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Rubber and plastics hoses and hose assemblies for automotive air conditioning — Specification —

Part 3: Refrigerant 1234yf

Tuyaux et flexibles en caoutchouc et en plastique pour climatisation des automobiles — Spécifications —

Partie 3: Réfrigérant 1234yf

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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).

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 45, *Rubber and rubber products*, Subcommittee SC 1, *Rubber and plastics hoses and hose assemblies*.

A list of all parts in the ISO 8066 series can be found on the ISO website.

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.

Rubber and plastics hoses and hose assemblies for automotive air conditioning — Specification —

Part 3: Refrigerant 1234yf

WARNING — Persons using this document should be familiar with normal laboratory practice. This document 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 health and safety practices and to ensure compliance with any national regulatory conditions.

1 Scope

This document specifies the requirements for rubber or thermoplastic hoses and hose assemblies used for circulating liquid and gaseous R1234yf (tetrafluoropropene) in the air-conditioning systems of automobiles. The hoses and hose assemblies are designed in such a way as to restrict losses of refrigerant and contamination of the system. The operational temperature range is −40 °C to +125 °C.

Due to the critical relationship between the hose and coupling for this application, a requirement that the coupling to be used in service be used for testing has been laid down.

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

ISO 4671:2007, *Rubber and plastics hoses and hose assemblies — Methods of measurement of the dimensions of hoses and the lengths of hose assemblies*

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

ISO 8330, *Rubber and plastics hoses and hose assemblies — Vocabulary*

ISO 23529, *Rubber — General procedures for preparing and conditioning test pieces for physical test methods*

ISO/TR 11340, *Rubber and rubber products — Hydraulic hose assemblies — External leakage classification for hydraulic systems*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8330 apply.

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

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

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

4 Classification

4.1 Types

4.1.1 General

Including, but not limited to the following.

4.1.2 Type A — Rubber, textile-reinforced, rubber-covered

The hose shall be built having a suitable seamless synthetic rubber tube. The reinforcement shall consist of textile yarn, cord, or fabric adhered to the tube and cover. The outer cover shall be heat- and ozone-resistant synthetic rubber.

4.1.3 Type B — Rubber, wire-reinforced, rubber-covered

The hose shall be built having a suitable seamless synthetic rubber tube. The reinforcement shall consist of steel wire adhered to the rubber tube. The cover shall consist of a heat-resistant textile yarn impregnated with a synthetic rubber cement.

4.1.4 Type C — Barrier, textile-reinforced, rubber-covered

The hose shall have a suitable thermoplastic barrier between rubber layers. The reinforcement shall consist of suitable textile yarn, cord, or fabric adhered to the tube and cover. The outer cover shall be heat- and ozone-resistant synthetic rubber.

4.1.5 Type D — Thermoplastic, textile-reinforced, thermoplastic-covered

The hose shall have a suitable thermoplastic tube. The reinforcement shall consist of a suitable textile yarn, cord, or fabric adhered to the tube and cover. The outer cover shall be heat- and ozone-resistant synthetic elastomer.

4.1.6 Type E — Veneer, textile-reinforced, rubber-covered

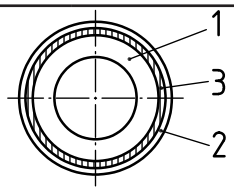
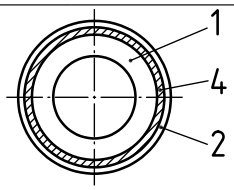
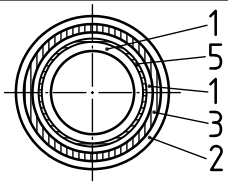
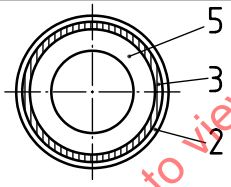
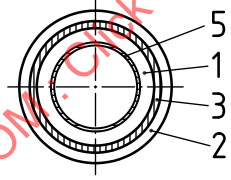
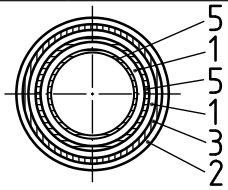
The hose shall have a suitable thermoplastic veneer lining with a rubber tube outer layer. The reinforcement shall consist of a textile yarn, cord, or fabric adhered to the tube and cover. The cover shall be heat- and ozone-resistant synthetic rubber.

4.1.7 Type F — Veneer, barrier, thermoplastic liner

The hose shall have a suitable thermoplastic veneer liner with a thermoplastic barrier between elastomeric layers. The reinforcement shall consist of a suitable textile yarn, cord, or fabric adhered to the tube and cover. The cover shall be heat- and ozone-resistant elastomer.

Table 1 gives the figure and applicable pressure class for each type.

Table 1 — Figure and applicable pressure class

Type	Figure	Applicable pressure class	
		High	Low
A		X	X
B		X	N/A
C		X	X
D		X	N/A
E		X	X
F		X	X

Key

1 rubber
2 cover
3 textile
4 wire
5 thermoplastic resin

X = Applicable
N/A = Not applicable

4.2 Pressure classes

4.2.1 High — Discharge and liquid applications.

4.2.2 Low — Suction application.

Working pressures are given in Table 2.

