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Rubber hoses and hose assemblies — Rubber-covered spiral-wire-reinforced hydraulic types for oil-based or water-based fluids — Specification

Tuyaux et flexibles en caoutchouc — Types hydrauliques avec armature hélicoïdale de fils métalliques pour fluides à base d'huile ou à base d'eau — Spécifications

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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.

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*.

This fifth edition cancels and replaces the fourth edition (ISO 3862:2017), which has been technically revised.

The main changes compared to the previous edition are as follows:

— in Clause 1, the temperature of water and water-based fluids has been increased from +60 °C to +70 °C;

— in 6.1, definitions of Table 1, Table 2, Table 3 and Table 4 have been updated;

— Table 1 has been split into Table 1, Table 2 and Table 3; subsequent tables and references have been renumbered;

— dimensions in Table 1, Table 2 and Table3 have been updated;

— in Table 5, Table 6 and Table 7, maximum working pressure, proof pressure and minimum burst pressure have been updated;

— in 7.4.2 and 7.9.3, the temperature of water and water-based fluids has been increased from +60 °C to +70 °C;

— in Clause 9, some of the marking requirements have been revised.

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 hoses and hose assemblies — Rubber-covered spiral-wire-reinforced hydraulic types for oil-based or water-based fluids — Specification

1 Scope

This document specifies requirements for five types of spiral-wire-reinforced hydraulic hoses and hose assemblies of nominal size from 6,3 to 51.

They are suitable for use with:

— oil-based hydraulic fluids HH, HL, HM, HR and HV as defined in ISO 6743-4 at temperatures ranging from −40 °C to +100 °C for types 4SP and 4SH hoses and from −40 °C to +120 °C for types R12, R13 and R15 hoses;

— water-based fluids HFC, HFAE, HFAS and HFB as defined in ISO 6743-4 at temperatures ranging from −40 °C to +70 °C;

— water at temperatures ranging from 0 °C to +70 °C.

This document does not include requirements for end fittings. It is limited to requirements for hoses and hose assemblies.

NOTE It is the responsibility of the user, in consultation with the hose manufacturer, to establish the compatibility of the hose with the fluid to be used.

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

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

ISO 6605, *Hydraulic fluid power — Test methods for hoses and hose assemblies*

ISO 6743-4, *Lubricants, industrial oils and related products (class L) — Classification — Part 4: Family H (Hydraulic systems)*

ISO 6803, *Rubber or plastics hoses and hose assemblies — Hydraulic-pressure impulse test without flexing*

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

ISO 8033:2016, *Rubber and plastics hoses — Determination of adhesion between components*

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

ISO 10619-1:2017, *Rubber and plastics hoses and tubing — Measurement of flexibility and stiffness — Part 1: Bending tests at ambient temperature*

ISO 10619-2:2017, *Rubber and plastics hoses and tubing — Measurement of flexibility and stiffness — Part 2: Bending tests at sub-ambient temperatures*

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:

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

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

4 Classification

Five types of hoses are specified, distinguished by their construction, working pressure and oil resistance:

— Type 4SP: medium-pressure hoses with four plies of steel wire spiral.

— Type 4SH: high-pressure hoses with four plies of steel wire spiral.

— Type R12: heavy-duty high-temperature hoses with a medium-pressure rating having four plies of steel wire spiral.

— Type R13: heavy-duty high-temperature hoses with a high-pressure rating having a multiple-steel-wire spiral.

— Type R15: heavy-duty high-temperature hoses with an extra-high-pressure rating having a multiple-steel-wire spiral.

5 Materials and construction

5.1 Hoses

Hoses shall consist of a rubber lining resistant to oil- or water-based hydraulic fluids or water, spiral plies of steel wire wrapped in alternating directions, and an oil- and weather-resistant rubber cover. Each spiral wire ply shall be separated by an insulating layer.

5.2 Hose assemblies

Hose assemblies shall be manufactured using hoses conforming to the requirements of this document.

Hose assemblies shall be manufactured only with those hose fittings whose correct functioning has been verified in accordance with 7.2, 7.4, 7.5 and 7.6. The manufacturer's instructions shall be followed for the preparation and fabrication of hose assemblies.

6 Dimensions

6.1 Hose diameters and hose concentricity

When measured in accordance with ISO 4671, the inside diameter of hoses shall conform to the values given in Table 1.

