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Small craft — Personal watercraft — Construction and system installation requirements

Petits navires — Motos aquatiques — Exigences de construction et d'installation des systèmes

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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 2.

The main task of technical committees is to prepare International Standards. 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 document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

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

This second edition cancels and replaces the first edition (ISO 13590:1997), which has been technically revised.

Small craft — Personal watercraft — Construction and system installation requirements

1 Scope

This International Standard applies to personal watercraft as defined in 3.1, for the construction and installation of builder's plate, permanently installed petrol fuel systems, electrical systems, steering systems, ventilation, hull structure and floatation, and requirements for stability, freeboard and owner's manual.

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

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

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

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

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

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

ISO 10240:—[2)], *Small craft — Owner's manual*

ASTM D 1621:2000, *Standard Test Method for Compressive Properties of Rigid Cellular Plastics*

3 Terms and definitions

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

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

1) To be published. (Revision of ISO 7840:1994)

2) To be published. (Revision of ISO 10240:1995)

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
engine compartment
space where the engine is permanently installed

3.10
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

3.11
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 is in its static floating position

3.12
design category
description of the sea and wind conditions for which a craft is assessed to be suitable

NOTE The following design categories apply:

— **C: Inshore:** Designed for voyages in coastal waters, large bays, estuaries, lakes and rivers where conditions up to and including wind force 6 and significant wave heights up to, and including, 2 m may be experienced;

— **D: Sheltered waters:** Designed for voyages on small lakes, rivers and canals where conditions up to and including wind force 4 and significant wave heights up to and including 0,5 m may be experienced.

3.13
builder's plate
label or plate to display critical information related to the personal watercraft

3.14
handlebar
mechanical means for applying manual steering effort into the helm, normally a horizontal configuration with hand grips at each end and the helm connected to the handle

3.15
helm
mechanism, exclusive of handlebar or other means for manual application of a controlling force, by which the controlling force is fed into a personal-watercraft steering-system cable

3.16
maximum recommended load
maximum weight of persons and portable equipment that may be carried on the personal watercraft

4 Builder's plate

4.1 General requirements

4.1.1 Size of characters

The minimum required information characters shall be at least 5 mm in height. Other characters shall be at least 3 mm in height.

4.1.2 Size of marking, pictograms and symbols

Pictogram and symbols shall be at least 8 mm in height.

4.1.3 Location

The “builder's plate” shall be readily visible, preferably near the driver's position. In any case, the builder's plate shall be separate from the hull identification number.

4.1.4 Fixing and marking

The “builder's plate” shall be permanently displayed, and characters and other marking shall be capable of withstanding the combined effects of water, oil, salt spray, direct sunlight, heat, cold and wear expected during normal operation of the personal watercraft without loss of legibility, and shall be resistant to removal and alteration of information without leaving some obvious sign of such effects.

Alternatively, the information may be printed or etched on the craft itself.

The colours applied to the label shall be fade resistant.

4.2 Display information

4.2.1 The following information shall be displayed on each “builder's plate”:

— manufacturer's name;

— design category;

— maximum recommended load, according to Clause 9;

— number of persons, recommended by the manufacturer, which the craft is designed to carry when underway, according to Clause 9.

4.2.2 The manufacturer may provide additional information on the label. The inclusion of this additional information shall not impair the legibility of the minimum required information.

5 Fuel system

5.1 General

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

5.1.2 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, or

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

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

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

5.2 Fuel tanks

5.2.1 Materials prohibited for fuel tanks

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

5.2.1.2 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.

5.2.1.3 A fuel tank encased in cellular plastic or in fibre-reinforced plastic shall not be constructed from a ferrous alloy.

5.2.2 Cellular plastic used to encase fuel tanks

5.2.2.1 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 in accordance with ISO 1817:1999, Table A.1, or an equivalent fuel;

— reference oil No. 2 in accordance with ISO 1817:1999, A.2.1.2, or an equivalent fuel;

— 5 % solution of trisodium phosphate in water.

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

5.2.2.3 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.

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

5.2.3 Fuel-level indication

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

5.2.4 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 % of the fuel-tank design pressure.

