INTERNATIONAL STANDARD

ISO 3994

Second edition
1998-04-01

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 3994:1998(E)

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.

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.

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

This second edition cancels and replaces the first edition (ISO 3994:1977), which has been technically revised.

Annexes A, B and C form an integral part of this International Standard.

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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, 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.

The list of nominal bores given in tables 1 and 2 is not intended to be restrictive or to preclude the manufacture of other sizes than those of the R 10 series of preferred numbers (the basis of the tables) and which may be the subject of individual national standards but compliance with this standard can not be claimed.

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

1 Scope

This International Standard specifies the requirements for three types of helical thermoplastic reinforced thermoplastics hoses for suction and discharge applications for use in the temperature range from -10 °C to +55 °C.

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

NOTE Hoses of a similar construction for suction and discharge for fire fighting are specified in ISO 14775.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 176:1976 *Plastics - Determination of loss of plasticizers - Activated carbon method.*

ISO 554:1976 *Standard atmospheres for conditioning and/or testing - Specifications*

ISO 1307:1992 *Rubber and plastics hoses for general-purpose industrial applications - Bore diameters and tolerances, and tolerances on length.*

ISO 1402:1994 *Rubber and plastics hoses and hose assemblies - Hydrostatic testing.*

ISO 1746:1983 *Rubber or plastics hoses and tubing - Bending test.*

ISO 4672:1997 *Rubber and plastics hoses - Sub-ambient temperature flexibility tests*

ISO 8330:1998 *Rubber and plastics hoses and hose assemblies - Vocabulary*

ISO 11758:1995 *Rubber and plastics hoses - Exposure to a Xenon arc lamp - Determination of changes in colour and appearance.*

3 Terms and definitions

For the purposes of this International Standard the terms and definitions given in ISO 8330 apply.

4 Types

Three types of hoses are specified related to the pressure of suction and safety ratios and related burst pressure, see tables 3, 4 and 5.

The safety ratios are as follows:

Type 1 - 1 : 2,5	(light service)
Type 2 - 1 : 3,15	(normal service)
Type 3 - 1 : 4	(heavy service)

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

5 Materials and construction

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

6 Dimensions and tolerances

6.1 Nominal bore, internal diameters and tolerances

The nominal bore, internal diameters and tolerances of the hoses shall meet the requirements given in tables 1 and 2, which are in accordance with ISO 1307.

Table 1 — Nominal bore, internal diameters and tolerances - Types 1 and 2

Nominal bore	Internal diameter mm	Tolerances mm
12,5	12,5	± 0,75
16	16	± 0,75
20	20	± 0,75
25	25	± 1,25
31,5	31,5	± 1,25
40	40	± 1,50
50	50	± 1,50
63	63	± 1,50
80	80	± 2,00
100	100	± 2,00
125	125	± 2,00
160	160	± 2,00

Table 2 — Nominal bore, internal diameters and tolerances - Type 3

Nominal bore	Internal diameter mm	Tolerances mm
25	25	± 1,25
31,5	31,5	± 1,25
40	40	± 1,50
50	50	± 1,50
63	63	± 1,50
80	80	± 2,00
100	100	± 2,00
125	125	± 2,00
160	160	± 2,00
200	200	± 2,00
250	250	± 3,00
315	315	± 3,00

6.2 Length tolerances

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

7 Performance requirements of hoses

7.1 Hydrostatic test at standard laboratory temperature

When tested by the method specified in ISO 1402 at standard laboratory temperature chosen from ISO 554, the hoses shall meet the requirements given in table 3.

At proof pressure (i.e. 50 % of minimum burst pressure) the hoses shall be examined for evidence of leakage, cracking, abrupt distortion indicating irregularity in materials or manufacture, or other signs of failure.

