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Rubber and plastics hoses and hose assemblies, wire- or textile-reinforced, for manually operated hydraulic jacks — Specification

Tuyaux et flexibles en caoutchouc et en plastique, à armature textile ou métallique, pour vérin hydrauliques — Spécifications

Reference number
ISO 16301:2017(E)

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Foreword

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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).

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This document was prepared by Technical Committee TC 45, *Rubber and rubber products*, Subcommittee SC 1, *Rubber and plastics hoses and hose assemblies*.

Rubber and plastics hoses and hose assemblies, wire- or textile-reinforced, for manually operated hydraulic jacks — Specification

1 Scope

This document specifies the requirements for three classes of wire- or textile-reinforced hydraulic hoses and hose assemblies of nominal sizes ranging from 5 to 25. The hoses and hose assemblies are used in hydraulic jack applications with manually operated hand pumps. They are suitable for use with hydraulic fluids HH, HL, HM, HR and HV at temperature ranging from −40 °C to +55 °C. For tools that require heavy duty services such as a rescue tool, ISO 19718[3] applies.

This document does not include requirements for the connection ends. It is limited to the performance of hoses and hose assemblies. The maximum working pressure of hose assemblies is regulated by the lowest maximum working pressure of the components.

NOTE 1 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.

NOTE 2 There are two International Standards for hoses for hydraulic jacks and tool applications, i.e. ISO 16301 and ISO 19718. The comparison table is given in Annex A.

NOTE 3 The classification of HH, HL, HM, HR and HV is found in ISO 6743-4[2].

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 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 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 10619-1:2011, *Rubber and plastics hoses and tubing — Measurement of flexibility and stiffness — Part 1: Bending tests at ambient temperature*

ISO 10619-2:2011, *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 http://www.iso.org/obp

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

4 List of significant hazards

4.1 General

This clause contains some of the significant hazards, hazardous situations and events, as far as they are dealt with in this document, identified by risk assessment as significant for this type of machinery and which require action to eliminate or reduce the risk.

4.2 Hazards due to bursting or leaking of hoses

Hazards can occur when a hose bursts or leaks. The escaping stream of liquid can cause personal injury or property damage.

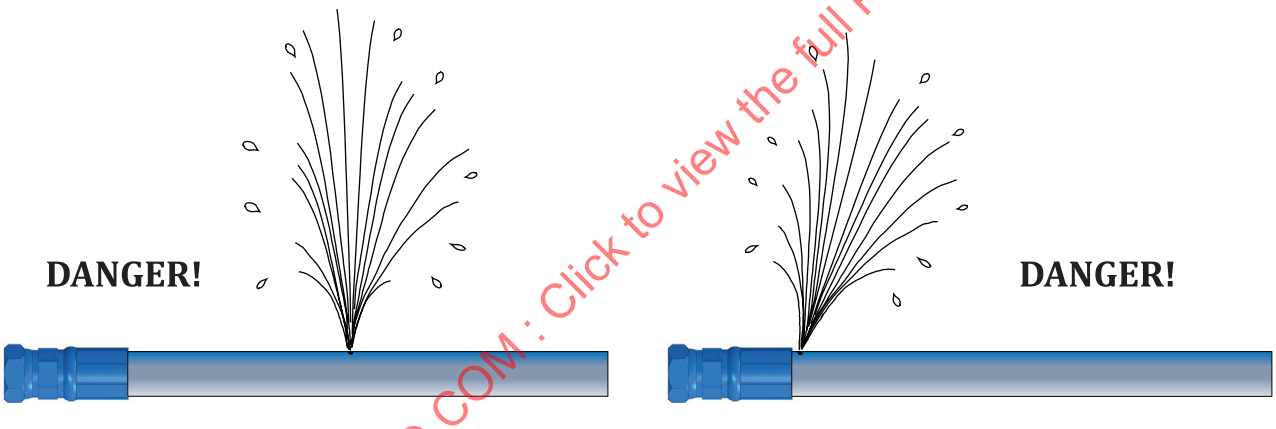


Figure 1 — Hazards due to bursting or leaking of hoses

4.3 Hazards due to failure of connectors

Hazards can occur when a connector fails. The escaping stream of liquid can cause physical damage and also a sudden repositioning of the hose assembly in a dangerous manner (whip).

