BS EN 854:2015

BSI Standards Publication

Rubber hoses and hose assemblies — Textile reinforced hydraulic type — Specification

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National foreword

This British Standard is the UK implementation of EN 854:2015. It supersedes BS EN 854:1997 which is withdrawn.

BSI, as a member of CEN, is obliged to publish EN 854 as a British Standard. However, attention is drawn to the fact that during the development of this European Standard, the UK committee voted against its approval as a European Standard.

This is due to concerns about the abrasion test method detailed in Annex A (normative). It is the opinion of the UK committee that the abrasion test method is not reliable and gives inconsistent results.

The UK participation in its preparation was entrusted to Technical Committee PRI/66, Rubber and plastics tubing, hoses and hose assemblies.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

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Gummischläuche und -schlauchleitungen - Hydraulikschläuche mit Textileinlage - Spezifikation

This European Standard was approved by CEN on 31 January 2015.

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Foreword

This document (EN 854:2015) has been prepared by Technical Committee CEN/TC 218 “Rubber and plastics hoses and hose assemblies”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2015 and conflicting national standards shall be withdrawn at the latest by October 2015.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 854:1996.

In comparison with EN 854:1996, the following significant changes have been made:

— updated normative references;

— tolerances for inside diameter in Table 1;

— deleted types R6 and R3;

— added Annex A;

— added Annex B;

— added Annex C.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard specifies requirements for three types of textile reinforced rubber hoses and hose assemblies of nominal bore from 5 to 100. The types are defined in Clause 3.

They are suitable for use with:

— hydraulic fluids in accordance with ISO 6743-4 with the exception of HRD R, HFD S and HFD at temperatures ranging from -40 °C to 100 °C;

— water-based fluids at temperatures ranging from -40 °C to +70 °C;

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

The European Standard does not include requirements for end fittings. It is limited to the performance of hoses and hose assemblies.

NOTE 1 The hoses are not suitable for use with castor oil based and ester based fluids.

NOTE 2 Hoses and hose assemblies are not be operated outside the limits of this standard.

NOTE 3 Requirements for hydraulic hoses for underground mining are standardized in separate standards.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN ISO 1302, *Geometrical Product Specifications (GPS) - Indication of surface texture in technical product documentation (ISO 1302)*

EN ISO 1402:2009, *Rubber and plastics hoses and hose assemblies - Hydrostatic testing (ISO 1402:2009)*

EN ISO 4671, *Rubber and plastics hoses and hose assemblies - Methods of measurement of the dimensions of hoses and the lengths of hose assemblies (ISO 4671)*

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

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

EN ISO 7233, *Rubber and plastics hoses and hose assemblies - Determination of resistance to vacuum (ISO 7233)*

EN ISO 7326, *Rubber and plastics hoses - Assessment of ozone resistance under static conditions (ISO 7326)*

EN ISO 8033:2006, *Rubber and plastics hoses - Determination of adhesion between components (ISO 8033:2006)*

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

ISO 1817:2005, *Rubber, vulcanized - Determination of the effect of liquids*

ISO 23529, *Rubber - General procedures for preparing and conditioning test pieces for physical test methods*

3 Classification

Three types of hose are specified, distinguished by their construction, maximum working pressure and minimum bend radius

— Type 1TE: hoses with a single layer of textile reinforcement;

— Type 2TE: hoses with one or more braid(s) of textile reinforcement;

— Type 3TE: hoses with one or more braid(s) of textile reinforcement (higher maximum working pressure).

NOTE Hose Types 1TE are used or low pressure applications therefore they are not subjected to impulse test and vacuum resistance test.

4 Materials and construction

4.1 Hoses

Hoses shall consist of an oil and water resistant synthetic rubber lining, one or more layers of textile yarn and an oil and weather resistant synthetic rubber cover.

4.2 Hose assemblies

Hose assemblies shall only be manufactured with those hose fittings whose functionality has been verified in accordance with subclauses 6.1, 6.3, 6.4 and 6.5 of this European Standard.

