INTERNATIONAL STANDARD

ISO 3994

Third edition
2007-08-15

Plastics hoses — Helical-thermoplastic-reinforced thermoplastics hoses for suction and discharge of aqueous materials — Specification

Tuyaux en plastiques — Tuyaux thermoplastiques à renforcement thermoplastique en spirale pour aspiration et refoulement de matières aqueuses — Spécifications

Reference number
ISO 3994:2007(E)

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

COPYRIGHT PROTECTED DOCUMENT

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 3994 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 1, *Hoses (rubber and plastics)*.

This third edition cancels and replaces the second edition (ISO 3994:1998), which has been technically revised.

Introduction

This International Standard has been prepared to provide minimum acceptable requirements for the satisfactory performance of polymer-reinforced thermoplastics hoses for suction and discharge applications, conveying water, weak aqueous chemical solutions and abrasive solids and slurries.

If there is a special requirement for resistance to deleterious chemicals, this shall be a matter for agreement between the supplier and the purchaser.

Plastics hoses — Helical-thermoplastic-reinforced thermoplastics hoses for suction and discharge of aqueous materials — Specification

WARNING — Persons using this International Standard should be familiar with normal laboratory practice. This standard 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 International Standard specifies the requirements for three types of helical-thermoplastic-reinforced thermoplastics hoses for suction and discharge of water, weak aqueous chemical solutions and abrasive solids and slurries, for use in the ambient temperature range from − 10 °C to + 55 °C.

The three types of hose are for light-, medium- and heavy-duty applications.

The types of hoses covered in this International Standard are not intended for use with flammable or combustible materials, nor with aromatic solvents.

NOTE Hoses of a similar construction for suction and discharge for fire-fighting are specified in ISO 14557, *Fire-fighting hoses — Rubber and plastics suction hoses and hose assemblies*.

2 Normative references

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

ISO 37, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*

ISO 176:2005, *Plastics — Determination of loss of plasticizers — Activated carbon method*

ISO 1307, *Rubber and plastics hoses — Hose sizes, minimum and maximum inside diameters, and tolerances on cut-to-length hoses*

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

ISO 1746, *Rubber or plastics hoses and tubing — Bending tests*

ISO 4672, *Rubber and plastics hoses — Sub-ambient temperature flexibility tests*

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

ISO 8331, *Rubber and plastics hoses and hose assemblies — Guidelines for selection, storage, use and maintenance*

ISO 11758:1995, *Rubber and plastics hoses — Exposure to a xenon arc lamp — Determination of changes in colour and appearance*

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.

4 Classification

Three types of hoses are specified, related to the maximum working pressure and suction pressure (see Tables 4 and 5):

— type 1: light-duty service;

— type 2: medium-duty service;

— type 3: heavy-duty service.

All types are designed to operate in the ambient temperature range − 10 °C to + 55 °C.

5 Materials and construction

The hoses shall be as uniform as commercially practicable in colour and other physical properties. They shall consist of a flexible thermoplastics material supported within the material by a helix of thermoplastic material of a similar molecular structure. The reinforcing and flexible components of the wall shall be fused together and free from visible cracks, porosity, foreign inclusions or other defects such as are liable to cause failure of the hose in service.

6 Dimensions and tolerances

6.1 Nominal bores, internal diameters and tolerances

The internal diameters and tolerances of hoses of different nominal bores shall meet the requirements given in Table 1.

6.2 Length tolerances

The tolerances on cut lengths shall be in accordance with ISO 1307.

Table 1 — Nominal bores, internal diameters and tolerances

Nominal bore	Internal diameter mm	Tolerances for types 1 and 2 mm	Tolerances for type 3 mm
12,5	12,5	± 0,75	—
16	16	± 0,75	—
19	19	± 0,75	—
20	20	± 0,75	—
25	25	± 1,25	± 1,25
32	32	± 1,25	± 1,25
38	38	± 1,25	± 1,50
40	40	± 1,25	± 1,50
50	50	± 1,50	± 1,50
63	63	± 1,50	± 1,50
76	76	± 1,50	± 2,00
80	80	± 1,50	± 2,00
90	90	± 2,00	± 2,00
100	100	± 2,00	± 2,00
102	102	± 2,00	± 2,00
125	125	± 2,00	± 2,00
127	127	± 2,00	± 2,00
152	152	± 2,00	± 2,00
160	160	± 2,00	± 2,00
200	200	—	± 2,00
250	250	—	± 3,00
300	300	—	± 3,00
315	315	—	± 3,00

7 Performance requirements

7.1 Hydrostatic testing at 23 °C ± 2 °C

When subjected to the proof pressure test and the burst pressure test specified in ISO 1402 at 23 °C ± 2 °C, hoses shall meet the following requirements:

— at the proof pressure specified in Table 2 (i.e. 40 % of the minimum burst pressure), the hoses shall show no evidence of leakage, cracking, abrupt distortion (indicating irregularity in materials or manufacture) or other signs of failure;

— the minimum burst pressure shall be as specified in Table 2.

