INTERNATIONAL STANDARD

ISO 8469

Fourth edition
2021-02

Small craft — Non-fire-resistant fuel hoses

Petits navires — Tuyaux souples pour carburant non résistants au feu

Reference number
ISO 8469:2021(E)

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Published in Switzerland

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 188, *Small craft,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 464, *Small craft*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This fourth edition cancels and replaces the third edition (ISO 8469:2013), which has been technically revised.

The main changes compared to the previous edition are as follows:

— requirements for low permeation fuel hoses have been added in 6.8;

— the test fluids in 6.2 for petrol have been clarified;

— the test set-up in Figure A.1 has been revised to remove the vented capillary tube.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Small craft — Non-fire-resistant fuel hoses

1 Scope

This document specifies general requirements and physical tests for non-fire-resistant hoses for conveying petrol or petrol blended with ethanol, and diesel fuel or diesel fuel blended with FAME, designed for a working pressure not exceeding 0,34 MPa for hoses with inner diameter up to and including 10 mm, and 0,25 MPa for hoses up to 63 mm inner diameter in small craft. .

It applies to hoses for small craft with permanently installed fuel systems.

Specifications for fire-resistant hoses are given in ISO 7840:2021. Specifications for permanently installed fuel systems are given in ISO 10088:2013.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 1402:2009, *Rubber and plastics hoses and hose assemblies — Hydrostatic testing*

ISO 1817:2015, *Rubber, vulcanized or thermoplastic — Determination of the effect of liquids*

ISO 7233:2016, *Rubber and plastics hoses and hose assemblies — Determination of resistance to vacuum*

ISO 7326:2016, *Rubber and plastics hoses — Assessment of ozone resistance under static conditions*

EN 14214:2012+A2:2019, *Liquid petroleum products — Fatty acid methyl esters (FAME) for use in diesel engines and heating applications — Requirements and test methods*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
FAME
fatty acid methyl ester
fuel composed of mono-alkyl esters of long-chain fatty acids derived from vegetable oils or animal fats

Note 1 to entry: The physical characteristics of fatty acid esters are closer to those of fossil diesel fuels than pure vegetable oils, but properties depend on the type of vegetable oil.

[SOURCE: ISO 16147:2020, 3.7, modified — Note 1 to entry has been added.]

3.2
tube
interior liner of the fuel hose that is normally in contact with the fuel

3.3
cover
outer jacket of the fuel hose, intended to provide weather and ozone protection for the *tube* (3.2)

3.4
craft
small craft
recreational boat, and other watercraft using similar equipment, of up to 24 m length of hull (L_H)

Note 1 to entry: The measurement methodology for the length of hull is defined in ISO 8666.

[SOURCE: ISO 8666:2020, 3.15, modified – Note 1 to entry has been added.]

4 General requirements

Hoses shall present a smooth inner surface free from pores, other defects and chemical contaminants.

Hoses shall demonstrate suitability for marine use by complying with the requirements of the tests in Clause 6. Hoses intended to be used for both petrol and diesel fuels shall be tested with both test fluids separately in sections requiring preconditioning. They shall be marked according to Clause 7.

5 Hose inner diameter

Table 1 provides the inner diameters and tolerances.

Table 1 — Inner diameters and tolerances

Dimensions in millimetres

Inner diameter, *d*	Tolerance
3,2 4 5	±0,5
6,3 7 8 9,5 10 12,5 16 19 20	±0,75
25 31,5 38	±1,25
40 50 63	±1,5

6 Physical tests on finished hose

6.1 General

New samples shall be used for each of the tests in 6.3 to 6.13.

6.2 Test liquids

a) Petrol:

   1) a mixture by volume of 90 % of liquid C as specified in ISO 1817:2015, Table A.1, and 10 % by volume of ethanol

b) Diesel:

   1) a mixture by volume of 90 % of liquid F as specified in ISO 1817:2015, Table A.1, and 10 % by volume of FAME as specified in EN 14214:2012+A2:2019.

6.3 Bursting pressure

Fill three hoses or sample lengths from hoses with the applicable test liquids as specified in 6.2, and store them for 40 days in air at a temperature of 40 °C ± 2 °C. For type 15 fuel hoses (see 6.8), the 40 day preconditioning test period may be reduced to 28 days.

Empty the liquid out and fill the hoses or sample lengths with water that is below 25 °C, and subject them to hydrostatic pressure as specified in ISO 1402:2009.