Table 2 — Working pressure

Pressure class	Working pressure MPa (bar)
High	3,28 (32,8)
Low	1,06 (10,6)

4.3 Moisture-ingression grades

4.3.1 ML — Low moisture ingression hose as defined in 6.14.

4.3.2 Mm — Medium moisture ingression hose as defined in 6.14.

4.4 Refrigerant-permeation grades

4.4.1 RU — Ultra low refrigerant permeation hose as defined in 6.3.2.

4.4.2 RL — Low refrigerant permeation hose as defined in 6.3.2.

4.4.3 Rm — Medium refrigerant permeation hose as defined in 6.3.2.

5 Dimensions

5.1 Hose inside diameters

Standard dimensions are given in Table 3, but not limited to the following.

Table 3 — Typical inside diameters

Nominal size	Mean inside diameter mm
8 (5/16)	8
10 (13/32)	10,3
11	11
13 (1/2)	12,7
14	14
15	15
16 (5/8)	15,9
19 (3/4)	19
25 (1)	25,4
NOTE Nominal size in parenthesis is in inches.	

5.2 Hose wall thickness variation

When the wall thickness is measured in accordance with method 2 of ISO 4671:2007, the variation in the wall thickness shall not exceed the values given in Table 4.

Table 4 — Wall thickness variation

Type A, B, C and E		Type D and F	
Nominal size	**Maximum departure from concentricity** mm	**Nominal size**	**Maximum departure from concentricity** mm
Up to and including 19	1,0	Up to and including 13	0,6
		Over 13 and including 19	0,8
Over 19	1,3	Over 19	1,0

6 Testing and performance requirements

6.1 Test conditions

The testing room shall be kept at standard temperature in accordance with ISO 23529. The temperature of the hoses or hose assemblies shall be stabilized for 24 h before testing.

6.2 Leakage

6.2.1 Method A for type test and production test

When determined in accordance with the procedure given in 6.2.2, the loss in mass of refrigerant shall be no greater than 10 % of the initial mass of the refrigerant and there shall be no visible deterioration in the hoses or hose assemblies.

6.2.2 Procedure for method A

Test three test pieces. Fill each test piece with R1234yf containing (10 ± 1) % refrigerant compatible lubrication oil. Maintain each test piece with the pressure listed in Table 2 for 24 h at a temperature of 80 °C ± 2 °C.

This test can be carried out separately or during the 24 h pre-conditioning period for the refrigerant loss test (see 6.3) at 80 °C ± 2 °C. When the test is carried out separately from 6.3, use the procedure described in Annex A.

6.2.3 Method B for routine test

When determined in accordance with the procedure given in 6.2.4, there shall be no leak and no visible deterioration in the hoses or hose assemblies. When pricked hose is tested, gas bubbles which form on the surface of the hose and decrease gradually after pressurizing may be observed but not be considered as a leak.

6.2.4 Procedure for method B

Immerse the test assembly in the water bath. Apply gas (air or inert gases) pressure and maintain the pressure listed in Table 2 for 5 min. Also, a gas leak detector, snoop liquid leak detector may be applied to check leakage under the pressure listed in Table 2 for 5 min.

6.3 Refrigerant permeation

6.3.1 Requirement

When determined in accordance with the procedure described in 6.3.2, the loss of refrigerant from the hoses or hose assemblies shall be no greater than the values given in Table 5.

6.3.2 Procedure

Test the hoses or hose assemblies in accordance with the procedure described in Annex A at 80 °C ± 2 °C.

Table 5 — Refrigerant permeation

Refrigerant-permeation grade	Maximum allowable loss of refrigerant kg/m^2/year
RU	1,5
RL	5
Rm	18

6.4 Ageing

6.4.1 Requirement

When tested in accordance with 6.4.2, there shall be no leak and no cracks in a test hose or hose assembly.

6.4.2 Procedure

Wind a hose or hose assembly, of length between 300 mm and 1 000 mm, on to a mandrel having a diameter eight times the outside diameter of the hose. Place the mandrel and hose or hose assembly in a circulating-air oven for 168 h at 125 °C ± 2 °C.

Take the mandrel and hose or hose assembly out of the oven, allow to cool to ambient temperature, unwind the hose or hose assembly and examine it externally for any cracks, disintegration or other defects. Then test the hose or hose assembly in accordance with the procedure given in 6.2.3 and 6.2.4.

6.5 Low-temperature test

When tested in accordance with the method described in Annex B, there shall be no leak or loss due to cracks or splits.

6.6 Vacuum resistance

6.6.1 General

A hose or hose assembly shall be subjected, consecutively, to the vacuum test, then the length variation test (6.7), then the burst test (6.8).

6.6.2 Requirement

The decrease in the outside diameter of the hose shall not exceed 20 % of the initial outside diameter and there shall be no obstruction of flow caused by the hose collapse when the hose or hose assembly is subjected to a reduced internal pressure (vacuum) of 1,33 kPa ± 0,66 kPa (absolute) for 2 min in accordance with 6.6.3.

