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

Part 4:
**Low vibration transmission type for
Refrigerant 1234yf**

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

*Partie 4: Type de transmission à faible vibration pour le réfrigérant
1234yf*

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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 document 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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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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.

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

Part 4:

Low vibration transmission type for 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 national regulatory conditions are taken into consideration.

1 Scope

This document specifies the requirements for rubber hoses and hose assemblies used for low-pressure application of circulating gaseous Refrigerant 1234yf (tetrafluoropropene) (hereinafter referred to as R1234yf) in the air-conditioning systems of automobiles. The hoses and hose assemblies are designed in such a way as to reduce vibration transmission between the engine room and the cabin. The operational temperature range is $-40\text{ }^{\circ}\text{C}$ to $+80\text{ }^{\circ}\text{C}$.

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 is 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 3448, *Industrial liquid lubricants — ISO viscosity classification*

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

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

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

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

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

3 Terms and definitions

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

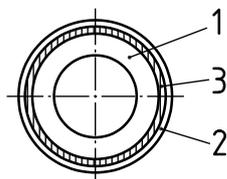
ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

4 Classification

4.1 Construction and material

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 (see [Figure 1](#)).



Key

- 1 rubber tube
- 2 outer cover
- 3 textile reinforcement

Figure 1 — Hose construction and material

4.2 Pressure class

The pressure class of the hose shall be low pressure class intended for suction applications. The hose should not be used for high pressure class intended for discharge and liquid applications.

Working pressures are given in [Table 1](#).

Table 1 — Working pressure

Pressure class	Working pressure
	MPa (bar) ^a
Low	1,06 (10,6)
^a 1 bar = 0,1 MPa = 10 ⁵ Pa; 1 MPa = 1 N/mm ² .	

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](#).

5 Dimensions

5.1 Hose inside diameters

Standard dimensions are given in [Table 2](#). Other dimensions may be used as needed.

Table 2 — Typical inside diameters

Nominal size	Mean inside diameter mm
14	14
15	15
16 (5/8)	15,9
19 (3/4)	19
25 (1)	25,4
NOTE Nominal size with parenthesis is based on inch.	

5.2 Hose wall thickness variation

When the wall thickness is measured in accordance with ISO 4671, the variation in the wall thickness shall not exceed the values given in [Table 3](#).

Table 3 — Wall thickness variation

Nominal size	Maximum departure from concentricity mm
Up to and including 19	1,0
Over 19	1,3

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 Gas 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. Maintain each test piece with the pressure listed in [Table 1](#) for 24 h at a temperature of (80 ± 2) °C.

This test may be carried out separately or during the 24 h pre-conditioning period for the refrigerant loss test (see [6.3](#)) at (80 ± 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 the pricked hose is tested, gas bubbles which form on the surface of the hose and decrease gradually after pressurizing may be observed but are not considered to be leakage.

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 1](#) for 5 min. A gas leak detector may also be applied to check leakage under the pressure listed in [Table 1](#) 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 5 kg/m²/year.

6.3.2 Procedure

Test the hoses or hose assemblies in accordance with the procedure described in [Annex A](#) at (50 ± 2) °C.

NOTE The test temperature is specified at 50 °C in consideration of the actual working temperature and the total operational temperature range.

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 ± 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.

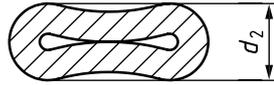
6.6 Vacuum resistance

6.6.1 General

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

6.6.2 Requirement

The outer diameter d_2 (see [Figure 2](#)) shall be more than twice the wall thickness 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 ± 0,66) kPa (absolute) for 2 min in accordance with [6.6.3](#).

**Key**

d_2 collapsed hose outside diameter

Figure 2 — Definition of the outer diameter d_2 of the collapsed hose

6.6.3 Procedure

The test hose or hose assembly shall have a free length of between 610 mm and 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. Apply a vacuum of $(1,33 \pm 0,66)$ 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. Check whether d_2 is more than twice the wall thickness and confirm the flow by vacuum application.