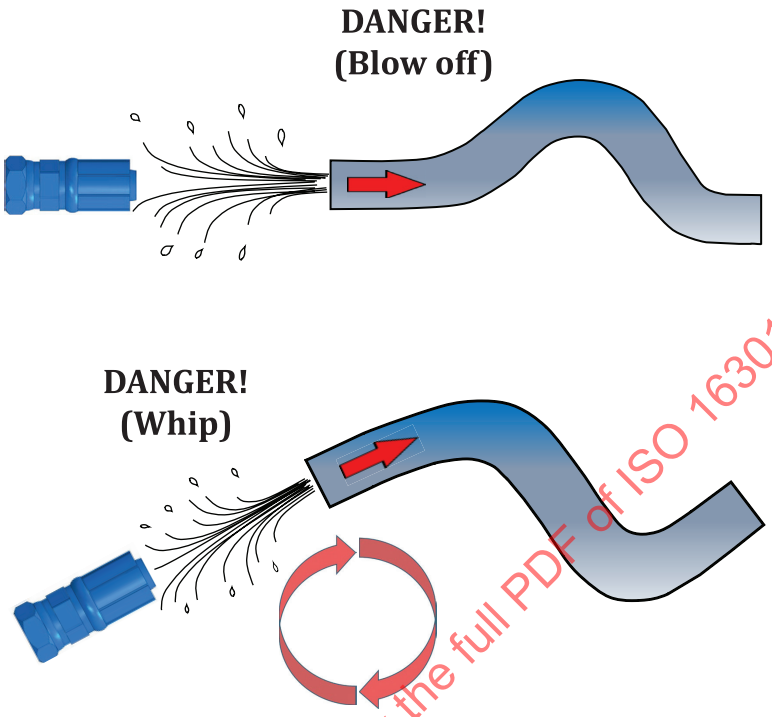


Figure 2 — Hazards due to failure of connectors

4.4 Hazards due to errors by the operator

Hazards can occur if the operator uses incompatible substances or incompatible components. Hazards can also occur if the operator exceeds the limits of use specified by the manufacturer (e.g. too high pressure, too high tensile stress), also pinhole caused by kink might result in a significant injury.

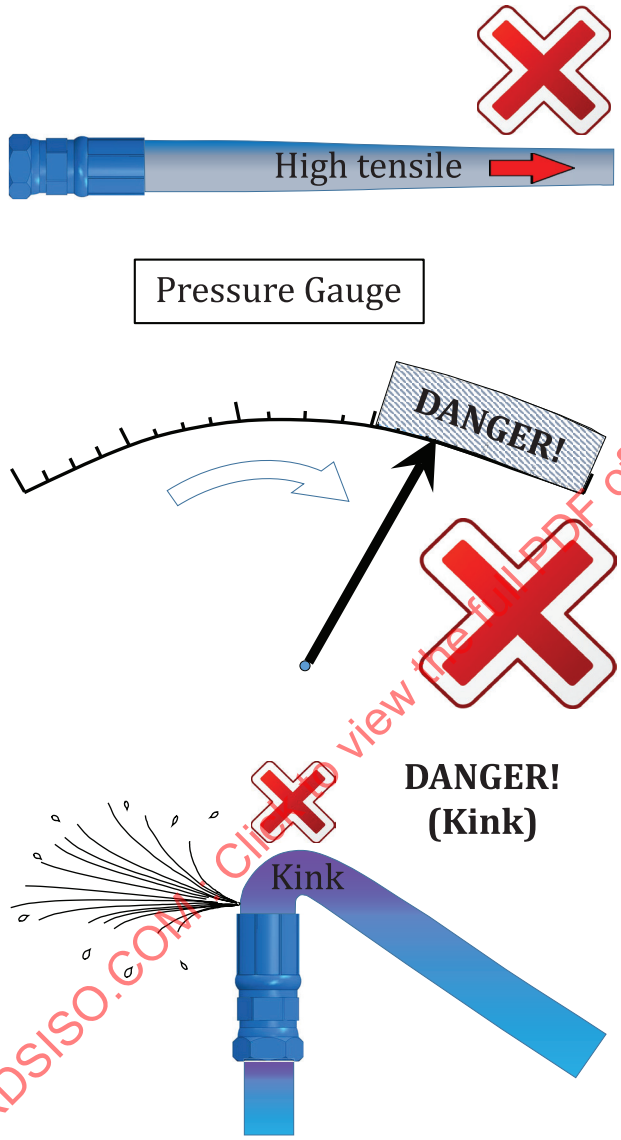


Figure 3 — Hazards due to errors by the operator

4.5 Hazards due to change in length of hose assembly

Hazardous situations occur when there is a sudden change of pressure in the hose assembly causing a change in length resulting in the operators losing their firm hold.