5 Dimensions

5.1 Diameters and concentricity

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

Table 1 — Diameters of hoses

Dimensions in millimetres except nominal bore

Nominal bore	Inside diameter		Outside diameter of hoses					
	All types		Type 1TE		Type 2TE		Type 3TE	
	min.	max.	min.	max.	min.	max.	min.	max.
5	4,9	5,2	10,0	11,6	11,0	12,6	12,0	13,6
6	6,4	6,9	11,6	13,2	12,6	14,2	13,6	15,2
8	7,9	8,4	13,1	14,7	14,1	15,7	16,1	17,7
10	9,5	10,0	14,7	16,3	15,7	17,3	17,7	19,3
12	12,7	13,3	17,7	19,7	18,7	20,7	20,7	22,7
16	15,8	16,5	21,9	23,9	22,9	24,9	24,9	26,9
19	18,8	19,8	-	-	26,0	28,0	28,0	30,0
25	25,4	26,2	-	-	32,9	35,9	34,4	37,4
31	31,8	32,8	-	-	-	-	40,8	43,8
38	38,1	39,1	-	-	-	-	47,6	51,6
51	50,6	51,8	-	-	-	-	60,3	64,3
60	59,6	61,2	-	-	-	-	70,0	74,0
80	79,6	81,2	-	-	-	-	91,5	96,5
100	99,4	101,4	-	-	-	-	113,5	118,5

When measured in accordance with EN ISO 4671, the concentricity of hoses shall conform to Table 2.

Table 2 — Concentricity of hoses

Dimensions in millimetres, except nominal bore

Nominal bore	Maximum variation in wall
	Between inside diameter and outside diameter
Up to and including 6	0,8
Over 6 and including 25	1,0
Over 25	1,3

5.2 Length

5.2.1 Hoses

Hoses shall be supplied in lengths as specified by the purchaser, subject to a tolerance on the specified lengths of ± 2%.

When no specific hose lengths have been ordered, the percentages of different lengths in any given delivery shall be as follows:

— over 20 m : Not less than 80 % of total length;

— over 10 m to 20 m : Not more than 20 % of total length;

— 1 m to 10 m : Not more than 3 % of total length.

The length of hose shall be at least 1 m.

5.2.2 Hose assemblies

The tolerances on the length of hose assemblies shall conform to Table 3.

Table 3 — Tolerances of length of hose assemblies

	Nominal bore		
	Up to and including 25	**Over 25 and including 50**	**Over 50**
Hose assembly length mm	**Tolerance**	**Tolerance**	**Tolerance**
Up to and including 630	+ 7 mm - 3 mm	+ 12 mm - 4 mm	+ 25 mm - 6 mm
Over 630 and including 1 250	+ 12 mm - 4 mm	+ 20 mm - 6 mm	
Over 1 250 and including 2 500	+ 20 mm - 6 mm	+ 25 mm - 6 mm	
Over 2 500 and including 8 000	+ 1,5 % - 0,5 %		
Over 8 000	+ 3 % - 1 %		

6 Requirements

6.1 Hydrostatic requirements

6.1.1 When tested in accordance with EN ISO 1402, the maximum working pressure, the proof pressure and 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 burst pressure

Nominal bore	Maximum working pressure bar [a]			Proof-pressure bar			Burst-pressure bar		
	Type			Type			Type		
	1TE	2TE	3TE	1TE	2TE	3TE	1TE	2TE	3TE
5	25	80	160	50	160	320	100	320	640
6	25	75	145	50	150	290	100	300	580
8	20	68	130	40	136	260	80	272	520
10	20	63	110	40	126	220	80	252	440
12	16	58	93	32	116	186	64	232	372
16	16	50	80	32	100	160	64	200	320
19	-	45	70	-	90	140	-	180	280
25	-	40	55	-	80	110	-	160	220
31	-	-	45	-	-	90	-	-	180
38	-	-	40	-	-	80	-	-	160
51	-	-	33	-	-	66	-	-	132
60	-	-	25	-	-	50	-	-	100
80	-	-	18	-	-	36	-	-	72
100	-	-	10	-	-	20	-	-	40

[a] 1 bar = 0,1 MPa.

6.1.2 When tested in accordance with EN ISO 1402, the change in length of hose at the maximum working pressure shall not exceed + 2 % to - 4 % up to and including nominal bore 31 and 0 % to + 5 % above nominal bore 31.