5.2.5 Fill and vent openings

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

5.2.6 Fuel-tank static-pressure test

5.2.6.1 A representative fuel tank shall not leak if tested using the procedures given in 5.2.6.2 and 5.2.6.3.

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

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

5.2.7 Fuel-tank shock test

5.2.7.1 A representative fuel tank shall not leak when tested using the procedures given in 5.2.7.2 to 5.2.7.7.

5.2.7.2 Confirm that the tank does not leak when pressure tested according to 5.2.6.

5.2.7.3 If the tank is non-metallic, 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.

5.2.7.4 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.

5.2.7.5 Fill the tank to capacity with water.

5.2.7.6 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 cycle measured from the base of the shock envelope shall be between 6 ms and 14 ms.

5.2.7.7 Check the tank for leaks using the procedure specified in 5.2.6.

5.3 Fuel-tank installations

5.3.1 Non-encased fuel tanks

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

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

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

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

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

5.3.2 Plastic-encased fuel tanks

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

5.3.2.2 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.

5.3.2.3 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.

5.4 Fuel-tank filling system

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

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

5.5 Fuel pumps

5.5.1 Each fuel pump with a diaphragm shall not leak fuel into the personal watercraft if the primary diaphragm fails.

5.5.2 Each electrically operated fuel pump shall operate only when the engine is operating or being started.

5.6 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, and

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

5.7 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.

5.8 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.

5.9 Spud, pipe and hose fitting

Except when used for a tank filling 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.

5.10 Clips, straps and hose clamps

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

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

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

5.11 Metallic fuel line

5.11.1 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.

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

5.12 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.

5.13 Vent and fuel-distribution hoses and connections

5.13.1 Each hose shall meet the requirements of 5.16.

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

5.14 Grounding (Earthing)

Each metallic component of the fuel filling 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-filling system and the fuel tank is less than 100 Ω.

5.15 Fire test

5.15.1 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.

5.15.2 Fill the fuel tank to one-fourth of total capacity.

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

5.15.4 Confirm that the fuel system meets the requirements of 5.1.3.

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

5.15.6 Ignite the heptane.

5.15.7 Observe burning heptane after ignition.

5.15.8 Close the engine compartment

5.15.9 Wait 2,5 min.

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

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

5.16 Fuel-hose specifications

5.16.1 General

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.

5.16.2 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

	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

5.16.3 Dry-heat resistance

After heat ageing in accordance with ISO 7840 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 %.

5.16.4 Ozone resistance

The test procedure, apparatus and acceptance level shall be in accordance with Methods 1, 2 or 3 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.

5.16.5 Oil resistance

After 70 h immersion at 100 °C ± 2 °C in Oil No. 3 in accordance with ISO 1817:1985, or equivalent oil, specimens taken from the hose shall meet the conditions given in Table 2.

Table 2 — Oil resistance

	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 %

5.16.6 Burst test

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

5.16.7 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 preformed parts shall be done on the finished part. This test does not apply to hoses of nominal diameter over 25 mm.

5.16.8 Cold flexibility

The test specimen shall be conditioned in accordance with ISO 7840 at −20 °C ± 2 °C for 5 h, and then flexed in the cold chamber through 180° from the centreline to a diameter of ten times the maximum outside diameter of the hose. The flexing shall take place within 4 s and the hose shall not fracture or show any cracks or breaks, or a proof pressure of 0,7 MPa shall be applied to determine hose damage. The test method for a hose of nominal diameter 19 mm may be in accordance with the test method of ISO 7840, using cutout specimens (100 mm × 6 mm).

5.16.9 Adhesion test (reinforced hose with cover)

The minimum load required to separate a 25 mm width of tube and cover at 23 °C ± 2 °C in accordance with ISO 7840 shall be 27 N.

5.16.10 Fuel resistance

5.16.10.1 After 48 h immersion at 23 °C ± 2 °C in liquid C in accordance with ISO 1817:1999, physical values of specimens taken from the hose shall not exceed the change in values listed in Table 3.

Table 3 — Fuel resistance

Specification	Change
Tensile	−45 %
Elongation	−45 %
Volume	0 to + 50 %

5.16.10.2 Permeation shall be tested in accordance with Annex B of ISO 7840:—[3] and shall not exceed 300 g/m^2 over 24 h.

3) To be published.

