BS ISO 13775-2:2016

BSI Standards Publication

Thermoplastic tubing and hoses for automotive use

Part 2: Petroleum-based-fuel applications

bsi.

National foreword

This British Standard is the UK implementation of ISO 13775-2:2016. It supersedes BS ISO 13775-2:2000 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PRI/66, Rubber and plastics tubing, hoses and hose assemblies.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Published by BSI Standards Limited 2016

ISBN 978 0 580 86680 7

ICS 23.040.70; 43.060.40

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 December 2016.

Amendments/Corrigenda issued since publication

Date	Text affected

BS ISO 13775-2:2016

INTERNATIONAL STANDARD

ISO 13775-2

Second edition
2016-12-15

Thermoplastic tubing and hoses for automotive use —

Part 2: Petroleum-based-fuel applications

Tubes et tuyaux en thermoplastique pour l'industrie automobile — Partie 2: Applications pour carburants à base de pétrole

Reference number
ISO 13775-2:2016(E)

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Foreword

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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).

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The committee responsible for this document is ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 1, *Rubber and plastics hoses and hose assemblies*.

This second edition cancels and replaces the first edition (ISO 13775-2:2000), which has been technically revised.

ISO 13775 consists of the following parts, under the general title *Thermoplastic tubing and hoses for automotive use*:

— *Part 1: Non-fuel applications*

— *Part 2: Petroleum-based-fuel applications*

Introduction

This part of ISO 13775 defines the requirements of extruded thermoplastic tubing/hoses for petroleum-based-fuel applications for automotive use. In addition, it can also be applied as a classification system to enable original equipment manufacturers (OEMs) to detail a "line call-out" of tests for specific applications where these are not covered by the six main types (see example in Annex A). In this case, the tubing or hose would not carry any marking showing this ISO specification number, but could detail the OEM's own identification markings as shown on their part drawings.

INTERNATIONAL STANDARD ISO 13775-2:2016(E)

Thermoplastic tubing and hoses for automotive use —

Part 2:
Petroleum-based-fuel applications

WARNING — Persons using this part of ISO 13775 should be familiar with normal laboratory practice. This part of ISO 13775 does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any national regulatory conditions.

1 Scope

This part of ISO 13775 specifies test requirements and test methods for extruded thermoplastic tubing and hoses for use in petroleum-based-fuel lines in vehicles powered by internal-combustion engines.

2 Normative references

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

ISO 188, *Rubber, vulcanized or thermoplastic — Accelerated ageing and heat resistance tests*

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

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

ISO 4926, *Road vehicles — Hydraulic braking systems — Non-petroleum-base reference fluids*

ISO 7628, *Road vehicles — Thermoplastics tubing for air braking systems*

ISO 8031:2009, *Rubber and plastics hoses and hose assemblies — Determination of electrical resistance and conductivity*

ISO 8033, *Rubber and plastics hoses — Determination of adhesion between components*

ISO 8308, *Rubber and plastics hoses and tubing — Determination of transmission of liquids through hose and tubing walls*

ISO 10619-1, *Rubber and plastics hoses and tubing — Measurement of flexibility and stiffness — Part 1: Bending tests at ambient temperature*

ISO 19013-2:2016, *Rubber hoses and tubing for fuel circuits for internal combustion engines — Specification — Part 2: Gasoline fuels*

ISO 30013, *Rubber and plastics hoses — Methods of exposure to laboratory light sources — Determination of changes in colour, appearance and other physical properties*

SAE J2260, *Non-metallic Fuel System Tubing with One or More Layers*

3 Classification and materials

The product shall consist of an extruded thermoplastic material with or without an integral reinforcement. The product may also have an inner veneer to impart improved fluid resistance and/or

reduced fuel vapour permeability. It may also have an extruded outer cover to improve environmental resistance and/or flame resistance. The outer cover is not necessarily bonded to the tubing or hose.

Six types of tubing and hose for specific applications are specified as follows:

— Type 1: feed and return lines from the fuel tank to the engine compartment — gasoline engines;

— Type 2: feed and return lines from the fuel tank to the engine compartment — diesel engines;

— Type 3: feed and return lines in the engine compartment — moderate-temperature (100 °C) environment —gasoline engines;

— Type 4: feed and return lines in the engine compartment — high-temperature (125 °C) environment — gasoline engines;

— Type 5: feed lines in the engine compartment — diesel engines;

— Type 6: multi-layer tubing or hoses for vapour lines.

4 Dimensions

Diameters and wall thicknesses shall be as given in Table 1.

The wall thickness shall be the sum of the individual thicknesses of the various elements in the construction of the tubing or hose. The thickness of each individual element shall be such that it is able to carry out its own function and the total function of the tubing or hose.