6.6.3 Procedure

The test hose or hose assembly shall have a free length of from 610 mm to 1 000 mm. Bend the hose into a U shape, whereby the internal radius of the base of the U shall be five times the mean outside diameter of the hose. Measure the minor axis, d_1, at the base of the U. Apply a vacuum of 1,33 kPa ± 0,66 kPa (absolute) to the bent hose for 2 min. At the end of this period and while the vacuum is still being

applied, measure the minor axis, d_2 at the base of the U. The ratio of the decrease in outside diameter R_d shall be calculated as below:

$$R_d = (d_1 - d_2)/d_1 \ (\times 100\ \%)$$

6.7 Length change under pressure

6.7.1 Requirement

When subjected to a pressure listed in Table 2, a hose or hose assembly shall not contract by more than 4 % or extend by more than 2 %.

6.7.2 Procedure

Subject the hose or hose assembly, in a horizontal position, to an internal hydrostatic pressure of 7 kPa (0,07 bar) and measure the length. Increase the pressure to the prescribed value and measure the length once again within the following minute. Express the length as a percentage of the length at 7 kPa (0,07 bar).

Refer to ISO 1402 for additional information.

6.8 Minimum bursting pressure

When determined in accordance with the method described in ISO 1402, using test pieces that have been subjected to the test for refrigerant loss described in 6.3, the minimum bursting pressure shall be the value listed in Table 6.

Table 6 — Minimum burst pressure

Pressure class	Minimum burst pressure MPa (bar)
High	13,12 (131,2)
Low	4,24 (42,4)

6.9 Proof pressure

6.9.1 Requirement

When tested in accordance with the procedure described in 6.9.2, a hose or hose assembly shall exhibit no leakage, cracking, abrupt distortion (indicating irregularity in materials or manufacture) or other signs of failure.

6.9.2 Procedure

Hydrostatically pressurize a hose or hose assembly to the value listed in Table 7 and hold the pressure for 2 min ± 30 s. During and after the proof pressure hold period, examine the hose.

Table 7 — Proof pressure

Pressure class	Proof pressure MPa (bar)
High	6,56 (65,6)
Low	2,12 (21,2)

6.10 Extraction by R1234yf

When determined in accordance with Annex C, the quantity of matter extracted from the lining of the hose by the R1234yf shall not exceed 118 g/m^2.

NOTE The substances extracted will be of an oily or greasy nature.

6.11 Ozone resistance

This requirement applies only to rubber covered hoses.

Bend the hose around a mandrel with a diameter equal to eight times the mean outside diameter of the hose and carry out the test in accordance with method 1 of ISO 7326:2016 using an ozone concentration of 50 mPa ± 5 mPa.

The hose cover shall exhibit no visible cracks when viewed under ×7 magnification.

6.12 Hose cleanliness

6.12.1 Requirement

The tube of the hose shall be dry and clean. When determined in accordance with 6.12.2, the mass of insoluble matter shall be a maximum of 270 mg/m^2 based on the internal surface area of the hose.

6.12.2 Procedure

Take a hose test piece having a minimum length of 300 mm. Bend the hose into a U-shape, with the legs of the U of equal length. Place the hose in a vertical position and fill the hose with a suitable solvent.

Immediately empty the hose, filtering the solvent through a prepared Gooch crucible, a sintered-glass crucible or a 0,4 mm filter of known mass.

After drying the filter and residue at approximately 70 °C for 20 min, determine the mass of insoluble matter by difference.

6.13 Impulse test

6.13.1 Requirement

When tested in accordance with 6.13.2, hoses or hose assemblies shall not leak or fail prior to 150 000 cycles.

6.13.2 Procedure

Carry out the test in accordance with Annex D.

Install a minimum of two hose assemblies on the test apparatus and subject them to a pulsating pressure listed in Table 8 at 30 cycles to 40 cycles per min.

Table 8 — Impulse test conditions

Pressure class	Temperature °C	Test pressure MPa (bar)
High	125	3,28 (32,8)
Low	100	1,06 (10,6)

Use a minimum bend radius of five times the outside diameter of the hose.

6.14 Moisture ingression

When determined in accordance with Annex E, the rate of ingress of moisture shall not exceed the values listed in Table 9.

Table 9 — Rate of ingression of moisture

Moisture-ingression grades	Maximum rate of ingress of moisture g/mm^2/year
ML	$3{,}90 \times 10^{-4}$
Mm	$1{,}11 \times 10^{-3}$

6.15 Coupling integrity (sealability)

The couplings used shall be the same as those intended for use in service.

Carry out the test in accordance with Annex F.

The maximum mass loss per canister (two couplings) per 12-day test shall not exceed 10 g.

None of the four post-exposure flexing evaluations shall produce hissing or visible oil loss at any location in the coupled assembly.

7 Frequency of testing

Type tests and routine tests shall be as specified in Annex G.

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 document. The tests shall be repeated at a maximum of five-year interval, 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 H, which should preferably be carried out to control the quality of manufacture. The frequencies in Annex H are given as a guide only.

8 Marking

Except where it is too small to label, the hose or hose assembly shall be marked with the following minimum information:

a) the manufacturer's name and trademark;

b) the number of this document, i.e. ISO 8066-3 (hose manufacturers shall use the latest publication of this document, otherwise the year of publication shall be included in the marking);

c) the type of hose;

d) the pressure class of hose;

e) the moisture ingression grade of hose;

f) the refrigerant permeation grade of hose;

g) the nominal size of the hose;

h) the name of the refrigerant, i.e. "R1234yf";

i) the month and year of manufacture.