6 Electrical system

6.1 Exemptions

The following items are exempt from 6.2, 6.5, 6.6, 6.7 and 6.8:

— circuits having a current flow of less than 1 A;

— conductors which are totally inside an equipment housing;

— resistance conductors that control circuit amperage;

— high-voltage secondary conductors and terminations that exist in ignition systems;

— pigtails of less than 180 mm of exposed length;

— cranking motor conductors.

6.2 Conductor type, size and identification

6.2.1 Each conductor shall be made of insulated, stranded copper.

6.2.2 Conductors shall comply with ISO 10133 or equivalent standards.

6.2.3 No conductor shall be used to carry amperage greater than that specified in Table 4 for its cross-sectional area.

6.2.4 A means of identification shall be used to distinguish individual conductors.

6.2.5 Table 4 gives permissible continuous current ratings in amperes determined for 30 °C ambient temperature.

Table 4 — Cross-sectional area of conductor, permissible continuous current and stranding

Cross-sectional area	Maximum current, in amperes, for single conductors at insulation temperature ratings						Minimum number of strands[a]	
mm^2	60 °C	70 °C	85 °C to 90 °C	105 °C	125 °C	200 °C	Type 1	Type 2
0,75	6	10	12	16	20	25	16	—
1	8	14	18	20	25	35	16	—
1,5	12	18	21	25	30	40	19	26
2,5	17	25	30	35	40	45	19	41
4	22	35	40	45	50	55	19	65
6	29	45	50	60	70	75	19	105
10	40	65	70	90	100	120	19	168
16	54	90	100	130	150	170	37	266
25	71	120	140	170	185	200	49	420
35	87	160	185	210	225	240	127	665
50	105	210	230	270	300	325	127	1 064
70	135	265	285	330	360	375	127	1 323
95	165	310	330	390	410	430	259	1 666
120	190	360	400	450	480	520	418	2 107
150	220	380	430	475	520	560	418	2 107

Note 1 The values given in this table are identical to those in ISO 10133.

Note 2 Conductor current ratings may be interpolated for cross-sectional areas between those shown in this table.

[a] Conductors with at least type 1 stranding shall be used for general craft wiring. Conductors with type 2 stranding shall be used for any wiring where frequent flexing is involved during use.

For conductors in engine compartments (ambient temperature 60 °C), the maximum current rating in Table 4 shall be derated by the factors given in Table 5.

Table 5 — Correction factors

Temperature rating of conductor insulation °C	Multiply maximum current from Table 4 by
70	0,75
85 to 90	0,82
105	0,86
125	0,89
200	1

6.2.6 For information, the voltage drop E under load, in volts, may be calculated using the following formula:

$$E = \frac{0{,}016\,4 \times I \times L}{A_{\mathrm{C}}}$$

where

I is the load current, in amperes;

L is the length, in metres, of conductor from the positive power source to the electrical device and back to the negative source connection;

A_{C} is the cross-sectional area of the conductor, in square millimetres.

6.3 Conductor support and protection

6.3.1 Each conductor shall be installed so that it is protected from physical damage.

6.3.2 Except for the first 500 mm of battery cables, conductors shall be supported by clamps or straps not more than 400 mm apart, unless the conductor(s) is contained in a conduit.

6.3.3 Clamps, straps or conduits shall be designed to prevent damage to the conductor insulation.

6.3.4 Conductors connecting components that can move with relation to each other shall be protected from stresses.

6.3.5 Conductors passing through bulkheads, junction boxes or other rigid surfaces shall be bushed with a conduit or grommets, or a protective sheath.

6.4 External ignition protection

A representative electrical system as installed in the personal watercraft, or in an enclosure simulating the personal watercraft, shall not ignite a propane gas and air mixture [volume fraction: 4,25 % to 5,25 % propane] surrounding the electrical system when it is operated in the mode in which it draws its maximum current. The test voltage supply shall be adjusted to 120 % of the nominal system voltage, except for magneto ignition systems.

6.5 Overcurrent protection

6.5.1 Except for conductors from self-limiting generators or alternators, each ungrounded current-carrying conductor shall be protected by a manual-reset trip-free circuit breaker or fuse. The fuse or breaker shall be within 180 mm of the origin of the conductor to be protected, as long as the fuse or breaker is sized for the smallest conductor in the circuit.

