INTERNATIONAL STANDARD

ISO 21487

Second edition
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Small craft — Permanently installed petrol and diesel fuel tanks

Petits navires — Réservoirs à carburant à essence et diesel installés à demeure

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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 21487 was prepared by Technical Committee ISO/TC 188, *Small craft*.

This second edition cancels and replaces the first edition (ISO 21487:2006), which has been technically revised. It also incorporates the Technical Corrigendum ISO 21487:2006/Cor.1:2008. The main changes from the first edition are the following:

— diesel tanks shall be equipped with inspection hatch(es) for cleaning and inspection (4.3.10);

— metallic tanks may be static pressure tested as an alternative to the pressure-impulse test (5.2.2);

— non-metallic, non-integral tanks, if installed in an engine compartment, shall be fire tested (6.2.3);

— non-metallic tanks shall be marked with the maximum temperature to which the tank may be exposed (Clause 8).

Small craft — Permanently installed petrol and diesel fuel tanks

1 Scope

This International Standard establishes requirements for design and test of petrol and diesel fuel tanks for internal combustion engines that are intended to be permanently installed in small craft of up to 24 m length of hull.

For installation requirements, ISO 10088 applies.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

ISO 10088, *Small craft — Permanently installed fuel systems*

ISO 11192, *Small craft — Graphical symbols*

ISO 12215-5, *Small craft — Hull construction and scantlings — Part 5: Design pressures for monohulls, design stresses, scantlings determination*

ISO 12215-6, *Small craft — Hull construction and scantlings — Part 6: Structural arrangements and details*

ISO 5817, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections*

3 Terms and definitions

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

3.1
petrol
hydrocarbon fuel or blend of hydrocarbon fuel and denatured ethanol which is liquid at atmospheric pressure and is used in spark ignition engines

3.2
diesel
hydrocarbon fuel, biofuel or blend of these which is liquid at atmospheric pressure and is used in compression ignition engines

3.3
spark ignition engine
engine in which an electrical spark is produced to ignite the fuel/air mixture

3.4
compression ignition engine
engine in which ignition is obtained by means of compressing the fuel/air mixture

3.5
permanently installed
securely fastened so that tools need to be used for removal

3.6
integral tank
tank which forms part of the structure of the craft

4 General properties

4.1 Resistance to liquids in contact

4.1.1 All seals such as gaskets, o-rings and joint-rings shall be of non-wicking, i.e. non-fuel absorbent, material.

4.1.2 All materials used shall be resistant to deterioration by the fuel for which the system is designed and to other liquids or compounds with which the material can come in contact as installed under normal operating conditions, e.g. grease, lubricating oil, bilge solvents and sea water.

4.2 Copper-based alloys

Copper-based alloys for fittings are acceptable for direct coupling with all tank materials specified in Table 1, except aluminium. Copper-based alloy fittings are allowed for aluminium tanks only if a galvanic barrier is arranged between fitting and tank.

4.3 Provisions to tanks

4.3.1 There shall be provisions to determine the fuel level or quantity in the tank considering also the requirements in 5.1.2 for petrol fuel tanks and 6.1.3 for diesel fuel tanks.

4.3.2 Metal tanks shall be designed or installed so that no exterior surface will trap water.

4.3.3 All rigid tubes and pipes which extend near the tank bottom shall have sufficient clearance to prevent contact with the bottom during normal operation of the craft.

4.3.4 On metallic tanks, all metallic non-integral tank supports, chocks or hangers shall either be separated from the surface of the tank by a non-metallic, non-hygroscopic, non-abrasive material or welded to the tank.

4.3.5 If baffles are provided, the total open area provided in the baffles shall be not greater than 30 % of the tank cross section in the plane of the baffle.

4.3.6 Baffle openings shall be designed so that they do not prevent the fuel flow across the bottom or trap vapour across the top of the tank.

4.3.7 The fuel fill pipe on the tank shall have a minimum inside diameter of 28,5 mm.

4.3.8 Each ventilation pipe on the tank shall have a minimum inside diameter of 11 mm (95 mm^2) or a ventilation opening designed to prevent the tank pressure from exceeding 80 % of the maximum test pressure marked on the tank label when tested in accordance with ISO 10088.

4.3.9 Suitable metallic tank materials and minimum recommended material thicknesses required for corrosion resistance are given in Table 1. Other materials may be used if they demonstrate equivalent fuel and corrosion resistance.