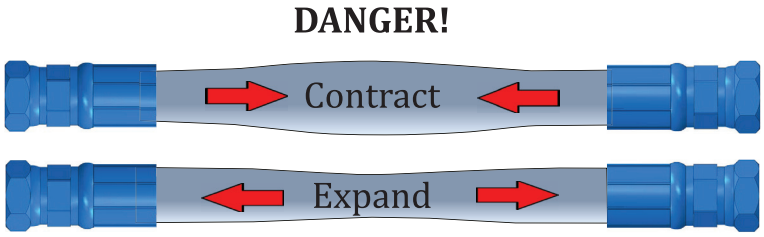


Figure 4 — Hazards due to change in length of hose assembly

5 Classification

5.1 Classes

Three classes of hose are specified, distinguished by their maximum working pressure and six sizes specified by nominal size as shown in Table 1.

Table 1 — Classes and nominal sizes

Class	70	100	140
Maximum working pressure (MPa)	70	100	140
Maximum working pressure (bar)	700	1 000	1 400
Nominal size			
5	X	X	X
6,3	X	X	X
8	X	X	X
10	X	X	N/A
12,5	X	X	N/A
19	X	N/A	N/A
25	X	N/A	N/A
NOTE X = Applicable, N/A = Not applicable			

5.2 Grades

All grades are classified on their electrical properties:

a) Grade 1, no electrical requirements.

b) Grade 2, non-conductive.

Non-conductive means the current reading shall be no greater than 50 µA when tested in accordance with Annex E.

6 Materials and construction

6.1 Hoses

Hoses shall consist of a hydraulic fluid resistant rubber or plastic lining, one or multiple layers of steel wire or textile and an oil, abrasion and weather resistant rubber or plastic cover. A layer of other materials on the rubber cover are allowed for improved abrasion or other resistance. Grade 2 hoses shall not be perforated on the cover.

6.2 Hose assemblies

Hose assemblies shall only be manufactured with those hose fittings whose functionality conforms to the requirements of 8.2.1, 8.2.4 and 8.2.5.

The manufacturer's instructions should be followed for proper preparation and fabrication of hose assemblies.

It is highly recommended that hose assemblies be provided with an anti-kink protection at each end, e.g. spring guards or bend restrictors.

7 Dimensions and tolerances

7.1 Diameters

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

Table 2 — Diameters of hoses

Nominal size	Inside diameter mm		Maximum outside diameter of hose mm		
	All classes		Class		
	Minimum	Maximum	70	100	140
5	4,6	5,4	17	18	20
6,3	6,1	7,0	20	21	22
8	7,7	8,5	22	25	28
10	9,3	10,1	24	28	—
12,5	12,3	13,5	28	32	—
19	18,6	19,8	35	—	—
25	25,0	26,4	43	—	—

7.2 Cover thickness

When measured in accordance with ISO 4671, the outer cover thickness of the hoses shall be at least 0,5 mm.

7.3 Concentricity

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

Table 3 — Concentricity of hoses

Nominal size	Maximum variation in wall thickness	
	Between inside diameter and outside diameter mm	Between inside diameter and reinforcement diameter mm
5 and 6,3	0,8	0,5
over 6,3 and including 19	1,2	0,7
over 19	1,3	0,9

8 Physical properties

8.1 Fluid resistance

8.1.1 Test pieces

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

For plastic hoses, the fluid resistance tests shall be carried out on moulded sheets of lining and cover materials having minimum thickness 2 mm and of equivalent state to that of the hose.

8.1.2 Oil resistance

When tested in accordance with ISO 1817, by immersion in oil No. 3 for 168 h at a temperature of 70 °C, the percentage change in volume of the lining ΔV shall be between −10 % and +60 %.

When tested in accordance with ISO 1817, by immersion in oil No. 3 for 168 h at a temperature of 70 °C, the percentage change in volume of the cover ΔV shall be between −10 % and +100 %.

8.2 Performance requirements

8.2.1 Hydrostatic requirements

When tested in accordance with ISO 1402, the maximum working pressure, the proof pressure and minimum burst pressure of the hoses and hose assemblies shall conform to the values given in Table 4.

Table 4 — Maximum working pressure, proof pressure and minimum burst pressure

Class	Maximum working pressure		Proof pressure		Minimum burst pressure	
	MPa	bar	MPa	bar	MPa	bar
70	70	700	105	1 050	175	1 750
100	100	1 000	150	1 500	250	2 500
140	140	1 400	210	2 100	350	3 500

All hose assemblies shall be subjected to proof pressure test with a pressure hold time of 1 min.