EXAMPLE XXX/ISO 8066-3/C/High/ML/RL/16/R1234yf/19/02

9 Test report

When requested by purchaser, the manufacturer or supplier shall supply a test report representing the purchased product (each length or batch of hoses).

10 Recommendations for packaging and storage

Recommendations for packaging and storage are given in ISO 8331.

Annex A
(Normative)

Determination of refrigerant permeation

A.1 Principle

The rate of permeation of refrigerant through the walls of the hose is determined by measuring the change in mass of refrigerant-filled test pieces over a given period of time.

A.2 Apparatus

A.2.1 Canister (optional), if a canister is used, the coupled hose assemblies are to be connected to canisters each having an internal volume between 475 cm^3 and 525 cm^3, a minimum bursting pressure of 21 MPa (210 bar) and appropriate fittings to enable a hose test assembly to be connected up to it.

A.2.2 Hose fittings, enabling the refrigerant to be held under pressure in the hose without any loss between the hose and the fittings, and being the same as the fittings intended for use in service.

A.2.3 Circulating-air oven, capable of maintaining uniform test temperatures for the duration of the test.

A.2.4 Scales, weighing to ±0,1 g.

A.3 Test assemblies

Take four assemblies, each with a free length of 1 m. Three of these assemblies shall be used for determining the refrigerant loss; the fourth shall serve as a reference for the determination of the change in mass of the body of the hose alone.

One end of each hose assembly is to be fitted with a capped charge fitting. The other end is to be attached to a canister (optional) or plugged with a fitting.

A.4 Procedure

A.4.1 Preliminary operations

Measure the free length of each hose at atmospheric pressure to the nearest 1 mm. Connect each of the four hoses to a canister (optional) and determine the mass of each hose/canister (optional) assembly, including the end-plug which is used to plug the free end of the hose, to within ±0,1 g. Introduce into three of the hose/canister assemblies 0,6 mg of refrigerant R1234yf containing (10 ± 1) % refrigerant compatible lubrication oil per mm^3 volume of the assembly with a tolerance of ±5 g.

A.4.2 Method 1

The hose/canister assemblies may be filled satisfactorily by cooling them in a refrigerator for a minimum of 4 h at a temperature of −30 °C or lower.

From the density of refrigerant R1234yf and (10 ± 1) % refrigerant compatible lubrication oil at the conditioning temperature, it is possible to calculate the volume of refrigerant/oil mixture required at

this temperature. Keeping the refrigerant/oil mixture and hose at the conditioning temperature, the hose may then be filled, measuring the volume of refrigerant/oil mixture using a graduated flask.

The filled assemblies are then plugged while still at the conditioning temperature but may be taken out of the refrigerator to tighten the connections.

A.4.3 Method 2

The hose/canister assemblies may be filled at ambient temperature by transferring the refrigerant/oil mixture under pressure. A suitable apparatus for this purpose is a cylinder of refrigerant, a receiver-type compressed-air system, a piston pump and a meter for measuring the quantity of liquid transferred.

A.4.4 Determination

A.4.4.1 Condition the three filled assemblies and the reference assembly by placing them together in the oven at the test temperature specified for 30 min ± 5 min to eliminate surface moisture. When in the oven, the assemblies shall not be bent to such an extent that the radius of curvature is less than 20 times the outside diameter of the hose.

A.4.4.2 Take the assemblies out of the oven and ensure that the filled assemblies are not leaking. Weigh them a minimum of 15 min and a maximum of 30 min after taking them out of the oven. Record the initial mass of each filled assembly (m_1) and the initial mass of the reference assembly (m_3).

A.4.4.3 Expose the four assemblies to a 24 h period in the oven at the test temperature specified. Weigh the assemblies at the end of this first 24 h period as specified in A.4.4.2 and record the mass of each filled assembly (m_2) and the mass of the reference assembly (m_4) for that cycle.

A.4.4.4 Repeat the 24 h exposure/weighing cycle until a steady state is reached, i.e.

a) until the values of the net loss of refrigerant $[(m_1 - m_2) - (m_3 - m_4)]$ for the last four exposure cycles are within 10 % of the lowest value, or

b) for 25 days,

whichever occurs first.

A.5 Calculation

Calculate the rate of loss of refrigerant R, in kilograms per square metre per year, for each of the filled assemblies using Formula (1):

$$R = \left[\frac{(m_1 - m_2)}{l_1} - \frac{(m_3 - m_4)}{l_2} \right] \times \left(\frac{k}{d \times t} \right) \qquad (1)$$

where

m_1 is the initial mass of the filled assembly after the conditioning period, in grams;

m_2 is the final mass of the filled assembly at the steady state, in grams;

m_3 is the initial mass of the reference assembly after the conditioning period, in grams;

m_4 is the final mass of the reference assembly at the steady state, in grams;

l_1 is the length of the filled assembly, in metres;

l_2 is the length of the reference assembly, in metres;

d is the inside diameter of the hose, in millimetres;

k is a constant (116,2) to convert R-values to kilograms per square metre per year;

t is the time taken to reach the steady state, in days.

A.6 Test report

The test report shall include the following information:

a) a reference to this document, i.e. ISO 8066-3:2020;

b) all details necessary for complete identification of the hose tested;

c) all details necessary for complete identification of the coupling used;

d) the results obtained;

e) any incident which is likely to have affected the results;

f) the date of test.