6.7 Length change under pressure**6.7.1 Requirement**

When subjected to a pressure listed in [Table 1](#), 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 bar¹⁾) 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 4](#).

Table 4 — Minimum burst pressure

Pressure class	Minimum burst pressure
	MPa (bar)
Low	4,24 (42,4)

6.9 Proof pressure

When tested in accordance with the procedure described in ISO 1402 at the pressure listed in [Table 5](#) and holding the pressure for $2 \text{ min} \pm 30 \text{ s}$, a hose or hose assembly shall exhibit no leakage, cracking, abrupt distortion (indicating irregularity in materials or manufacture) or other signs of failure.

1) 1 bar = 0,1 MPa = 10^5 Pa; 1 MPa = 1 N/mm².

Table 5 — Proof pressure

Pressure class	Proof pressure
	MPa (bar)
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/m².

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

6.11 Ozone resistance

The test shall be carried out on the hose itself in accordance with ISO 7326. Bend the hose with a bend radius equal to four times the mean outside diameter and mount on a test piece holder or wind the hose around a cylinder with a diameter equal to eight times the mean outside diameter specified by the manufacturer and the test shall be carried out using an ozone concentration of (50 ± 5) mPa.

The hose cover shall exhibit no visible cracks when viewed under $\times 7$ 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/m² 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 6](#) at 30 cycles per minute to 40 cycles per minute.

Table 6 — Impulse test conditions

Pressure class	Temperature	Test pressure
	°C	MPa (bar)
Low	100	1,06 (10,6)

6.14 Moisture ingress

When determined in accordance with [Annex E](#), the rate of ingress of moisture shall not exceed the values listed in [Table 7](#).

Table 7 — Rate of ingress 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.

6.16 Vibration transmissibility

Carry out the test in accordance with [Annex G](#).

Vibration damping as opposed to vibration transmissibility shall exceed the value agreed between the interested parties.

7 Frequency of testing

Type tests and routine tests shall be as specified in [Annex H](#).

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 I](#), which should preferably be carried out to control the quality of manufacture. The frequencies in [Annex I](#) 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, e.g. "XXX";
- b) the number of this document, i.e. ISO 8066-4; the hose manufacturer shall use the latest edition of this document, otherwise the year of publication shall be included in the marking;
- c) the type of hose, e.g. "A";
- d) the pressure class of the hose, e.g. "low";
- e) the moisture ingress grade of the hose, e.g. "ML";
- f) the nominal size of the hose, e.g. "16";
- g) the name of the refrigerant, i.e. "R1234yf";
- h) the last two digits of the year and the month of manufacture, e.g. "22/03".

EXAMPLE XXX/ISO 8066-4/A/Low/ML/16/R1234yf/22/03.

For 8 b), the hose manufacturer shall use the latest edition of this document, otherwise the year of publication of the standard used shall be included in the marking.

9 Test report

When requested by the 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

These 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 of between 475 cm³ and 525 cm³, 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 $\pm 0,1$ 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 will be used to plug the free end of the hose, to within $\pm 0,1$ g. Introduce into three of the hose–canister assemblies 0,6 mg of refrigerant R1234yf per mm³ 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 at the conditioning temperature, it is possible to calculate the volume of refrigerant–oil mixture required at this temperature. Keeping the refrigerant and hose at

the conditioning temperature, the hose may then be filled, measuring the volume of refrigerant 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 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 ± 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 for 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:

- 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 \(A.1\)](#):

$$R = \left[\frac{(m_1 - m_2)}{l_1} - \frac{(m_3 - m_4)}{l_2} \right] \times \left(\frac{1}{\pi d} \right) \times \left(\frac{365}{t} \right) \quad (\text{A.1})$$

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;
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 8066-4:2023;
- 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 according to [A.5](#);
- e) any deviations from the procedure;
- f) any incident which is likely to have affected the results;
- g) the date of the test.

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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 shows no leak and no cracks.