Table 3 — Hydrostatic tests at standard laboratory temperature

Nominal bore	Maximum working pressure, all types, bar[a)]	Minimum burst pressure, bar		
		Type 1	Type 2	Type 3
12,5 up to and including 25	7	17	22	28
31,5 up to and including 63	5	12,5	16	20
80	4	10	12,5	16
100 up to and including 125	3	7,5	9,5	12
160 up to and including 250	2,5	6	8	10
315	2	-	-	8

[a)] 1 bar = 0,1MPa

7.2 Hydrostatic test at 55 °C ± 2 °C

When tested by the method specified in ISO 1402 at 55 ± 2 °C, the hoses shall meet the requirements given in table 4.

Table 4 — Hydrostatic test at 55 ± 2 °C

Nominal bore	Maximum working pressure, all types, bar	Minimum burst pressure, bar		
		Type 1	Type 2	Type 3
12,5 up to and including 25	2	5	6,5	8
31,5 up to and including 63	1,5	4	4,5	6
80	1,3	3	4	5
100 up to and including 125	1	2,5	3	4
160 up to and including 250	0,8	2	2,5	3
315	0,6	-	-	2,5

7.3 Pulsating pressure test requirements

When tested in accordance with the method specified in annex A, the hoses shall withstand a minimum of 10 000 cycles. The test piece shall be considered to have failed if it develops a leak or rupture. In the event of a failure within one diameter distance from either coupling the test shall be disregarded and a further test piece tested. The maximum pressure of the test cycle (see figure A.1) shall be 120 % of maximum working pressure.

7.4 Vacuum test requirements

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

Table 5 — Pressures for the vacuum test

Nominal bore	Types 1 and 2 hose, absolute pressure, bar	Type 3 hose, absolute pressure, bar
12,5 up to and including 160	0,35	-
25 up to and including 315	-	0,20

7.5 Reinforcement fracture test requirements

When tested in accordance with the method specified in annex C, the polymer reinforcement shall be capable of reverse bending without cracking after 336 h extended over the appropriate size extension piece listed in table 6.

The period of extension of 336 h is intended as a control test. For a type test a period of four months shall be used.

Table 6 — Extension pieces for fracture test

Nominal bore	Block width mm	Nominal bore	Block width mm
12,5	10	80	38
16	12	100	44
20	16	125	49
25	19	160	53
31,5	23	200	59
40	27	250	66
50	31	315	75
63	34		

7.6 Minimum bend radius requirements

When tested in accordance with ISO 1746 using a minimum radius of curvature (c) 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 hose, the hoses shall not crack and shall pass the proof test, see 7.1.

For the purposes of this test the numeric value of the nominal bore shall have the designation of mm.

7.7 Cold bend radius requirements

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 (c) of 20 times the nominal bore, in the case of Type 1 and Type 2, and 32 times the nominal bore in the case of Type 3 hose, the hose shall not crack and shall pass the proof test, see 7.1.

For the purposes of this test the numeric value of the nominal bore shall have the designation of mm.

7.8 Loss in mass on heating

When tested in accordance with ISO 176 (method B), the flexible thermoplastics material used in the construction shall have a loss in mass not greater than 4 %.

7.9 Exposure to xenon arc lamp

When tested in accordance with ISO 11758, using light source method A or B, without spraying, the change in colour shall be not greater than that agreed between manufacturer and purchaser.

8 Marking

The hoses shall be marked either using a contrasting indelible ink or as agreed between the supplier and the purchaser with at least the following information:

a) the manufacturer's name or trade mark;

b) the number of this International Standard;

c) the hose type;

d) the hose nominal bore;

e) the quarter and year of manufacture (1Q 1997).

NOTE - Characters should be at least 5 mm high.

ANNEX A
(normative)

PRESSURE IMPULSE TEST

A.1 Apparatus

A circuit capable of applying an internal hydraulic pressure which can be released at a predetermined level, delayed by a fixed period of time and the cycle repeated. The cycle shall comply with the pressure/time requirements shown in figure A.1.

A suitable circuit is shown in figure A.2.

A.2 Test fluid

The test fluid shall be water, which may be suitably dyed.

NOTE Other fluids may be used by agreement between the customer and the supplier.

