
**Rubber-covered rollers —
Determination of apparent
hardness —**

**Part 3:
Pusey and Jones method**

*Cylindres revêtus de caoutchouc — Détermination de la dureté
apparente —*

Partie 3: Méthode Pusey et Jones



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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 voluntary nature of standards, 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.

This document was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 2, *Testing and analysis*.

This fourth edition cancels and replaces the third edition (ISO 7267-3:2011), of which it constitutes a minor revision to update the normative references in [Clause 2](#).

A list of all parts in the ISO 7267 series can be found on the ISO website.

Introduction

The hardness of a roller covering has traditionally been determined on the finished roller, since it is this hardness that is critical to the correct functioning of the roller in its end application. Values of hardness, determined by whichever method is chosen, are therefore dependent not only on the method employed and on the rubber, but also on the diameter of the roller, on the thickness of the covering and, in the case of thin coverings, on the nature of the roller core. For this reason the term “apparent hardness” is used to distinguish between the values obtained by the methods described in the various parts of this document and those that would be obtained for the rubber if it was possible to use the standard test methods for standard test pieces forming the subjects of other International Standards.

Since rollers vary considerably in size, construction and end use, and in view of the fact that hardness determinations are made for such different purposes as specification and factory process control, it has not been possible to standardize one test method. Consequently, three methods are described in the ISO 7267 series, each capable of standing alone.

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Rubber-covered rollers — Determination of apparent hardness —

Part 3: Pusey and Jones method

WARNING 1 — Persons using this document should be familiar with normal laboratory practice. This document does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to determine the applicability of any other restrictions.

WARNING 2 — Certain procedures specified in this document might involve the use or generation of substances, or the generation of waste, that could constitute a local environmental hazard. Reference should be made to appropriate documentation on safe handling and disposal after use.

1 Scope

This document specifies a method for the determination of the apparent hardness of vulcanized- or thermoplastic-rubber roller covers, expressed as the Pusey and Jones indentation value.

The Pusey and Jones plastometer apparatus is used to measure the depth of indentation of an indenter under a specified force into the surface of the rubber. The indentation value should not be confused with hardness as measured by the international rubber hardness test method ISO 48, [1] since in this method the rubber immediately adjacent to the indenter is precompressed. The Pusey and Jones indentation value is an inverse measurement of hardness, i.e. the harder the rubber the lower the Pusey and Jones indentation value.

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 18899:2013, *Rubber — Guide to the calibration of test equipment*

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 following terms and definitions 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/>

3.1

Pusey and Jones indentation value

depth of indentation of a ball 3,175 mm in diameter under a force of 9,8 N

Note 1 to entry: It is expressed in hundredths of a millimetre.

4 Time-interval between vulcanization/finished grinding and testing

Tests shall be carried out not less than 16 h after vulcanization and/or finished grinding and, for arbitration purposes, not less than 72 h after vulcanization (see ISO 23529).

5 Conditioning and temperature of test

Where possible, the test shall be carried out at standard laboratory temperature in accordance with ISO 23529. The product under test should be maintained under the test condition for sufficient time to reach temperature equilibrium with the test environment. Where this is impracticable, the period of time and the conditions shall be given in the product specification (see the Note).

The same temperature shall be used throughout any one test or series of tests intended to be comparable.

NOTE For large rollers having heavy metal cores, ambient conditions might not allow equilibrium temperatures to be obtained.

6 Apparatus

6.1 Plastometer, consisting of a supporting frame, an indenter, a mass for applying a fixed gravitational force on the indenter, a depth indicator and a specimen holder.

6.1.1 Supporting frame, so configured that the indenter and mass can be independently raised or lowered vertically, permitting the indenter to rest on the surface of the test roller and the mass to be applied subsequently to the indenter.