Annex B
(normative)

Low-temperature test

B.1 Principle

The test verifies that a hose filled with refrigerant R1234yf containing (10 ± 1) % refrigerant compatible lubrication oil, aged beforehand for 48 h at 70 °C, kept at −40 °C for 24 h, then bent to 180° on a mandrel. There shall be no leak and no cracks in a test hose or hose assembly.

B.2 Test assembly

The length of the test assembly shall be between 450 mm and 1 000 mm.

B.3 Procedure

Fill the test assembly with a quantity of liquid R1234yf containing (10 ± 1) % refrigerant compatible lubrication oil corresponding to 70 % of the capacity of the hose at ambient temperature. The hose assembly and the liquid may be cooled below −30 °C so that the refrigerant is in the liquid state, thus facilitating handling.

Place the assembly in a circulating-air oven at 70 °C for 48 h. Take the assembly out and allow it to cool to ambient temperature.

Keeping the hose straight, place the assembly in a test chamber at −40 °C and leave for 24 h. The test chamber shall be able to maintain a uniform atmosphere of cold dry air or a mixture of air and carbon dioxide at the specified temperature to within ±2 °C. Without taking the hose out of the test chamber, bend to 180° on a mandrel of diameter 8 times the mean outside diameter of the hose in 4 s to 8 s.

Allow the hose to warm up to ambient temperature and remove the liquid refrigerant.

Then test the hose or hose assembly in accordance with the procedure given in 6.2.3 and 6.2.4.

B.4 Test report

The test report shall include the following information:

a) a reference to this document, i.e. ISO 8066-3:2020;

b) all details necessary for complete identification of the hose tested;

c) the result obtained;

d) any incident which is likely to have affected the result;

e) the date of test.

Annex C
(normative)

Determination of amount of matter extracted from hoses by liquid R1234yf

C.1 Principle

This method measures the quantity of material extracted by liquid R1234yf from the tube in air-conditioning hose assemblies. The extraction is achieved by keeping the liquid refrigerant for 24 h at 70 °C inside the hose assembly.

C.2 Test assembly

The free length of the test assembly shall be between 450 mm and 1 000 mm.

C.3 Procedure

Fill the test assembly to capacity with one of the following solvents: n-propyl bromide, a hydrofluoroether or a decafluoropentane/dichloroethylene blend, then empty immediately to remove any surface contamination.

NOTE Trichlorotrifluorethane used to be the recommended solvent for this purpose, but it is not available for most applications and in many locations since it has been identified as an ozone-depleting chemical.

Fill the test assembly to 70 % of its capacity at ambient temperature with liquid R1234yf. For convenience, the hose assembly and refrigerant may be cooled to below −30 °C so that the refrigerant is in the liquid state, thus facilitating handling. Place the filled assembly in a circulating-air oven at 70 °C ± 2 °C for 24 h. At the end of this ageing period, cool the hose to −34 °C or lower, pour the liquid refrigerant into a tared beaker and allow to evaporate at ambient temperature. After the liquid refrigerant has evaporated, condition the beaker at 70 °C for 1 h to eliminate condensed moisture, then reweigh.

C.4 Expression of results

Express the result in g/m^2 of internal hose surface, based on the nominal inside diameter of the hose.

C.5 Test report

The test report shall include the following information:

a) a reference to this document, i.e. ISO 8066-3:2020;

b) all details necessary for complete identification of the hose tested;

c) the result obtained;

d) any incident which is likely to have affected the result;

e) the date of test.

Annex D
(normative)

Impulse test

D.1 Principle

The test verified hose assemblies that are subjected to pulsating pressure.

D.2 Apparatus

Pressure-application apparatus, capable of applying an internal pulsating pressure to the test piece at a rate specified in 6.13.2 using a test fluid, while the fluid is maintained at the required test temperature. Each pressure cycle shall be within the tolerance shown in Figure D.2. The rate of pressure rise shall be such that the pulse remains within the wave form envelope (see Figure D.2).

Graphical recorder, digital-storage facility or oscilloscope, capable of measuring the pressure cycle to ensure that the wave form is within the envelope shown in Figure D.2. The recorder shall have a natural frequency of more than 250 Hz and shall be critically damped to give a response which is flat to within 5 % at up to 0,6 times the natural frequency.

D.3 Test fluid

Use the fluid as agreed upon between the customer and manufacture, which shall be compatible lubricant with refrigerant 1234yf. When the test fluid is not specified, select a test fluid preferably with a kinematic viscosity from 32 mm^2/s to 100 mm^2/s at 40 °C (i.e. from grade ISO VG 32 to ISO VG 100 as specified in ISO 3448), which shall also be compatible lubricant with refrigerant 1234yf.

D.4 Test temperature

In order to control the specified test temperature of the hose, the test pieces shall be externally heated in the test chamber at the test temperature given in Table 8 and 6.13 with a tolerance of 3 °C. It is not necessary to circulate the test fluid.