A.3 Test pieces

A minimum of three test pieces of hose with end fittings shall be tested. The clear distance between fittings shall be at least 5 times the nominal bore designated, for this purpose, in mm.

A.4 Conditioning

No test shall be carried out within 24 h of manufacture. Test pieces shall be conditioned at standard laboratory temperature (see ISO 554) for at least 3 h before testing, which may be part of the 24 h.

A.5 Procedure

Connect the test piece in the straight condition to the apparatus and ensure that the temperatures of both the test fluid and the ambient conditions are standard laboratory temperature at which conditioning was carried out. Purge all air from the test piece. Apply 10 000 impulse cycles.

A.6 Test report

The test report shall include the following details:

a) the number of cycles to failure, if less than 10 000;

b) the position and mode of failure for each test piece;

c) the test fluid and dye used, if applicable;

d) the date of test.

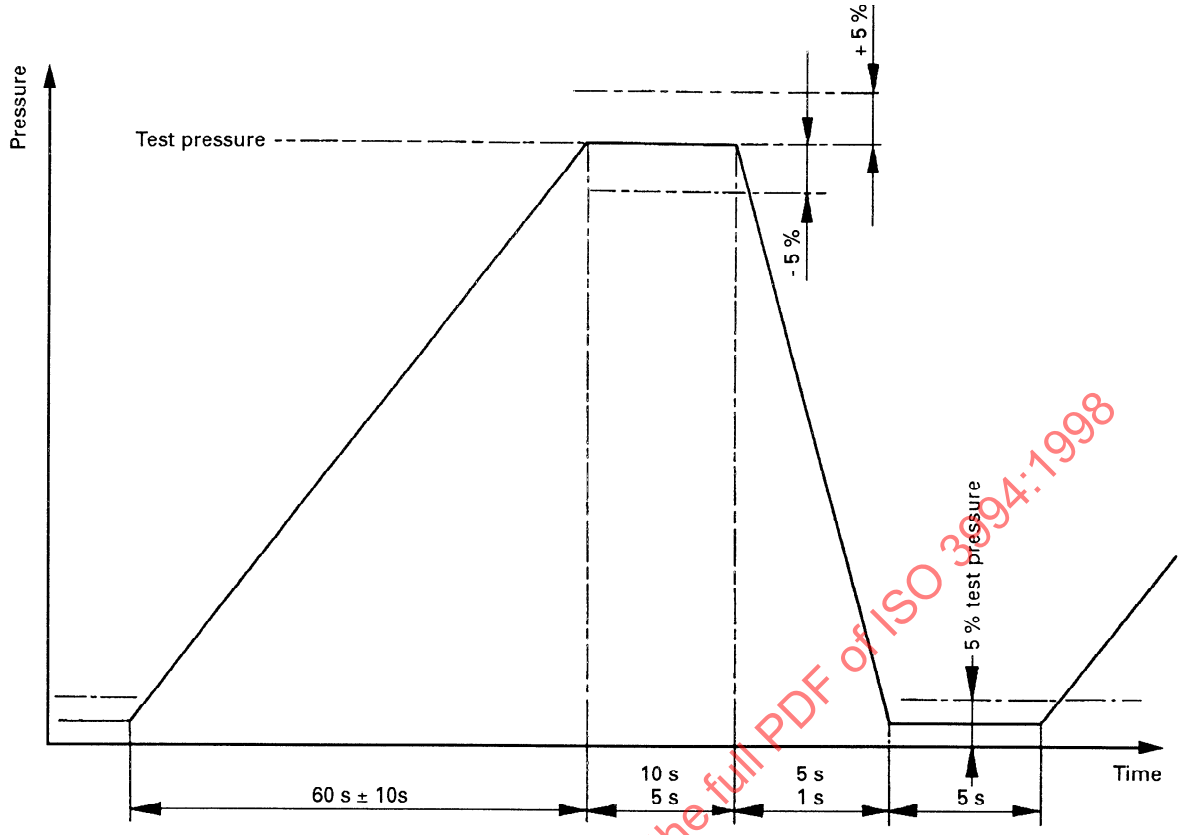

Figure A.1 — Pressure impulse cycle

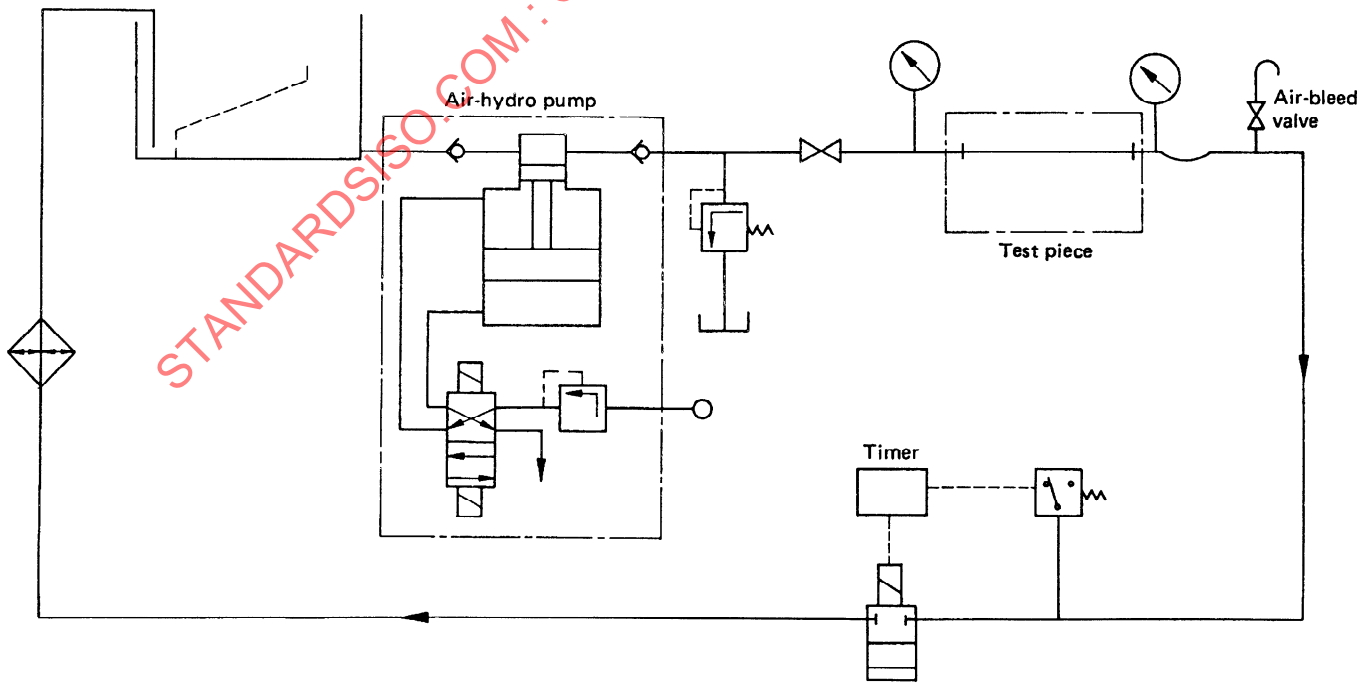

Figure A.2 — Suitable diagrammatic impulse test circuit

ANNEX B
(normative)

VACUUM TEST

B.1 Apparatus

A vacuum pump capable of achieving an absolute pressure of 0,2 bar; the evacuation rate should be uniform and be such that the vacuum is achieved in less than 1 min.

B.2 Test piece

A minimum test length clear of the fittings of five times the bore of the test hose shall be used.

B.3 Conditioning

No test shall be carried out within 24 h of manufacture. Test pieces shall be conditioned at standard laboratory temperature (see ISO 554) for at least 3 h before testing, which may be part of the 24 h.

