



**International
Standard**

ISO 12046

**Synchronous belt drives —
Automotive belts — Determination
of physical properties**

*Transmissions synchrones par courroies — Courroies pour la
construction automobile — Détermination des caractéristiques
physiques*

**Third edition
2025-01**

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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 document 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).

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For an explanation of 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 41, *Pulleys and belts (including veebelts)*, Subcommittee SC 4, *Synchronous belt drives*.

This third edition cancels and replaces the second edition (ISO 12046:2012), which has been technically revised.

The main changes are as follows:

- [Clause 2](#) has been updated;
- volumetric units have been clarified ([7.9.2](#)).

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Synchronous belt drives — Automotive belts — Determination of physical properties

1 Scope

This document specifies test methods for determining the physical properties of synchronous belts used in driving engine parts, such as camshafts, fuel injection pumps, balancing shafts. These test methods are intended to provide a means of characterizing synchronous belt properties for belts which are evaluated and qualified by dynamic laboratory and field testing.

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 48-2, *Rubber, vulcanized or thermoplastic — Determination of hardness — Part 2: Hardness between 10 IRHD and 100 IRHD*

ISO 1817, *Rubber, vulcanized or thermoplastic — Determination of the effect of liquids*

ISO 5288, *Synchronous belt drives — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5288 apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

4 Principle

The objective of the test methods covered in this document is the evaluation of the physical properties of automotive synchronous belts through standardized testing. These test methods are independent of tooth profiles.

5 Test methods

The tests covered in this document are listed in [Table 1](#).

Table 1 — Tests

Test	Subclause
Hardness of rubber core	7.1
Tensile strength	7.2
Fabric adhesion	7.3
Tension-cord adhesion	7.4
Tooth shear	7.5
Resistance to high temperature	7.6
Resistance to low temperature	7.7
Resistance to oil	7.8
Resistance to ozone	7.9
Resistance to water	7.10

6 General conditions for testing

6.1 Standard environmental conditions

Standard conditions in the laboratory shall be maintained at a temperature of $(25 \pm 5) ^\circ\text{C}$, a relative humidity of $(65 \pm 20) \%$ and an atmospheric pressure of 86 kPa to 106 kPa. The test conditions should be recorded.

6.2 Standard conditions of test specimens

The test specimens shall be tested at least 16 h after vulcanization and shall be kept for at least 1 h prior to test in a room maintained under standard conditions.

6.3 Rounding off the test results

The results of each test shall be rounded off. Results shall be recorded according to the number of figures specified in [Table 2](#).

Table 2 — Rounding off of results

Test	Unit	Measured test value	Test results to be obtained
Hardness of rubber core	Shore A or IRHD	Integer	Integer
Tensile strength	N	Nearest 10	Nearest 100
Fabric adhesion	N	Integer	Integer
Tension-cord adhesion	N	Nearest 10	Nearest 10
Tooth shear	N	Nearest 10	Nearest 10
EXAMPLES	Nearest tens 3 474 → 3 470 3 475 → 3 480	Nearest hundreds 3 440 → 3 400 3 450 → 3 500	

6.4 Test report

For each test, the test report shall include the following information:

- number of teeth, pitch, tooth profile and width of specimen;
- constituent materials of specimen;
- production code of specimen;
- date of test;
- number of specimens;

- f) test temperature, relative humidity and atmospheric pressure;
- g) type of test apparatus;
- h) reference to this document (including its year of publication).

7 Static property tests

7.1 Test for hardness of rubber core

7.1.1 Test specimens

The test specimen shall be either an endless belt or a cut belt with a minimum length of 100 mm.

7.1.2 Procedure

Place the specimen, with teeth pointing downward, on a flat surface and measure the flat portion of the belt above a tooth, using either;

- a Shore type A durometer as specified in ISO 48-2;
- an IRHD tester as described in ISO 48-2;
- an equivalent apparatus.

7.1.3 Expression of results

Record the average of five different measurements along the belt, rounded off as in the following examples.

