is for information only.

Small craft — Personal watercraft — Construction and system installation requirements

1 Scope

This International Standard applies to personal watercraft as defined in 3.1, for construction and installation of permanently installed petrol fuel systems, electrical systems, ventilation and floatation.

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 1402:1994, *Rubber and plastics hoses and hose assemblies — Hydrostatic testing.*

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

ISO 7326:1991, *Rubber and plastics hoses — Assessment of ozone resistance under static conditions.*

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

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

ASTM D 380:1994, *Methods of Testing Rubber Hose.*

ASTM D 413:1993, *Test Method for Rubber Property — Adhesion to Flexible Substrate.*

ASTM D 471:1996, *Test Method for Rubber Property — Effect of Liquids.*

ASTM D 573:1994, *Test Method for Rubber — Deterioration in an Air Oven.*

ASTM D 1621:1994, *Compressive Properties of Rigid Cellular Plastics.*

SAE J378:1988, *Marine Engine Wiring.*

SAE J1127:1995, *Battery Cable.*

SAE J1128:1995, *Low Tension Primary Cable.*

SAE J1527:1993, *Marine Fuel Hoses.*

SAE J2031:1996, *High Tension Ignition Cable.*

3 Definitions

3.1 personal watercraft: Vessel less than 4 m in length, which uses an internal combustion engine powering a water jet pump as its primary source of propulsion, and is designed to be operated by a person or persons sitting, standing, or kneeling on, rather than within, the confines of a hull.

3.2 fuel system: Entire assembly of the fuel fill, vent, tank and distribution components, including and not limited to pumps, valves, strainers, carburettors and filters.

3.3 static floating position: Attitude in which a personal watercraft floats in calm water, with each fuel tank filled to its rated capacity, but with no person or items of portable equipment on board.

3.4 conduit: Any type of rigid plastic or metal piping or tubing which supports the conductors contained within.

3.5 AWG: American Wire Gauge.

3.6 ignition protection: Design and construction of a device such that under design operation conditions; it will not ignite an inflammable hydrocarbon mixture surrounding the device when an ignition source causes an internal explosion, or it is incapable of releasing sufficient electrical or thermal energy to ignite a hydrocarbon mixture, or the source of ignition is hermetically sealed.

3.7 sheath: Material used as a continuous protective covering, such as electrical tape, moulded rubber, moulded plastic or flexible tubing, around one or more insulated conductors.

3.8 open to the atmosphere: Space or compartment that has at least 0,34 m^2 of open area directly exposed to the atmosphere for each cubic metre of net compartment volume.

3.9 ventilation: Changing of air within a compartment by natural means.

NOTE — Ventilation may be affected by dilution of contaminated air by introduction of fresh air, or by local exhaust of contaminated air.

3.10 engine compartment: Space where the engine is permanently installed.

3.11 bilge: Area, excluding engine rooms, in the personal watercraft below a height of 100 mm measured from the lowest point in the personal watercraft, where liquid can collect when the personal watercraft is in its static floating position.

3.12 engine-compartment bilge: Space in the engine compartment or a connected compartment below a height of 300 mm measured from the lowest point where liquid can collect when the personal watercraft if in its static floating position.

4 Fuel system

4.1 General

4.1.1 Each fuel system fitting, joint and connection shall be arranged so that it can be reached for inspection, removal or maintenance without removal of permanent watercraft structure.

4.1.2 The fuel system shall be designed not to leak liquid fuel into the watercraft when

— the personal watercraft is overturned through 180° of roll in either direction and

— the personal watercraft is overturned through 90° of pitch in either direction.

4.1.3 The fuel system shall be designed not to leak liquid fuel into the personal watercraft when subjected to 20 kPa or 90 % design relief pressure of the system, whichever is greater.

4.1.4 The fuel system shall be designed to automatically stop the supply of fuel to the engine when the engine is not running.

4.2 Fuel tanks

4.2.1 Fuel tank prohibited materials

4.2.1.1 A fuel tank shall not be constructed of terne-plate.

4.2.1.2 Unless it has an inorganic sacrificial galvanic coating on the inside and outside of the tank, a fuel tank shall not be constructed of black iron or steel.

4.2.1.3 A fuel tank encased in cellular plastic or in fiber reinforced plastic shall not be constructed from a ferrous alloy.

4.2.2 Cellular plastic used to encase fuel tank

4.2.2.1 Cellular plastic used to encase fuel tanks shall not change volume by more than 5 % or dissolve after being immersed in any of the following liquids for 24 h at 29 °C:

— reference fuel B of ASTM D 471 or equivalent fuel;

— No. 2 reference oil of ASTM D 471 or equivalent fuel;

— 5 % solution of trisodium phosphate in water.