D.5 Test pieces

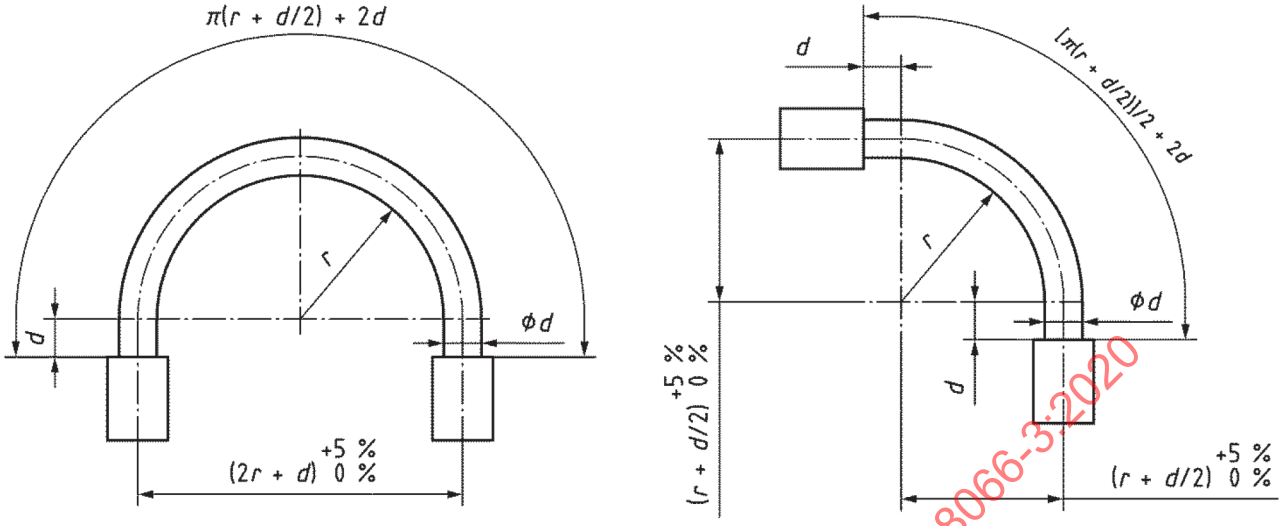
Test pieces shall be complete hose assemblies with suitable end fittings attached. Unless otherwise specified, test unaged hose assemblies with end fittings which have attached for not more than 30 days. Where the referring standard requires, also test aged hose assemblies.

Calculate the necessary free length of the hose in the test pieces as shown in figure.

For values of d less than 25,4 mm, use d = 25,4 mm for the +2d term in the expression for the hose free length, so that the hose between the fitting shell and the start of the bend radius is straight.

The actual free hose length shall agree with the calculated free hose length to within $^{+1}_{0}$ % or $^{+8}_{0}$ mm, whichever is greater.

Use a minimum bend radius of five times the outside diameter of the hose.



a) Hose sizes up to and including 22 mm **b) Hose sizes larger than 22 mm**

Key

r minimum bend radius

d hose outside diameter

Figure D.1 — Test pieces for impulse test

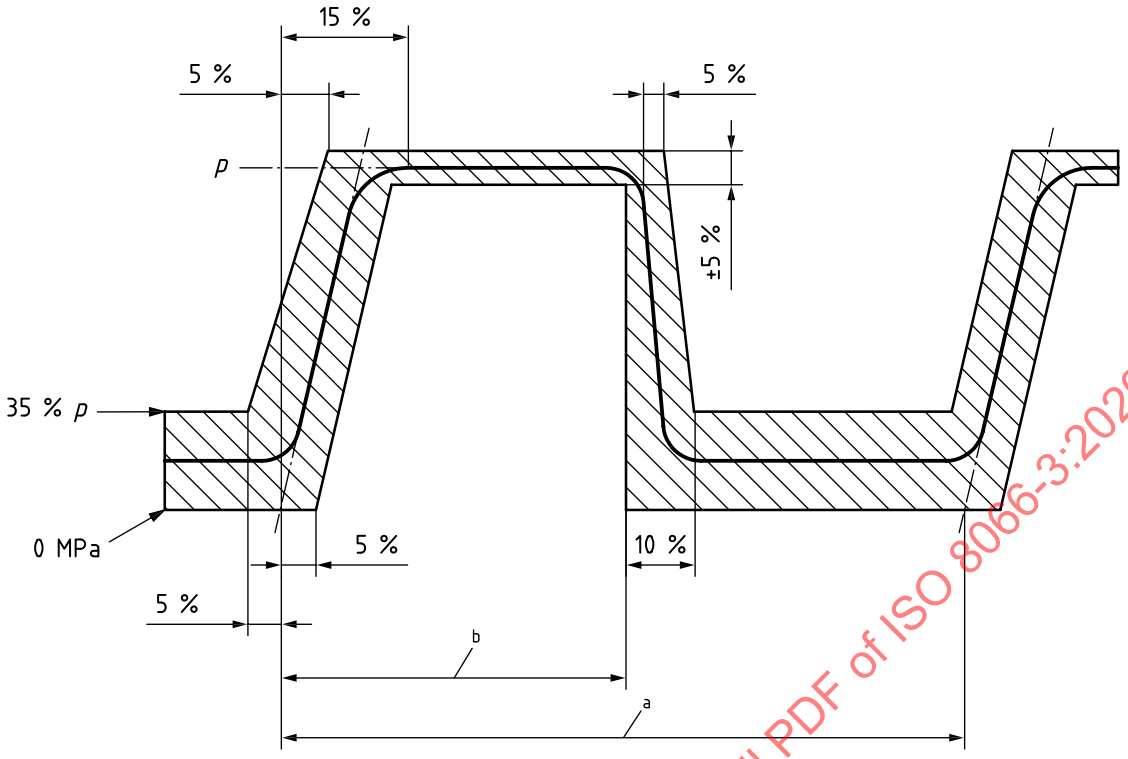
D.6 Procedure

Connect the test pieces to the apparatus. The test pieces shall be installed in accordance with Figure D.1, i.e. test pieces of hose of nominal inside diameter up to and including 22 mm shall be bent through 180° and hoses of nominal inside diameter larger than 22 mm shall be bent through 90°.