Table 2 — Hydrostatic testing at 23 °C ± 2 °C

Nominal bore	Type 1		Type 2		Type 3	
	Proof pressure	Minimum burst pressure	Proof pressure	Minimum burst pressure	Proof pressure	Minimum burst pressure
	bar	bar	bar	bar	bar	bar
12,5 up to and including 25	6,8	17	8,8	22	11,2	28
32 up to and including 63	4,8	12	6	15	7,2	18
76 up to and including 90	3,6	9	4,8	12	6	15
100 up to and including 127	2,8	7	3,6	9	4,8	12
152 up to and including 250	2,4	6	3,2	8	3,6	9
300 and 315	—	—	—	—	3,2	8

7.2 Hydrostatic testing at 55 °C ± 2 °C

When subjected to the burst pressure test specified in ISO 1402 at 55 °C ± 2 °C, hoses shall meet the requirements given in Table 3.

Table 3 — Hydrostatic testing at 55 °C ± 2 °C

Nominal bore	Minimum burst pressure		
	Type 1	Type 2	Type 3
	bar	bar	bar
12,5 up to and including 25	5	6,5	8
32 up to and including 63	4	4,5	6
76 up to and including 90	3	4	5
100 up to and including 127	2,5	3	4
152 up to and including 250	2	2,5	3
300 and 315	—	—	2,5

7.3 Maximum working pressure

The maximum working pressure shall be as specified in Table 4.

Table 4 — Maximum working pressures

Nominal bore	Maximum working pressure bar					
	23 °C ± 2 °C			55 °C ± 2 °C		
	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3
12,5 up to and including 25	5,6	7,3	9,3	1,6	2,1	2,6
32 up to and including 63	4	5	6	1,3	1,5	2
76 up to and including 90	3	4	5	1	1,3	1,6
100 up to and including 127	2,3	3	4	0,8	1	1,3
152 up to and including 250	2	2,6	3	0,6	0,8	1
300 up to and including 315	—	—	2,6	—	—	0,8

7.4 Tensile adhesion test

When tested in accordance with the method specified in Annex A, test pieces taken from the hose wall shall have a minimum tensile strength of 50 % of the tensile strength of the flexible thermoplastic material (determined in accordance with ISO 37). The test piece shall be considered to have failed if it is below this value.

7.5 Vacuum test

When tested in accordance with the method specified in Annex B, using the absolute pressure indicated in Table 5, hoses shall not fail due to collapse or fracture at a point that is more than one diameter distance from the end fittings. In the event of failure closer to an end fitting, the test shall be disregarded and a further test piece tested.

Table 5 — Pressures for the vacuum test

Nominal bore	Absolute pressure bar	
	Type 1 and 2 hoses	Type 3 hoses
12,5 up to and including 160	0,35	—
25 up to and including 315	—	0,20

7.6 Reinforcement fracture test

When tested in accordance with the method specified in Annex C, the reinforcement shall be capable of being bent back on itself without cracking after it has been extended for 336 h ± 4 h over the appropriate-size extension block given in Table 6.

Table 6 — Extension blocks for reinforcement fracture test

Nominal bore	Block width mm	Nominal bore	Block width mm
12,5	10	90	42
16	12	100	44
20	16	102	44
25	19	125	49
32	23	127	49
38	26	152	52
40	27	160	53
50	31	200	59
63	34	250	66
76	37	300	73
80	38	315	75

7.7 Minimum bend radius

When tested in accordance with ISO 1746, using a minimum radius of curvature of five times the nominal bore in the cases of type 1 and type 2 hoses and eight times the nominal bore in the case of type 3 hoses, hoses shall not crack and shall subsequently pass the proof pressure test (see 7.1).

For the purposes of this test, the numerical value of the nominal bore shall be taken as the internal diameter in millimetres.

7.8 Cold-bend radius

When tested at − 10 °C ± 2 °C in accordance with the requirements of ISO 4672 after conditioning for 5 h at that temperature and using a minimum radius of curvature of 20 times the nominal bore in the case of type 1 and type 2 hoses and 32 times the nominal bore in the case of type 3 hoses, hoses shall not crack and shall subsequently pass the proof pressure test (see 7.1).

For the purposes of this test, the numerical value of the nominal bore shall be taken as the internal diameter in millimetres.

7.9 Loss in mass on heating

When determined in accordance with ISO 176:2005 (method B), the loss in mass of the flexible thermoplastics material used in the construction shall not be greater than 4 %.