Table 1 — Nominal sizes, internal diameters and wall thicknesses

Nominal size	Internal diameter mm	Wall thickness (min) mm
2	2 ± 0,1	0,9
4	4 ± 0,1	0,9
6	6 ± 0,1	0,9
6	6 ± 0,1	1,35
7,5	7,5 ± 0,1	1,12
8	8 ± 0,1	0,9
8	8 ± 0,1	1,35
9	9 ± 0,1	1,35
10	10 ± 0,1	1,8
12	12 ± 0,1	1,35
12	12 ± 0,1	1,8
14	14 ± 0,1	1,8

5 Requirements

The following tests shall be selected for each application of the tubing or hose, based on the performance requirements of the finished product. The tests to be carried out for each type of tubing or hose classified in Clause 3 are given in Table E.1.

a) Burst pressure: When determined in accordance with ISO 1402, the minimum burst pressure for all constructions shall be 5,5 MPa gauge (55 bar).

b) Cold impact resistance: After cold impact testing at −40 °C in accordance with ISO 7628, all constructions shall show no evidence of external fracture or cracking and shall meet the burst pressure requirements of a).

c) Heat ageing resistance: After ageing at one or more of the following sets of conditions in accordance with ISO 188, all constructions shall meet the cold impact requirements of b):

1) 1 000 h at 70 °C;
2) 1 000 h at 100 °C;
3) 1 000 h at 125 °C;
4) 168 h at 100 °C;
5) 168 h at 125 °C;
6) 168 h at 140 °C.

d) Resistance to light: All constructions shall meet the cold impact requirements of b) after 1 000 kJ/m^2 xenon-arc exposure in accordance with ISO 30013.

NOTE This test is for applications that require exposure to daylight either during normal vehicle usage or on chassis that can be stored in the open prior to final assembly of the vehicle.

e) Resistance to fuels: When tested in accordance with SAE J2260, for 1 000 h at 60 °C ± 2 °C, using one or more of the following test fuels, all constructions shall meet the cold impact requirements of b) and the adhesion requirements of k) where applicable:

1) a mixture of 85 % by volume of liquid C (ISO 1817) and 15 % by volume of methanol;
2) a mixture of 75 % by volume of liquid C (ISO 1817) and 25 % by volume of methanol;
3) a mixture of 50 % by volume of liquid C (ISO 1817) and 50 % by volume of methanol;
4) a mixture of 15 % by volume of liquid C (ISO 1817) and 85 % by volume of methanol;
5) by volume 100 % liquid 2 (ISO 1817);
6) a mixture of 90 % by volume of liquid 2 (ISO 1817) and 10 % by volume of ethanol;
7) liquid F (ISO 1817) (simulated diesel fuel);
8) a mixture of 90 % by volume of liquid F (ISO 1817) and 10 % by volume of rape seed methyl ester;
9) a mixture of 80 % by volume of liquid F (ISO 1817) and 20 % by volume of rape seed methyl ester;
10) PN 180 oxidized fuel in accordance with ISO 19013-2:2016, Annex D.

f) Volume change in the test fluids: Determine the change in volume of the hose (tube and cover) by the procedure described in ISO 1817. Place the test pieces in test liquids as specified in e) at a temperature of 40 °C ± 2 °C for 40 d. 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 hose with an inner layer of fuel-resistance 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.

g) Resistance to stress cracking: When tested in accordance with ISO 7628, all constructions shall show no evidence of stress cracking and shall meet the cold impact requirements of b).

h) Resistance to battery acid: When tested in accordance with ISO 7628, all constructions shall show no evidence of cracking or degradation and shall meet the cold impact requirements of b).

i) Resistance to surface contamination by engine oil and petroleum-based hydraulic fluid: When tested in accordance with Annex B, using ISO 1817 Oil No. 3, all constructions shall meet the cold impact requirements of b) and the adhesion requirements of k) where applicable.

j) Resistance to surface contamination by non-petroleum hydraulic (brake/clutch) fluid: When tested in accordance with Annex B, using hydraulic fluid in accordance with ISO 4926, all constructions shall meet the cold impact requirements of b) and the adhesion requirements of k) where applicable.

k) Adhesion: For any constructions with two or more co-extruded or bonded layers only: When determined in accordance with the appropriate procedure of ISO 8033, the separation force between bonded layers shall not be less than 1,5 kN/m.

l) Flame resistance: When tested in accordance with Annex C, the tubing or hose shall withstand a minimum of 60 s exposure to flame without loss of pressure.

m) Internal cleanliness: When determined in accordance with Annex D, the insoluble impurities shall not exceed 5 g/m^2 and the fuel-soluble impurities shall not exceed 3 g/m^2.

n) Fuel permeability: When determined in accordance with ISO 8308, the permeability to a mixture of 85 % by volume of liquid C (ISO 1817) and 15 % by volume of methanol shall not exceed 25 g/m^2/24 h.

o) Electrical resistance: When determined in accordance with ISO 8031:2009, 4.5, 4.6, or 4.7, the electrical resistance shall not exceed 10 MΩ.

p) Resistance to kinking: When determined in accordance with ISO 10619-1, the maximum coefficient of deformation (*T/D*) shall not exceed 0,7.