Bring the test pieces to the test temperature and then apply a pulsating pressure listed in Table 9 and 6.13.2 internally to the hose assemblies. Record the pulse rate used. The pressure cycle shall fall within the shaded area of either Figure D.2. The pressure pulse shall be within the wave form envelope. Continue the test for the specified number of cycles or until an assembly fails. Leakage of class 1 as defined in ISO/TR 11340 shall constitute a failure of the hose assembly. Any leakage shall be reported in accordance with the classification in ISO/TR 11340.

It is recommended that the test fluid be changed frequently to prevent breakdown.

This is a destructive test. Assemblies which have been subjected to this test, should therefore be discarded.



Key

p test pressure

a One pulse cycle.

b 45 % to 55 % of the cycle.

Figure D.2 — Pressure pulse wave form envelope

D.7 Expression of results

Record the number of cycles to failure or, if failure did not occur, the number of cycles completed.

NOTE The test results obtained are only valid for the combination of hose, fitting type and fitting design that was actually tested.

D.8 Test report

The test report shall include the following information:

a) reference to this document, i.e. ISO 8066-3:2020;

b) full description of the hose or assembly tested, including the fitting identification and attachment details, such as crimp diameter;

c) test temperature;

d) test pressure;

e) test fluid;

f) rate of pressure rise;

g) pulse cycle rate;

h) whether the test pieces were bent through 90° or through 180°;

i) number of cycles to failure, or the number of cycles completed, for each test piece;

j) position and mode of failure of each test piece, or the condition of each test piece on completion of the test;

k) date of the test.

Annex E
(normative)

Moisture ingression test

E.1 Expression of results

Hose assemblies are subjected to a humid environment and a vacuum is drawn on the inside of the hose. The amount of moisture which ingresses through the hose wall is measured.

E.2 Apparatus and material (see Figure E.1)

E.2.1 Humidity cabinet.

E.2.2 Methanol/dry-ice bath, maintained at −70 °C or lower.

E.2.3 Vacuum/cold-trap system.

E.2.4 Vacuum pump.

E.2.5 Nitrogen gas or dry-air supply.

E.2.6 Distilled water.

E.2.7 Circulating-air oven, capable of maintaining 80 °C.

E.2.8 Desiccator.

E.2.9 Balance, capable of 0,000 1 g accuracy.