The bursting pressure shall be at least 1,4 MPa for hoses with an inner diameter of 10 mm or less, and 1,00 MPa for hoses with an inner diameter of more than 10 mm.

6.4 Vacuum collapse test

Carry out the test in accordance with ISO 7233:2016, method A, using the test conditions specified in Table 2.

Table 2 — Pressure conditions for the vacuum collapse test

Inner diameter, *d* mm	**Vacuum** kPa
$d \leq 10$	80
$10 < d \leq 25$	35
$d > 25$	No test required

The test duration shall be 60 s and the diameter of the sphere 0,8 *d* (inner diameter of the hose). The sphere shall pass freely through the hose while under vacuum.

6.5 Volume change in test liquids

Determine the change of volume of the hose test sample (tube and cover). Completely submerge the test pieces in test liquids as specified in 6.2 at a temperature of 40 °C ± 2 °C for 40 days.

If the hose is made of a homogeneous compound (with or without reinforcement), the swelling shall not exceed 35 % by volume, as measured by displacement in water. For hoses with a tube of fuel- resistant material and a cover of another material, mainly intended for weather and ozone resistance, the increase in volume shall not exceed 35 % for the tube and 120 % for the cover.

6.6 Mass reduction of test hose

Determine the reduction in mass of the tube by the procedure specified in 8.2 of ISO 1817:2015. Fill three hoses or sample lengths from the hoses with test liquids, as specified in 6.2, and store them for 40 days in air at a temperature of 40 °C ± 2 °C. For type 15 fuel hoses (see 6.8), the 40 day test period may be reduced to 28 days.

The reduction in mass of the tube shall not exceed 8 % of the initial mass of the test pieces.

NOTE A reduction in mass of 8 % corresponds to a decrease in volume of approximately 10 %.

6.7 Effect of ozone

The hose shall be tested in accordance with ISO 7326:2016, method 1. The sample shall show no visible cracks at 7x magnification.

6.8 Fuel permeation

The permeation rate for the hoses shall be determined according to the method specified in Annex A or an equivalent test method. The hoses shall be classified as follows and marked in accordance with Clause 7:

— Type 1: hoses with a permeation rate greater than 15 g/m^2 per 24 h but less than 100 g/m^2 per 24 h;

— Type 2: hoses with a permeation rate of 100 g/m^2 per 24 h, up to and including 300 g/m^2 per 24 h.

— Type 15: hoses with a permeation rate of 15 g/m^2 or less per 24 h

6.9 Cold flex test

For straight hoses of 19 mm inner diameter and smaller, condition three hose samples for 5 h at an ambient temperature of −20 °C ± 2 °C. Flex the hose in the cold chamber through 180° from the centreline to a diameter of 10 times the outside diameter of the hose. Each flexing shall take place within 4 s and the hose shall not fracture or show any cracks, checks or breaks in the tube or cover.

For straight hoses larger than 19 mm inner diameter and all pre-formed hoses, prepare three samples (100 ± 5) mm × (6 ± 1) mm from the whole hose wall and condition them for 5 h at a temperature of −20 °C ± 2 °C in an unrestrained loop; position between two jaws 50 mm wide and 64 mm apart. While in the cold chamber, bring the jaws together rapidly until they are 25 mm apart. The samples shall not fracture or show any cracks, checks or breaks.

6.10 Abrasion test

Hose samples of 38 mm inner diameter and larger with embedded wire reinforcement shall be selected for the test. Larger inner diameter hose sizes to be qualified by the test shall not have a cover thickness or construction less than those of the test samples.

Three identical 38 mm inner diameter or larger hose samples shall be tested. Condition hose samples for at least 24 h at a temperature of 23 °C ± 2 °C and relative humidity of 50 % ± 5 %. The test hose shall be mandrel-(core-) supported and rotate at a constant speed of 80 r/min ± 2 r/min. Subject the hose to a laterally moving abrasive surface, i.e. 80 grit aluminium oxide (Al_2O_3) emery cloth, parallel to the longitudinal axis of the hose. The abrasive surface shall be (25 ± 5) mm × (75 ± 5) mm affixed to a hard surface which cycles back and forth 75 mm ± 5 mm in each direction while loaded with a constant normal force of 45 N ± 5 N. One test cycle shall equal one 360° rotation of the outside diameter of the hose and one back and forth movement of the abrasive surface. After 1 000 cycles, the three test samples shall have no helical wire reinforcement exposed at the point of contact with the abrasive surface.