The mandrel diameter shall be 140 mm for tubing and hoses up to nominal size 10, 220 mm for nominal size 10 and up to and including nominal bore 12 and 300 mm for nominal size 14.

6 Frequency of testing

Type tests and routine tests shall be as specified in Annexes E and F, respectively.

Type tests are those required to confirm that a particular hose or hose assembly design, manufactured by a particular method from particular materials, meets all the requirements of this part of ISO 13775. The tests shall be repeated at a maximum of five-year intervals, or whenever a change in the method of manufacture or materials used occurs. They shall be performed on all sizes and types except those of the same size and construction.

Routine tests are those required to be carried out on each length of finished hose or hose assembly prior to dispatch.

Production tests are those specified in Annex G, which should preferably be carried out to control the quality of manufacture. The frequencies in the annex are given as a guide only.

7 Marking

All constructions shall be continuously marked with at least the following information:

a) the manufacturer's name or trade mark;

b) the number of this part of ISO 13775, i.e. ISO 13775-2;

c) the type number;

d) the nominal size;

e) the word "Fuel";

f) the quarter and year of manufacture.

EXAMPLE XXX, ISO 13775-2, Type 1, 6, Fuel, 2Q/2016.

Parts made from short cut lengths may not be long enough to show the entire marking sequence.

Annex A
(informative)

Example of how a non-standard type of tubing or hose could be specified using a matrix

Material: Clause 5

Burst pressure 3 MPa (30 bar).....	a	X
	b	X
	c1	
1 500 h at 100 °C.....	c2	X
	c3	
	c4	
	c5	X
	c6	
	d	
	e1	X
	e2	
	e3	
	e4	
	e5	X
	e6	
	e7	
	e8	
	e9	
Peroxide no. PN 90.....	e10	X
	f	X
	g	X
	h	X
	i	X
	j	X
	k	X
	l	X
Fuel-soluble impurities 1 g/m^2.....	m	X
	n	X
8 MΩ max.....	o	X
	p	X
Burst pressure at 100 °C: 2 MPa (20 bar).....	z1	X
Colour blue.....	z2	X

Annex B
(normative)

Method for determining the resistance to surface-contaminating fluids

Tightly plug the ends of sufficient specimens of tubing or hose to enable the cold impact test b) to be carried out. Fully immerse each specimen in the specified contaminating fluid for 2 h at 60 °C. At the end of the immersion period, wipe the fluid from the surface of the specimens and test as required.

Annex C
(normative)

Method of test for flame resistance

WARNING — This test is hazardous and extreme care shall be taken to avoid injury to persons and damage to property.

C.1 Test equipment/materials

C.1.1 Flame chamber, construction as shown in Figures C.1 to C.5.

C.1.2 Reagent-grade methanol.

C.1.3 Timing device, capable of measuring to the nearest 1 s.

C.2 Test preparation

This test shall be carried out on a straight hose specimen manufactured by the correct process for the product type and of sufficient length to fit into the test fixture rather than a complete assembly.

Insert a straight length of aluminium rod into the specimen to provide support for the test. The support rod shall be long enough to extend completely across the test chamber and shall be less than one-half the nominal size of the tubing or hose.

Attach the specimen to the test fixture and check for leaks with an applied pressure of 0,15 MPa gauge (1,5 bar).

Fill the fuel pan with a sufficient quantity of methanol to burn for at least 90 s.

