# GB

NATIONAL STANDARD OF THE

PEOPLE'S REPUBLIC OF CHINA

ICS 61.060

CCS Y 78

# GB/T 26703-2021

Replace GB/T 26703-2011

# Determination of abrasion resistance for top piece of leather shoes

皮鞋跟面耐磨性能试验方法

**Issued on: October 11, 2021** **Implemented on: May 1, 2022**

**Issued by: State Administration for Market Regulation;**
**Standardization Administration of PRC.**

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# Determination of abrasion resistance for top piece of leather shoes

## 1 Scope

This document describes two test methods (Method A and Method B) for evaluating the abrasion resistance of the Top Piece of leather shoes. Method A is the method by using a rotating cylindrical drum device. Method B is the method by using a reciprocating abrasion machine.

This document applies to the Top Piece of leather shoes for general use (hereinafter referred to as “the Top Piece”).

## 2 Normative references

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) is applicable to this standard.

GB/T 533-2008 Rubber, vulcanized or thermoplastic -- Determination of density

GB/T 2703-2017 Footwear -- Vocabulary

ISO 4649:2017 Rubber, vulcanized or thermoplastic -- Determination of abrasion resistance using a rotating cylindrical drum device

## 3 Terms and definitions

Terms and definitions defined in GB/T 2703-2017 are applicable to this document.

## 4 Test equipment and materials

### 4.1 Method A - using a rotating cylindrical drum device

#### 4.1.1 Rotating cylindrical drum device

The abrasion machine shall comply with the requirements of 5.1 in ISO 4649:2017; a non-rotating gripper shall be used.

# 5 Samples

## 5.1 Method A

### 5.1.1 Size and number of the test samples

**5.1.1.1** The sample shall be a cylinder with a diameter of (16.0 ± 0.2) mm and a thickness of at least 6 mm.

**5.1.1.2** For the samples with a thickness of less than 6 mm, they can be fixed on the substrate of the same material or with hardness not less than that of the samples, but the thickness of the samples to be ground shall not be less than 2 mm.

**5.1.1.3** There shall be no less than 4 samples in each group. For arbitration purposes, 10 samples are required.

### 5.1.2 Preparation and conditioning of the samples

**5.1.2.1** Select an appropriate preparation method according to the material and size of the Top Piece.

**5.1.2.2** Use a rotary cutter (4.1.5) to cut out the sample. When cutting, add water as lubricant to the cutting edge of the cutter for lubrication. Blanking is not allowed.

**5.1.2.3** When it is not suitable to use a rotary cutter (4.1.5) for sampling, a grinding machine for Top Piece of leather shoes (4.1.6) may be used to prepare the sample.

Note: This preparation method is suitable for the Top Piece with a small size or high hardness.

**5.1.2.4** Use the Top Piece's side that is in contact with the ground as the test surface, remove or keep its original pattern (indicated in the test report). If the non-test surface of the sample is not flat, it shall be smoothed.

**5.1.2.5** If the size of the Top Piece is too small to be produced to a complete sample, a sample can be taken from the processed test piece that is produced by the same formula as the Top Piece; or directly fix Top Piece on the substrate specified in 5.1.1.2 to form a combined sample. If necessary, use the grinding machine (4.1.6) to trim the combined sample. This situation shall be noted in the test report.

Note: For the Top Piece with a pin, it can be directly inserted into the substrate with holes and fixed to form a combined sample.

**5.1.2.6** All samples shall be conditioned for at least 16 h at the temperature of (23.0±2.0) °C and the relative humidity of (50.0±5.0) % before the test.

## 5.2 Method B

### 5.2.1 Size and number of test samples

**5.2.1.1** Appropriately cut the sample according to the size of the Top Piece's area that is in contact with the ground; it shall be rectangular with a length-width ratio not exceeding 2:1 or other shapes (such as circles). The optional sizes are shown in Table 1.

**5.2.1.2** There shall be no less than 2 samples in each group.

### 5.2.2 Preparation and conditioning of samples

**5.2.2.1** Use the Top Piece's side that is in contact with the ground as the test surface, remove or keep its original pattern (indicated in the test report). If the non-test surface of the sample is not flat, it shall be smoothed. For the Top Piece with a pin, the pin shall be removed.

**5.2.2.2** All samples shall be conditioned for at least 16 h at the temperature of (23.0±2.0) °C and the relative humidity of (50.0±5.0) % before the test.

## 6 Test steps

### 6.1 Method A

**6.1.1** The test shall be carried out at the temperature of (23.0±2.0) °C and the relative humidity of (50.0±5.0) %.

**6.1.2** Set the wear stroke of standard rubber (4.1.4) to be (40.0±0.2) m, and carry out the test according to the provisions of 6.1.3. Before and after each test, the standard rubber (4.1.4) shall be measured three times respectively; for each test, the mass loss shall be between 180 mg and 220 mg.

**6.1.3** Before each test, use a stiff brush or a vacuum cleaner to remove debris from the abrasive cloth.

Weigh the mass of the sample, it shall be accurate to 1 mg. Fix the sample on the gripper of the abrasion machine, and make the length of the sample protruding from the opening be (2±0.2) mm; the length can be measured with the gauge equipped with the abrasion machine.