When measured in accordance with ISO 4671, the diameter over reinforcement of hoses shall conform to the values given in Table 2.

When measured in accordance with ISO 4671, the outside diameter of hoses shall conform to the values given in Table 3.

When measured in accordance with ISO 4671, the concentricity of hoses shall conform to the values given in Table 4.

Table 1 — Inside diameters of hoses

Nominal size[a]	Inside diameter mm									
	Type 4SP		Type 4SH		Type R12		Type R13		Type R15	
	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
6,3	6,2	7,0	—	—	—	—	—	—	—	—
10	9,4	10,1	—	—	9,3	10,1	—	—	9,3	10,1
12,5	12,6	13,5	—	—	12,3	13,5	—	—	12,3	13,5
16	15,8	16,7	—	—	15,5	16,7	—	—	—	—
19	18,8	19,8	19,1	19,8	18,6	19,8	18,6	19,8	18,6	19,8
25	25,4	26,4	25,5	26,4	25,0	26,4	25,0	26,4	25,0	26,4
31,5	31,8	33,0	32,0	33,0	31,4	33,0	31,4	33,0	31,4	33,0
38	38,0	39,3	38,2	39,3	37,7	39,3	37,7	39,3	37,7	39,3
51	50,6	52,0	50,6	52,0	50,4	52,0	50,4	52,0	50,4	52,0

[a] The nominal sizes correspond to those given in ISO 1307.

Table 2 — Diameter over the reinforcement of hoses

Nominal size[a]	Diameter over the reinforcement mm									
	Type 4SP		Type 4SH		Type R12		Type R13		Type R15	
	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
6,3	14,1	15,3	—	—	—	—	—	—	—	—
10	16,9	18,1	—	—	16,6	17,8	—	—	—	20,3
12,5	19,4	21,0	—	—	19,9	21,5	—	—	—	24,0
16	23,0	24,6	—	—	23,8	25,4	—	—	—	—
19	27,4	29,0	27,6	29,2	26,9	28,4	28,2	29,8	—	32,9
25	34,5	36,1	34,4	36,0	34,1	35,7	34,9	36,4	—	38,9
31,5	45,0	47,0	40,9	42,9	42,7	45,1	45,6	48,0	—	48,4
38	51,4	53,4	47,8	49,8	49,2	51,6	53,1	55,5	—	56,3
51	64,3	66,3	62,2	64,2	62,5	64,8	66,9	69,3	—	71,0

[a] The nominal sizes correspond to those given in ISO 1307.

Table 3 — Outside diameters of hoses

Nominal size[a]	Outside diameters of hose mm									
	Type 4SP		Type 4SH		Type R12		Type R13		Type R15	
	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
6,3	17,1	18,7	—	—	—	—	—	—	—	—
10	20,6	22,2	—	—	19,5	21,0	—	—	—	23,3
12,5	23,8	25,4	—	—	23,0	24,6	—	—	—	26,8
16	27,4	29,0	—	—	26,6	28,2	—	—	—	—
19	31,4	33,0	31,4	33,0	29,9	31,5	31,0	33,2	—	36,1
25	38,5	40,9	37,5	39,9	36,8	39,2	37,6	39,8	—	42,9
31,5	49,2	52,4	43,9	47,1	45,4	48,6	48,3	51,3	—	51,5
38	55,6	58,8	51,9	55,1	51,9	55,0	55,8	58,8	—	59,6
51	68,2	71,4	66,5	69,7	65,1	68,3	69,5	72,7	—	74,0

[a] The nominal sizes correspond to those given in ISO 1307.

Table 4 — Concentricity of hoses

Nominal size	Maximum variation in wall thickness mm	
	Between inside diameter and outside diameter	Between inside diameter and reinforcement outside diameter
6,3	0,8	0,5
over 6,3 and up to and including 19	1,0	0,7
over 19	1,3	0,9

6.2 Length

The length of supplied hoses and hose assemblies shall be the subject of agreement between the manufacturer and the purchaser.

NOTE Recommendations for supplied lengths of hoses and hose assemblies are given in Annex C.

7 Performance requirements

7.1 General

The requirements for type and routine testing are given in Annex A and recommendations for production acceptance testing in Annex B.

7.2 Hydrostatic requirements

When tested in accordance with ISO 1402 or ISO 6605 at the relevant proof pressure given in Table 5 and the relevant minimum burst pressure given in Table 6, the hoses and hose assemblies shall not leak.

