INTERNATIONAL STANDARD

ISO 28017

Third edition
2018-02

Rubber hoses and hose assemblies, wire or textile reinforced, for dredging applications — Specification

Tuyaux et flexibles en caoutchouc, à armature textile ou métallique, pour des applications de dragage — Spécifications

Reference number
ISO 28017:2018(E)

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Published in Switzerland

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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 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).

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For an explanation on 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 the following URL: 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 third edition cancels and replaces the second edition (ISO 28017:2011), of which it constitutes a minor revision. The changes compared to previous edition are as follows: the Amendment ISO 28017:2011/Amd 1:2015 has been incorporated and the normative references have been updated.

Rubber hoses and hose assemblies, wire or textile reinforced, for dredging applications — Specification

1 Scope

This document specifies requirements for two types, seven classes and three grades of wire- or textile-reinforced dredging hoses with nominal sizes ranging from 100 to 1 200. Within each class, all grades and sizes have the same maximum working pressure. Such hoses are suitable for the delivery or suction of seawater or freshwater mixed with silt, sand, coral and small stones with a specific gravity in the range from 1,0 to 2,3 at ambient temperatures ranging from –10 °C to +40 °C.

This document covers two types of hose, as follows:

— type 1: floating type, for delivery only, which includes flotation material to give the hose buoyancy;

— type 2: submarine type for delivery and suction.

This document does not specify requirements concerning the service life of hoses or hose assemblies. Specifying such requirements is the responsibility of the customer, in consultation with the hose manufacturer.

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 34-2:2015, *Rubber, vulcanized or thermoplastic — Determination of tear strength — Part 2: Small (Delft) test pieces*

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

ISO 1431-1, *Rubber, vulcanized or thermoplastic — Resistance to ozone cracking — Part 1: Static and dynamic strain testing*

ISO 4649:2010, *Rubber, vulcanized or thermoplastic — Determination of abrasion resistance using a rotating cylindrical drum device*

ISO 4662:2017, *Rubber, vulcanized or thermoplastic — Determination of rebound resilience*

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

ISO 7233:2016, *Rubber and plastics hoses and hose assemblies — Determination of resistance to vacuum*

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

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

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

3 Terms and definitions

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

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

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

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

4 Classification

4.1 Classes

Seven classes of hose are specified, distinguished by their maximum working pressure, of nominal sizes from 100 to 1 200, as shown in Table 1.

Table 1 — Classes and corresponding maximum working pressures and nominal sizes

Nominal size	Class						
	5	10	15	20	25	30	40
	Maximum working pressure, MWP						
	bar						
	5	10	15	20	25	30	40
	MPa						
	0,5	1,0	1,5	2,0	2,5	3,0	4,0
100	X	X	X	X	X	X	X
150	X	X	X	X	X	X	X
200	X	X	X	X	X	X	X
250	X	X	X	X	X	X	N/A
300	X	X	X	X	X	X	N/A
350	X	X	X	X	X	X	N/A
400	X	X	X	X	X	X	N/A
450	X	X	X	X	X	X	N/A
500	X	X	X	X	X	X	N/A
550	X	X	X	X	X	X	N/A
600	X	X	X	X	X	X	N/A
650	X	X	X	X	X	X	N/A
700	X	X	X	X	X	X	N/A
750	X	X	X	X	X	X	N/A
800	X	X	X	X	X	X	N/A
850	X	X	X	X	X	X	N/A
900	X	X	X	X	X	X	N/A
1 000	X	X	X	X	X	X	N/A
1 100	X	X	X	X	X	X	N/A
1 200	X	X	X	X	X	N/A	N/A

X: Applicable

N/A: Not applicable

4.2 Grades

Type 2 hoses are classified into three grades, A, B and C, according to their construction (number of reinforcing helical wires), as shown in Table 2.

Type 1 hoses are not divided into grades.

Table 2 — Grades

Type	Grade	Construction and purpose	
		Number of reinforcing wires	Purpose
1	—	0	Delivery only
2	A	2	Delivery or suction
	B	1	Delivery or suction
	C	0	Delivery only

The types and grades available in each class (i.e. for each maximum working pressure) are as shown in Table 3.

