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Rubber and plastics hoses and hose assemblies — Determination of resistance to vacuum

Tuyaux et flexibles en caoutchouc et en plastique — Détermination de la résistance à l'aspiration

Reference number
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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.

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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 1, *Rubber and plastics hoses and hose assemblies*.

This fourth edition cancels and replaces the third edition (ISO 7233:2006), which has been technically revised with the following changes:

— Clause 11 has been re-written to clarify further on the minor axis measurement (D_2 and D_3) as shown in the new Figure 2; as well as addition of a paragraph for examining interior and exterior of the hose;

— Clause 12 f) has been re-written to include the observation that needs to be made for method C.

Introduction

Vacuum testing is applied to hoses to determine whether they will withstand the differential pressure encountered in service resulting from reduced pressure within the hose.

Rubber and plastics hoses and hose assemblies — Determination of resistance to vacuum

1 Scope

This document specifies three methods for determining the resistance to vacuum of hoses and hose assemblies manufactured from plastic or rubber. Applicable dimensions of hoses for each method are as follows:

— method A for hoses of nominal bore up to and including 80 mm;

— method B for hoses of nominal bore greater than 80 mm;

— method C for hoses of all dimensions.

Methods A and B can also be used to check the adhesion of the lining to the reinforcement (delamination) in a length of hard-wall hose or hose assembly.

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 4671:2007, *Rubber and plastics hoses and hose assemblies — Methods of measurement of the dimensions of hoses and the lengths of hose assemblies*

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

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:

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

— ISO Online browsing platform: available at http://www.iso.org/obp

4 Principle

The test methodology for determining the resistance to vacuum of plastic and rubber hoses and hose assemblies consists of reducing the internal pressure in a length of hose by means of a vacuum pump and gauge, while examining the hose for any signs of deformation or delamination of reinforcement or lining.

5 Apparatus

5.1 Vacuum pump, provided with a gauge and capable of reducing the internal pressure in the hose within 60 s to the pressure specified in the product standard for the hose under test and maintaining it at that pressure for a minimum of 10 min.

5.2 Smooth, solid ball (for method A), with a diameter equal to 0,9 times the bore of the hose under test, rounded down to the nearest whole millimetre.

5.3 Two transparent airtight plates (for method B), for sealing each end of the hose. One of the plates shall permit attachment of the vacuum pump to the hose, while allowing internal visual inspection of the hose during the test.

6 Test pieces

If the complete hose or hose assembly is more than 1 m long, each test piece shall consist of a minimum length of hose, clear of the end fittings, of 1 m. If the complete hose or hose assembly is less than 1 m long, the complete length shall be used.

7 Conditioning of test pieces

No tests shall be carried out within 24 h of manufacture. Test pieces shall be conditioned at the appropriate temperature in accordance with ISO 23529 for at least 3 h before testing.

This 3 h period may form part of the minimum period of 24 h between manufacture and testing.

8 Test pressure

The internal pressure to which the hose is subjected to for the duration of the test shall be that stated in the product standard for the hose under test as being the minimum internal pressure which the hose is required to withstand.

9 Procedure (method A)

Lay out the hose as straight as possible on a flat surface and blank off one end to form an airtight seal. Insert into the hose a smooth, solid ball (5.2) and then connect the open end of the hose to a vacuum pump and gauge. Reduce the pressure in the hose within 60 s to the required test pressure and maintain this pressure for the required period, which shall not be less than 10 min.

While the test pressure is being maintained, examine the hose externally for any signs of indentation or collapse and then tilt the hose to permit the solid ball to traverse the full length of the hose to check for any obstructions caused by internal deformation or delamination.

10 Procedure (method B)

Lay out the hose as straight as possible on a flat surface and fit transparent airtight plates (5.3) to both ends of the hose, one of which shall then be connected to a vacuum pump and gauge. Reduce the pressure in the hose within 60 s to the required test pressure and maintain this pressure for the required period, which shall not be less than 10 min.

