International Standard 1402

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Rubber and plastics hoses and hose assemblies — Hydrostatic testing

Tuyaux et flexibles en caoutchouc et en plastique — Essais hydrostatiques

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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

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Rubber and plastics hoses and hose assemblies — Hydrostatic testing

1 Scope and field of application

This International Standard specifies methods for the hydrostatic testing of rubber and plastics hoses and hose assemblies, including methods for the determination of dimensional stability.

2 References

ISO 471, *Rubber — Standard temperatures, humidities and times for the conditioning and testing of test pieces.*

ISO 4671, *Rubber and plastics hoses and hose assemblies — Methods of measurement of dimensions.*[1]

ISO 7751, *Rubber and plastics hoses and hose assemblies — Ratios of proof and burst pressure to design working pressure.*

3 General

Unless otherwise specified, all tests shall be carried out at standard laboratory temperature (see ISO 471).

4 Apparatus

4.1 Pressure source, capable of applying pressure at the rate specified in 6.2.2, up to the required test pressure.

4.2 Calibrated pressure gauges, chosen for each test so that the test pressure is between 15 % and 85 % of the full-scale reading.

NOTE — In the interest of accuracy, calibrated pressure gauges should be checked at frequent intervals and the fitting of restrictors is recommended to minimize shock damage.

4.3 Sliding vernier callipers or **micrometer,** and **measuring tape.**

5 Test pieces

5.1 Hose assemblies

When hose assemblies are to be tested, the manufactured length shall be used for the test.

5.2 Hoses

5.2.1 Proof pressure test

The proof pressure test may be carried out on a test piece or on a manufactured length. The minimum length of the test pieces shall be 0,75 m when deformation is to be measured, and 0,5 m when it is not.

5.2.2 Burst test

The burst test should be carried out on a test piece having a free length excluding end fittings and end reinforcements of preferably 1 m and in no case less than 0,35 m.

5.3 Number of test pieces

At least two test pieces shall be tested.

6 Application of hydrostatic pressure

6.1 General

Water or another liquid suitable for the hose under test shall be used as the test medium.

WARNING — The use of air and other gaseous materials as testing media should be avoided because of the risk to operators. In special cases, where such media are re-

1) At present at the stage of draft.

quired for the tests, strict safety measures are imperative. Furthermore, it is stressed that when a liquid is used as the test medium, it is essential that all air is expelled from the test piece because of the risk of injury to the operator due to the sudden expansion of trapped air released when the hose bursts.

6.2 Procedure

6.2.1 Fill the test piece with test liquid, expelling all air, and connect to test equipment. Close the valve and apply the hydrostatic pressure at a uniform rate of increase. Measure the pressure using a calibrated pressure gauge (4.2).

NOTE — It is important to allow unrestricted movement of the free- or plugged end of the test piece during the test.

6.2.2 The rate of pressure increase shall be

a) between 0,075 and 0,175 MPa/s for hoses having burst pressures up to 12,5 MPa;

b) between 0,35 and 1,0 MPa/s for hoses having burst pressures greater than 12,5 MPa.

A higher constant rate of pressure increase shall be used when the test pressure is above 40 MPa, in order that the final pressure is reached within 120 s.

NOTE — If these rates are not attainable, the interested parties should agree, in advance, upon a suitable rate.

7 Hydrostatic pressure tests — Excluding hydraulic hoses

7.1 Proof pressure hold test

When proof pressure tests are used to determine leakage of hoses or couplings, apply the proof pressure in accordance with 6.2.2 and hold it for not less than 30 s or more than 60 s, examining the test piece during this period for evidence of leakage, cracking, abrupt distortion indicating irregularity in material or manufacture, or other signs of failure.

Unless otherwise specified for the hose, the proof pressure shall be related to the design working pressure by the ratio given in ISO 7751.

NOTE — The test is not applicable on curved hose.

7.2 Measurement of deformation under working pressure

7.2.1 General procedure

When tests for determining change in length, change in external diameter and twisting are required, straighten the hose, lay it out horizontally for inspection and apply a hydrostatic pressure of 0,07 MPa. Make three reference marks (A, B and C) on the outer surface of the hose, the middle mark B being made approximately midway along the length of the hose, and the two outer marks (A and C) being 0,25 m from B. Each mark shall consist of an arc of the circumference of the hose through which is drawn a straight line perpendicular to the arc, the three straight lines being collinear (see figure 1).

Maintain the initial pressure of 0,07 MPa and make the appropriate measurements (see 7.2.2, 7.2.3 and 7.2.4) at the reference marks.

Apply the specified working pressure at the rate specified in 6.2.2 and maintain for 1 min before making the test measurements, which shall then be made as quickly as possible to avoid prolonging the test period.

