INTERNATIONAL STANDARD

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Second edition
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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

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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.

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 28017 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 28017:2009), which has been technically revised. The main changes are the following:

— 5.1: minimum lining thicknesses have been specified for hoses of different nominal sizes;

— 5.2: additional requirements have been specified for flotation materials;

— Clause 6: tighter tolerances have been specified for the inside diameters of all nominal sizes;

— 7.1.2: requirements have been included for the tear strength of the hose lining;

— 7.1.3: requirements have been included for the rebound resilience properties of the hose lining;

— 7.2.5: the requirements concerning minimum reserve buoyancy have been made clearer;

— 7.2.6: the flotation material recovery test procedure has been made clearer;

— 7.2.9: requirements have been included for the minimum tensile strength of empty hose assemblies;

— 7.3: a more detailed description of type test requirements has been given;

— Annex A: a tear strength test and a rebound resilience test of the lining compound have been included, as well as a tensile-strength test on empty hose assemblies;

— a new annex (Annex C) specifying a tensile-strength test has been added.

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

1 Scope

This International Standard 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 International Standard 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 International Standard 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 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 34-1:2010, *Rubber, vulcanized or thermoplastic — Determination of tear strength — Part 1: Trouser, angle and crescent test pieces*

ISO 34-2:2011, *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 4662:2009, *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 7233:2006, *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 8331, *Rubber and plastics hoses and hose assemblies — Guidelines for selection, storage, use and maintenance*

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.

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

NOTE 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
NOTE 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, may 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).

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 %.

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
1 000	994	1 006
1 100	1 093	1 107
1 200	1 193	1 207

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 34-2:2011, measuring the test pieces in accordance with method 2 (Subclause 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 34-1:2010, 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 might require a lining with high rebound resilience properties. In this case, the lining compound shall be tested for rebound resilience in accordance with ISO 4662:2009, 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.

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 %.

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)

7.2.3 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.

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 percent, is calculated from the following equation:

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

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.