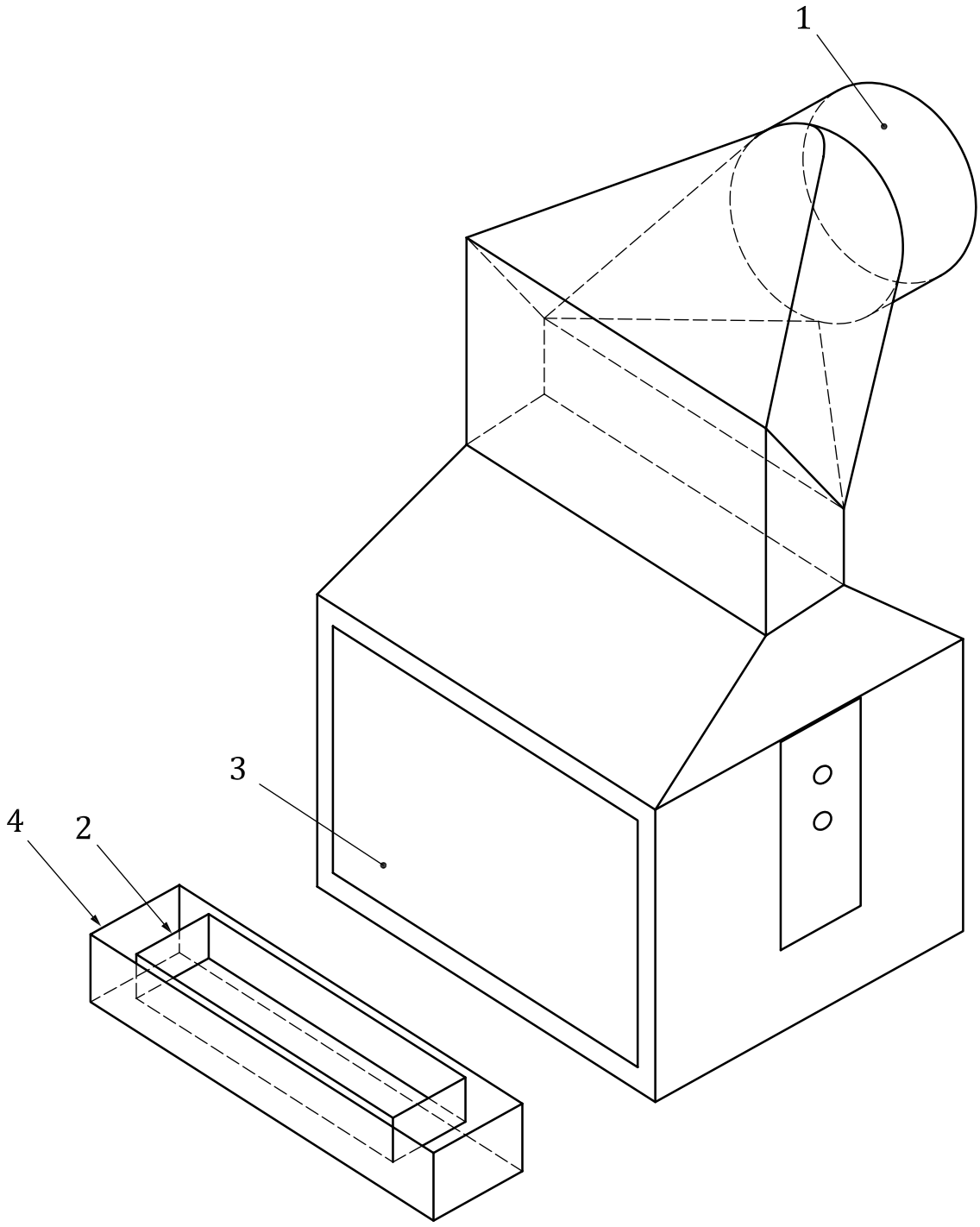
Fill the fuel coolant pan completely with water.

C.3 Test procedure

Apply 0,15 MPa bar gauge (1,5 bar) air pressure to the specimen.

Simultaneously ignite the pan of methanol and start the timing device.

Stop the test by extinguishing the flames if no pressure loss has occurred after 60 s.