7.2.2 Change in length

Measure the length between the two outermost reference marks (A and C) with an accuracy of ± 1 mm, using the measuring tape (4.3), at the initial pressure (0,07 MPa) and at the test pressure.

The change in length, Δl, expressed as a percentage of the original length, is given by the formula

$$\Delta l = \frac{l_1 - l_0}{l_0} \times 100$$

where

l_0 is the distance between the two outermost reference marks (A and C), measured under a pressure of 0,07 MPa;

l_1 is the distance between the same two reference marks, measured at the proof test pressure.

NOTE — Δl will be positive in the case of an increase in length and negative in the case of a decrease in length.

7.2.3 Change in external diameter

7.2.3.1 General

The external diameter should preferably be determined from measurements of circumference made with an accuracy of 1 mm using the measuring tape (see ISO 4671). The measurements may, however, be made directly, using sliding vernier calipers having a minimum useful tip width of 5 mm.

7.2.3.2 Determination by measuring the change in external circumference

Using the measuring tape (4.3), measure the circumference at each of the three reference marks (A, B and C) at the initial pressure (0,07 MPa) and at the test pressure.

The change in diameter ΔD, expressed as a percentage of the original diameter, is given by the formula

$$\Delta D = \frac{\Sigma C_1 - \Sigma C_0}{\Sigma C_0} \times 100$$

where

ΣC_0 is the sum of the circumferences at the three reference marks, measured under a pressure of 0,07 MPa;

ΣC_1 is the sum of the circumferences at the three reference marks, measured at the test pressure.

NOTE — ΔD will be positive in the case of an increase in diameter and negative in the case of a decrease in diameter.

7.2.3.3 Direct measurement of change in external diameter

Using the sliding vernier calipers (4.3) measure two perpendicular diameters at each of the three reference marks at the initial pressure (0,07 MPa) and at the test pressure.

The change in diameter ΔD, expressed as a percentage of the original diameter, is given by the formula

$$\Delta D = \frac{\Sigma D_1 - \Sigma D_0}{\Sigma D_0} \times 100$$

where

ΣD_0 is the sum of the six diameters measured at the reference marks under a pressure of 0,07 MPa;

ΣD_1 is the sum of the six diameters measured at the reference marks at the test pressure.

NOTE — ΔD will be positive in the case of an increase in diameter and negative in the case of a decrease in diameter.

7.2.4 Twisting

If twisting of the hose develops under pressure, the original lines forming the reference marks will take up a helical pattern (see figure 2).

With the hose at the test pressure, project the straight line in the length of the hose at reference mark A until it intersects, at C', the circular arc at reference point C.

Then measure the length D of the circular arc CC' to the nearest millimetre using the measuring tape (4.3).

The amount of twisting per metre, T, expressed in radians, is given by the formula

$$T = \frac{D \times 2\pi}{C_C \times l_0}$$

where

C_C is the circumference at reference mark C, measured as described in 7.2.3.1;

l_0 is the distance between A and C as measured in 7.2.2.

Report the twisting line (right or left twisting).

7.2.5 Warping

Warping in hose tests is the deviation from a straight line drawn from fitting to fitting in a plane parallel to the surface on which the hose rests. The amount of warping is the maximum deviation of any portion of the hose from a straight line drawn from centre to centre of the fittings. Express warping as the distance from this line to the centre line of the hose at the point of maximum deviation. A tightly stretched cord may be used to establish the straight line from centre to centre of the fittings. Report the results to the nearest 5 mm.

7.3 Burst pressure test

7.3.1 Procedure

Increase the pressure at a rate in accordance with 6.2.2 until the specified minimum burst pressure is reached or until the hose bursts, which ever is required. If the test is discontinued before bursting occurs, the sample shall be destroyed.

7.3.2 Failure criteria

When testing hose assemblies, failure caused by blowing off of couplings or by bursts within 25 mm of the fittings shall not be interpreted as a true hose burst or be recorded as such in the test report.

When testing test pieces of hose, failures occuring within 25 mm of the end fittings, or within a distance equal to the external diameter of the hose, whichever is the greater, shall be discounted and the test shall be repeated.

8 Hydrostatic pressure tests — Hydraulic hoses

Tests shall be carried out as described in clauses 3 to 7, with the following exceptions:

a) the minimum test piece length for the measurement of deformation shall be 300 mm;

b) before making the reference marks, the pressure shall be increased to the specified working pressure, held for 30 to 120 s, and then reduced to zero;

c) the reference marks shall be no closer to an end fitting than a distance equal to twice the nominal bore.

NOTE — It is not normally necessary to test hydraulic hoses for change in external diameter, twisting or warping.

9 Burst pressure test

Tests shall be carried out as described in clauses 3, 4, 5, 6 and 8, with the following exceptions:

a) a minimum test piece length shall be 300 mm;

b) the rate of pressure increase shall be such that the specified burst pressure is reached in not more than 60 s.