6.2 Minimum bend radius

When bent to the minimum bend radius given in Table 5 measured on the inside of the bend, the flatness shall not exceed 10 % of the original outside diameter.

Measure the hose outside diameter with a calliper before bending the hose. Bend the hose to the minimum bend radius and measure the flatness with the calliper.

Table 5 — Minimum bend radius

Nominal bore	Minimum bend radius mm		
	Type 1TE	Type 2TE	Type 3TE
5	35	35	40
6	45	40	45
8	65	50	55
10	75	60	70
12	90	70	85
16	115	90	105
19	-	110	130
25	-	150	150
31	-	-	190
38	-	-	240
51	-	-	300
60	-	-	400
80	-	-	500
100	-	-	600

6.3 Impulse test requirements

(Not applicable to type 1TE hoses.)

6.3.1 The impulse test shall be in accordance with EN ISO 6803. The test temperature shall be 100 ˚C.

6.3.2 For type 2TE hoses, when tested at impulse pressure equal to 125 % of the maximum working pressure, the hose shall withstand a minimum of 100 000 impulse cycles.

For type 3TE hoses, when tested at impulse pressure equal to 133 % of the maximum working pressure for hoses of nominal bore up to and including 25 and at 100 % of the maximum working pressure for nominal bore above 25, the hose shall withstand a minimum of 200 000 impulse cycles.

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

6.3.4 This test shall be considered a destructive test and the test piece shall be disposed of in accordance with local environmental guidelines.

6.4 Leakage of hose assemblies

When tested in accordance with EN ISO 1402:2009, 8.4, there shall be no leakage or evidence of failure. This test shall be considered a destructive test and the test piece shall be disposed of in accordance with local environmental guidelines.

6.5 Cold flexibility

When tested in accordance with Method B of EN ISO 10619-2 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 EN ISO 1402 after regaining ambient temperature.

6.6 Adhesion between components

When tested in accordance with EN ISO 8033:2006, the adhesion shall be as follows:

a) Between lining and reinforcement:

   1) up to and including nominal bore 8: min. 1,5 N/mm

   2) over nominal bore 8: min. 2,5 N/mm

b) Between cover and reinforcement:

   1) up to and including nominal bore 8: min. 2,0 N/mm

   2) over nominal bore 8: min. 2,5 N/mm

Test pieces shall be type 5 for lining and reinforcement and type 2 or type 6 for cover and reinforcement as described in Table 1 of EN ISO 8033:2006.

6.7 Vacuum resistance

(Not applicable to type 1TE.)

When tested in accordance with EN ISO 7233, the hoses and hose assemblies shall conform to the values given in Table 6.

Table 6 — Degree of vacuum

<table>
<tr><th rowspan="2">Nominal bore</th><th colspan="2">Negative gauge pressure, bar [a] max.</th></tr>
<tr><th>Type 2TE</th><th>Types 3TE</th></tr>
<tr><td>5</td><td rowspan="5">-0,6</td><td rowspan="5">-0,8</td></tr>
<tr><td>6</td></tr>
<tr><td>8</td></tr>
<tr><td>10</td></tr>
<tr><td>12</td></tr>
<tr><td>16</td><td rowspan="10">-</td><td rowspan="5">-0,6</td></tr>
<tr><td>19</td></tr>
<tr><td>25</td></tr>
<tr><td>31</td><td rowspan="10">-</td></tr>
<tr><td>38</td></tr>
<tr><td>51</td></tr>
<tr><td>60</td></tr>
<tr><td>80</td></tr>
<tr><td>100</td></tr>
<tr><td colspan="3">[a] 1bar = 0,1 MPa.</td></tr>
</table>

6.8 Abrasion resistance

All hose types shall be tested in accordance with Annex A.

For all hose types when tested with a vertical force of (25 ± 0,5) N the loss of mass after 2 000 cycles shall not be greater than 1 g for the average value of three or more test pieces.

6.9 Fluid resistance

6.9.1 Test pieces

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

6.9.2 Oil resistance

When tested in accordance with ISO 1817, the lining immersed in Oil No. 3 for 168 h at a temperature of 100 ˚C shall show no shrinkage and no volume swelling greater than 25 %.