If a conductor is continuously protected from physical damage by a sheath or enclosure between its terminal ends, the maximum distance to its protecting fuse or breaker may be increased to 500 mm from the power source measured along the conductor.

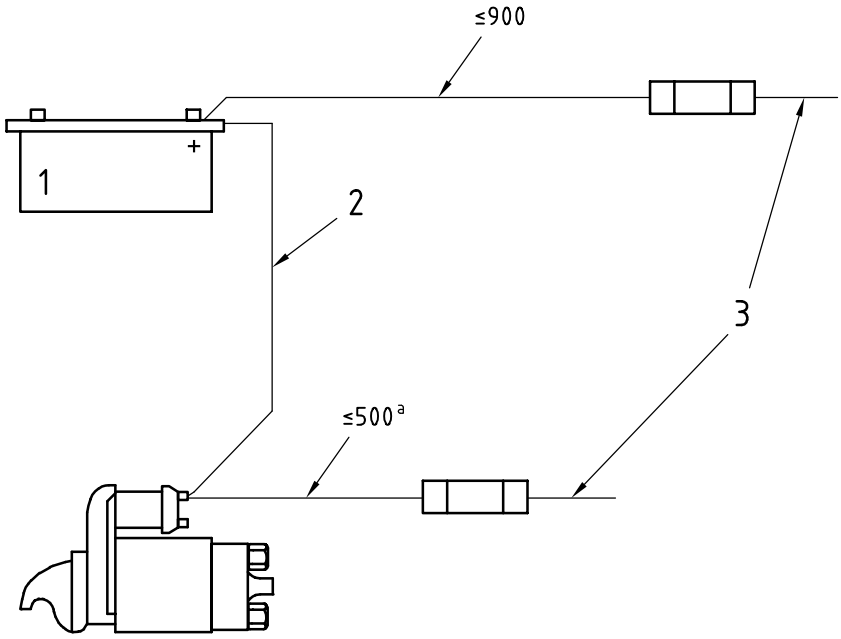
An ungrounded supply conductor starting at a storage battery shall have its breaker or fuse within 900 mm of the battery, measured along the conductor (see Figure 1).

6.5.2 The voltage rating of each circuit breaker or fuse shall not be less than the nominal voltage of the circuit it is protecting.

6.5.3 The current ratings of the circuit breaker or fuse shall not be more than 150 % of the value in Table 4 for the conductor it is protecting, including the correction factor if any part of the conductor is in an engine compartment.

6.5.4 Circuit breakers or fuses for non-self-limiting generators and alternators shall have a current rating not exceeding 120 % of the maximum rated output at 60 °C.

Dimensions in millimetres



Key

1 battery

2 cranking motor conductor (no length restriction)

3 conductors to various loads as needed (no length restriction)

a) A distance up to 500 mm is allowed if the conductor, throughout this distance, is contained in an enclosure or sheath such as a junction box, control box or enclosed panel.

Figure 1 — Breaker/fuse location for an ungrounded supply conductor starting at a storage battery

6.6 Conductor terminations

6.6.1 All connections outside junction boxes or enclosures shall be made with closed ring, eyelet, captive spade, or mechanical or spring-lock-type connectors. Wire nuts shall not be used on any connection.

6.6.2 Single or multi-connector plugs outside junction boxes or enclosures shall not separate under a tensile force of 25 N applied for 1 min.

6.6.3 A soldered joint shall not be the sole means of connection to any conductor, except for battery-terminal connectors with soldered joints at least 1,5 times longer than the diameter of the conductor strands.

6.6.4 Conductor joints outside junction boxes or enclosures shall not break when subjected for 1 min to the tensile force given in Table 6 for the smallest conductor in the connection.

6.6.5 Ungrounded terminal fittings and conductors shall be protected from accidental short circuiting with grounded metal or other ungrounded circuits in the event of loosening a termination. Continuously energized terminations without circuit protection shall be covered with boots or be equivalently protected.