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 eight 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. After that, 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 8066-4:2023;
- b) all details necessary for complete identification of the hose tested;
- c) the result obtained according to [6.2.3](#);
- d) any deviations from the procedure;
- e) any incident which is likely to have affected the result;
- f) the date of the 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 Trichlorotrifluoroethane used to be the recommended solvent for this purpose, but it is no longer available for most applications and in many locations as 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 ± 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 8066-4:2023;
- b) all details necessary for complete identification of the hose tested;
- c) the result obtained according to [C.4](#);
- d) any deviation from the procedure;
- e) any incident which is likely to have affected the result;
- f) the date of the test.

Annex D (normative)

Impulse test

D.1 Principle

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

D.2 Apparatus

D.2.1 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](#)).

D.2.2 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 a fluid as agreed upon between the interested parties; the fluid shall be compatible lubricant with R1234yf. When the test fluid is not specified, select a test fluid preferably with a kinematic viscosity from 32 mm²/s to 100 mm²/s at 40 °C (i.e. from grade ISO VG 32 to ISO VG 100 as specified in ISO 3448); this fluid shall also be compatible lubricant with R1234yf.

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 6](#), with a tolerance of 3 °C. It is not necessary to circulate the test fluid.

D.5 Test pieces

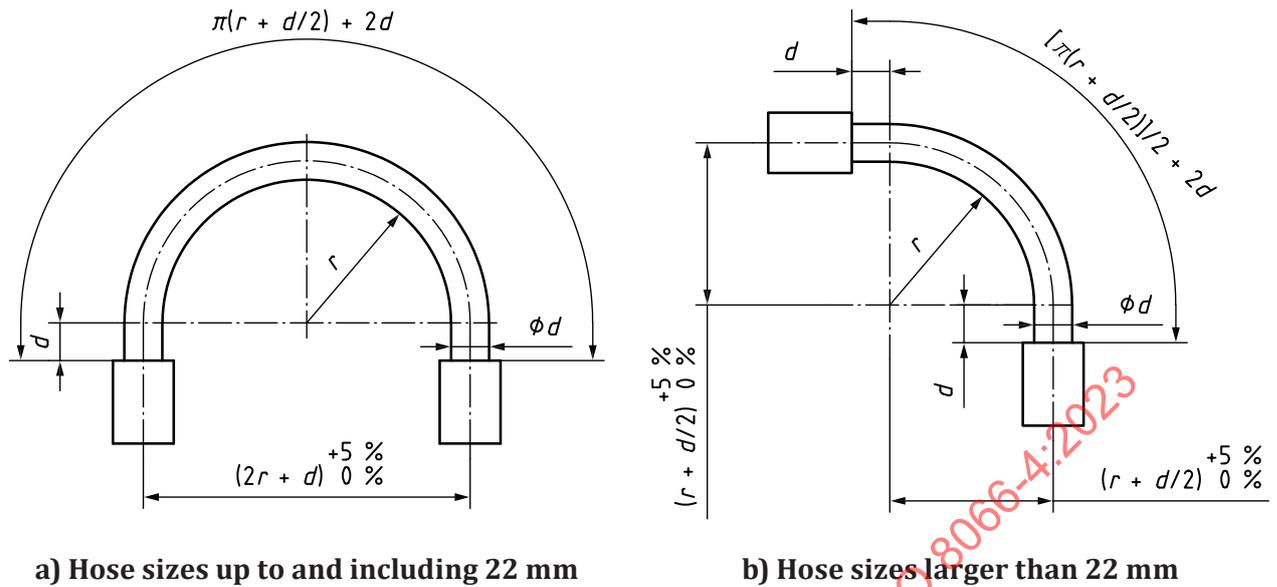
Test pieces shall be complete hose assemblies with suitable end fittings attached. Unless otherwise specified, test unaged hose assemblies with end fittings that have been assembled for less than 30 days. Where the referring standard requires, also test aged hose assemblies.

Calculate the necessary hose free length in the test pieces as shown in [Figure D.1](#).