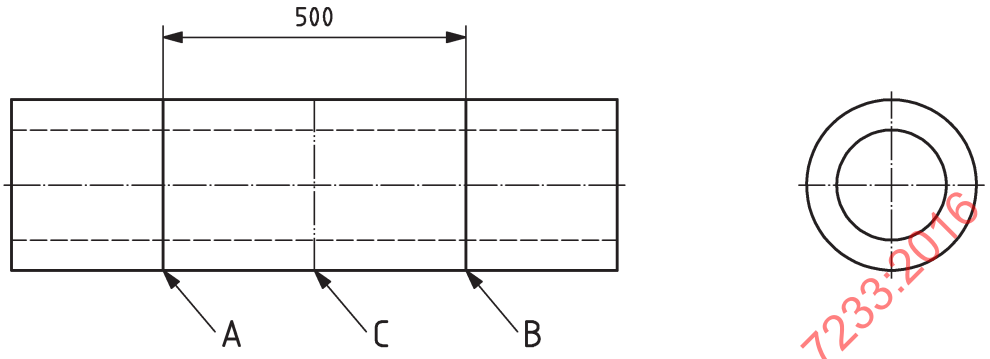
While the test pressure is being maintained, examine the interior of the hose through one of the transparent plates by means of illumination supplied through the transparent plate at the other end of the hose for signs of delamination or blistering of the lining. Also examine the exterior of the hose for signs of indentation or collapse.

11 Procedure (method C)

Lay out the hose as straight as possible on a flat surface, blank off one end to form an airtight seal, and connect the other end to a vacuum pump and gauge.

Before reducing the pressure in the hose, mark two lines (lines A and B), equidistant from the centre and 500 mm apart, round the hose (see Figure 1). Then, mark a third line (line C) round the hose at a point between lines A and B. Measure the average outside diameter of the hose round line C in accordance with the method specified in ISO 4671:2007, 5.2.

Dimensions in millimetres

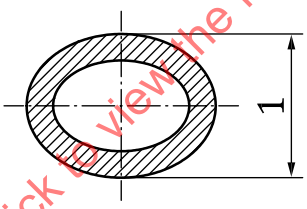


Key

A, B lines marked on test piece for measurement of change in length

C line marked on test piece for measurement of change in outside diameter

Figure 1 — Marking measurement lines on test piece



Key

1 minor axis (D_2, D_3)

Figure 2 — Minor axis of a deformed test piece

Reduce the pressure in the hose to the required test pressure and maintain this pressure for the required period, which shall not be less than 10 min. After 10 min or the required test period (whichever is greater) and before releasing the pressure, measure the distance between lines A and B, as well as the minor axis, D_2, (see Figure 2) round line C, as before.

Release the pressure and, after 10 min, measure, for a third time, the distance between lines A and B and the minor axis, D_3, round line C.

After releasing the pressure, examine the interior of the hose for signs of delamination or blistering of the lining. Also examine the exterior of the hose for signs of indentation or collapse.

The percentage change in the length of the hose, ΔL, before and after releasing the pressure is given by Formula (1) and Formula (2):

$$\Delta L_t = \left(\frac{L_2 - L_1}{L_1} \right) \times 100 \quad (1)$$

$$\Delta L_p = \left(\frac{L_3 - L_1}{L_1} \right) \times 100 \quad (2)$$

where

ΔL_t is the temporary length change (before releasing the pressure);

ΔL_p is the permanent length change (after releasing the pressure);

L_1 is the distance between lines A and B before reducing the pressure, in millimetres;

L_2 is the distance between lines A and B before releasing the pressure, in millimetres;

L_3 is the distance between lines A and B after releasing the pressure, in millimetres.

The percentage change in the outside diameter of the hose, ΔD, before and after releasing the pressure is given by Formula (3) and Formula (4):

$$\Delta D_t = \left(\frac{D_2 - D_1}{D_1} \right) \times 100 \quad (3)$$

$$\Delta D_p = \left(\frac{D_3 - D_1}{D_1} \right) \times 100 \quad (4)$$

where

ΔD_t is the temporary outside diameter change (before releasing the pressure);

ΔD_p is the permanent outside diameter change (after releasing the pressure);

D_1 is the average outside diameter of the hose before reducing the pressure, in millimetres;

D_2 is the minor axis of the hose before releasing the pressure, in millimetres;

D_3 is the minor axis of the hose after releasing the pressure, in millimetres.

12 Test report

The test report shall contain the following information:

a) the number and year of publication of this document, i.e. ISO 7233:2016;

b) a full description of the hose tested;

c) the method of test used;

d) the internal test pressure applied, expressed in bars below atmospheric pressure;

NOTE 1 bar = 0,1 MPa.

e) the period for which the test pressure was applied;

f) observations on the behaviour of the hose during the test, including any external signs of indentation or collapse and, if method A was used, whether or not the ball traversed the full length of the test piece or, if method B or C was used, whether or not lining delamination or blistering was observed;

g) if method C was used, the percentage change in the length (temporary and permanent) of the hose when the pressure was reduced and after the pressure was released;

h) if method C was used, the percentage change in the outside diameter (temporary and permanent) of the hose when the pressure was reduced and after the pressure was released;

i) the date of the test.