Table 6 — Tensile test values for wire joints

(Conductor-conductor and conductor-connector joints)

Wire cross-section mm^2 (AWG)	Tensile force N
0,8 (18)	44
1 (16)	64
2 (14)	132
3 (12)	157
5 (10)	175
8 (8)	200
13 (6)	220
16 (5)	265
19 (4)	315
25 (3)	350
32 (2)	400
40 (1)	440

6.7 Batteries

6.7.1 Each installed battery shall not move by more than 25 mm in any direction when a pulling force of twice the battery weight is applied through the centre of gravity of the battery as follows:

— vertically in both directions for a duration of 1 min;

— horizontally and parallel to the personal watercraft's centreline for a duration of 1 min fore and 1 min aft;

— horizontally and perpendicular to the personal watercraft's centreline for a duration of 1 min to starboard and 1 min to port.

6.7.2 Each battery shall be installed so that metallic objects cannot come in contact with the ungrounded battery terminals.

6.7.3 Each metallic fuel line and fuel-system component within 100 mm above the horizontal plane of the battery top surface, as installed, shall be shielded with dielectric material.

6.7.4 Each battery shall not be directly above or below a fuel tank, fuel filter or fitting in a fuel line.

6.7.5 A vent system or other means shall be provided to allow the discharge from the personal watercraft of hydrogen gas released by the battery.

6.7.6 Each battery-terminal connector shall not depend on spring tension for its mechanical connection to the terminal.

6.8 Secondary circuits of ignition systems

6.8.1 Each conductor in a secondary circuit of an ignition system shall meet the requirements in ISO 10133 or equivalent standards.

6.8.2 The connection of each ignition conductor to a spark plug, coil or distributor shall have a tight fitting cap, boot or nipple.

7 Ventilation

7.1 Specified in 7.2 to 7.7. Personal watercraft shall have a ventilation system that meets the requirements.

7.2 Ventilation means an airflow in a compartment in a personal watercraft achieved by having

— a supply opening or duct from the atmosphere or from a ventilated compartment that is open to the atmosphere, and

— an exhaust opening into another ventilated compartment or an exhaust duct to the atmosphere.

7.3 Each exhaust opening or exhaust duct shall originate in the lower third of the compartment.

7.4 The two openings shall be separated by locating them either at the fore and aft sides of the engine compartment, or on opposite sides of the personal watercraft.

7.5 Each supply and exhaust opening or duct in a compartment shall be above the normal accumulation of bilge water.

7.6 Except as specified in 7.7, the combined area of supply openings or supply ducts, and the combined area of exhaust openings or exhaust ducts, shall have a minimum internal cross-sectional area calculated as follows:

$$A = 3\,300 \times \ln(V/0{,}14)$$

where

A is the minimum combined internal cross-sectional area of the openings or ducts, in square millimetres;

V is the net compartment volume equal to the total compartment volume minus the volume of permanently installed components in it, in cubic metres.

7.7 The minimum internal cross-sectional area of each supply and exhaust opening or duct shall exceed 2 000 mm^2.

8 Hull-structure test

8.1 Drop test

A representative personal watercraft shall be tested in the manner described in 8.2.

8.2 Testing

Load the personal watercraft to the maximum recommended load, with the tanks filled. The distribution of this load shall represent passengers in their normal positions.

The loaded personal watercraft shall be dropped horizontally from a height of 2,5 m (measured from water to the lowest point of the personal watercraft) into the water.

8.3 Passing or failing the test

There shall be no structural failures in the form of fractures, cracks, tears, separation, etc. on any part of the hull or personal-watercraft component, such as the deck, when the personal watercraft is closely examined at the end of the test.

9 Floatation test

9.1 General

This test is intended to provide manufacturers of personal watercraft with specific guidelines for determining the amount of floatation necessary to keep a portion of the personal watercraft above the surface of the water after it has been swamped, and safely support each person it is rated to carry.

9.2 Test conditions

Each personal watercraft shall be loaded with its permanent appurtenances or with a weight equivalent to its permanent appurtenances.

The fuel and/or oil tanks shall be full.

An additional iron weight of 10 kg shall be added for each person that the personal watercraft is rated to carry. The additional weight shall be secured to a portion of the personal watercraft that will be submerged during the test.

9.3 Test procedure

The personal watercraft shall be swamped, allowing calm, fresh water to flow between the inside and outside of the personal watercraft, either over the sides, through a hull opening, or both. Entrapped air in the flooded portion of the personal watercraft shall be eliminated.

If air chambers are used to provide floatation on the personal watercraft, water shall flood the two largest air chambers and all chambers that are integral with the hull.