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 hose free length shall agree with the calculated hose free length to within +1 % or +8 mm, whichever is greater.

Use five times of the outside diameter of the hose specified by the manufacturer as a bend radius.

**Key**

- r bend radius
 d hose outside diameter

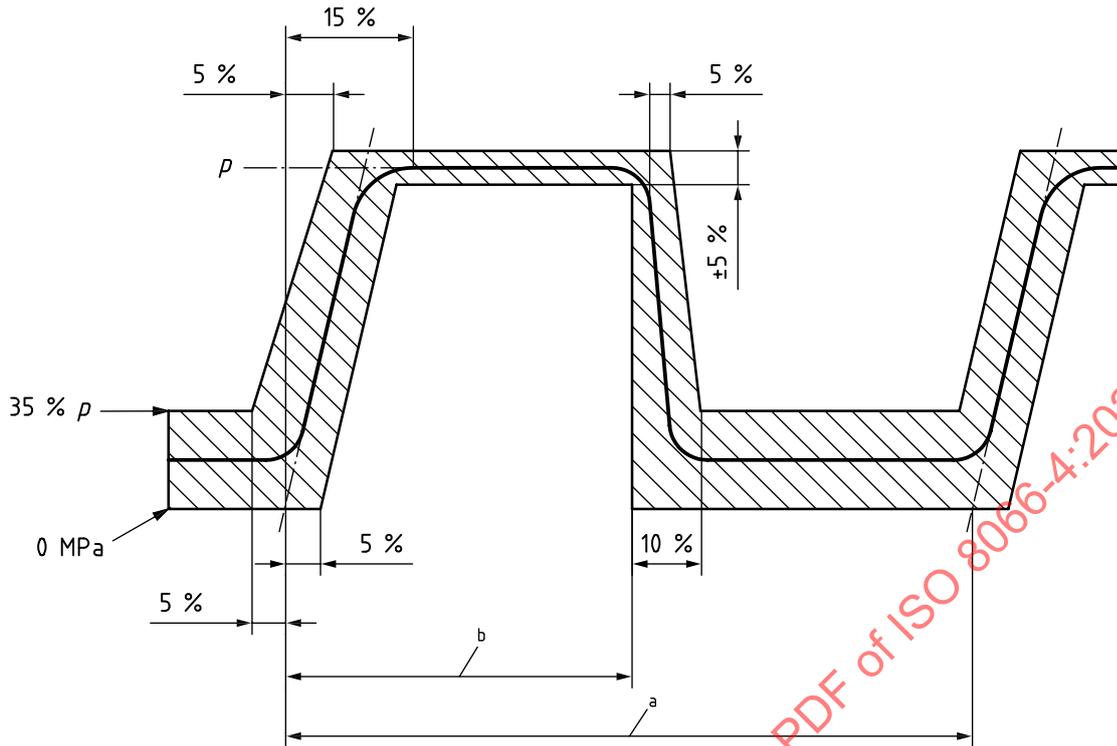
Figure D.1 — Test pieces for impulse test**D.6 Procedure**

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 6](#) internally to the hose assemblies. Record the pulse rate used. The pressure cycle shall fall within the shaded area of either [Figure D.2 a\)](#) or [b\)](#). 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) a reference to this document, i.e. ISO 8066-4:2023;
- 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) any deviations from the procedure;
- l) any unusual features observed;
- m) the date of the test.

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Annex E (normative)

Moisture ingress 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 $-70\text{ }^{\circ}\text{C}$ 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 $80\text{ }^{\circ}\text{C}$.

E.2.8 Desiccator.

E.2.9 Balance, capable of $0,000\text{ }1\text{ g}$ accuracy.