Table 3 — Types and grades available in each class

Type	Grade	Class						
		5	10	15	20	25	30	40
		Maximum working pressure, MWP						
		bar						
		5	10	15	20	25	30	40
		MPa						
		0,5	1,0	1,5	2,0	2,5	3,0	4,0
1	—	X	X	X	X	X	X	X
2	A	X	X	X	N/A	N/A	N/A	N/A
	B	X	X	X	N/A	N/A	N/A	N/A
	C	X	X	X	X	X	X	X
X: Applicable N/A: Not applicable								

5 Materials and construction

5.1 Hoses

Type 1 hose assemblies shall consist of an abrasion-resistant rubber lining, one or more layers of steel or textile reinforcement, a textile-reinforced rubber undercover, a flexible closed-cell flotation material integrally fitted round the hose body as described in 5.2, an abrasion- and weather-resistant rubber or thermoplastic outer cover (which, in the case of a rubber cover, can include one or two textile breaker layers), and end fittings as described in 5.3 on both ends.

Type 2 hose assemblies shall consist of an abrasion-resistant rubber lining, one or more layers of steel or textile reinforcement, a textile-reinforced rubber, full rubber or thermoplastic cover at least 6 mm thick for hoses of nominal size less than 500, at least 10 mm thick for hoses of nominal size in the range from 500 to 850 inclusive and at least 12 mm thick for hoses of nominal size in the range from 900 to 1 200 inclusive, and end fittings as described in 5.3 on both ends. The lining thickness shall be at least 8 mm for nominal sizes up to and including 200, at least 10 mm for nominal sizes 250 to 500 inclusive, at least 12 mm for nominal sizes 550 to 800 inclusive and at least 16 mm for nominal sizes 850 to 1 200 inclusive.

5.2 Flotation material

The closed-cell flotation material used in type 1 hose assemblies shall adhere firmly both to the hose body and to the outer cover so that it cannot move or tend to become detached in service. At the ends of the hose, a space shall be provided to facilitate the insertion of connection bolts and to allow the use

of mechanical tools for tightening nuts on the bolts. The flotation material shall be distributed over the whole length of the hose assembly in such a manner that the hose assembly floats evenly when connected to other assemblies in a string. This does not apply to hose assemblies for special applications (e.g. the end of a string, tapered hose, etc.).

5.3 End fittings and end connections

End fittings shall be mechanically and chemically bonded to the hose body. With hoses intended for delivery use only, clamped-on and swaged-on nipples are not acceptable, but such nipples may be utilized with hoses intended for suction use. Alternatively, flanged end connections built up of hose reinforcement, lining and cover material are acceptable provided they are additionally reinforced by steel stiffening rings to avoid distortion when the connection bolts are tightened. All hose assemblies shall be fitted with either end fittings or flanged end connections unless otherwise required by the end user.

6 Dimension and tolerances

6.1 Diameters

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

When measured in accordance with ISO 4671, the outside diameters of hoses shall conform to the values specified by the customer.

NOTE For hoses manufactured on mandrels with diameters in inches, the tolerances on the inside diameter are the same as those given for hoses with diameters in metric units in Table 4 (i.e. ± 3 mm for sizes 4 in to 8 in inclusive, ± 4 mm for 10 in to 12 in inclusive, ± 5 mm for 14 in to 30 in inclusive, ± 6 mm for 32 in to 40 in inclusive and ± 7 mm for 44 in and 48 in).

Table 4 — Diameters of hoses

Nominal size	Actual inside diameter mm	
	min.	max.
100	97	103
150	147	153
200	197	203
250	246	254
300	296	304
350	345	355
400	395	405
450	445	455
500	495	505
550	545	555
600	595	605
650	645	655
700	695	705
750	745	755
800	794	806
850	844	856
900	894	906

Table 4 *(continued)*

Nominal size	Actual inside diameter mm	
	min.	max.
1 000	994	1 006
1 100	1 093	1 107
1 200	1 193	1 207

6.2 Hose assembly length

The hose assembly length shall be determined according to the conditions of use. Unless otherwise agreed between the customer and the manufacturer, the tolerances on the hose assembly length shall be +2 % and −2 %.

7 Physical properties

7.1 Rubber compounds

7.1.1 Abrasion resistance of lining

7.1.1.1 Test pieces

Test pieces shall be prepared from sheets of lining compound (of cure state equivalent to that of the hose) of thickness at least 6 mm. The method of preparation shall be as specified in ISO 4649.

7.1.1.2 Abrasion resistance

When the test is carried out in accordance with ISO 4649:2010, method A, the relative volume loss, ΔV_{rel}, shall not be greater than 200 mm^3. This test is required each time type testing is carried out and when a change in lining compound is made, and shall be regularly repeated in accordance with the manufacturer's quality control procedures.