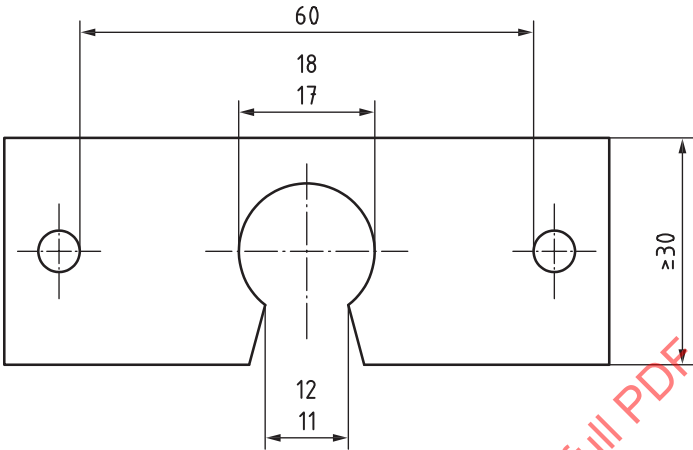
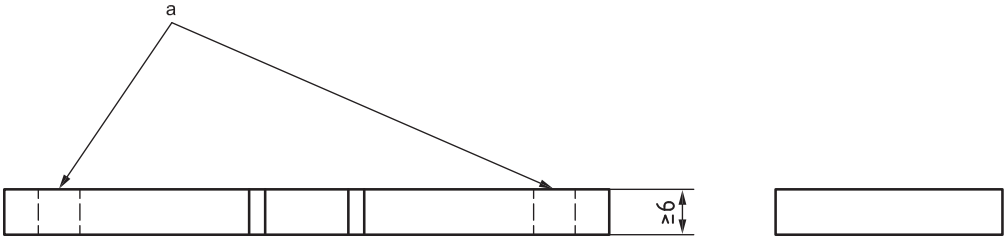
6.1.2 Indenter, consisting of a vertical steel shaft attached at the upper end to the spindle of the indicator gauge and having at the lower end a steel ball. The steel ball shall be $(3,175 \pm 0,015)$ mm in diameter and shall be made of highly polished, non-corrosive hard metal properly treated to resist wear.

6.1.3 Mass, of $(1\,000 \pm 2)$ g.

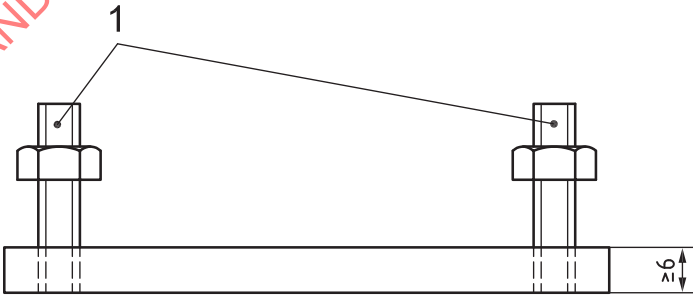
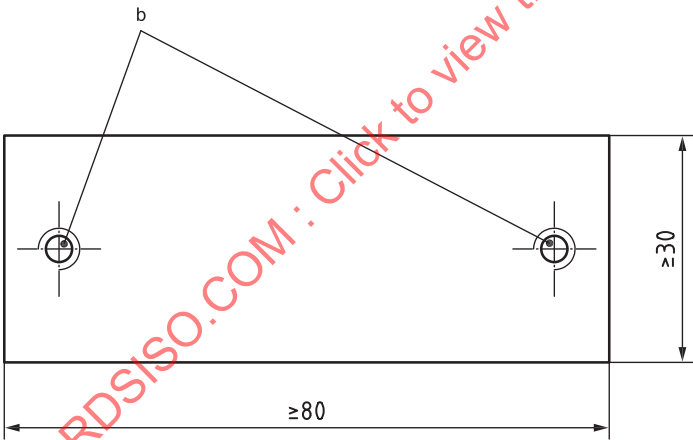
6.1.4 Depth indicator, comprising a dial gauge or other suitable device graduated in increments of 0,01 mm and having a range of at least 3 mm to indicate the movement of the indenter.

6.1.5 Specimen holder, consisting of a clamp made of two metal plates held together by two threaded bolts as shown in [Figure 1](#). The purpose of the clamp is to hold the test roller flat and free from slight movements that might introduce variations into the test. The top plate shall be provided with a hole and slot for the operation of the indenter.