When tested in accordance with ISO 1817, the cover immersed in Oil No. 3 for 168 h at a temperature of 70 ˚C shall show no shrinkage and no volume swelling greater than 100 %.

6.9.3 Water-based fluid resistance

When tested in accordance with ISO 1817, the lining and cover immersed in a test liquid made up of equal volumes of 1,2-ethanediol and distilled water for 168 h at a temperature of 70 ˚C shall show no shrinkage. The volume swelling shall be not greater than 25 % for lining and 100 % for cover.

6.9.4 Water resistance

When tested in accordance with ISO 1817, the lining and cover immersed in distilled water for 168 h at a temperature of 70 °C shall show no shrinkage. The volume swelling shall be not greater than 25 % for lining and 100 % for cover.

6.10 Ozone resistance

The test shall be in accordance with EN ISO 7326, Method 1 or 2, depending on the nominal bore of the hose. There shall be no cracking and no deterioration of the cover visible under x2 magnification.

7 Designation

Hoses shall be designated as the following example:

Designation of a Type 1TE textile reinforced hydraulic hose and a nominal bore of 10:

Hose EN 854 — 1TE 10

8 Marking

8.1 Hoses

Hoses shall be marked at a maximum spacing of 500 mm with at least the following information:

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

b) the number of this European Standard 'EN 854';

c) type, e.g. 1TE;

d) nominal bore, e.g. 16;

e) quarter and last two digits of year of manufacture, e.g. 1Q15.

EXAMPLE XXX/EN 854/1TE/16/1Q15.

NOTE Other information, as agreed between the purchaser and the manufacturer, can be included, if requested.

8.2 Hose assemblies

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

a) Hose assembler’s name or identification, e.g. XXX;

b) maximum working pressure of the assemblies, in bar, e.g. 16;

c) month and last two digits of year of assembly, e.g. 1501.

EXAMPLE XXX/16bar/1501.

NOTE Other information, as agreed between the purchaser and the hose assembler, can be included, if requested.

Annex A
(normative)

Procedure for the measurement of abrasion

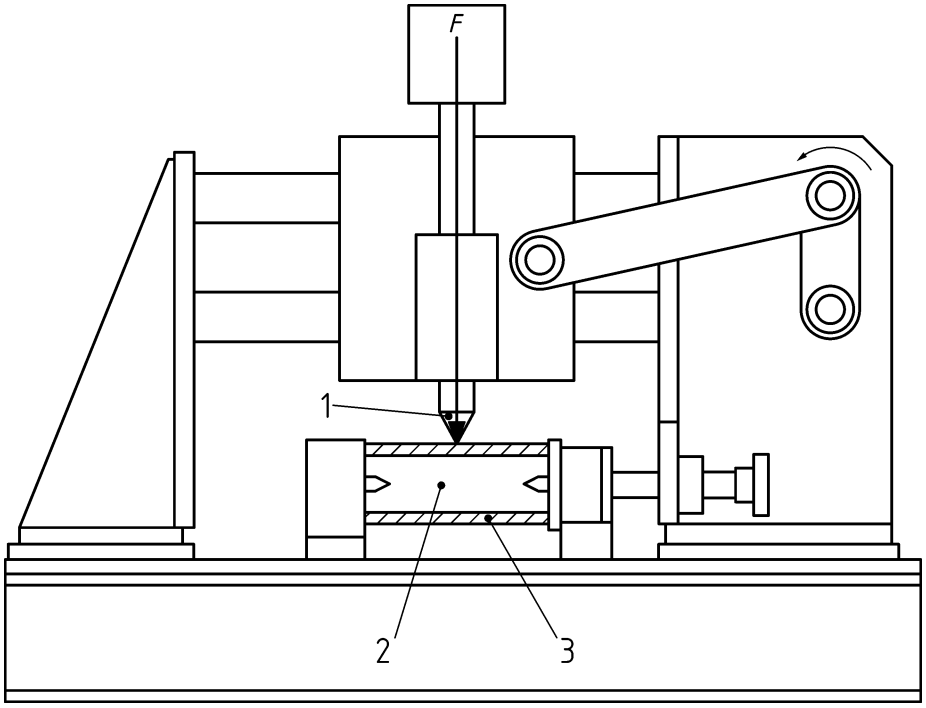
A.1 Apparatus

This method uses an apparatus consisting of a wheel and crank arrangement, capable of moving the abrading tool 100 mm back and forth along the test piece with sinusoidal motion at a rate of 1,25 Hz (one cycle equals 200 mm of travel). A typical arrangement is shown in Figure A.1. The traversing arrangement shall be designed to ensure that:

a) the mid-point of the traversed length is coincident with the mid-point of the assembled hose and mandrel;

b) the axes of the abrading tool and hose are mutually perpendicular at the mid-point;

c) the plane of travel is parallel to the longitudinal axis of the test piece.



Key

1 abrading tool
2 mandrel
3 hose test piece

Figure A.1 — Typical test apparatus

This method requires a recording device, to record the number of cycles completed, and capable of being pre-set to terminate the test after completion of the specified number of cycles.

This method requires means of applying a vertical force *F*, as specified in this product standard, to the abrading tool at the point of contact with the test piece.

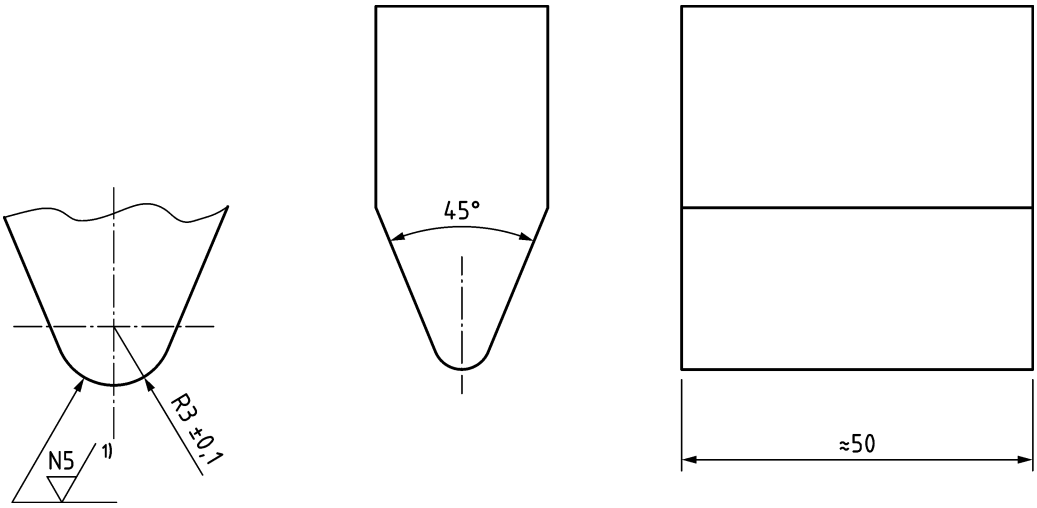
This method requires a mandrel, 150 mm long, on to which the test piece will fit tightly. It is essential that the mandrel is a tight fit in the test piece to prevent distortion of the test piece under the action of the reciprocating abrading tool. For accurate determinations, it is recommended that the mandrel is made of lightweight materials and is of hollow section, so that it is capable of supporting the abrading load but its mass is kept to an absolute minimum. If a solid mandrel is used, this shall be removed prior to weighing the test piece, taking care to avoid loss of material from the hose lining.

A.2 Method

This method uses an abrading tool manufactured from tool steel, heat-treated to give a minimum hardness of HV 890.

The principal dimensions shall be as shown in Figure A.2. It is essential that the specified profile and surface finish are maintained, and that any extraneous material on the surface of the abrading tool is cleaned off before testing is started.

Dimensions in millimeters



[1)] The roughness grade N5 in accordance with EN ISO 1302 corresponds to a roughness value Ra of 0,4 µm.

Figure A.2 — Abrading tool

A.3 Test pieces

Each test piece shall be a sample of hose of length 150 mm ± 0,5 mm. A minimum of three test pieces shall be tested.