7.1.2 Tear strength of lining

When tested in accordance with ISO 34-2:2015, measuring the test pieces in accordance with method 2 (ISO 34-2:2015, 6.2.2.3), the tear strength, F_0, shall be greater than 35 N. This test is required for each batch of lining compound (which might be used to manufacture more than one hose). Alternatively, the tear strength of the lining may be determined in accordance with ISO 34-1:2015, method B, procedure (b), in which case the minimum required value is 35 kN/m.

7.1.3 Rebound resilience of lining

For certain slurries containing a large quantity of sharp gravel, broken rocks or coral, the hose user can require a lining with high rebound resilience properties. In this case, the lining compound shall be tested for rebound resilience in accordance with ISO 4662:2017, Clause 5 (the pendulum method). A recommended minimum rebound resilience value is 35 %.

7.1.4 Ozone resistance of cover

7.1.4.1 Test pieces

Test pieces shall be prepared from sheets of cover compound (of cure state equivalent to that of the hose) of thickness at least 2 mm. The method of preparation shall be as specified in ISO 1431-1. For

type 1 hoses, it is the compound from which the outer cover (that surrounds the flotation material) is made which is tested.

7.1.4.2 Ozone resistance

When the test is carried out in accordance with ISO 1431-1, no cracking or other deterioration of the test pieces shall be visible under × 2 magnification after 72 h at 40 °C and 20 % strain in 50 pphm ozone. This test is required each time type testing is carried out and shall be repeated whenever a change in compound is made and regularly afterwards when required by the manufacturer's quality control procedures.

7.2 Performance requirements

7.2.1 Hydrostatic requirements

When determined in accordance with ISO 1402, the proof pressure and the minimum burst pressure of hoses and hose assemblies shall conform to the values given in Table 5.

The theoretical minimum burst pressure for each hose assembly of each design in a manufacturer's range shall be calculated and included in the manufacturer's sales documentation for the information of potential users.

Burst testing shall be carried out on a mid-range or larger nominal size of each design in the manufacturer's range. The minimum burst pressure of other sizes of the same design, construction (with a reinforcement type identical to that of the hose assembly tested but not necessarily the same number of plies), materials and method of manufacture shall be determined by calculation. However, this is an acceptable method only if calculation, before testing, of the burst pressure of the hose assembly tested gives a result which is not more than 5 % higher than the actual measured burst pressure. If the calculated burst pressure is more than 5 % higher, the minimum burst pressure of all other sizes in the range shall be determined by testing.

For type 1 hoses, the burst test shall be carried out on a hose assembly without its flotation material.

Table 5 — Maximum working pressure, proof pressure and minimum burst pressure

Class	Maximum working pressure	Proof pressure		Minimum burst pressure	
		Type 1	Type 2	Type 1	Type 2
	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)	MPa (bar)
5	0,5 (5)	0,5 (5)	0,5 (5)	1,5 (15)	1,5 (15)
10	1,0 (10)	1,0 (10)	1,0 (10)	3,0 (30)	3,0 (30)
15	1,5 (15)	1,5 (15)	1,5 (15)	4,5 (45)	4,5 (45)
20	2,0 (20)	2,0 (20)	2,0 (20)	6,0 (60)	6,0 (60)
25	2,5 (25)	2,5 (25)	2,5 (25)	7,5 (75)	7,5 (75)
30	3,0 (30)	3,0 (30)	3,0 (30)	9,0 (90)	9,0 (90)
40	4,0 (40)	4,0 (40)	4,0 (40)	12,0 (120)	12,0 (120)

7.2.2 Change in length

When determined in accordance with ISO 1402, the change in length of the hose at the maximum working pressure shall not exceed +11 % or –2 %.

7.2.3 Bending test

When bent to the minimum bend radius given in Table 6, in accordance with one of the methods specified in ISO 10619-1 (use the method most appropriate to the size of hose), hoses shall show no damage or kinking.

In addition, the coefficient of deformation, T/D, shall not be lower than 0,95.

The difference in minimum bend radii for identical nominal sizes between the various grades depends on the number of helical reinforcing wires in the construction.