When determined in accordance with ISO 1402 or ISO 6605, the change in length of hoses at the maximum working pressure (see Table 7) shall not exceed +2 % or −4 % for types 4SP and 4SH, or +2 % or −2 % for types R12, R13 and R15.

Table 5 — Proof pressure

Nominal size	Type				
	4SP	4SH	R12	R13	R15
	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
6,3	90,0 (900)	—	—	—	—
10	90,0 (900)	—	56,0 (560)	—	84,0 (840)
12,5	84,0 (840)	—	56,0 (560)	—	84,0 (840)
16	70,0 (700)	—	56,0 (560)	—	—
19	70,0 (700)	84,0 (840)	56,0 (560)	70,0 (700)	84,0 (840)
25	56,0 (560)	76,0 (760)	56,0 (560)	70,0 (700)	84,0 (840)
31,5	42,0 (420)	65,0 (650)	42,0 (420)	70,0 (700)	84,0 (840)
38	37,0 (370)	58,0 (580)	35,0 (350)	70,0 (700)	84,0 (840)
51	33,0 (330)	50,0 (500)	35,0 (350)	70,0 (700)	84,0 (840)

Table 6 — Minimum burst pressure

Nominal size	Type				
	4SP	4SH	R12	R13	R15
	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
6,3	180,0 (1 800)	—	—	—	—
10	180,0 (1 800)	—	112,0 (1 120)	—	168,0 (1 680)
12,5	168,0 (1 680)	—	112,0 (1 120)	—	168,0 (1 680)
16	140,0 (1 400)	—	112,0 (1 120)	—	—
19	140,0 (1 400)	168,0 (1 680)	112,0 (1 120)	140,0 (1 400)	168,0 (1 680)
25	112,0 (1 120)	152,0 (1 520)	112,0 (1 120)	140,0 (1 400)	168,0 (1 680)
31,5	84,0 (840)	130,0 (1 300)	84,0 (840)	140,0 (1 400)	168,0 (1 680)
38	74,0 (740)	116,0 (1 160)	70,0 (700)	140,0 (1 400)	168,0 (1 680)
51	66,0 (660)	100,0 (1 000)	70,0 (700)	140,0 (1 400)	168,0 (1 680)

Table 7 — Maximum working pressure

Nominal size	Type				
	4SP	4SH	R12	R13	R15
	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
6,3	45,0 (450)	—	—	—	—
10	45,0 (450)	—	28,0 (280)	—	42,0 (420)
12,5	42,0 (420)	—	28,0 (280)	—	42,0 (420)
16	35,0 (350)	—	28,0 (280)	—	—
19	35,0 (350)	42,0 (420)	28,0 (280)	35,0 (350)	42,0 (420)
25	28,0 (280)	38,0 (380)	28,0 (280)	35,0 (350)	42,0 (420)
31,5	21,0 (210)	32,5 (325)	21,0 (210)	35,0 (350)	42,0 (420)
38	18,5 (185)	29,0 (290)	17,5 (175)	35,0 (350)	42,0 (420)
51	16,5 (165)	25,0 (250)	17,5 (175)	35,0 (350)	42,0 (420)

7.3 Minimum bend radius

When bent to the minimum bend radius given in Table 8, measured in accordance with method A1 of ISO 10619-1:2017, the hose shall conform, in the bent state, to the impulse and cold flexibility requirements of 7.4 and 7.6.

Table 8 — Minimum bend radius

Nominal size	Minimum bend radius mm				
	Type 4SP	Type 4SH	Type R12	Type R13	Type R15
6,3	150	—	—	—	—
10	180	—	130	—	150
12,5	230	—	180	—	200
16	250	—	200	—	—
19	300	280	240	240	265
25	340	340	300	300	330
31,5	460	460	420	420	445
38	560	560	500	500	530
51	660	700	630	630	700

7.4 Resistance to impulse

7.4.1 Oil-based fluid impulse test

The impulse test shall be in accordance with ISO 6803 or ISO 6605. The test fluid temperature for type 4SP and 4SH hoses shall be 100 °C. The test fluid temperature for type R12, R13 and R15 hoses shall be 120 °C.

For type 4SP and 4SH hoses, when tested at an impulse pressure equal to 133 % of the maximum working pressure, the hose shall withstand a minimum of 400 000 impulse cycles.