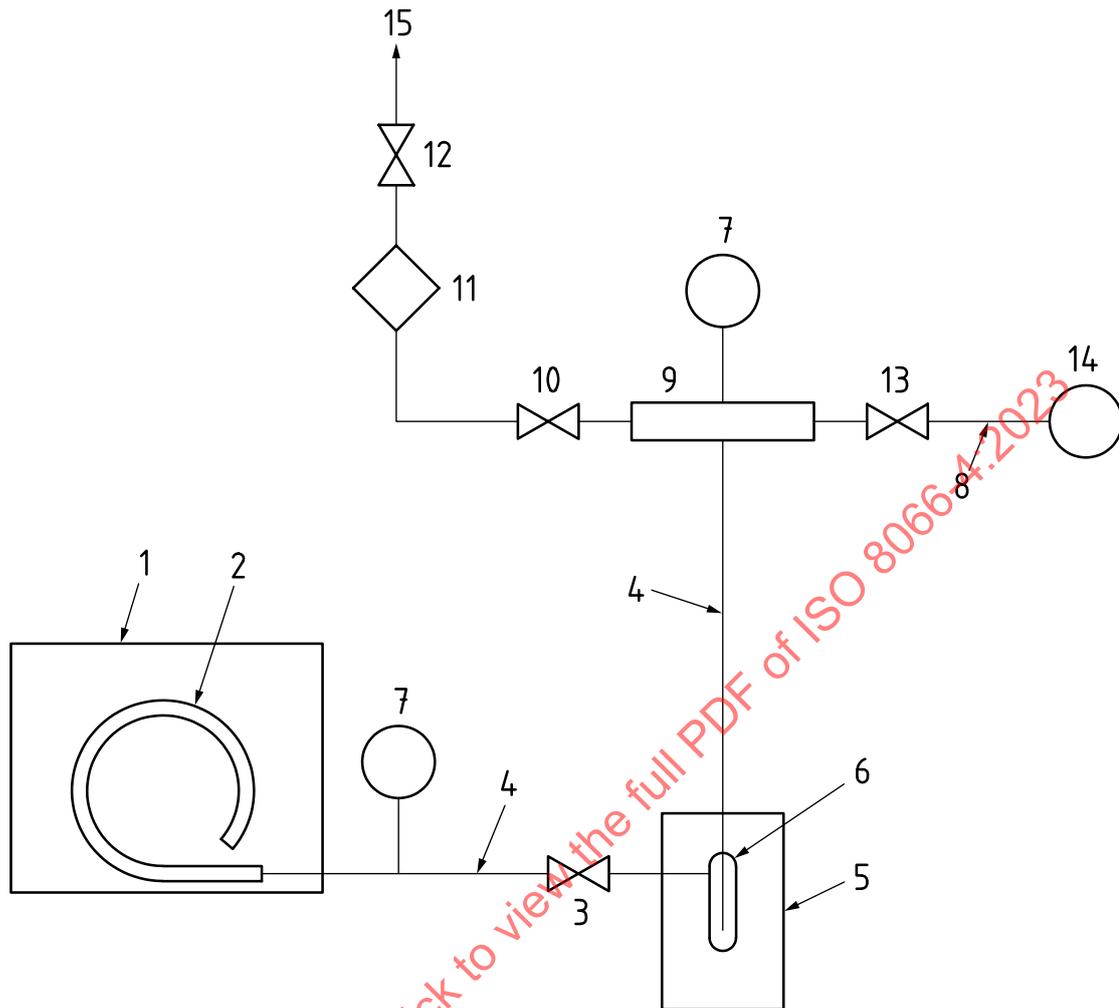
E.3 Test assemblies

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

Measure and record the inside diameter of each hose assembly in accordance with Method 2 of ISO 4671:2022.

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 ingress 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 $(50 \pm 2) ^\circ\text{C}$ and wet-bulb temperature at $(47,2 \pm 2) ^\circ\text{C}$. Allow the cabinet to stabilize for at least 4 h at the specified temperatures and $(85 \pm 5) \%$ 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 ± 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 (key reference 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 may 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 the 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.

E.4.12 Repeat [E.4.8](#), [E.4.9](#) and [E.4.11](#) at 72 h or 96 h intervals until steady-state conditions are reached. A steady state is taken as reached when the last four readings are within 10 % of the lowest reading of the last four.