Table 6 — Minimum bend radius

Nominal size	Minimum bend radius mm			
	Type 1	Type 2		
	—	Grade A	Grade B	Grade C
100	600	500	800	1 200
150	900	750	1 200	1 800
200	1 200	1 000	1 600	2 400
250	1 500	1 250	2 000	3 000
300	1 800	1 500	2 400	3 600
350	2 100	1 750	2 800	4 200
400	2 400	2 000	3 200	4 800
450	2 700	2 250	3 600	5 400
500	3 000	2 500	4 000	6 000
550	3 300	2 750	4 400	6 600
600	3 600	3 000	4 800	7 200
650	3 900	3 250	5 200	7 800
700	4 200	3 500	5 600	8 400
750	4 500	3 750	6 000	9 000
800	4 800	4 000	6 400	9 600
850	5 100	4 250	6 800	10 200
900	5 400	4 500	7 200	10 800
1 000	6 000	—	—	—
1 100	6 600	—	—	—
1 200	7 200	—	—	—

7.2.4 Leakage of hose assemblies (proof pressure test)

When tested in accordance with ISO 1402, hose assemblies shall show no leakage or other evidence of failure at the proof pressure.

7.2.5 Minimum reserve buoyancy

Type 1 hoses shall have a minimum reserve buoyancy of 5 % when the hose, including the flotation material and outer cover, is fully immersed in seawater or fresh water and filled with a mixture of water and solids representative of that which will be conveyed through the hose during dredging operations. The specific gravity of this mixture shall be supplied by the customer.

The reserve buoyancy, B_r, in per cent, is calculated from the following formula:

$$B_r = \frac{m_D - (m_H + m_W)}{m_H + m_W} \times 100$$

where

m_D is the mass of seawater or fresh water displaced by the hose when fully submerged, including the seawater or fresh water displaced by the flotation material and the seawater or fresh water inside the hose bore;

m_H is the mass of the empty hose, including the flotation material, in air;

m_W is the mass of the mixture of seawater or fresh water and solids inside the hose bore during dredging operations, the specific gravity of which shall be supplied by the customer.

7.2.6 Flotation material recovery

The nature and structure of the flotation material used for a type 1 hose shall be such that the maximum loss in reserve buoyancy after immersing the flotation material at 10 m water depth for 24 h, followed by a recovery period also of 24 h, is 8 % for nominal sizes from 100 to 700 and 5 % for sizes from 750 to 1 200. This test is carried out without fittings.

The reserve buoyancy is calculated using the equation in 7.2.5.

The loss in reserve buoyancy, ΔB, in per cent, is calculated from the following formula:

$$\Delta B = \frac{B_R - B_0}{B_0} \times 100$$

where

B_0 is the reserve buoyancy before immersion (%);

B_R is the reserve buoyancy after immersion (%).

This test may be performed on a sample of flotation material, fully covered by the same type of outer cover as the hose. The reserve buoyancy of the hose after immersion for 24 h at 10 m water depth can be calculated from the results of the test. This test is required for type testing only.

7.2.7 Adhesion between components

When determined in accordance with ISO 8033, the adhesion between the lining and reinforcement, between different reinforcement layers and between the cover and reinforcement shall not be less than 4 N/mm. The adhesion strength between the various layers of the cover, including the case of a rubber/thermoplastic cover, shall not be less than 3 N/mm.

The test pieces used shall be type 5 for adhesion between the lining and reinforcement and type 2 or type 6 for adhesion between the cover and reinforcement, prepared as described in ISO 8033.

7.2.8 Adhesion between end fitting and lining

When determined by the method specified in Annex B, the adhesion between an end fitting and the lining shall not be less than 5 N/mm.

7.2.9 Minimum tensile strength of empty hose assemblies

The empty hose assembly shall withstand a minimum tensile load which is equivalent to 50 % of the axial force generated on the end fittings during application of the hydrostatic pressure with blind flanges at both ends. This tensile load is calculated using the formula:

$$T_S = 0{,}5 \times \frac{P \times \pi \times D_i^{\,2}}{4}$$

where

T_S is the minimum required tensile load (N);

P is the maximum working pressure (MPa);

D_i is the actual inside diameter of the hose (mm).

This test is required each time type testing is carried out and is specified in Annex C.

7.2.10 Vacuum resistance

When tested in accordance with ISO 7233:2016, method B, hose assemblies shall show no external signs of indentation or collapse and no signs of lining delamination or blistering when the internal pressure is reduced to −0,08 MPa for a period of 10 min. This requirement applies only to type 2 (grade A and B) hoses.