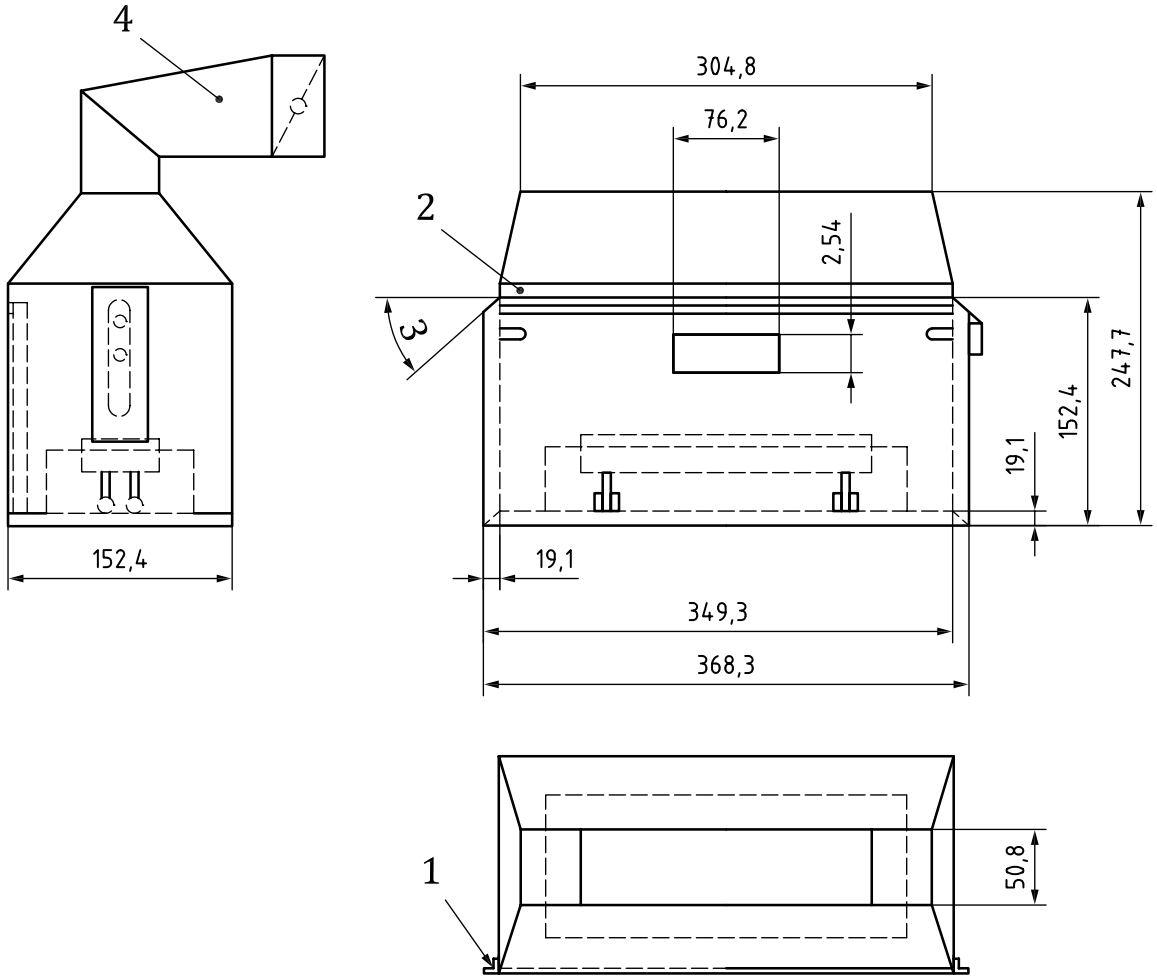


Key

1 damper location
2 fuel pan
3 door
4 fuel coolant pan

Figure C.1 — Flame chamber — General arrangement

Dimensions in millimetres

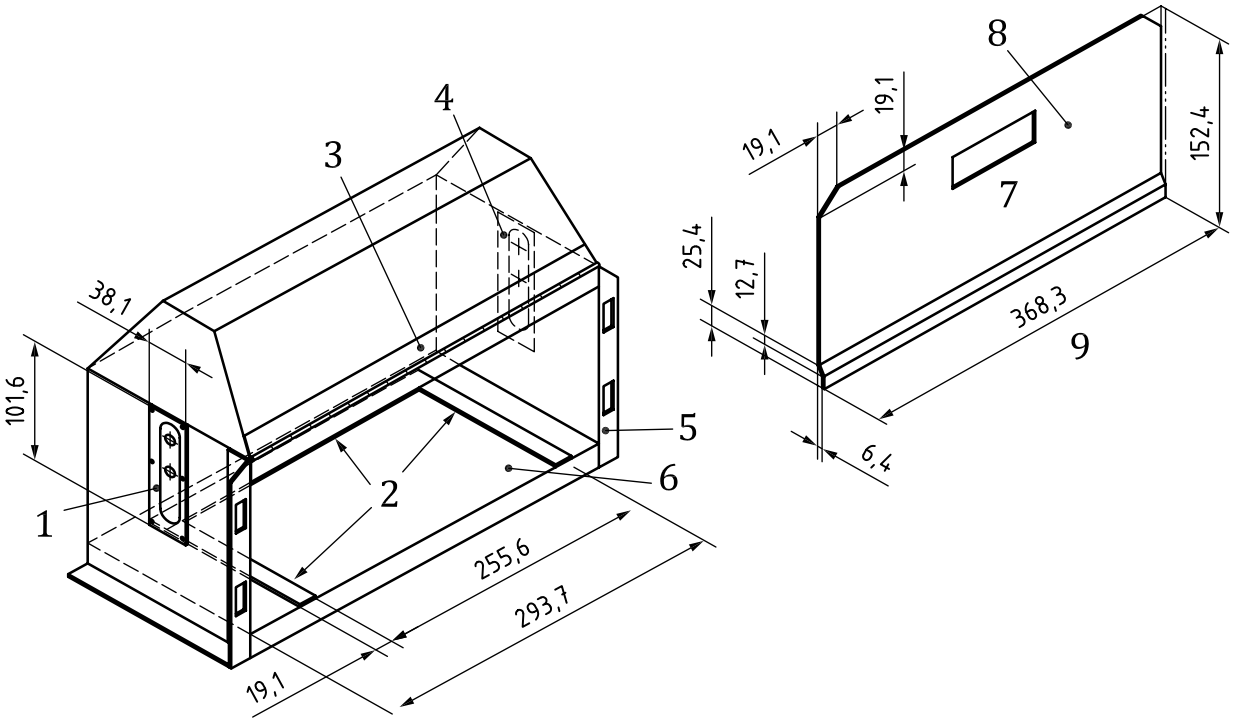


Key

1 aluminium angle, 3,18 mm × 19,1 mm
2 piano hinge
3 angle typically 45°
4 sheet-metal elbow boot with damper, 57,2 mm × 304,8 mm × 152,4 mm