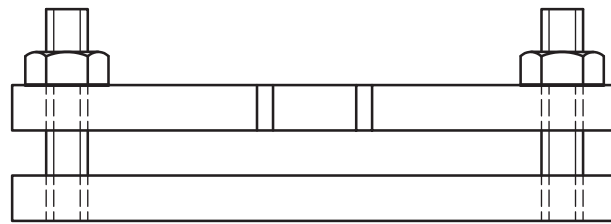
Dimensions in millimetres



a) Top plate



b) Bottom plate



c) Assembled view

Key

- 1 threaded bolts
- a Drill to clear stud bolts.
- b Tap for stud bolts.

Figure 1 — Holder for test specimen

7 Calibration

The test apparatus shall be calibrated in accordance with [Annex A](#).

8 Procedure

8.1 Firmly position the roller to be tested with its major axis horizontal and with the area in which the hardness is to be measured uppermost. Place the plastometer (6.1), with the axis of the indenter (6.1.2) vertical, on the roller over the position where the hardness is to be measured and lower the indenter into contact with the roller surface and until the gauge needle of the depth indicator (6.1.4) makes three revolutions. Adjust the dial gauge to read zero. Apply the indenting force by lowering the supporting frame (6.1.1) so that the mass (6.1.3) rests fully on the indenter as shown by a space of approximately 5 mm between the supporting plate and the shoulder of the mass tube. Read the amount of indentation on the gauge 60 s after the application of the force.

8.2 Make three measurements, at different points at least 6 mm apart, within each test area in which the hardness is to be determined.

NOTE Several test areas along the length and around the circumference of the roller might be required to determine the average hardness of the covering and the hardness variation over a single roller (see ISO 6123-1[2]).

9 Expression of results

Express the apparent hardness as the median of three measurements for each test area, reported to the nearest whole number as the Pusey and Jones indentation value.

10 Test report

The test report shall include the following information:

- a) a full description of the roller and its origin;
- b) a full reference to the test method used, i.e. the reference number of this document (ISO 7267-3);
- c) test details:
 - 1) the time and temperature of conditioning prior to test,

- 2) the temperature of test, if other than a standard laboratory temperature, and the relative humidity if necessary,
 - 3) details of any procedures not specified in this document;
- d) test results:
- 1) the number of areas or rollers tested,
 - 2) the individual test results,
 - 3) the apparent hardness, expressed as the Pusey and Jones indentation value (see [Clause 9](#));
- e) the date of the test.

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Annex A (normative)

Calibration schedule

A.1 Inspection

Before any calibration is undertaken, the condition of the items to be calibrated shall be ascertained by inspection and recorded on any calibration report or certificate. It shall be reported whether calibration is carried out in the “as-received” condition or after rectification of any abnormality or fault.

It shall be ascertained that the apparatus is generally fit for the intended purpose, including any parameters specified as approximate and for which the apparatus does not therefore need to be formally calibrated. If such parameters are liable to change, then the need for periodic checks shall be written into the detailed calibration procedures.

A.2 Schedule

Verification or calibration of the test apparatus is a mandatory part of this document. However, the frequency of calibration and the procedures used are, unless otherwise stated, at the discretion of the individual laboratory, using ISO 18899 for guidance.

The calibration schedule given in [Table A.1](#) has been compiled by listing all of the parameters specified in the test method, together with the specified requirement. A parameter and requirement can relate to the main test apparatus, to part of that apparatus or to an ancillary apparatus necessary for the test.

For each parameter, a calibration procedure is indicated by reference to ISO 18899, to another publication or to a procedure particular to the test method which is detailed (whenever a calibration procedure which is more specific or detailed than that in ISO 18899 is available, it shall be used in preference).

The verification frequency for each parameter is given by a code-letter. The code-letters used in the calibration schedule are:

- C requirement to be confirmed, but no measurement;
- N initial verification only;
- S standard interval as given in ISO 18899.

Table A.1 — Calibration frequency schedule

Parameter	Requirement	Subclause in ISO 18899:2013	Verification frequency guide
Plastometer	As specified in 6.1	C	N
Supporting frame	As specified in 6.1.1	C	N
Indentor	Polished steel ball, diameter 3,175 mm ± 0,015 mm	15.2	S
Mass	1 000 g ± 2 g	22.2	S
Depth indicator	Range of 3 mm graduated in 0,01 mm	15.1	S
Specimen holder	As specified in 6.1.5	C	N