7.2.11 Dimensions of flange and other connections

The dimensions of flange and other connections shall comply with the specifications agreed between the customer and manufacturer.

7.2.12 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.

7.3 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 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 least every 10 years or whenever a change in the method of manufacture, the basic construction, the design or the materials, in particular the reinforcement materials, used occurs. They shall be performed on each hose design. Hose assemblies with a diameter smaller than that of a successfully tested type, but with the same basic construction and fabricated by the same method, although having fewer reinforcement plies due to the smaller diameter but required to have at least the same burst strength, do not require a type test unless specified by the purchaser.

The purchaser's approval of a hose design does not release the manufacturer from the responsibility for satisfactory fabrication and hose assembly performance.

Routine tests are those tests required to be carried out, prior to dispatch, on each length of finished hose or hose assembly except for the change-in-length test, leakage test and bending test, which shall be carried out, for each purchase order, on a number of hoses or hose assemblies agreed between the customer and manufacturer.

8 Test certificate or report

When requested by a customer, the manufacturer or supplier shall supply a test certificate or report with each length or batch of hoses or hose assemblies supplied to the purchaser.

9 Marking

Hoses shall be marked at each end, at diametrically opposed locations, with at least the following information:

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

b) the number and year of publication of this document, i.e. ISO 28017:2017;

c) the hose type and grade, e.g. type 1 or type 2A;

d) the specific gravity of the material which the hose is intended to transfer, e.g. SG 1,3;

e) the nominal size, e.g. 700;

f) the maximum working pressure, in megapascals and in bars, with the units indicated, e.g. 1,0 MPa(10 bar);

g) the quarter and the last two digits of the year of manufacture, e.g. 3Q17.

EXAMPLE XXX/ISO 28017:2017/type 1/SG 1,3/700/1,0 MPa(10 bar)/3Q17.

10 Recommendations for packaging and storage

These are given in ISO 8331.

Annex A
(normative)

Type tests and routine tests

Property	**Type tests** Frequency (for each hose type, class, grade and largest size): at initial product qualification, in the event of product changes after initial qualification and after 10 years	**Routine tests** Performed on each length of finished hose prior to warehousing or sale (unless otherwise stated)	**Reference to relevant subclause**
Compound tests			
Abrasion resistance of lining	X	X[a]	7.1.1
Tear strength of lining	X	X	7.1.2
Rebound resilience of lining	X	X[b]	7.1.3
Ozone resistance of cover	X	X[a]	7.1.4
Hose and hose assembly tests			
Measurement of inside diameter	X	X	6.1
Measurement of outside diameter	X	X	6.1
Measurement of length	X	X	6.2
Burst test	X	N/A	7.2.1
Change-in-length test at maximum working pressure	X	X[c]	7.2.2
Bending test	X	X[c]	7.2.3
Leakage test	X	X[c]	7.2.4
Reserve buoyancy check	X	X	7.2.5
Buoyancy recovery test	X	N/A	7.2.6
Adhesion between components	X	N/A	7.2.7
Adhesion between end fitting and lining	X	N/A	7.2.8
Tensile-strength test	X	N/A	7.2.9
Vacuum resistance test (type 2, grades A and B, only)	X	X	7.2.10
Measurement of flange connections	X	X	7.2.11
Visual examination	X	X	7.2.12

X: Test required

N/A: Test not applicable

[a] Test frequency as required by 7.1.1 and 7.1.4 (change in compound or in accordance with manufacturer's quality control procedures).

[b] Test frequency as required by 7.1.3 (by special request from customer when high rebound resilience properties of the lining are required for highly abrasive slurries containing sharp gravel, broken rocks or coral).

[c] Test frequency as agreed between customer and manufacturer (see 7.3, last paragraph).

Annex B
(normative)

Measurement of adhesion between end fitting and lining

B.1 General

For hoses with built-in nipples, a tear test shall be carried out to check the adhesion between end fitting and lining. The test shall be performed on a nipple, constructed as agreed between the customer and the manufacturer, at two or more locations, as shown in Figure B.2.

B.2 Construction of test piece

B.2.1 General

The test piece shall consist of a hose end fitting of the same size and with the same nipple design as the end fitting built into the hose assemblies manufactured for type testing and shall be cured together with these hose assemblies on the same mandrel.

B.2.2 Preparation of fitting nipple

The nipple shall be prepared in accordance with the standard procedure developed by the hose manufacturer for production hose assembly end fittings (i.e. cleaning, degreasing, sand- or shot-blasting, when applicable, and application of the bonding agent).