NOTE Selection of test pieces is permitted to ensure that there are no surface irregularities greater than 0,5 mm and that they are free from surface contamination.

A.4 Condition of test pieces

No test shall be carried out within 24 h of manufacture. For evaluations which are intended to be comparable, the test shall, as far as possible, be carried out after the same time interval after manufacture. Before testing,

test pieces shall be conditioned for at least 3 h at the standard temperature and humidity of 23 °C ± 2 °C and (50 ± 5) % relative humidity or 27 °C ± 2 °C and (65 ± 5) % relative humidity, in accordance with ISO 23529; this 3 h period may be part of the 24 h interval after manufacture.

A.5 Procedure

Weigh each test piece on or off the mandrel and record the mass ($m1$). Mount the assembled test piece and mandrel in the apparatus, ensuring that the test piece is restrained from axial and/or rotational movement. Place the abrading tool in contact with the test piece, apply the vertical static force F as specified in this product standard, and start the machine. Continue until the specified number of cycles has been completed, then remove the test assembly from the apparatus and reweigh the test piece, either on or off the mandrel, as for the initial weighing. It is important to remove any loose particles of cover compound prior to weighing. Record the mass ($m2$) and the number of cycles completed.

For guidance in preparing requirements in product standards, the static force should be 50 N or 100 N, the latter being selected where higher abrasion resistance if the cover is expected. If it becomes evident during the test that wear has taken place to an extent that the reinforcement is exposed, stop the test, remove the test assembly from the apparatus and reweigh. Record the mass and the number of cycles completed. All weighings shall be carried out to an accuracy of ± 0,01 g.

A.6 Expression of results

The loss of mass Δm, in grams, is given by the formula:

$$\Delta m = m1 - m2$$

where

$m1$ is the mass, in grams, of the test piece before testing;

$m2$ is the mass, in grams, of the test piece after testing.

A.7 Test report

The test report shall include the following information:

a) a reference to this European Standard;

b) a full description of the hose tested;

c) the temperature at which the test was carried out;

d) the number of cycles specified;

e) the number of cycles completed on each test piece;

f) the vertical static force F applied;

g) the mass of each test piece before the test;

h) the mass of each test piece after completion of the specified number of cycles or after discontinuation of the test;

i) the loss of mass from each test piece;

j) the average loss in mass of the three (or more) test pieces;

k) any observations on the nature of wear, particularly any evidence of exposure of reinforcement;

l) the date of the test.

Annex B
(normative)

Type and routine testing of production hoses

Property	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 prior to warehousing or sale
Dimensions		
Measurement of inside diameter	X	X
Measurement of outside diameter	X	X
Measurement of outer cover thickness (if applicable – see Table 1)	X	N/A
Measurement of concentricity	X	N/A
Hose tests		
Proof test	X	X
Burst test	X	N/A
Minimum bend radius test	X	N/A
Change in length test (see 6.1.2)	X	X
Impulse test	X	N/A
Leakage test (hose assemblies)	X	N/A
Cold flexibility test	X	N/A
Adhesion (cover)	X	N/A
Adhesion (lining)	X	N/A
Vacuum resistance test	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
Visual examination	X	X
X Test shall be carried out. N/A Test not applicable.		

Annex C
(informative)

Production acceptance testing

Property	Productions tests	
	Frequency: every 3 000 m produced of each hose type and size	Frequency: every 12 months of production for each hose type and size
Dimensions		
Measurement of inside diameter	X	X
Measurement of outside diameter	X	X
Measurement of outer cover thickness (if applicable – see Table 1)	X	X
Measurement of concentricity	X	X
Hose tests		
Proof test	X	X
Burst test	X	X
Minimum bend radius test	N/A	X
Change in length test (see 6.1.2)	X	X
Impulse test	N/A	X
Leakage test (hose assemblies)	N/A	X
Cold flexibility test	N/A	X
Adhesion (cover)	N/A	X
Adhesion (lining)	N/A	X
Vacuum resistance test	N/A	X
Fluid resistance test for cover	N/A	X
Fluid resistance test for lining	N/A	X
Ozone resistance test	N/A	X
Visual examination	X	X

X Test shall be carried out.

N/A Test not applicable.

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