Figure C.2 — Flame chamber — General dimensions

Dimensions in millimetres

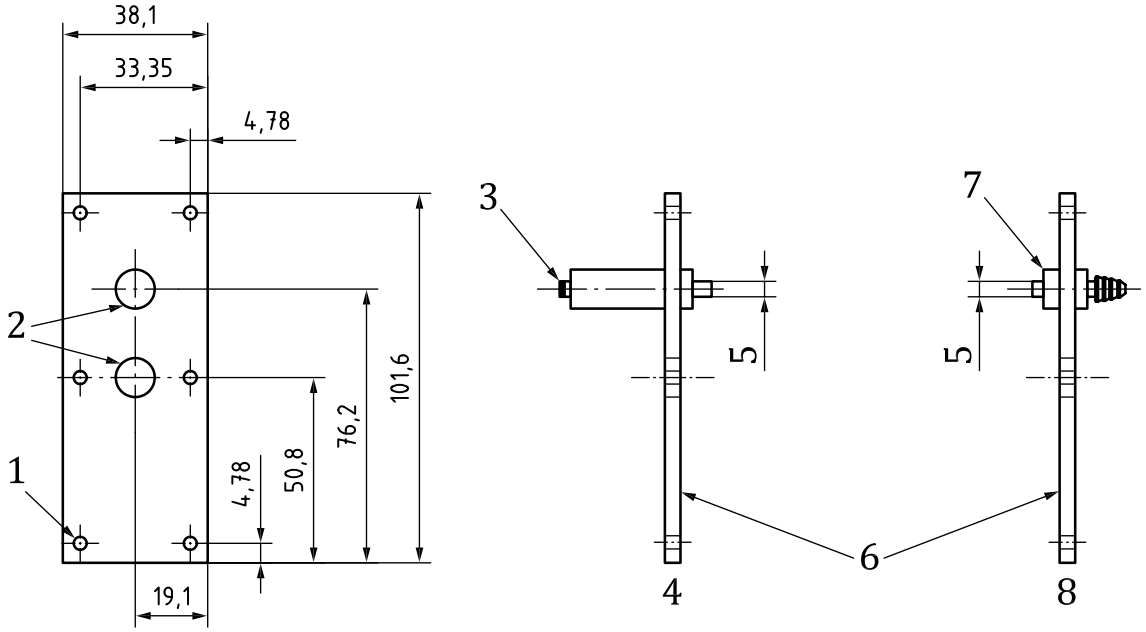


Key

1 L.H. end plate
2 fuel pan positioning strips (three required)
3 piano hinge
4 R.H. end plate
5 door stop
6 door removed
7 door
8 aluminium screen, both sides (hardware cloth in centre)
9 material: 3,18 mm thick aluminium (remove all sharp edges)