7.10 Exposure to xenon-arc lamp

When tested in accordance with ISO 11758:1995, using the light source for method A or B, and with water-spraying, the change in colour shall not be greater than that agreed between the manufacturer and purchaser, and the cover shall show no signs of cracking or other defects which would cause the hose to be unserviceable.

8 Type, routine and production testing

For type testing and routine testing, the tests specified in Annex D shall be carried out.

For production testing, the tests given in Annex E are recommended.

Note that

— type tests are those tests required to obtain product approval;

— routine tests are those carried out on each length of hose;

— production tests are those carried out on each production batch.

9 Marking

Hoses shall be marked in characters at least 5 mm high, either using a contrasting indelible ink or as otherwise agreed between the supplier and the purchaser, with at least the following information:

a) the manufacturer's name or trade mark, e.g. Man;

b) the number and date of this International Standard, i.e. ISO 3994:2007;

c) the hose type, e.g. Type 1;

d) the nominal bore, e.g. 50;

e) the quarter and the last two digits of the year of manufacture, e.g. 3Q07.

EXAMPLE Man/ISO 3994/Type 1/50/3Q07

10 Recommendations for packing and storage

These are given in ISO 8331.

Annex A
(normative)

Tensile adhesion test

A.1 Apparatus

A.1.1 Tensile-testing machine, with suitable grips, capable of testing at a speed of 500 mm/min and with a 2,5 kN load cell.

A.1.2 Dumb-bell test piece cutter, 115 mm long, 25 mm wide at the ends and 6 mm wide along the narrow, parallel-sided section.

A.2 Sampling

Testing shall be carried out on the first sample from a production batch. The sample shall be a length of hose approximately 250 mm long.

A.3 Conditioning of sample

Cool the sample hose to within ± 5 °C of one of the standard laboratory temperatures specified in ISO 23529.

A.4 Preparation of test pieces

Slit the conditioned 250 mm sample of hose longitudinally into two halves and, from the hose wall of these two halves, cut a minimum of three dumb-bell test pieces longitudinally (i.e. at least one test piece from each half).

A.5 Procedure

Determine the cross-sectional area of the narrow, parallel-sided section of the test pieces and then test each to break in the tensile-testing machine at a speed of 500 mm/min.

A.6 Calculation

Calculate the tensile strength of each test piece, in megapascals, by dividing the maximum (breaking) load, in newtons, by the cross-sectional area, in square millimetres.

The mean value of the values obtained for the individual test pieces shall be at least 50 % of the tensile strength of the flexible thermoplastic material (see 7.4).

A.7 Test report

The test report shall include the following details:

a) the cross-sectional area of the test pieces;

b) the breaking load of each test piece;

c) the nature and position of the break in each test piece;

d) the individual tensile strength of each test piece, and the mean value;

e) the tensile strength of the flexible thermoplastic material;

f) the date and time of testing.

Annex B
(normative)

Vacuum test

B.1 Apparatus

Use a vacuum pump capable of achieving an absolute pressure of 0,2 bar in less than 1 min at a uniform evacuation rate.

B.2 Test piece

Use a length of hose long enough to give a length clear of the end fittings of at least five times the bore of the hose.

B.3 Conditioning

No test shall be carried out within 24 h of manufacture. Condition the test pieces at standard laboratory temperature (see ISO 23529) for at least 3 h before testing. This 3 h of conditioning may be part of the 24 h period after manufacture.

B.4 Procedure

Attach end fittings to the test piece without causing damage to the hose.

Ensure that the ambient temperature is the standard laboratory temperature at which conditioning was carried out. Apply the appropriate vacuum listed in Table 5 over a period of, at the most, 1 min. Maintain for 10 min.

Repeat the test on a second test piece, but at a temperature of 55 °C ± 2 °C.

B.5 Test report

The test report shall state, for each test temperature, whether the test was a pass or a fail and, if it was a fail, shall also state the position and nature of the failure.

Annex C
(normative)

Reinforcement fracture test

C.1 Apparatus

The extension block, which may be made of hardwood or metal, shall be of rectangular cross-section, with one cross-sectional dimension of the appropriate value given in Table 6.

C.2 Test pieces

Prepare three test pieces each of sufficient length to contain three turns of reinforcement. Slit each open with a clean cut along its whole length.

C.3 Conditioning

No test shall be carried out within 24 h of manufacture. Condition the test pieces at standard laboratory temperature (see ISO 23529) for at least 3 h before testing. This 3 h of conditioning may be part of the 24 h period after manufacture.