EXAMPLE 1

$$\frac{74+75+75+74+74}{5} = 74,4 \rightarrow 74$$

EXAMPLE 2

$$\frac{75+75+75+74+74}{5} = 74,6 \rightarrow 75$$

7.2 Tensile strength test

7.2.1 Test specimens

The test specimen shall be either an endless belt or two cut belts with a minimum length of 250 mm each.

7.2.2 Procedure

Mount an endless-belt test specimen, with teeth pointing upward, on two flat pulleys having an equivalent diameter ranging between 100 mm and 175 mm and which are free to rotate. Apply a tension force to the specimen at the speed of (50 ± 5) mm/min until belt separation occurs.

If two cut belts are used as test specimens, the length gripped shall be at least 50 mm with a minimum distance of 150 mm between the two grips. Apply a tension force to one specimen at the speed of (50 ± 5) mm/min until separation takes place. Repeat the test with the second specimen.

7.2.3 Expression of results

The value for the tensile strength shall be taken as half the measured value for the endless-belt specimen or the smaller of the measured values of the two cut belts. Any data obtained when the specimen separates on the pulley surface or at the gripped portion shall be discarded.

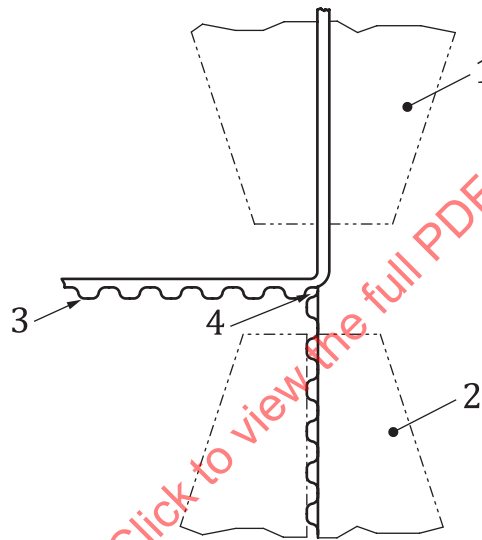
7.3 Fabric adhesion test

7.3.1 Test specimens

Two specimens with a minimum length of 100 mm shall be cut from a belt.

7.3.2 Procedure

Place each specimen in the grips of a tensile-testing device, positioning the root line of the first tooth (No. 1) between 1 and 2, as illustrated in [Figure 1](#).



Key

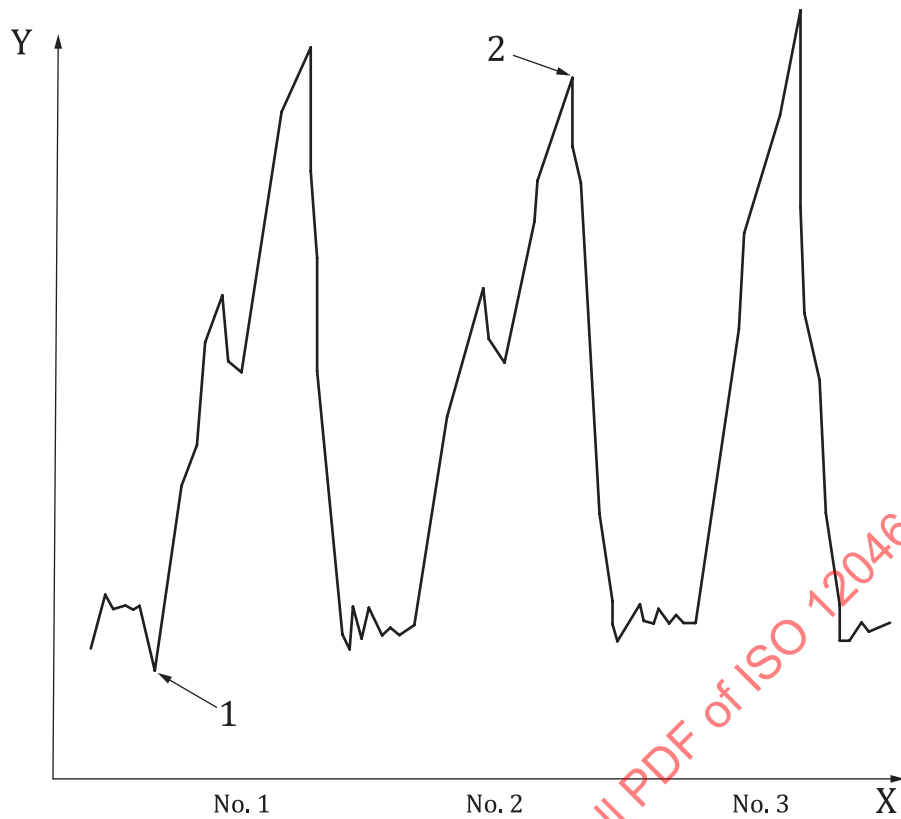
- 1 grip A of the tensile-testing device
- 2 grip B of the tensile-testing device
- 3 tooth body
- 4 root line of first tooth