Figure C.3 — Chamber dimensions

Dimensions in millimetres

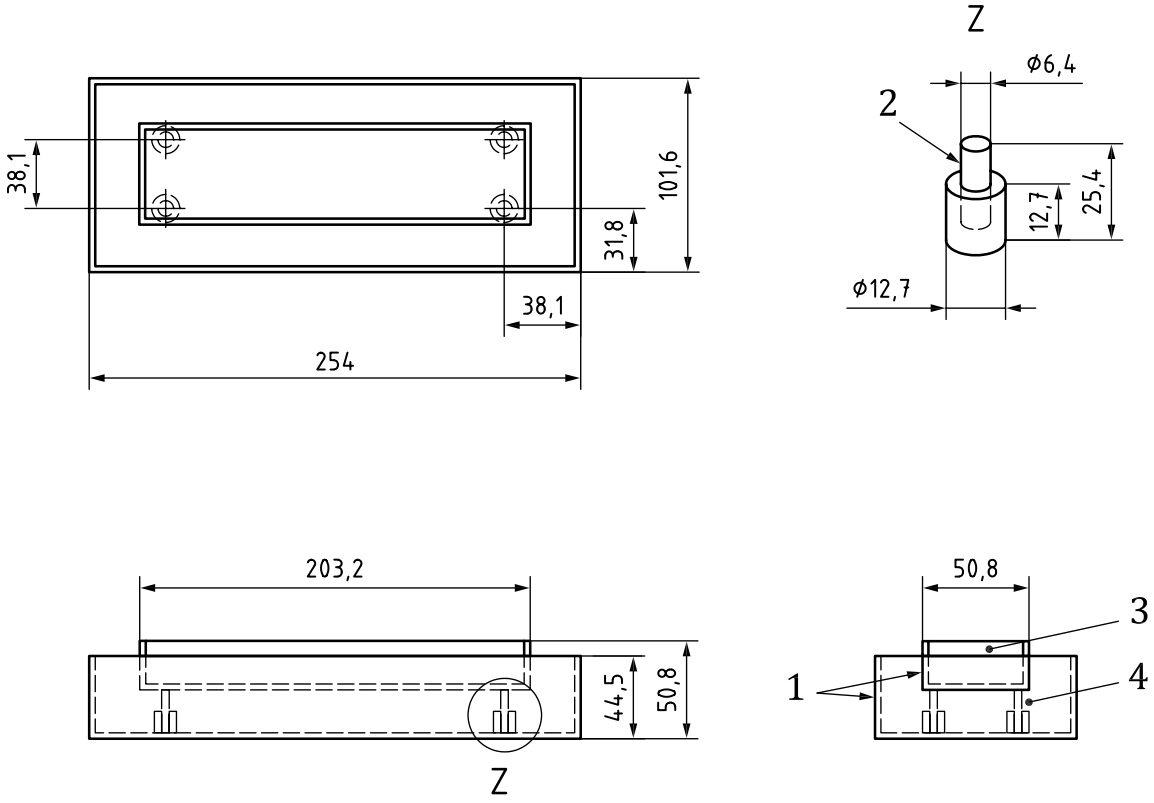


Key

1 six holes to match no. 10–32 drill and tapped holes in cabinet end panels
2 drill and tap 6,35 mm (1/4 inch) pipe thread
3 Schrader valve (input)
4 L.H. end plate
5 diameter to be compatible with diameter of hoses to be tested
6 material: aluminium plate, 3,18 mm thick
7 output to barbed fitting for manometer hose
8 R.H. end plate

Figure C.4 — End plate dimensions

Dimensions in millimetres



Key

1 material of both pans: aluminium
2 positioning legs (four required)
3 fuel pan
4 coolant pan

Figure C.5 — Fuel pan/coolant pan dimensions

Annex D
(normative)

Cleanliness and extractables test

D.1 General

This annex specifies a method for the determination of the quantity of insoluble impurities ("dirt"), liquid C solubles and waxy extractables present in hoses and tubing used in liquid-fuel circuits.

D.2 Principle

A quantity of ISO 1817 liquid C is left for a period of 24 h at ambient temperature inside a length of hose or tubing. After this time, the test piece is emptied and the inside washed by gravity flow of liquid C.

The total solution is collected and the insoluble matter filtered out, dried and weighed. The remaining solution is evaporated to dryness and the total content of liquid C soluble material calculated. The waxy material is dissolved from this residue with methanol and the resulting solution is evaporated to dryness and weighed.

D.3 Apparatus and materials

D.3.1 Glass filter funnel.

D.3.2 Evaporating dishes, (two).

D.3.3 Beaker, 250 cm^3.

D.3.4 Fuel evaporator, fitted with an extraction hood.

D.3.5 Ventilated drying oven, capable of being maintained at 85 °C ± 5 °C.

D.3.6 Balance, accurate to 0,1 mg.

D.3.7 Sintered-glass filter, porosity grade P3.

D.3.8 Liquid C, as specified in ISO 1817.

D.3.9 Methanol, minimum purity 99 %.

D.3.10 Metal stoppers, to seal the ends of the hoses/tubing.

D.4 Procedure

Take a length of hose or tubing between 300 mm and 500 mm in length and measure its internal dimensions. Plug one end with a metal stopper (D.3.10) and hang vertically. Fill this test piece with liquid C (D.3.8) and seal the top end with another metal stopper. Calculate the internal surface area in contact with liquid C taking into account the area in contact with the stoppers. Leave the test pieces for 24 h ± 30 min at 21 °C ± 2 °C.