E.5 Calculation

Calculate the average condensate mass collected during a 24 h period using [Formula \(E.1\)](#):

$$A = \left(\frac{R_1 + R_2 + R_3 + R_4}{4} \right) \times \left(\frac{24}{t} \right) \quad (\text{E.1})$$

where

- A is the average condensate mass, in grams per 24 h;
- R_1 is reading 1, in grams;
- R_2 is reading 2, in grams;
- R_3 is reading 3, in grams;
- R_4 is reading 4, in grams;
- t is the time interval between readings, in hours (i.e. 72 h or 96 h).

Reading 1, reading 2, reading 3 and reading 4 are the last four readings taken when steady-state conditions are reached.

Calculate the moisture ingress rate using [Formula \(E.2\)](#):

$$W = \frac{365A}{\pi DL} \quad (\text{E.2})$$

where

- W is the moisture ingress rate, in grams per square millimetre per year;
- A is the average condensate mass, in grams per 24 h;
- D is the inside diameter of the hose, in millimetres;
- L is the exposed hose length between the couplings, in millimetres.

E.6 Test report

The test report shall include the following information:

- a) a reference to this document, i.e. ISO 8066-4:2023;
- b) all details necessary for complete identification of the hose tested;
- c) all details necessary for complete identification of the couplings used;
- d) the result obtained according to [E.5](#);
- e) any deviations from the procedure;
- f) any incident which is likely to have affected the results;
- g) the date of the test.

Annex F (normative)

Coupling integrity (sealability)

F.1 Principle

This test evaluates hose performance and the compatibility between the hose and end fitting by cycling refrigerant-charged assemblies through temperature extremes from +80 °C to -30 °C.

F.2 Test assemblies

Take six production-coupled assemblies having (76 ± 3) mm of exposed hose and (56 ± 8) mm of straight nominal outside diameter metal tubing between the couplings and terminations. Attach each assembly to a canister having a minimum internal volume of 900 cm³ and equipped with a charging fitting.

F.3 Procedure

F.3.1 Charge the canister assembly with an amount of refrigerant-compatible lubricant equivalent to half of the internal volume of the hose assembly. Evacuate and add (100 ± 1) g of R1234yf refrigerant. Weigh the test assembly to give the original mass. Check all fittings to ensure against extraneous R1234yf leakage. Ensure that this weighing and all subsequent weighings are made in the temperature range 18 °C to 29 °C to the nearest 0,01 g. After charging, agitate the assembly to ensure that the refrigerant and lubricant are mixed and all internal surfaces are wetted.

F.3.2 Orient the assembly so that the canister is at $(4 \pm 2)^\circ$ to the horizontal to ensure that the liquid will always drain into the hose. Subject the canister-hose assembly to the following exposures, in the sequence given, and follow each exposure with a leakage evaluation and, when required, recharging, before the next exposure:

Exposure 1: 96 h at (80 ± 2) °C.

Exposure 2: 48 h of thermal cycling between -30 °C and (80 ± 2) °C in a timer-controlled chamber, the chamber temperature changing every 4 h and the chamber design being such that the canister-hose assembly reaches the desired temperature within 3 h of each temperature change.

Exposure 3: 96 h at (80 ± 2) °C.

Exposure 4: 48 h of thermal cycling between -30 °C and (80 ± 2) °C in a timer-controlled chamber, the chamber temperature changing every 4 h and the chamber design being such that the canister-hose assembly reaches the desired temperature within 3 h of each temperature change.

F.3.3 At the end of each exposure, as soon as the canister/hose assembly reaches room temperature (i.e. is within the range 18 °C to 29 °C), carry out the following procedure:

Weigh the assembly and determine and record the loss in mass, in grams, for the exposure.

If the loss in mass is greater than 7 g, terminate the test.

Flex-test the coupled assembly on the canister to $\pm 15^\circ$. Make 10 flex cycles in approximately 10 s in each of two perpendicular planes. Immediately evaluate the leakage at each coupling by:

— listening for hissing (charge loss);