4.2.2.2 Cellular plastic used to encase fuel tanks shall not absorb more than 60 g of water per 0,1 m^2 of cut surface.

4.2.2.3 Non-polyurethane cellular plastic used to encase metallic fuel tanks shall have a compressive strength of at least 400 kPa at 10 % deflection, when determined in accordance with ASTM D 1621.

4.2.2.4 Polyurethane cellular plastic used to encase metallic fuel tanks shall have a density of at least 0,032 g/cm^3.

4.2.3 Fuel level indication

A means shall be provided to check the fuel level or a reserve fuel supply shall be provided.

4.2.4 Tank pressure limitation

With the personal watercraft in its static floating position, a fuel tank when filled shall have an air expansion volume or be equipped with a system that prevents pressure in the tank from exceeding 80 % fuel tank design pressure.

4.2.5 Fill and vent openings

Fill and vent openings shall be at or above the liquid level when the tank is filled to capacity in its static floating position.

4.2.6 Fuel tank static pressure test

A representative fuel tank shall not leak if tested using the following procedures.

4.2.6.1 Fill the tank with air or inert gas to 20 kPa or 90 % of the design relief pressure, whichever is greater.

4.2.6.2 Examine each tank fitting and seam for leaks using a leak detection method other than the pressure drop method.

4.2.7 Fuel tank shock test

A representative fuel tank shall not leak when tested using the following procedure.

4.2.7.1 Confirm that the tank does not leak when pressure tested according to 4.2.6.

4.2.7.2 If the tank is nonmetallic, precondition the tank by filling it to capacity with petrol that has at least a 50 % aromatic content. Keep the fuel in the tank at 21 °C or higher for at least 30 days prior to testing.

4.2.7.3 Mount the empty tank on the platform of an impact test machine in a manner similar to the manner in which the tank and hold-down arrangement is installed in the personal watercraft.

4.2.7.4 Fill the tank to capacity with water.

4.2.7.5 Apply 1 000 cycles of vertical accelerations of 25 *g* at a rate of 80 cycles or less per minute. Apply the accelerations within 76 mm of the centre of the horizontal mounting surface of the tank. The duration of each vertical acceleration pulse measured at the base of the shock envelope shall be between 6 ms and 14 ms.

4.2.7.6 Check the tank for leaks using the procedure specified in 4.2.6.

4.3 Fuel tank installations

4.3.1 Non-encased fuel tanks

4.3.1.1 Each fuel tank shall not support a deck, bulkhead or other structural component.

4.3.1.2 Fuel tanks shall not be integral with the hull or engine.

4.3.1.3 Each metallic fuel tank as installed shall allow water to drain from the top surface when the personal watercraft is in its static floating position.

4.3.1.4 Each fuel tank support, chock or strap that is not integral with a metallic fuel tank shall be insulated from the tank surface by a material that does not absorb moisture.

4.3.1.5 Cellular plastic shall not be the sole support for a metallic fuel tank.

4.3.2 Plastic encased fuel tanks

4.3.2.1 Each fuel tank encased in cellular plastic foam or in fibre reinforced plastic shall have the connection and fittings accessible for inspection and maintenance.

4.3.2.2 If a metallic fuel tank is encased in cellular plastic or in fibre reinforced plastic, water shall not collect between the plastic and the surface of the tank or be held against the tank by capillary action.

4.3.2.3 If the plastic is bonded to the surface of a metallic fuel tank, the adhesive strength of the metal to plastic bond shall exceed the cohesive strength of the plastic.

4.4 Fuel tank fill system

4.4.1 Each fuel fill opening shall be located so that when the personal watercraft is in its static floating position, a petrol overflow of up to 19 l/min for at least 5 s will not enter the personal watercraft.

4.4.2 Each hose in the tank fill system shall be secured to a pipe, spud or hose fitting by a method that prevents leaks and prevents the hose from becoming disconnected.

4.5 Fuel pumps

4.5.1 Each diaphragm fuel pump shall not leak fuel into the personal watercraft if the primary diaphragm fails.

4.5.2 Each electrically operated fuel pump shall not operate except when the engine is operating or when the engine is being started.

4.6 Carburettors

Each carburettor shall not leak externally more than 5 cm^3 of fuel in 30 s when:

— the float valve is open (if applicable),

— the carburettor is at half throttle or,

— the engine is cranked without starting or the fuel pump is delivering the maximum pressure specified by its manufacturer (if applicable).

4.7 Fuel stop valves

Each electrically operated fuel stop valve in a fuel line between the fuel tank and the engine shall open electrically only when the ignition switch is on.

4.8 Fuel filters and strainers

Each fuel filter and strainer shall be supported on the engine or watercraft structure independent from its fuel line connections, unless the fuel filter or strainer is inside a fuel system component.