B.4 Procedure

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

Ensure that the ambient temperature is standard laboratory temperature at which conditioning was carried out. Apply the appropriate vacuum listed in table 5 within 1 min. Maintain for 10 min.

Repeat the test on additional samples but at a temperature of 55 ± 2 °C.

B.5 Test report

The test report shall state either no failure or the position and mode of failure for each test piece, as applicable.

ANNEX C
(normative)

REINFORCEMENT FRACTURE TEST

C.1 Apparatus

Extension pieces of hardwood or metal of rectangular section, with one cross-section dimension of the appropriate value given in table 6.

C.2 Test pieces

The test piece shall contain three helices of reinforcement. This shall be split with clean cut along its length. Three test pieces shall be tested.

C.3 Conditioning

No test shall be carried out within 24 h of manufacture. Test pieces shall be conditioned at standard laboratory temperature (see ISO 554) for at least 3 h before testing, which may be part of the 24 h.

C.4 Procedure

Open up the test piece and place it on the block extension appropriate to its nominal bore (see table 6) as indicated in figure C.1.

Leave in this condition for either 336 h (for a control test) or 4 months (for a type test) as appropriate at the same standard laboratory temperature at which the test pieces were conditioned.

Reverse bend the test piece until the outside surfaces touch, and examine for cracking of the helix (see figure C.1).

C.5 Test report

The test report shall state either no failure or the position and mode of failure for each test piece, as applicable.

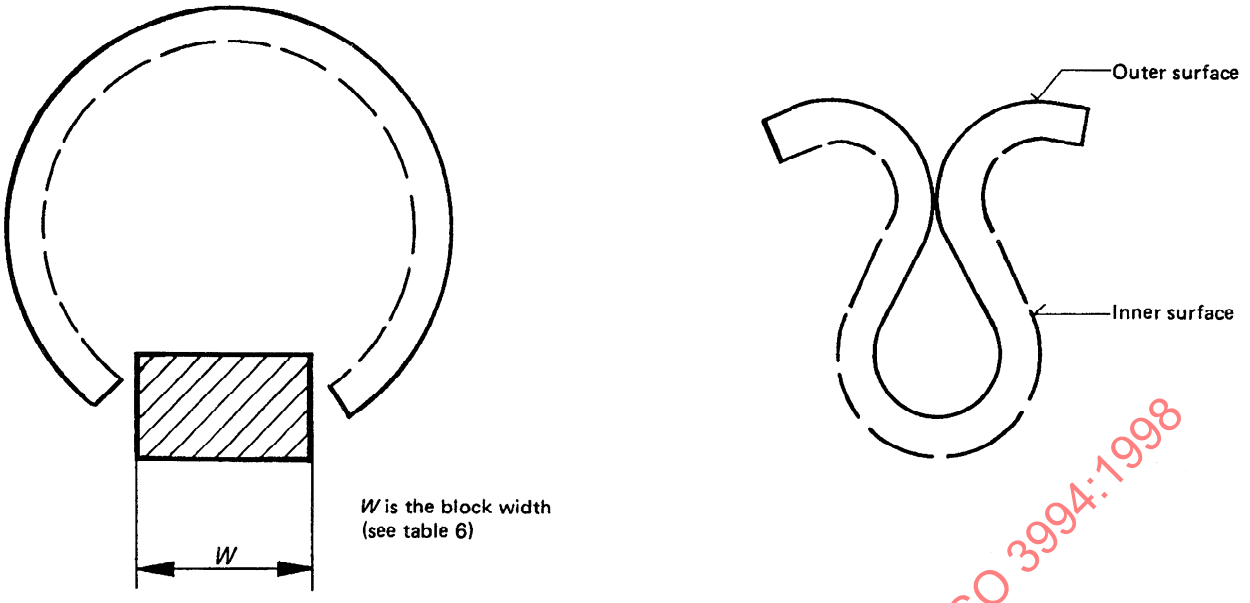

Figure C.1 — Diagrammatic representation of reinforcement fracture test