For type R12 hoses, when tested at an impulse pressure equal to 133 % of the maximum working pressure, the hose shall withstand a minimum of 500 000 impulse cycles.

For type R13 and R15 hoses, when tested at an impulse pressure equal to 120 % of the maximum working pressure, the hose shall withstand a minimum of 500 000 impulse cycles.

There shall be no leakage or other evidence of failure before reaching the specified number of cycles.

This test shall be considered a destructive test, and the test piece shall be discarded after the test.

7.4.2 Water-based fluid impulse test

The impulse test shall be in accordance with ISO 6803 or ISO 6605. The test fluid temperature shall be 70 °C. The test fluid used shall be HFC, HFAE, HFAS or HFB as defined in ISO 6743-4.

For type 4SP and 4SH hoses, when tested at a pressure equal to 133 % of the maximum working pressure, the hose shall withstand a minimum of 400 000 impulse cycles.

For type R12 hoses, when tested at an impulse pressure equal to 133 % of the maximum working pressure, the hose shall withstand a minimum of 500 000 impulse cycles.

For type R13 and R15 hoses, when tested at an impulse pressure equal to 120 % of the maximum working pressure, the hose shall withstand a minimum of 500 000 impulse cycles.

There shall be no leakage or other evidence of failure before reaching the specified number of cycles.

This test shall be considered a destructive test, and the test piece shall be discarded after the test.

The following test can be used as an option to maximize test efficiency by reducing the amount of testing needed:

a) oven-age assemblies filled with one of the water-based fluids specified in 7.4.2 for 120 h at 70 °C;

b) impulse-test the aged assemblies using an oil-based hydraulic fluid as specified in ISO 6803 or ISO 6605 and the test conditions specified in ISO 6803 or ISO 6605.

For type 4SP and 4SH hoses, when tested at a pressure equal to 133 % of the maximum working pressure and a temperature of 100 °C, the hose shall withstand a minimum of 400 000 impulse cycles.

For type R12 hoses, when tested at an impulse pressure equal to 133 % of the maximum working pressure and a temperature of 120 °C, the hose shall withstand a minimum of 500 000 impulse cycles.

For type R13 and R15 hoses, when tested at an impulse pressure equal to 120 % of the maximum working pressure and a temperature of 120 °C, the hose shall withstand a minimum of 500 000 impulse cycles.

There shall be no leakage or other evidence of failure before reaching the specified number of cycles.

This test shall be considered a destructive test, and the test piece shall be discarded after the test.

7.5 Leakage of hose assemblies

When tested in accordance with ISO 1402 or ISO 6605, there shall be no leakage or other evidence of failure. This test shall be considered a destructive test, and the test piece shall be discarded after the test.

7.6 Low temperature flexibility

When tested in accordance with method B of ISO 10619-2:2017 at a temperature of −40 °C, there shall be no cracking of the lining or cover. The test piece shall not leak or crack when subjected to a proof pressure test in accordance with ISO 1402 or ISO 6605 after regaining ambient temperature.

7.7 Adhesion between components

When determined in accordance with ISO 8033, the adhesion between lining and reinforcement and between cover and reinforcement shall be no less than 2,5 kN/m for type 4SP and 4SH hoses and no less than 1,4 kN/m for type R12, R13 and R15 hoses.

Test pieces shall be type 5 for lining and reinforcement and type 2 or type 6 or type 8 for cover and reinforcement as described in ISO 8033:2016, 6.1 and 6.3.

7.8 Abrasion resistance

Abrasion resistance test requirements to be added when new abrasion resistance test methods are available.

7.9 Fluid resistance

7.9.1 General

The fluid resistance tests shall be carried out on moulded sheets of lining and cover compound having a minimum thickness of 2 mm and of cure state equivalent to that of the hose.

7.9.2 Oil resistance

When determined in accordance with ISO 1817 by immersion in IRM 903 oil for 168 h at a temperature of 100 °C, the percentage change in volume of the lining of type 4SP and type 4SH hoses shall be between 0 % and +60 % (i.e. shrinkage is not permissible).

When determined in accordance with ISO 1817 by immersion in IRM 903 oil for 168 h at a temperature of 70 °C, the percentage change in volume of the cover of type 4SP and type 4SH hoses shall be between 0 % and +100 % (i.e. shrinkage is not permissible).