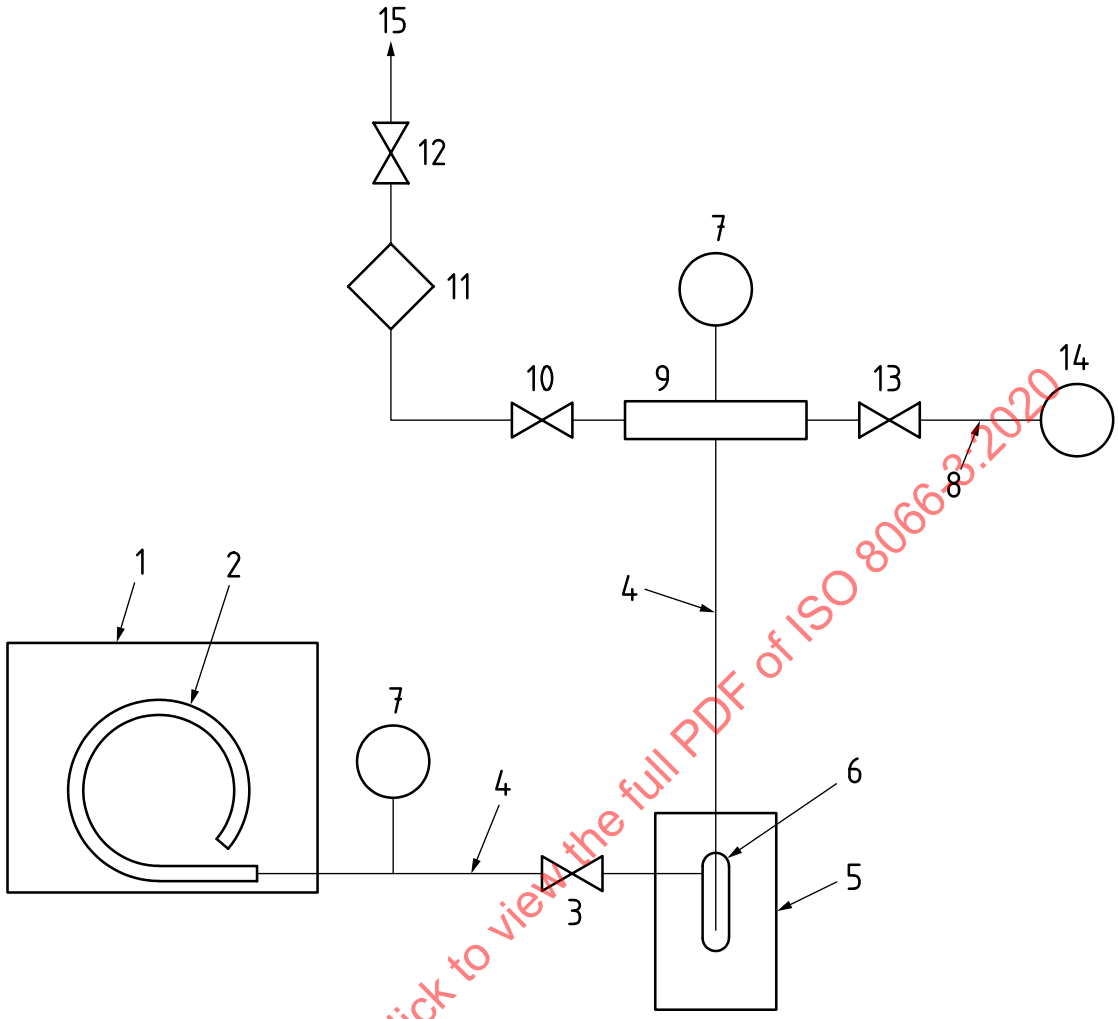
E.3 Test assemblies

Prepare a minimum of two test assemblies with couplings crimped on each end. There shall be 1 500 mm ± 25 mm of exposed hose length between the couplings.

Measure and record the inside diameter of each hose assembly in accordance with ISO 4671.

Measure and record the exposed length of hose between the couplings.

Leak-check to ensure a leak-free assembly.



Key

1	humidity cabinet	9	vacuum manifold
2	hose assembly	10	stainless-steel valve
3	stainless-steel valve	11	desiccant (indicator silica gel)
4	copper or stainless-steel tubing	12	quick-open valve
5	methanol/dry-ice bath	13	vacuum valve
6	glass vacuum trap	14	vacuum pump
7	vacuum gauge	15	to atmosphere
8	vacuum hose		

Figure E.1 — Moisture ingression test schematic

E.4 Procedure

E.4.1 Install the test assemblies in the humidity cabinet by plugging one end fitting and attaching the other end to one of the vacuum lines located in the cabinet. Arrange the test assemblies to maximize surface exposure to the environmental conditions (see Figure E.1).

E.4.2 Seal the humidity cabinet and set the dry-bulb temperature at 50 °C ± 2 °C and wet-bulb temperature at 47,2 °C ± 2 °C. Allow the cabinet to stabilize for at least 4 h at the specified temperatures and (85 ± 5) % relative humidity.

E.4.3 Thoroughly clean all vacuum traps, inside and out, by using dry compressed air or nitrogen and a suitable solvent.

E.4.4 Wipe off the traps and then place in an oven set at 80 °C ± 2 °C for a minimum of 1 h.

E.4.5 Upon removing the traps from the oven, immediately transfer to a desiccator for stabilization at room temperature.

E.4.6 When the traps have reached room temperature, remove them one at a time, wipe the trap exterior with a lint-free towel, and immediately weigh to the nearest 0,1 mg. Plug the end of each trap immediately after weighing. Record the mass of each trap.

E.4.7 Immediately after weighing, install the traps (item 6 in Figure E.1) in a bath maintained at (−70 ± 2) °C and attach the traps to the connecting lines using vacuum grease on all O-ring connections.

E.4.8 After all connections are made, turn on the vacuum pump and open valve 13 and then valve 3 and valve 12. A quick vacuum check can be carried out as follows:

a) Close valve 12.

b) Shut off the pump for approximately 5 min, noting any vacuum drop. If there is any loss, seal the leak and then recheck.

c) Restart the vacuum pump and open valve 12.

d) After running system for 1 h, close valve 12 and turn off the vacuum pump for 30 min. If there is any loss of vacuum, the test shall be discontinued and the leak sealed. Return to E.4.3 to restart the test.

E.4.9 Once the system is evacuated and integrity is ensured, maintain a vacuum of 95 kPa (absolute). Record the time and temperatures.

E.4.10 After 24 h has elapsed, proceed to the sequence of operations in E.4.11. Longer periods may be used as long as the data are adjusted to the specified time period (72 h or 96 h).

E.4.11 Sequence of operations (for installation of new moisture traps):

a) Record the time and the temperatures of the wet and dry bulbs and the trap bath.

b) Close valve 3.

c) Close valve 13.

d) Turn off the vacuum pump.

e) Slowly open valve 10 and valve 12. This sequence is necessary to ensure the traps are charged with dry nitrogen or dry air at atmospheric pressure [the regulator of the gas supply shall be set at 7 kPa (1 psi)].

f) Remove the traps one at a time and immediately plug all tubing connections.

g) Repeating steps d) to f), install another set of traps prepared beforehand.

h) Allow the traps removed from the cold bath to return to room temperature in a desiccator.

i) Wipe the exterior of each trap with a lint-free towel, remove the plugs, and immediately weigh each.

j) Calculate the change in mass and record.