4.3.10 Diesel tanks shall be equipped with inspection hatch(es) having a suitable diameter of at least 120 mm at suitable position(s) for cleaning and inspection of the lowest part(s) of the tank. The hatch must remain accessible when the tank has been installed in the craft. The hatch(es) may be located on the top or side of the tank.

Table 1 — Metallic tank materials

Material	Minimum nominal sheet thickness for corrosion resistance mm	Fuel
Copper, internally tin-coated	1,5	Petrol only
Aluminium alloys containing no more than 0,1 % copper	2,0	Diesel and petrol
Stainless steel, with all welding deposits removed	1	Diesel and petrol
Mild steel	2	Diesel only
Mild steel externally hot-dip zinc-coated after fabrication	1,5	Diesel only
Mild steel externally and internally hot-dip zinc-coated after fabrication	1,5	Petrol only
Aluminized steel	1,2	Diesel and petrol

4.4 Installation of non-integral tanks

4.4.1 Tank mechanical fixing

Non-integral tanks shall be installed so that the loads due to the mass of the full tank are safely introduced into the structure, with due consideration given to upward and downward acceleration due to the craft's movements at maximum speed in the sea. In this respect, continuous flexible supports spreading loads are preferable to rigid ones.

Metal or textile hold-down straps are considered as a good practice provided that chafe and corrosion are kept to a minimum.

4.4.2 Other installation requirements

For other installation requirements (filling, vent lines, fuel circuit, etc.), ISO 10088 applies.

5 Petrol fuel tanks: design and tests

5.1 Design

5.1.1 Petrol fuel tanks shall not be integral with the hull.

5.1.2 Petrol fuel tanks shall have all fittings and openings on top, except metallic fill and ventilation pipes, which may be connected to the sides or ends of metal petrol fuel tanks, provided that they are welded to the tank and reach above the top of the tank.

5.1.3 Tank drains are not permitted on petrol fuel tanks.

5.2 Tests to be performed

5.2.1 Petrol fuel tanks shall be leakage tested in accordance with 7.2.1

5.2.2 Petrol fuel tanks shall be pressure-impulse tested in accordance with 7.3. Metallic tanks may as an alternative method be pressure tested in accordance with 7.2.2, using a pressure which is the higher of the following:

— 30 kPa; or

— 1,5 times the highest hydrostatic pressure to which the tank may be subjected in service (maximum fill-up height above tank top) plus 10 kPa.

During this test, the tank shall not crack or leak; however, it may be permanently deformed.

This alternative test method for metal tanks may only be used if:

— plating thicknesses, section modules and web shear areas of stiffeners meet the requirements in ISO 12215-5 for integral tanks;

— construction follows the recommendations in ISO 12215-6 regarding structural details of metal construction;

— welding quality meets at least class B in accordance with ISO 5817.

5.2.3 Non-metallic petrol fuel tanks shall meet the fire test in accordance with 7.4 or 7.5.

6 Diesel fuel tanks: design and tests

6.1 Design

6.1.1 Diesel fuel tanks may be constructed independent of or integral with the hull. If integral and a cored hull construction are used, the core shall not deteriorate from exposure to diesel fuel, and commonly used additives, and shall not permit fuel to migrate.

6.1.2 Diesel fuel integral tanks shall be built in accordance with ISO 12215-5.

6.1.3 Fittings in the bottom, sides or ends are allowed provided that each connection has a shut-off valve directly coupled to the tank. The valve shall be protected or located to prevent physical damage or be of at least 25 mm nominal diameter.

6.1.4 Diesel fuel tank drains, where fitted, shall have a shut-off valve with a plug on the outlet that can only be removed by the use of tools, or the handle of the drain shut-off valve shall be removable with the valve in its closed position.

6.1.5 Sight gauges, if used, shall be fitted with a self-closing valve at the bottom and that can only be manually operated to open while attended. The top valve is not required to be self-closing.

6.2 Tests to be performed

6.2.1 Diesel tanks shall be leakage tested in accordance with 7.2.1.

6.2.2 Diesel tanks shall be pressure tested in accordance with 7.2.2.

6.2.3 Non-metallic, non-integral tanks, if installed in an engine compartment, shall be fire tested in accordance with 7.4 or 7.5

7 Tests

7.1 General

Fuel tanks shall be tested with all their accessories installed.

7.2 Hydraulic pressure test

WARNING — Take care not to exceed the maximum static test pressure. Do not use solutions containing ammonia for testing.