10 Test report

The test report shall include the following particulars

a) a full description of the hose tested;

b) a reference to this International Standard, i.e. ISO 1402;

c) the method used;

d) the number of test pieces tested and the length of each test piece;

e) the test pressure and rate of pressure increase;

f) the test medium (if other than water);

g) the results obtained for each test piece;

h) if the test piece fails, the position and mode of failure;

j) the twisting line (right or left twisting);

k) any unusual features noted during the test;

m) date of test.

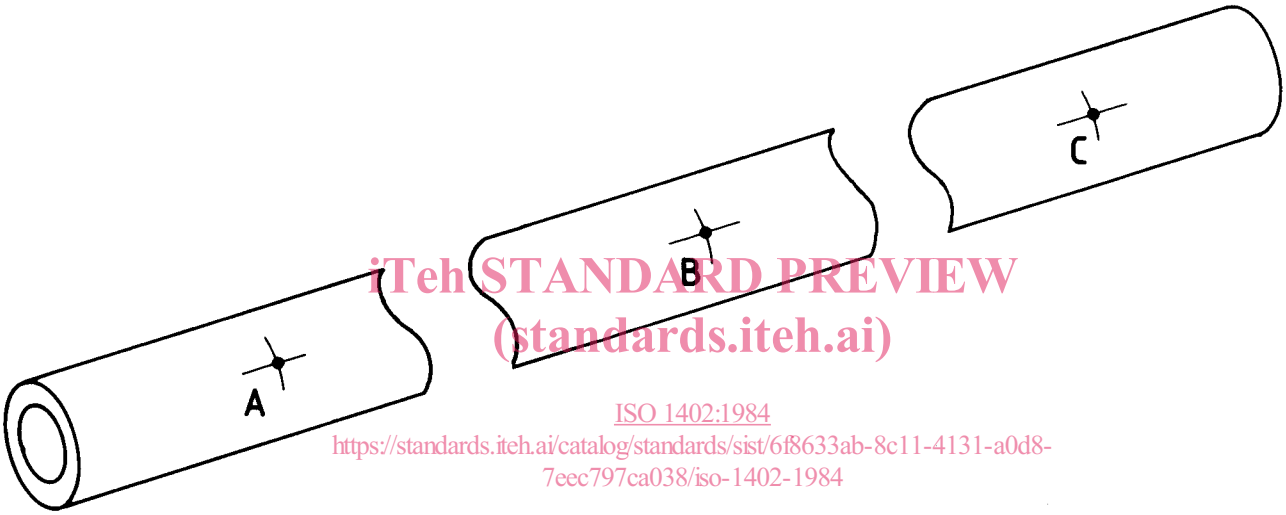

Figure 1 — Measurement of dimensional stability

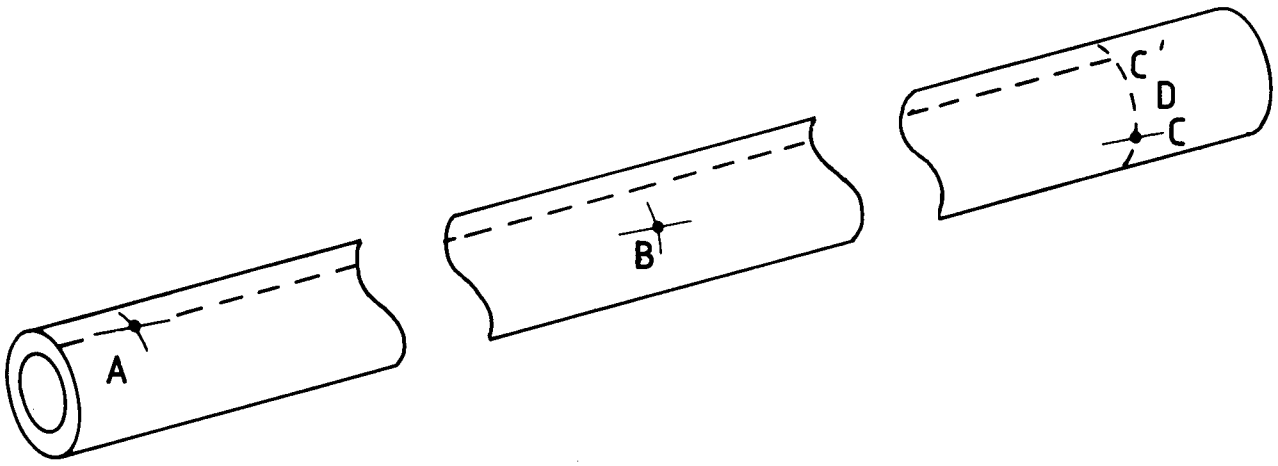

Figure 2 — Measurement of amount of twisting