At the end of this period, remove one of the stoppers and pour the contents into the beaker (D.3.3). Remove the other stopper and hang the hose or tubing vertically over the beaker. By means of the filter funnel (D.3.1), rinse the inside of the hose or tubing with five portions each of 20 cm^3 of liquid C.

Filter the entire contents of the beaker through the previously weighed sintered-glass filter (D.3.7), using a small amount of clean liquid C to rinse out the beaker. Collect the filtrate in a previously weighed evaporating dish (D.3.2). Dry the filter in the oven (D.3.5) at 85 °C ± 5 °C until a constant mass is obtained.

Calculate the total mass of insoluble matter.

Place the evaporating dish and its contents on the fuel evaporator (D.3.4) under the extraction hood and evaporate the liquid to dryness. Dry the residue in the oven at 85 °C ± 5 °C until a constant mass is obtained.

Calculate the total mass of soluble material extracted by liquid C.

Keep the dried residue in the evaporating dish under the extraction hood at 21 °C ± 5 °C for a minimum of 16 h, then dissolve the residue in 30 cm^3 of methanol (D.3.9) at the same temperature. Filter the solution through the sintered-glass filter into the second pre-weighed evaporating dish. Rinse the first dish with 10 cm^3 of fresh methanol and filter as before. Rinse and filter once more.

Place the second evaporating dish containing the filtered solution on the fuel evaporator under the extraction hood and evaporate all the methanol. Dry the residue in the oven at 85 °C ± 5 °C until constant mass is attained.

Calculate, in g/m^2, the mass of waxy extractables dissolved by the methanol per unit internal surface area.

Annex E
(normative)

Type tests

Table E.1 gives the tests to be carried out for type testing as defined in Clause 5.

Table E.1 — Type test

Test (see Clause 5)	Applicability					
	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
a	X	X	X	X	X	X
b	X	X	X	X	X	X
c1	X	X	NA	NA	NA	X
c2	NA	NA	X	NA	X	NA
c3	NA	NA	NA	X	NA	NA
c4	X	X	NA	NA	NA	X
c5	NA	NA	X	NA	X	NA
c6	NA	NA	NA	X	NA	NA
d	X	X	X	X	X	X
e1	X	NA	X	X	NA	X
e2	X	NA	X	X	NA	X
e3	X	NA	X	X	NA	X
e4	X	NA	X	X	NA	X
e5	X	NA	X	X	NA	X
e6	X	NA	X	X	NA	X
e7	NA	X	NA	NA	X	NA
e8	NA	X	NA	NA	X	NA
e9	NA	X	NA	NA	X	NA
e10	X	NA	X	X	NA	X
f	X	X	X	X	X	X
g	X	X	X	X	X	X
h	NA	NA	X	X	X	NA
i	NA	NA	X	X	X	NA
j	NA	NA	X	X	X	NA
k	X	X	X	X	X	X
l	X	X	X	X	X	X
m	X	X	X	X	X	X
n	X	X	X	X	X	X
o	X	NA	X	X	NA	NA
p	X	X	X	X	X	X

X Test shall be carried out.
NA Test not applicable.

Annex F
(normative)

Routine tests

Table F.1 gives the tests to be carried out for routine testing as defined in Clause 5.

Table F.1 — Routine test

Test	Applicability
Dimensions	X
Concentricity	X
Clause 5 tests:	
a	NA
b	NA
c	NA
d	NA
e	NA
f	NA
g	NA
h	NA
i	NA
j	NA
k	NA
l	NA
m	NA
n	NA
o	NA
p	NA
X Test shall be carried out.	
NA Test not applicable.	

Annex G
(informative)

Production tests

Table G.1 gives the suggested frequency for production tests to be carried out per batch or 10 batches. A batch is defined as 1 000 m of hose or tubing produced.

Table G.1 — Recommended frequency for production test

Test	Per batch	Per 10 batches
Dimensions	X	X
Concentricity	X	X
Clause 5 tests:		
a	X	X
b	X	X
c (168 h tests)	NA	X
d	NA	NA
e	NA	NA
f	NA	NA
g	NA	NA
h	NA	NA
i	NA	NA
j	NA	NA
k	NA	NA
l	NA	NA
m	X	X
n	NA	NA
o	X	X
p	X	X
X Test is carried out.		
NA Test not applicable.		

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[1] ISO 4925, *Road vehicles — Specification of non-petroleum-base brake fluids for hydraulic systems*

ICS 83.140.40; 83.140.30; 43.060.40

Price based on 19 pages

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