The end fitting shall then be put on the same mandrel on which hose assemblies for type testing are built and built up in the same way as a type-test hose assembly (but only for the first two layers of reinforcement).

Before application of the first lining layer, a strip of approximately 100-mm-wide polyethylene sheet (approximately 0,25 mm thick) shall be placed, in the longitudinal direction, on the surface of the nipple (on top of the dried bonding agent), as shown in Figure B.1.

This is necessary in order to create an unbonded section between the vulcanized lining rubber and the nipple metal to have a starting point for pulling off a 25-mm-wide strip of liner and reinforcement (see Figure B.2).

B.2.3 Building up the test piece

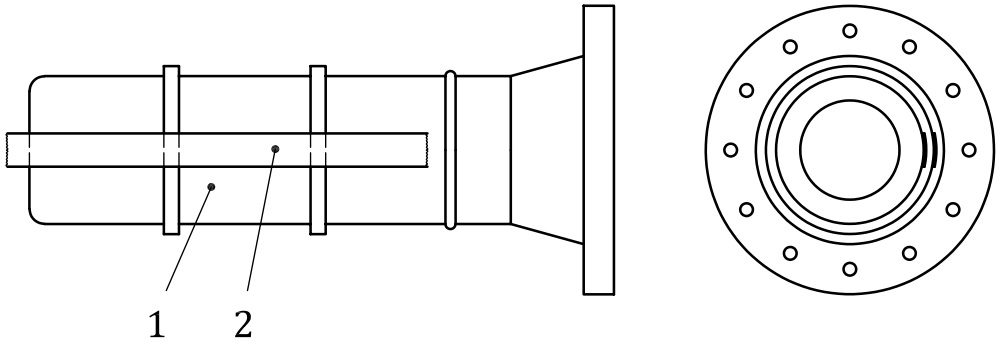
To the fitting nipple prepared as specified in B.2.2, apply the first layer of lining (and, when applicable, in accordance with the standard hose assembly design, subsequent layers) and (when applicable) a breaker layer, concurrently with the type-test hose assembly.

For the subsequently applied layers of reinforcement, two layers are sufficient for the nipple adhesion test, and helical wires which might be part of the type-test assembly design shall not be included. For this test piece, the lining which is applied only needs to be a few millimetres thick (i.e. not the full thickness normally required by the design).

In order to facilitate the formation of the 25-mm-wide test strips (see Figure B.2), apply the two layers of standard reinforcement in the circumferential direction (not in a spiral as normally called for by the hose assembly design).

Finally, apply a thin layer of standard cover (with a breaker layer when this is standard procedure) and wrap the test piece for curing. When the construction of the type-test hose assembly test piece is

also completed, put both test pieces, on the same mandrel, into an autoclave and cure them under the conditions used in the normal manufacturing process.