All deviations to that shall be agreed between hose assembly manufacturer and purchaser.

8.2.2 Change in length

When tested in accordance with ISO 1402, the change in length of hose at the maximum working pressure shall not exceed +2 % to −4 % for rubber hoses, +3 % to −3 % for plastic hoses.

8.2.3 Minimum bend radius

Use a test piece having a length at least four times the minimum bend radius. Measure the hose outside diameter with callipers in the straight-lay position before bending the hose. Bend the hose through 180° to the minimum bend radius (see Table 5) and measure the flatness with the callipers.

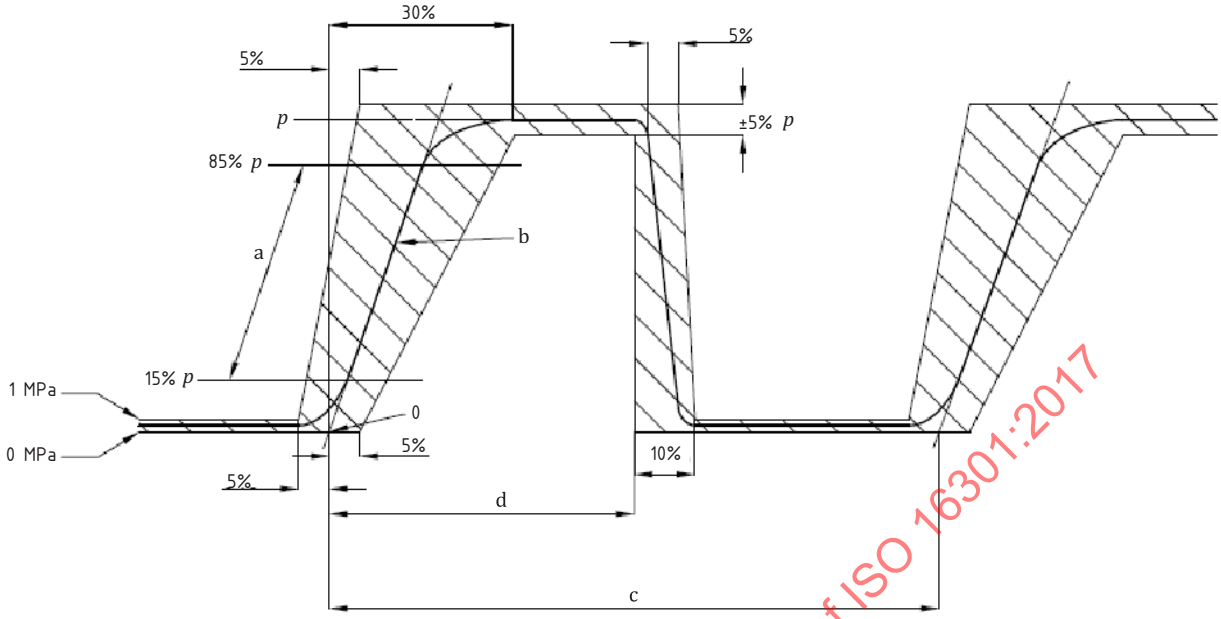
When the hose is bent to the minimum bend radius given in Table 5 and tested in accordance with ISO 10619-1:2011, Method A1, the flatness shall not exceed 10 % of the original outside diameter.

Table 5 — Minimum bend radius

Nominal size	Minimum bend radius mm		
	Class		
	70	100	140
5	90	90	120
6,3	120	130	130
8	130	150	180
10	150	170	—
12,5	180	180	—
19	200	—	—
25	280	—	—

8.2.4 Resistance to impulse

8.2.4.1 The test shall be done in accordance with ISO 6803 except the pressure rise and the pulse cycle. The pressure rise shall be contained within the wave form envelope as shown in Figure 5. The test fluid temperature shall be 55 °C.



Key

p test pressure

a Rate of rise to be determined between these points.

b Secant pressure rise.

c One pulse cycle (0,2 Hz to 0,5 Hz).

d 45 % to 55 % of the cycle.

Figure 5 — Pressure pulse wave

8.2.4.2 When tested at impulse pressure equal to 100 % of the maximum working pressure, the hose assemblies shall withstand a minimum of 20 000 impulse cycles.

8.2.4.3 There shall be no leakage or other malfunction before reaching the specified number of cycles.

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

8.2.5 Leakage of hose assemblies

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

8.2.6 Cold bending test

When tested in accordance with ISO 10619-2:2011, Method B, 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 after regaining ambient temperature. The values found for T0 and T1 shall be stated on the type test report.

