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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)*.

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# 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, freshwater, silt, sand, coral and small stones with a specific gravity in the range from 1,0 to 2,3 at ambient temperatures ranging from  $-10\text{ }^{\circ}\text{C}$  to  $+40\text{ }^{\circ}\text{C}$ .

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 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 1746, *Rubber or plastics hoses and tubing — Bending tests*<sup>1)</sup>

ISO 4649:2002, *Rubber, vulcanized or thermoplastic — Determination of abrasion resistance using a rotating cylindrical drum device*

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*

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1) Under revision as ISO 10619-1.

### 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						
	MPa (bar)						
	0,5 (5)	1,0 (10)	1,5 (15)	2,0 (20)	2,5 (25)	3,0 (30)	4,0 (40)
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, 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 MPa (bar)						
		0,5 (5)	1,0 (10)	1,5 (15)	2,0 (20)	2,5 (25)	3,0 (30)	4,0 (40)
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 may be textile-reinforced, 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.

**5.2 Flotation material**

The flotation material 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.

**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.

**Table 4 — Diameters of hoses**

Nominal size	Actual inside diameter mm	
	min.	max.
100	90	110
150	140	160
200	190	210
250	240	260
300	290	310
350	340	360
400	390	410
450	440	460
500	490	510
550	540	560
600	590	610
650	640	660
700	690	710
750	740	760
800	790	810
850	840	860
900	890	910
1 000	990	1 010
1 100	1 090	1 110
1 200	1 190	1 210

## 6.2 Hose unit length

The hose unit length shall be determined according to the conditions of use. Unless otherwise agreed between the customer and the manufacturer, the tolerances on the unit 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 4649:2002, method A, the relative volume loss  $\Delta V_{rel}$  shall not be greater than 200 mm<sup>3</sup>.

#### 7.1.2 Ozone resistance of cover

##### 7.1.2.1 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 surrounding the flotation material) is made which is tested.

##### 7.1.2.2 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  $\times 2$  magnification after 72 h at 40 °C and 20 % strain in 50 pphm ozone.

## 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.

Burst testing shall be carried out on a mid-range 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 tested but not necessarily the same number of plies), materials and method of manufacture shall then be determined by calculation. Note, however, that this is an acceptable method only if the calculated burst pressure of the mid-range size hose is not more than 5 % lower than the measured burst pressure. If the calculated burst pressure is more than 5 % lower, the minimum burst pressure of all the 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 1746 (use the method most appropriate to the size of hose), hoses shall show no damage or kinking.

In addition, the coefficient of deformation *TID* shall not be lower than 0,95.

**7.2.4 Leakage of hose assemblies**

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

**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 immersed in seawater or fresh water (which may include sand, small stones, etc.) of specific gravity specified 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 immersed, including the seawater or fresh water displaced by the flotation material and the seawater or fresh water inside the hose bore (g);

$m_H$  is the mass of the empty hose, including the flotation material, in air (g);

$m_W$  is the mass of the seawater or fresh water (including any sand, small stones, etc., it may contain) inside the hose bore (g).

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	—	—	—

### 7.2.6 Flotation material recovery

The flotation structure of 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  $\Delta B$ , in percent, is calculated from the following equation:

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

where

$B_0$  is the reserve buoyancy before immersion (%);

$B_R$  is the reserve buoyancy after immersion (%).

### 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 Vacuum resistance

When tested in accordance with ISO 7233:2006, 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 hoses.

### 7.2.10 Dimensions of flange and other connections

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

### 7.2.11 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.

## 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 International Standard. The tests shall be repeated at least every 10 years or whenever a change in the method of manufacture or materials used occurs. They shall be performed on all sizes and on all types, classes and grades except those of the same size and construction.

**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 on a number of hoses or hose assemblies agreed between the customer and manufacturer.

## 8 Test certificate

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

## 9 Marking

Hoses shall be marked at each end with at least the following information:

- a) the manufacturer's name or identification, e.g. MAN;
- b) the number and year of publication of this International Standard, i.e. ISO 28017:2009;
- 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 1,0;
- e) the nominal size, e.g. 700;
- f) the maximum working pressure, in megapascals, e.g. 1,0 MPa;
- g) the quarter and the last two digits of the year of manufacture, e.g. 3Q09.

EXAMPLE      MAN/ISO 28017:2009/type 1/SG 1,0/700/1,0 MPa/3Q09

## 10 Recommendations for packaging and storage

These are given in ISO 8331.

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## Annex A (normative)

### Type tests and routine tests

Property	<b>Type tests</b> Frequency (for each hose type, class, grade and size): at initial product qualification, in the event of product changes after initial qualification and after 10 years	<b>Routine tests</b> Performed on each length of finished hose prior to warehousing or sale (unless otherwise stated)	<b>Reference to relevant subclause</b>
<b>Compound tests</b>			
Abrasion resistance of lining	X	N/A	7.1.1
Ozone resistance of cover	X	N/A	7.1.2
<b>Hose and hose assembly tests</b>			
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	X	X <sup>a</sup>	7.2.2
Bending test	X	X <sup>a</sup>	7.2.3
Leakage test	X	X <sup>a</sup>	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
Vacuum resistance test (type 2 only)	X	X	7.2.9
Measurement of flange connections	X	X	7.2.10
Visual examination	X	X	7.2.11
NOTE X = test shall be carried out, N/A = test not applicable.			
<sup>a</sup> Test frequency as agreed between customer and manufacturer (see 7.3).			