Key

1 nipple covered with bonding agent

2 polyethylene strip

Figure B.1 — Fitting nipple prepared for application of lining and reinforcement

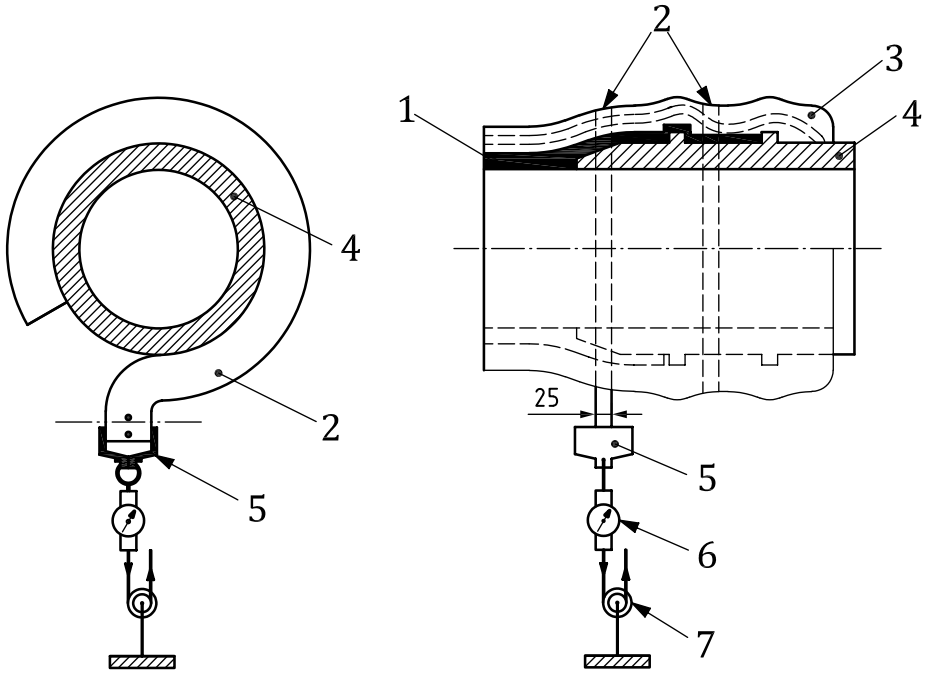
B.2.4 Test procedure

The test shall be conducted at least two locations as shown in Figure B.2. When deemed necessary, more locations may be chosen.

At each location, make two circumferential cuts about 25 mm apart through the rubber and the reinforcement to the steel, the cuts extending completely round the nipple.

At the position where the polyethylene strip lies between the lining and the nipple, cut the test strip formed between the two circumferential cuts and lift the end to give a tab at least 50 mm long. Grip the tab with a suitable clamp and, using a suitable pulling device, tear the 25-mm-wide strip between the two cuts away from the nipple, continuing until the adhesion force measured as shown in Figure B.2 has reached a steady level (i.e. until the reading on the load cell or spring balance between the clamp and pulling device is more or less stable).

No separation shall occur between the rubber lining and the nipple at less than the minimum force specified in 7.2.8. Continue the test until the strip has been completely torn from the nipple. Failure shall be within the rubber.



Key

1 rubber lining (full design thickness not required)
2 test strip
3 hose body (only two layers of reinforcement)
4 nipple
5 clamp
6 load cell or spring balance
7 pulling device (e.g. hoist or block and tackle)

Figure B.2 — Measurement of adhesion between end fitting and lining

Annex C
(normative)

Hose assembly tensile-strength test

C.1 General

This test is required for all hose assemblies for which a type test is required. The test shall be performed on a full-length standard production hose assembly or, alternatively, on a specially built shorter sample length of identical construction as the production length. When a short sample length assembly is used to carry out this test, the free length between the inboard ends of the fitting nipples shall be at least four times the inside diameter.

C.2 Equipment required

— Two blind flanges of sufficient thickness to take up the required tensile load applied to the centrally located eyebolts (see Figure C.1) without deforming the flanges.

— Two fixed anchoring points at a suitable distance from each other to accommodate the test set-up (see Figure C.1) and capable of resisting the tensile test load.

— Suitable wire rope slings (or chains) and shackles to connect the hose assembly to the anchoring points, pulling device and load-measuring equipment.

— A load cell or other suitable device of sufficient capacity to measure the tensile load applied.

— If necessary, single- double- or triple-sheave pulley block(s) to apply the tensile load, with a pulling device designed for lower tensile loads than are required for the test.

C.3 Test bench (test machine)

For high test loads (required for large-diameter hose assemblies of MWP higher that 2,0 MPa (20 bar), it is, in the interests of safety, recommended that the test be performed on a test bench in a test house (specially designed for testing large hawsers, wire rope and chains). This decision is the responsibility of the manufacturer.

C.4 Test procedure

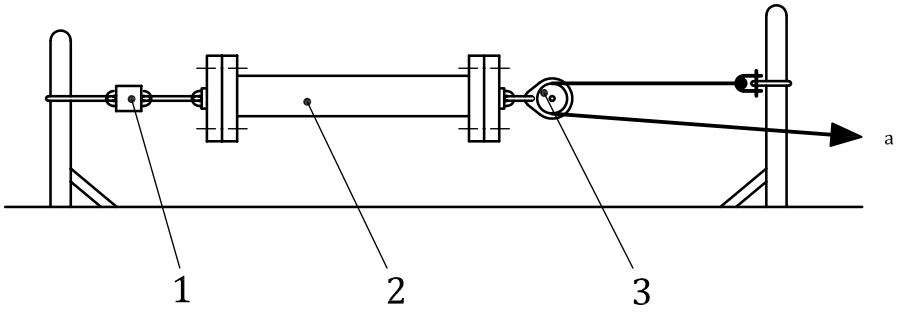
C.4.1 Initial setting up

Fit the blind flanges, equipped with suitable eyebolts (screwed and welded to the flanges) to both flanges of the empty assembly. Connect one end of the assembly to the load cell and the other end of the load cell to one of the anchor points, as shown in Figure C.1 and Figure C.2.