7.2.1 Leakage test

Each fuel tank shall be internally tested with a hydraulic pressure. The test pressure shall be the greater of

— 20 kPa; or

— 1,5 times the highest hydrostatic pressure to which the tank may be subjected in service (maximum fill-up height above tank top).

The static test pressure shall be applied for 5 min without pressure drop or rise. After the test, the test fuel tank shall not show any leakage when using a leak detection method other than the pressure-drop method.

7.2.2 Hydraulic pressure/strength type test

After the leakage test (7.2.1) the tank representative of the tank series type, with all its accessories, shall be pressurized again as given in 7.2.3 to 7.2.6.

7.2.3 Metal and fibre-reinforced plastic (FRP) tanks

The pressure shall be gradually increased to the greater of

— 20 kPa; or

— 1,5 times the highest hydrostatic pressure to which the tank may be subjected in service (maximum fill-up or overflow height above tank top).

This pressure shall be maintained for 1 min.

During this time, the tank shall shall not crack or leak; however, it may be permanently deformed.

7.2.4 Thermoplastic tanks

Prior to the hydraulic pressure test, thermoplastic tanks shall be stored filled with test liquid C in accordance with ISO 1817 or the fuel for which the tank is fabricated for at least 28 d at an ambient temperature of not less than 21 °C. The hydraulic pressure test shall be performed immediately after emptying the test liquid out of the tank.

7.2.5 Thermoplastic of density $\geq$ 935 kg/m^3

The pressure shall be gradually increased to the greater of

— 20 kPa; or

— 1,5 times the highest hydrostatic pressure to which the tank may be subjected in service (maximum fill-up height above tank top).

This pressure shall be maintained for 60 min.

During this time, the tank shell shall not crack or leak; however, it may be permanently deformed.

7.2.6 Thermoplastic of density $<$ 935 kg/m^3

The pressure shall be gradually increased to the greater of

— 20 kPa; or

— 1,5 times the highest hydrostatic pressure to which the tank may be subjected in service (maximum fill-up height above tank top).

This pressure shall be maintained for 5 h.

During this time, the tank shell shall not crack or leak; however, it may be permanently deformed.

7.3 Pressure-impulse type test for petrol fuel tanks

7.3.1 A test fuel tank, representative of the tank series type, shall not exhibit any leakage or other signs of failure after 25 000 cycles of pressure impulses.

7.3.2 The pressure-impulse test of thermoplastic tanks shall be conducted on a tank prepared in accordance with 7.2.4.

7.3.3 The tank to be tested fully filled with water shall be mounted using support, chocks or brackets, either furnished with the tank or as intended to be used in a craft installation.

7.3.4 The tank to be tested shall be attached to a regulated source of pressure of either air, nitrogen or water. The control mechanism of the pressure source shall then be set to cause pressure in the tank under test, measured at its top-most surface, to vary from 0 kPa to 20 kPa to 0 kPa at a rate of not more than 15 cycles per minute.

7.3.5 Before and after the pressure-impulse test, the tank shall meet the requirements of 7.2.

7.4 General fire-resistance test of non-metallic fuel tanks

7.4.1 This test shall be conducted to qualify tanks if the actual installation conditions are not known.

7.4.2 Prior to the fire test, the tank to be tested shall meet the requirements of 7.2 and the test liquid shall be removed.

7.4.3 The tank to be tested shall be supported at its ends and at each baffle in a test enclosure. The enclosure shall be a fire-resistant box closed on its top, bottom and ends, and only open on one of its sides (see Figure 1). The clearance between the tank to be tested and the test enclosure shall be at least 50 mm on the sides, 150 mm on the ends and between 175 mm and 850 mm on the top.

7.4.4 The lowest point of the tank to be tested shall be vertically 75 mm above the liquid surface of the reservoir containing heptane. The sides of the reservoir shall extend 50 mm beyond the vertical sides and 150 mm beyond the ends of the tank to be tested. The reservoir shall be made leakproof and accommodate enough heptane to burn continuously for at least 2,5 min. See Figure 1.

7.4.5 The area in which the test is to be conducted shall be free from draughts but shall allow a free inflow of air during the test.

7.4.6 Fill the tank to be tested to 25 % of its rated capacity with the intended fuel.

All openings in the tank to be tested shall be capped or plugged, except fuel-tank vent lines which shall be extended outside the fire-test area. Components fixed on the tank or in the test rig that are not intended to be tested shall be sufficiently heat protected.