Press the sample on the roller with a vertical force of (10.0±0.2) N.

Move the gripper with the sample from the slideway to the starting point of the roller and start the machine to carry out the test. If there is abnormal vibration during the test, the test result is invalid.

After the test, weigh the mass of the sample again, it shall be accurate to 1 mg. The

debris adhering to the sample shall be removed before weighing.

**6.1.4** Take a sample for pre-grinding as specified in 6.1.3. Set the pre-grinding stroke to be (20.0±0.1) m. Calculate the amount of the sample's wear during pre-grinding. Select wear stroke of the test according to the amount of the sample's wear during pre-grinding:

a) If the amount of the sample's wear during pre-grinding is less than 200 mg, then set the wear stroke of the test for the remaining samples to be 40 m;

b) If the amount of the sample's wear during pre-grinding is greater than 200 mg but less than 300 mg, then set the wear stroke of the test for the remaining samples to be 40 m. When the stroke reaches 20 m, stop the test, readjust the protruding length of the sample to (2.0 ± 0.2) mm, and then continue the test to complete the remaining stroke.

c) If the amount of the sample's wear during pre-grinding is greater than 300 mg, then set the wear stroke of the test for the remaining samples to be 20 m (if necessary, it can be shorter). Finally, convert the result of the wear amount to that when the wear stroke is 40 m (explain the situation in the test report);

d) After the test, the sample shall not be worn through.

**6.1.5** The rest of the samples shall be tested according to the stipulations in 6.1.3 and the wear stroke determined in 6.1.4.

**6.1.6** Determine the density of the sample according to the provisions of Method A in GB/T 533-2008.

**6.2 Method B**

**6.2.1** The test shall be carried out at the temperature of (23.0±2.0) °C and the relative humidity of (50.0±5.0) %.

**6.2.2** Determine the standard rubber's mass loss $S$ according to 6.1.3.

**6.2.3** Measure the sample's original thickness $h_0$ with a thickness gauge; it shall be accurate to 0.01mm.

**6.2.4** According to the area of the Top Piece sample that is in contact with the ground, select a corresponding load to apply to the friction hammer (see Table 1).

**6.2.5** Cut out an appropriate size of abrasive cloth (4.2.3), and fix it on the friction table with the fixing clip.

**6.2.6** Change a new abrasive cloth after the test of each sample of the leather shoe's Top Piece.

$m_1$ --- The mass of the sample before the test, in milligrams (mg);

$m_2$ --- The mass of the sample after the test, in milligrams (mg).

Take the arithmetic mean of the mass losses of the tested samples (excluding pre-ground samples) as the result.

**7.1.3** The result of the sample's wear is expressed by the relative volume of wear.

Calculate the relative volume $V$ of the sample's wear when the wear stroke is 40 m according to formula (3):

$$V = \frac{m \times S_0}{\rho \times S} \qquad \cdots\cdots (3)$$

Where:

$V$ --- The relative volume of the sample's wear, in cubic millimeters (mm3);

$m$ --- The arithmetic mean of the sample's mass losses, in milligrams (mg);

$\rho$ --- The sample's density, in milligrams per cubic millimeter (mg/mm3);

$S_0$ --- The fixed mass loss of the standard rubber (200 mg), in milligram (mg);

$S$ --- The arithmetic mean of the standard rubber's mass losses, in milligrams (mg).

The result of wear is rounded to an integer.

**7.2 Method B**

**7.2.1** Calculate the standard rubber's mass loss $S$ according to formula (4):

$$S = M_1 - M_2 \qquad \cdots\cdots (4)$$

Where:

$S$ --- The mass loss of standard rubber, in milligrams (mg);

$M_1$ --- The mass of the standard rubber before the test, in milligrams (mg);

$M_2$ --- The mass of the standard rubber after the test, in milligrams (mg).

Take the arithmetic mean of 3 calculation results of standard rubber's mass loss as the result.

**7.2.2** Calculate the sample's relative thickness loss $H$ according to formula (5):

$$H = \frac{(h_0 - h_1) \times S_0}{S} \qquad \cdots\cdots(5)$$

Where:

$H$ --- The relative thickness loss of the sample, in millimeters (mm);

$h_0$ --- The initial thickness of the sample before the test, in millimeters (mm);

$h_1$ --- The thickness of the sample after the test, in millimeters (mm);

$S_0$ --- The fixed mass loss of the standard rubber (200 mg), in milligram (mg);

$S$ --- The arithmetic mean of the standard rubber's mass losses, in milligrams (mg).

Take the arithmetic mean of the relative thickness losses of the two samples as the result; the result shall be accurate to 0.05 mm.

The difference between the relative thickness losses of the two samples shall not be greater than 10% of the arithmetic mean, otherwise, the test shall be carried out again. If both the relative thickness losses of the two samples are less than 0.2 mm, there are no requirements for the data deviation.

# 8 Test reports

## 8.1 Method A

The test report for Method A shall include the following:

a) The description of the sample's style, color, material, etc.

b) The number of this document;

c) The density;

d) The relative volume of wear;

e) The preparation method of the sample (When the size of the Top Piece is too small to be produced to a complete sample with a diameter of 16 mm);

f) The date of the test;

g) Any deviation from this test method.

## 8.2 Method B

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