9.4 Acceptance level

The watercraft shall have enough floatation to keep part of the personal watercraft above the surface of the water when it has been submerged for at least 18 h.

9.5 Floatation material

9.5.1 Introduction

Floatation materials shall meet the requirements in 9.5.2 to 9.5.8 as listed in Table 7 when used in the engine-compartment bilge, and engine compartment or bilge, unless located in a sealed compartment.

9.5.2 Vapour test

The floatation material shall not lose more than 5 % of its buoyant force after being immersed in a fully saturated petrol-vapour atmosphere for 30 days at a minimum temperature of 38 °C.

9.5.3 Petrol test lasting 24 h

The floatation material shall not lose more than 5 % of its buoyant force after being immersed for 24 h at 23 °C ± 2 °C in reference fuel B of ISO 1817:1999, Table A.1, or an equivalent fuel.

9.5.4 Petrol test lasting 30 days

The floatation material shall not lose more than 5 % of its buoyant force after being immersed for 30 days at 23 °C ± 2 °C in reference fuel B of ISO 1817:1999, Table A.1, or an equivalent fuel.

9.5.5 Oil test lasting 24 h

The floatation material shall not lose more than 5 % of ist buoyant force after being immersed for 24 h at 23 °C ± 2 °C in reference oil No. 2 of ISO 1817:1999, A.2.1.2, or an equivalent lubricant.

9.5.6 Oil test lasting 30 days

The floatation material shall not lose more than 5 % of ist buoyant force after being immersed for 30 days at 23 °C ± 2 °C in reference oil No. 2 of ISO 1817:1999, A.2.1.2, or an equivalent lubricant.

9.5.7 Bilge-cleaner test lasting 24 h

The floatation material shall not lose more than 5 % of ist buoyant force after being immersed for 24 h at 23 °C ± 2 °C in a 5 % solution of trisodium phosphate in water.

9.5.8 Bilge-cleaner test lasting 30 days

The floatation material shall not lose more than 5 % of ist buoyant force after being immersed for 30 days at 23 °C ± 2 °C in a 5 % solution of trisodium phosphate in water.

NOTE The buoyant force reduction in 9.5.2 to 9.5.8 may be measured in accordance with ASTM D 2842.

Table 7 — Floatation performance tests

Tests	Areas		
	Engine-compartment bilge (3.11)	Engine compartment unless open to atmosphere (3.9)	Bilge (3.10)
9.5.2 Vapour test		X	
9.5.3 Petrol test lasting 24 h			X
9.5.4 Petrol test lasting 30 days	X		
9.5.5 Oil test lasting 24 h			X
9.5.6 Oil test lasting 30 days	X		
9.5.7 Bilge-cleaner test lasting 24 h			X
9.5.8 Bilge-cleaner test lasting 30 days	X		

10 Steering-system test

10.1 General

Component tests are intended to establish minimum acceptable design criteria for components of steering systems.

Each steering system, including helm, cable, and attachment components, shall withstand an axial cable load of 630 N in tension and compression, applied at the connection to the jet drive, throughout its travel range, without severance of components.

10.2 Axial-force test

A 540 N push-pull force shall be cycled for 10 tension-to-compression cycles at a duration of 5 s, applied as appropriate:

— distributed over not more than 100 mm of a hand grip of a handlebar, applied axially to the pivot shaft.

10.3 Tangential force test

A 360 N force in either direction shall be cycled from zero-to-360-to-zero for 10 cycles at a duration of 5 s, applied as appropriate:

— at the point of maximum leverage of a handlebar applied in the direction of steering arc.

10.4 Fatigue test

The steering components shall withstand a cyclic force resulting from 360 N tension and compression, applied axially to the output of the steering cable, with the helm locked at the mid-travel position. This force shall be applied for 50 000 reversals without causing separation.