C.4.2 Test set-up for light tensile loads (small hoses and low MWPs)

Connect the other end of the assembly to the pulley block, and the wire rope to the second anchor point (see Figure C.1) when only one single-sheave block is sufficient to transfer the required tensile load. Connect the other end of the wire rope to the pulling device (which can be a forklift truck or winch, hoisting tackle or even an overhead crane when a lead block is placed underneath this crane) and start the test by slowly applying the load, constantly checking the load cell display screen. When the required tensile load is reached, hold it for 5 min (if necessary adjusting it to compensate for the elongation of the

assembly) and check the assembly for signs of failure (fitting pull-out, carcass rupture or collapse, etc.). Release the test load after the 5 min test period without failure and remove the blind flanges. Inspect the hose internally for signs of damage. Any failure will be cause for disqualification of the design, or method of manufacture, of the type-tested hose assembly.



Key

1 load cell

2 hose assembly

3 single-sheave pulley block

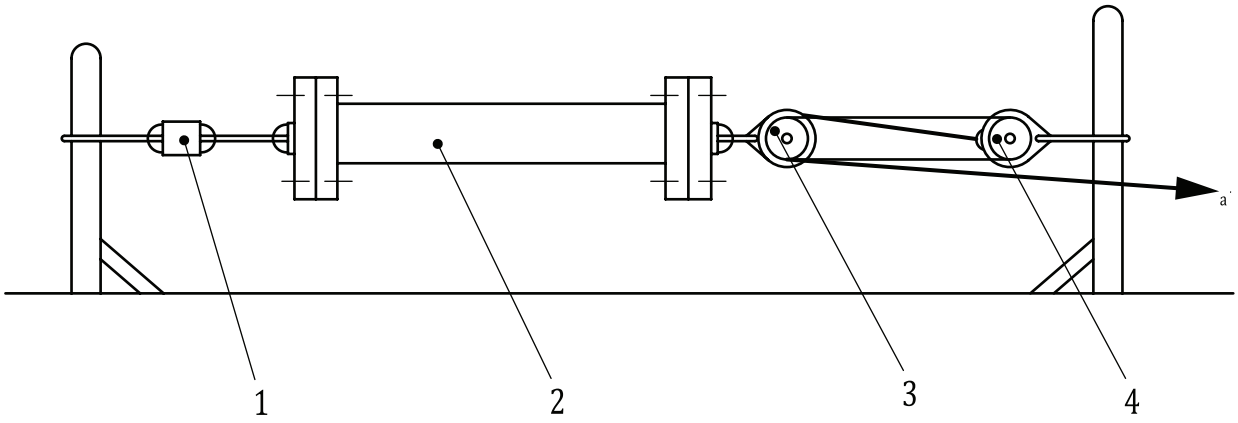
a To pulling device (when necessary, via a lead block).

Figure C.1 — Example of test arrangement for low tensile test loads

C.4.3 Test set-up for higher tensile loads (larger hoses and higher MWPs)

For this test, two pulley blocks are required, as shown in Figure C.2, either one single-sheave block and one double-sheave block or, for high tensile loads, one double-sheave block and one triple-sheave block.

Connect the double-sheave block (3) to the hose assembly and the single-sheave block (4) to the second anchor point, as shown in Figure C.2. The wire is connected to the bottom becket of the single-sheave block (4) and passes in standard configuration over the two sheaves of block 3 and the one sheave of block 4 (see Figure C.2). For very high loads, when one triple-sheave block (3) and one double-sheave block (4) are used, the wire will be connected to the bottom becket of block 4 and passed over the three sheaves of block 3 and two sheaves of block 4 in standard configuration. The free end of the wire is then connected to the pulling device (if necessary, guiding it through a lead block to connect it to an overhead crane), and the test is carried out as described in C.4.2.



Key

1 load cell
2 hose assembly
3 double-sheave pulley block
4 single-sheave pulley block
a To pulling device (when necessary, via a lead block).

Figure C.2 — Example of test arrangement for higher tensile test loads

Bibliography

[1] ISO 34-1:2015, *Rubber, vulcanized or thermoplastic — Determination of tear strength — Part 1: Trouser, angle and crescent test pieces*

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

ICS 83.140.40

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