6.11 Dry heat resistance test

After heat ageing for 70 h at 100 °C ± 2 °C, samples taken from the cover material shall have a minimum tensile strength of 80 % of the original value and no more than 50 % change in elongation at break when compared with hose samples that have not been heat aged.

Samples of the cover material for this test and the oil resistance test may be taken from a sample of the hose or may be a representative test sample of the material as long as the sample is an identical representation of the hose cover.

6.12 Oil resistance test

After 70 h immersion in oil No. 3 specified in ISO 1817:2015, at a temperature of 100 °C ± 2 °C, samples taken from the cover shall not have a reduction of tensile strength or elongation at break exceeding 40 % or a volumetric change outside the range of −5 % to +25 % of the pre-immersion values. Samples taken from the cover material shall not have a volumetric change outside the range of 0 % to +100 %.

6.13 Adhesion test

The force required to separate a 25 mm width sample of bonded adjacent layers, such as the tube and cover of hose material, by tensile force on partially separated layers applied in opposite directions, at 23 °C ± 2 °C, shall be not less than 27 N.

7 Marking

A hose complying with this document shall be marked at least every 0,3 m along its length with the following:

— name or trade mark of the manufacturer;

— last two figures of the year of manufacture;

— inner diameter, in millimetres;

— “ISO 8469 - B1” or “ISO 8469 - B2” or “ISO 8469 – B15”;

— E10/B10 compatible.

“B” is used to designate a non-fire-resistant type of fuel hose; “1” designates a fuel hose with a fuel permeation rate greater than 15 g/m^2 per 24 h but less than 100 g/m^2 per 24 h; “2” designates a fuel hose with a permeation rate of 100 g/m^2 to 300 g/m^2 per 24 h; “15” designates a fuel hose with a permeation rate of 15 g/m^2 or less per 24 h.

“E10” is used to designate a fuel hose resistant to petrol blended with 10 % ethanol, and “B10” is used to designate a fuel hose resistant to diesel blended with 10 % FAME.

The marking shall be in letters and figures at least 3 mm high and shall withstand washing with ordinary detergents.

Additional information may be included in the marking.

Annex A
(normative)

Fuel permeation test

A.1 Principle

Pieces of the hose to be tested shall be filled with test fuel and stored for 40 days at a temperature of 40 °C ± 2 °C or for 56 days at a temperature of 23 °C ± 2 °C, before the test begins. The test pieces are then filled with test fuel and the fuel lost by permeation during time periods of 24 h is determined by weighing for 15 consecutive days or until a peak has been established. For type 15 fuel hoses, the 40 day preconditioning test period at 40 °C ± 2 °C may be reduced to 28 days.

A.2 Sampling

Three test pieces of the hose shall be tested simultaneously. The test pieces shall be 300 mm ± 3 mm long.

A.3 Equipment

The test equipment shall be as shown in Figure A.1.

A well-ventilated, draught-free test chamber, at a controlled temperature of 23 °C ± 2 °C, shall be used for the testing.

The glass test tube shown in Figure A.1 shall have a tight fit to the inner diameter of the tested hose. The pipe in the lower end of the hose shall be impermeably tight in its lower end. The upper end of the test tube shall be plugged.

A.4 Test procedure

Fill the sample lengths of hose with test liquid as specified in 6.2 and store them for seven days in air at standard laboratory temperature (23 °C ± 2 °C).

Empty the liquid out and assemble the test hoses and glass test tube as shown in Figure A.1. Fill the sample lengths and pipes with test liquid specified in 6.2 up to a level 70 mm ± 5 mm above the upper end of the hose. Fit the plug in the top of the tube.

Weigh the assembly with an accuracy of 0,01 g. Store the assembly in a vertical position for 24 h at standard laboratory temperature and weigh the assembly again. Record the loss of mass. Invert the test tube to agitate the test liquid in the fixture.

Repeat the 24 h storage period and weight measurement 15 times or until a maximum permeation has been established.

Calculate the average value of the three highest mass-loss values recorded. Calculate the permeation rate in g/m^2/24 h based on this average mass loss, the inner diameter of the hose and the effective length of the hose between the inner ends of the glass test tube.