When determined in accordance with ISO 1817 by immersion in IRM 903 oil for 70 h at a temperature of 120 °C, the percentage change in volume of type R12, R13 and R15 hoses shall be between 0 % and +100 % for the lining and between 0 % and +125 % for the cover (i.e. shrinkage is not permissible).

7.9.3 Water resistance

For all types of hose, when tested in accordance with ISO 1817 by immersion in distilled water for 168 h at a temperature of 70 °C, the percentage change in volume of the lining shall be between 0 % and +25 % and the percentage change in volume of the cover shall be between 0 % and +100 % (i.e. shrinkage is not permissible).

7.10 Ozone resistance

When tested in accordance with method 1 or 2 of ISO 7326:2016, depending on the nominal size of the hose, no cracking or other deterioration of the cover shall be visible under × 2 magnifications.

7.11 Visual examination

Hoses shall be examined for visible defects in the outer cover and to verify that the hose identification is correct and has been properly marked. Hose assemblies shall, in addition, be inspected to verify that the correct fittings are fitted.

8 Frequency of testing

Type testing and routine testing shall be as specified in Annex A.

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

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

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

9 Marking

9.1 Hoses

Hoses meeting the requirements of this document shall be marked at least once every 760 mm with at least the following information:

a) the manufacturer's name or identification, e.g. XXX;

b) a reference to this document, i.e. ISO 3862;

c) the type, e.g. 4SP;

d) the nominal size, e.g. 19;

e) the maximum working pressure, in megapascals and in bars, or in either, with the unit indicated, e.g. 35 MPa (350 bar);

f) the quarter and last two digits of the year of manufacture, e.g. 4Q18 (other date-coding methods indicating, for instance, the month or day of manufacture are allowed as long as they are clear to the user).

EXAMPLE XXX/ISO 3862/4SP/19/35 MPa (350 bar)/4Q18.

For 9.1 b), hose manufacturer shall use the latest publication of this document, otherwise the year of publication shall be included in the marking.

9.2 Hose assemblies

Hose assemblies meeting the requirements of this document shall be permanently marked with at least the following information:

a) the manufacturer's name or identification, e.g. XXX;

b) the maximum working pressure of the assembly, in megapascals and in bars, or in either, with the units indicated, e.g. 35 MPa (350 bar);

NOTE 1 The maximum working pressure of a hose assembly is equal to the maximum working pressure of the component having the lowest maximum working pressure.

c) two digits indicating the last two digits of the year of assembly followed by a slash and the two digits indicating the month of assembly, e.g. 18/11 (monthly, daily and other code dating methods are allowed as long as they are clear to the user).

EXAMPLE XXX/35 MPa (350 bar)/18/11.

NOTE 2 Typical markings include but are not limited to stamping the fitting socket, embossing on a metal or plastic ring.

The sequence of the elements is optional and they do not need to be in one row.

Annex A
(normative)

Test frequency for type tests and routine tests

Property/Test	Type tests Frequency (for each hose type and size): at initial product qualification, in the event of product changes after initial qualification and after 5 years	Routine tests Performed on each length of finished hose or hose assembly prior to warehousing or sale
Hose tests		**Per length**[a]
Visual examination	X	X
Measurement of inside diameter	X	X
Measurement of outside diameter	X	X
Measurement of outer cover thickness (if applicable — see Table 2)	X	N/A
Measurement of concentricity	X	N/A
Adhesion test (cover)	X	N/A
Adhesion test (lining)	X	N/A
Proof pressure test	X	X
Change in length test[b]	X	X
Burst pressure test[b]	X	N/A
Low temperature flexibility test[b]	X	N/A
Minimum bend radius[b]	X	N/A
Fluid resistance test for cover	X	N/A
Fluid resistance test for lining	X	N/A
Ozone resistance test	X	N/A
Abrasion resistance test	TBD	TBD
Hose assembly tests (to be performed by the hose assembler)	**Per assembly**	
Visual examination	X	X
Proof pressure test	X	X
Change in length test	X	X
Leakage test	X	N/A
Burst pressure test	X	N/A
Impulse test	X	N/A

X = Test required;

N/A = Test not applicable.

[a] A length is defined as a continuously produced length up to a maximum of 3 000 m.

[b] These tests may be carried out with hose assemblies.