4.9 Spud, pipe and hose fitting

Except when used for a tank fill line, each spud, pipe or hose fitting used with hose clamps shall have a bead, flare or a series of annular grooves or serration no less than 0,4 mm in depth.

4.10 Clips, straps and hose clamps

4.10.1 Each clip, strap, and hose clamp shall be of a corrosion resistant material and not cut or abrade the fuel line.

4.10.2 Hose clamps, when used, shall be used with hose designed for clamps.

4.10.3 Hose clamps, when used, shall be beyond the bead or flare, or over the serration of the mating spud, pipe or hose fitting.

4.11 Metallic fuel line

4.11.1 Each metallic fuel line connecting the fuel tank with the fuel inlet connection on the engine shall not be made of carbon steel. Except for corrugated flexible fuel lines, each metallic fuel line shall have a minimum wall thickness of 0,74 mm.

4.11.2 Each metallic fuel line that is mounted to the watercraft structure shall be connected to the engine by a flexible fuel line and shall be attached to the personal watercraft's structure within 100 mm of its connections to a flexible fuel line.

4.12 Plugs and fittings

A fuel system shall not have a fitting for draining fuel.

Exception: a plug used to remove fuel and/or water within the fuel filter or strainer shall have a tapered pipe thread or be a screw type fitting with a locking device other than a split lock washer.

4.13 Vent and fuel distribution hoses and connections

4.13.1 Each hose shall meet the requirements of 4.16.

4.13.2 Each hose shall be secured by a method that prevents leaks and prevents the hose from becoming disconnected.

4.14 Grounding (Earthing)

Each metallic component of the fuel fill system and fuel tank that is in contact with fuel shall be statically grounded (earthed) so that resistance between the ground (earth) and each metallic component of the fuel fill system and the fuel tank is less than 100 Ω.

4.15 Fire test

The fuel system in a representative personal watercraft equipped with its complete engine and fuel system shall not leak when tested using the following procedure.

4.15.1 Fill the fuel tank to one-fourth total capacity.

4.15.2 Close all bilge drains that might allow the fuel to flow out of the engine compartment.

4.15.3 Confirm that the fuel system meets the requirements of 4.1.3.

4.15.4 Pour an amount of heptane over the engine sufficient to burn for at least 2,5 min, but no longer than 5 min.

4.15.5 Ignite the heptane.

4.15.6 Observe burning heptane after ignition.

4.15.7 Close engine compartment

4.15.8 Wait 2,5 min.

4.15.9 Open engine compartment and extinguish any remaining flame with carbon dioxide (CO_2).

4.15.10 Pressurize the fuel system to 2 kPa with air or inert gas and check for leaks.

4.16 Fuel hose specifications

The fuel hose shall either meet the performance specifications in ISO 7840 or ISO 8469, or meet the following hose specifications, which apply to two types of fuel hose for personal watercraft. One type is a reinforced hose with a cover and the other is a hose without a cover.

4.16.1 Tensile strength and elongation

A test for tensile strength and elongation shall be made, and specimens shall meet the conditions given in table 1.

Table 1 — Tensile strength and elongation

Specification	Hose with cover		Hose without cover
	Tube material	Cover material	Hose material
Original strength	8 MPa	7 MPa	8 MPa
Original elongation	200 % minimum	200 % minimum	200 % minimum

4.16.2 Dry heat resistance

After heat aging in accordance with ASTM D 573 for 70 h at 100 °C ± 2 °C specimens taken from the hose shall not have a reduction in tensile strength of more than 20 % or a reduction in elongation of more than 50 %.

4.16.3 Ozone resistance

Test procedure, apparatus and acceptance level shall be in accordance with Method 1 of ISO 7326:1991. This test applies to the outer surface of the hose only and cracks in the inner surface or cut edges shall be ignored.

4.16.4 Oil resistance

After 70 h immersion at 100 °C ± 2 °C in ASTM Oil No. 3 in accordance with ASTM D 471, specimens taken from the hose shall meet the conditions given in table 2.

Table 2 — Oil resistance

Specification	Hose with cover		Hose without cover
	Tube material	Cover material	Hose material
Reduction in Tensile strength	Not more than 40 %	—	Not more than 40 %
Reduction in elongation	Not more than 40 %	—	Not more than 40 %
Volumetric change	- 5 % to + 25 %	0 to + 100 %	- 5 % to + 25 %

4.16.5 Burst test

The minimum burst when tested in accordance with ISO 1402 shall be 300 kPa.

4.16.6 Vacuum collapse test

A 1 m length of hose shall be held in a straight line, and no diameter shall decrease by more than 20 % during application of a vacuum of 67 kPa for a minimum of 15 s and not more than 60 s. The vacuum collapse test on