8.2.7 Ozone resistance

When tested in accordance with ISO 7326:2016, Method 1 or 2, no cracking or deterioration of the cover shall be visible under ×2 magnification.

8.2.8 Electrical conductivity

This test applies to Grade 2 hose assemblies only (this test shall not be applied to hoses with a perforated cover).

When tested in accordance with Annex E, the current reading shall be no greater than 50 µA.

8.2.9 Visual examination

Hoses shall be examined for visible defects on 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.

9 Frequency of testing

Type tests and routine tests shall be as specified in Annex B.

Type tests are those 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 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 types except those of the same size and construction.

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

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

10 Marking

10.1 Hoses

Hoses shall be marked permanently with at least the following information, and the marking shall be repeated every 760 mm or less:

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

b) the number of this document, i.e. ISO 16301;

c) Grade, e.g. Grade 2(non-conductive); for grade 2 hoses the words “non-conductive” shall appear in each marking.

d) nominal size, e.g. 10;

e) Class, e.g. 70;

f) maximum working pressure, in megapascals and in bars, or either, with units indicated, e.g. 70 MPa (700 bar);

g) quarter and last two digits of year of manufacture, e.g. 2Q17.

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

EXAMPLE 1 XXX/ISO 16301/Grade 1/10/Class 70/70 MPa (700 bar)/2Q17.

EXAMPLE 2 XXX/ISO 16301/Grade 2(non-conductive)/10/Class 70/70 MPa (700 bar)/2Q17.

10.2 Hose assemblies

Hose assemblies shall be marked preferably at the coupling with at least the following information:

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

b) maximum working pressure of the assemblies, in megapascals and in bars, or either, with units indicated, e.g. 70 MPa (700 bar);

NOTE The maximum working pressure of the assembly is the lowest maximum working pressure of any of its components.

c) the month and last two digits of year of assembly, e.g. 02/17.

EXAMPLE XXX/70 MPa (700 bar)/02/17.

11 Test report

When requested by the purchaser, the manufacturer or supplier will supply a test report representing the purchased product (each length or batch of hoses).

12 Recommendations for packaging and storage

These are given in ISO 8331.

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

Annex A
(informative)

Selection of hoses

A.1 General

Wire- or textile-reinforced hoses are designed to operate under very high pressures and are used in a variety of applications.

For risk avoidance purposes, the solutions below are highly recommended for usage.

For hose assemblies:

— anti-kink protection at each end, e.g. spring guards.

For systems:

— safety valve;

— check valve;

— fuse valve;

— clamp to prevent from kinking or abrasion.

For other safety information, see ISO 4413[1].

A.2 Comparison table

Table A.1 provides the different/common points between specifications of ISO 16301 and ISO 19718.

Table A.1 — Comparison between ISO 16301 and ISO 19718

	ISO 16301	ISO 19718
Applications	hydraulic jack	hydraulic jack, torque wrench, hydraulic press, hydraulic cutter, hydraulic crusher, hydraulic bender, rescue tool, high-voltage cable crimper
	general use	heavy duty use
Pressure source	manually operated pump	manually operated pump, electric pump, booster pump
Temperature ranging	from −40 °C to +55 °C	from −20 °C to +55 °C
Hydrostatic requirements	design factor: proof pressure: 1,5 × MWP[a] MBP[b]: 2,5 × MWP	design factor: proof pressure: 2,0 × MWP[a] MBP[b]: 4,0 × MWP
Impulse test conditions	55 °C 1,0 x MWP[b] 20 000 cycles	55 °C 1,33 × MWP[b] 200 000 cycles
	See Figure 5	See ISO 19718:—, Figure 5

[a] MWP = Maximum working pressure

[b] MBP = Minimum burst pressure

Annex B
(normative)

Test frequency

Table B.1 gives the frequency of testing for type tests and routine tests (see Clause 9 for description of these tests).

Table B.1 — Test frequency

Property	Type test	Routine test
Compound test		
Oil resistance test for cover	X	N/A
Oil resistance test for lining	X	N/A
Hose test		
Visual examination (inside and outside)	X	X
Measurement of inside diameter	X	X
Measurement of outside diameter	X	X
Measurement of outer cover thickness	X	X
Measurement of concentricity	X	X
Proof test	X	X
Burst test	X	N/A
Change in length test	X	X
Cold bending test	X	N/A
Ozone resistance test	X	N/A
Hose assembly test		
Proof test	X	X
Impulse test	X	N/A
Leakage test	X	N/A
Electrical conductivity (Grade 2 only)	X	N/A
NOTE X = Test carried out; N/A = Not applicable.		