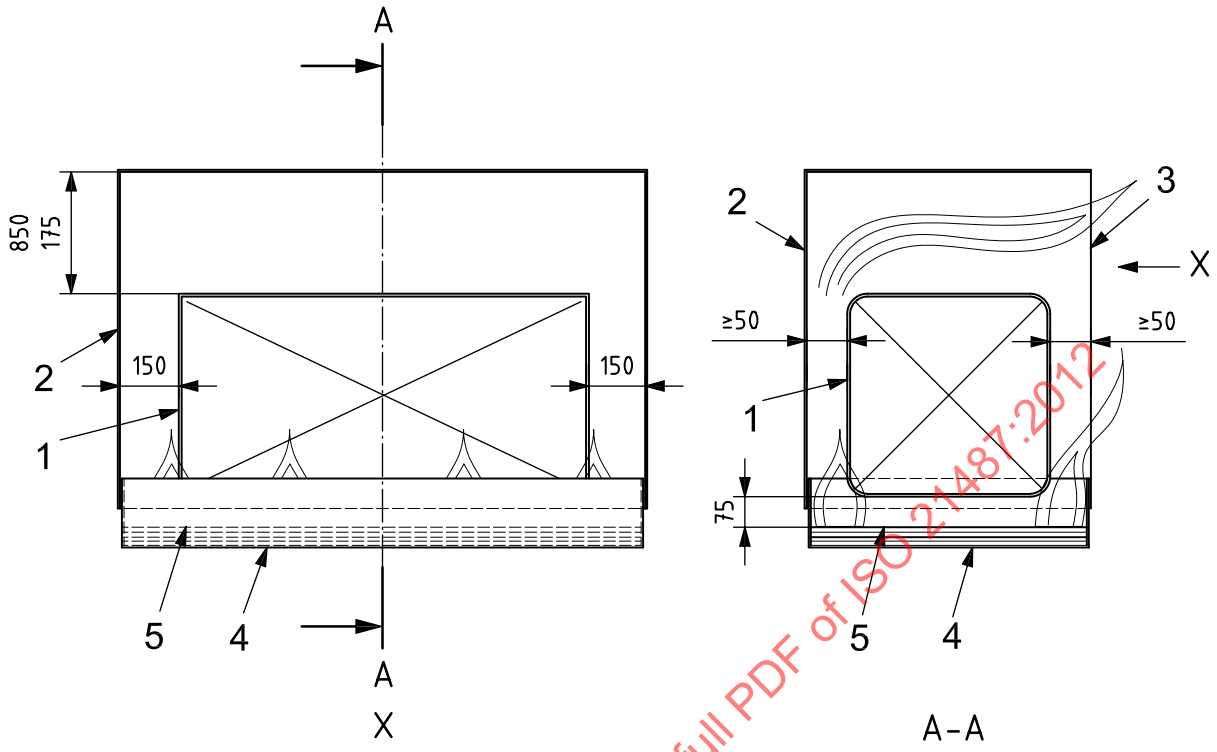
7.4.7 The heptane in the reservoir shall be ignited and permitted to burn for a continuous period of 2,5 min. The temperature shall be at least 650 °C some time during the test, at least at one point within 25 mm of the tank to be tested.

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

7.4.9 After cooling down, the tested tank shall be examined for leakage. It shall be drained and pressure tested with a slowly increased air or inert gas pressure up to 1,8 kPa.

The tank shall show no evidence of leakage when checked with methods other than the pressure-drop method.

Dimensions in millimetres



Key

1 tank to be tested
2 test enclosure
3 open part of the enclosure
4 bottom of heptane pan
5 top of heptane level

Figure 1 — Sketch of tank to be tested and test enclosure

7.5 As-installed fire-resistance test of non-metallic fuel tanks

7.5.1 This test shall be conducted to qualify tanks intended to be installed in a particular craft model, or series, where the installation conditions are specified or otherwise controlled.

7.5.2 Install the tank to be tested in an actual or simulated hull section of sufficient size to simulate fire conditions aboard the craft. All structural elements shall be made of the same material as that used on the craft, or of a material of equivalent flammability.

7.5.3 To qualify a tank intended for use in a craft series, the tank to be tested shall be installed in a simulated hull section providing the maximum fire exposure representative of that series.

7.5.4 Prior to the fire test, the tank to be tested shall meet the requirements of 7.2. Then, the test pressure shall be released.

7.5.5 The area in which the test is to be conducted shall be free from draughts but shall allow a free inflow of air during the test.