10.5 Impact test

10.5.1 Impact test 1

See Figure 2 for impact test fixture (h = 210 mm). The helm shall withstand a single impact of 160 J on the hand grip of a handlebar, without

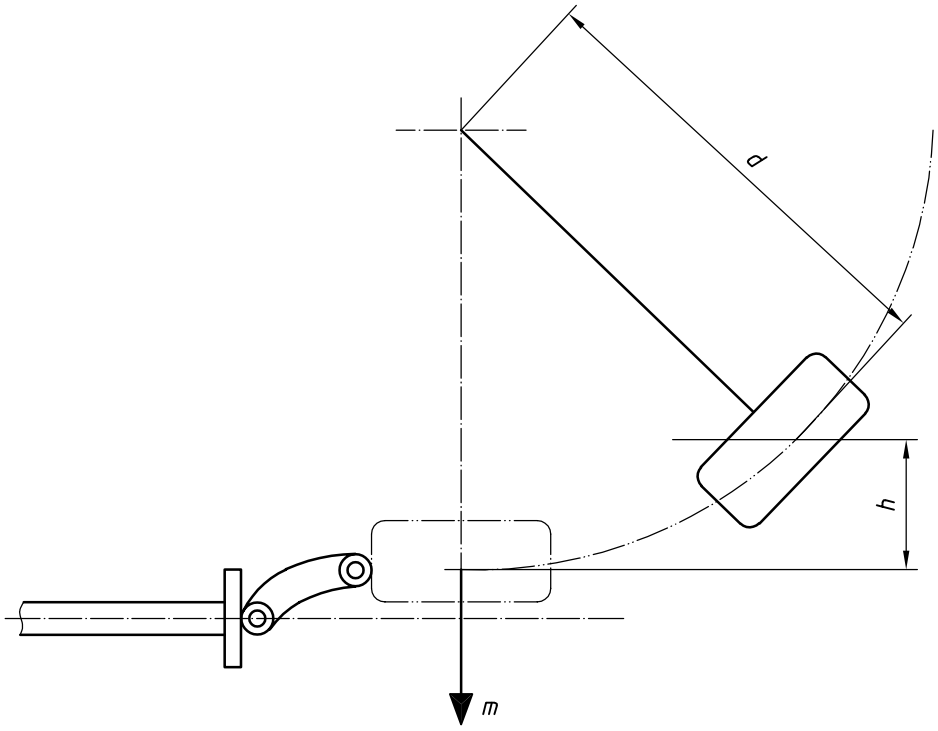
— deformation that would cause loss of minimum retained system performance,

— propagation of any cracks existing before this test, or

— the appearance of new cracks.

10.5.2 Impact test 2

The helm shall withstand a single impact of 270 J, on the hand grip of a handlebar, without complete separation of the helm and the mechanical means for applying the manual steering effort. See Figure 2 for the impact-test fixture (h = 350 mm).



Key

d = 2 285 mm ± 150 mm

m = 80 kg

h = 210 mm for a single impact ⩾ 160 J

h = 350 mm for a single impact ⩽ 270 J

Figure 2 — Impact-test fixture for steering handlebar

The impact test fixture to be used shall be a completely filled leather bag of diameter 250 mm containing lead, with a mass of 80 kg in total, and suspended on a free swinging cable, such that the centre of mass is 2 285 mm ± 150 mm from a supporting pivot. The impact face of the bag shall be a 250 mm diameter end. The bag shall be elevated through sufficient arc to achieve the desired value of impact upon a rigidly mounted helm and control element by swinging the bag as indicated in the drawing. The fixture shall be rigidly secured against movement. Other devices than that specified, such as a falling-weight bag, may be used, providing that the impact is equivalent.

11 Stability

Personal watercraft have limited stability in the static floating condition.

When a personal watercraft is floating upside-down, the operator shall be able to return the personal watercraft to the upright position, and go on board again.

The personal watercraft shall facilitate reboarding from the water for the operator and passengers, either one by one and/or in accordance with the manufacturer's instruction.

12 Means of reboarding

The personal watercraft shall be designed either with an automatic engine cut-off or with an automatic switch to reduce speed and proceed in a circular, forward movement, when the driver dismounts deliberately or falls overboard.

13 Towing

All craft shall be fitted with one or more points for accepting the towing loading.

14 Off-throttle steering

The manufacturer shall provide appropriate instructions regarding off-throttle steering characteristics.

15 Owner's manual

The following instruction shall be included in the owner's manual and labels: “Each passenger must always put on a Personal Floating Device”.

An instruction shall be included in the owner's manual to: “follow regulations for operator and (or) license requirements in the country of use”.

Other information, as appropriate, shall be included in the owner's manual in accordance with ISO 10240.

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