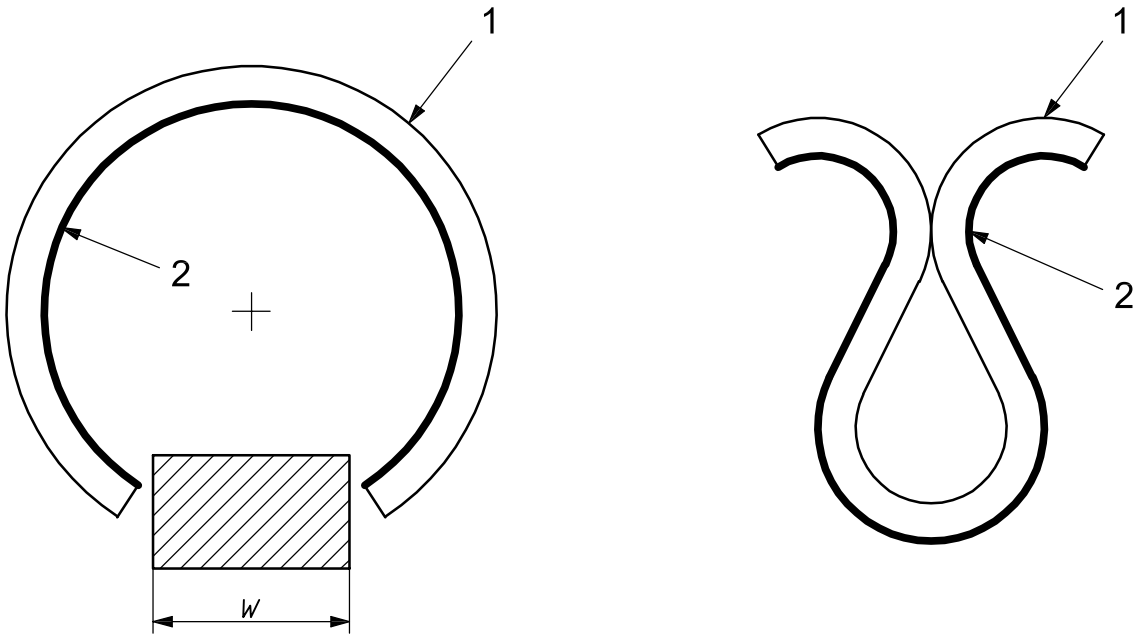
C.4 Procedure

Open up a slit test piece and place it over the extension block appropriate to the nominal bore of the hose (see Table 6) as indicated in Figure C.1.

Leave the test piece with the extension block in place for 336 h $\pm$ 4 h at the same standard laboratory temperature at which it was conditioned.

After 336 h, remove the extension block and bend the test piece back on itself until the outside surfaces touch (see Figure C.1). Examine the test piece for cracking of the helix.

Repeat the procedure for the remaining test pieces.



Key

1 outside surface of hose

2 inside surface of hose

W block width (see Table 6)

Figure C.1 — Diagrammatic representation of reinforcement fracture test

C.5 Test report

The test report shall state, for each test piece, whether the test was a pass or a fail and, if it was a fail, shall also state the position and nature of the failure.

Annex D
(normative)

Type and routine tests

Table D.1 gives the tests to be carried out for type and routine testing as defined in Clause 8.

Table D.1

Dimension/property under test (with reference to relevant subclause)	**Routine testing**	**Type testing**
Internal diameter (6.1)	X	X
Hydrostatic tests (7.1 and 7.2)	N.A.	X
Tensile adhesion test (7.4)	N.A.	X
Vacuum test (7.5)	N.A.	X
Reinforcement fracture test (7.6)	N.A.	X
Minimum bend radius test (7.7)	N.A.	X
Cold-bend test (7.8)	N.A.	X
Loss in mass on heating (7.9)	N.A.	X
Exposure to xenon-arc lamp (7.10)	N.A.	X
X = Test required. N.A. = Not applicable.		

Annex E
(informative)

Recommended tests for production testing

Table E.1 gives the recommended tests for production testing (see Clause 8) to be carried out on each manufactured batch. A manufactured batch is defined as, at the most, 3 000 m of hose or 1 000 kg of plastic material.

Table E.1

Dimension/property under test (with reference to relevant subclause)	**Production test**
Internal diameter (6.1)	X
Hydrostatic tests (7.1 and 7.2)	X
Tensile adhesion test (7.4)	X
Vacuum test (7.5)	N.A.
Reinforcement fracture test (7.6)	X
Minimum bend radius test (7.7)	N.A.
Cold-bend test (7.8)	N.A.
Loss in mass on heating (7.9)	N.A.
Exposure to xenon-arc lamp (7.10)	N.A.
X = Test required. N.A. = Not applicable.	

ICS 23.040.70

Price based on 14 pages