Figure 1 — Installation of the specimen

Apply a tension force to the specimen using the power-actuated grip. The grip should travel uniformly at (50 ± 5) mm/min, causing the fabric to peel from the surface of the belt. Measure the adhesion force of three consecutive teeth.

7.3.3 Expression of results

The test results shall be summarized separately for adhesion at the tooth body and at the root line between teeth. Results are recorded in terms of force per millimetre width. The adhesion force at the tooth body is the lowest peak value of the two specimens, as illustrated in [Figure 2](#). The adhesion force at the root line between teeth is the lowest value of the two specimens at the beginning of the first tooth (No. 1).



Key

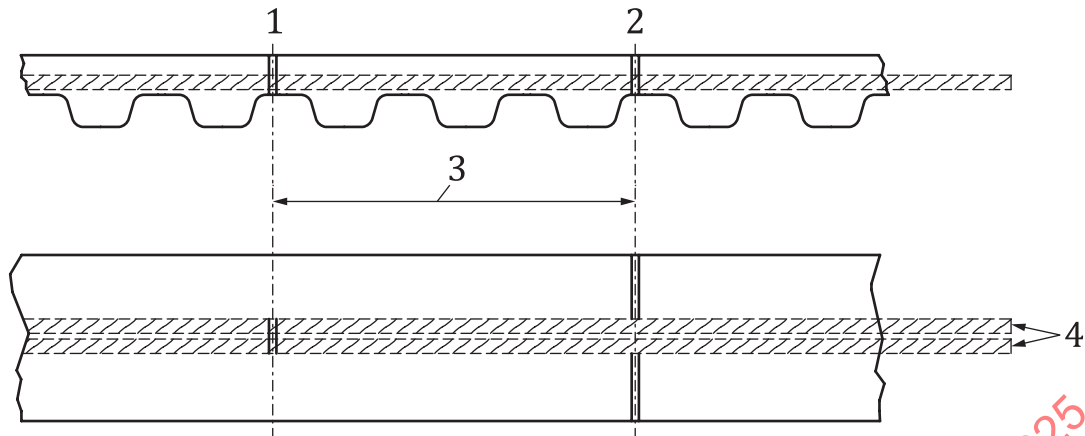
- X teeth
- Y fabric adhesion force
- 1 tooth bottom
- 2 tooth body peak

Figure 2 — Adhesion results for three consecutive teeth

7.4 Tension-cord adhesion test

7.4.1 Test specimens

These shall be partially cut at two positions located the root of tooth (see [7.4.2](#)) apart to extract two cords, as illustrated in [Figure 3](#). The number of teeth between cuts shall be either 3 teeth or agreed between the manufacturer and users.

**Key**

- 1 cut in the two cords
- 2 cut in all but two cords
- 3 cut length
- 4 tension cords

Figure 3 — Specimen for tension-cord adhesion test

7.4.2 Procedure

Place the test specimen in the grips of a tensile-testing device. Apply a tension force to the specimen at the speed of (50 ± 5) mm/min until the two cords are extracted. If the cords break before they are extracted, the cut length may be reduced to a value that allows complete extraction.

Repeat the test using the second test specimen.

7.4.3 Expression of results

The lower value obtained from the two specimens is taken as the tension-cord adhesion value. Any tests showing results of improper sample preparation should be repeated.

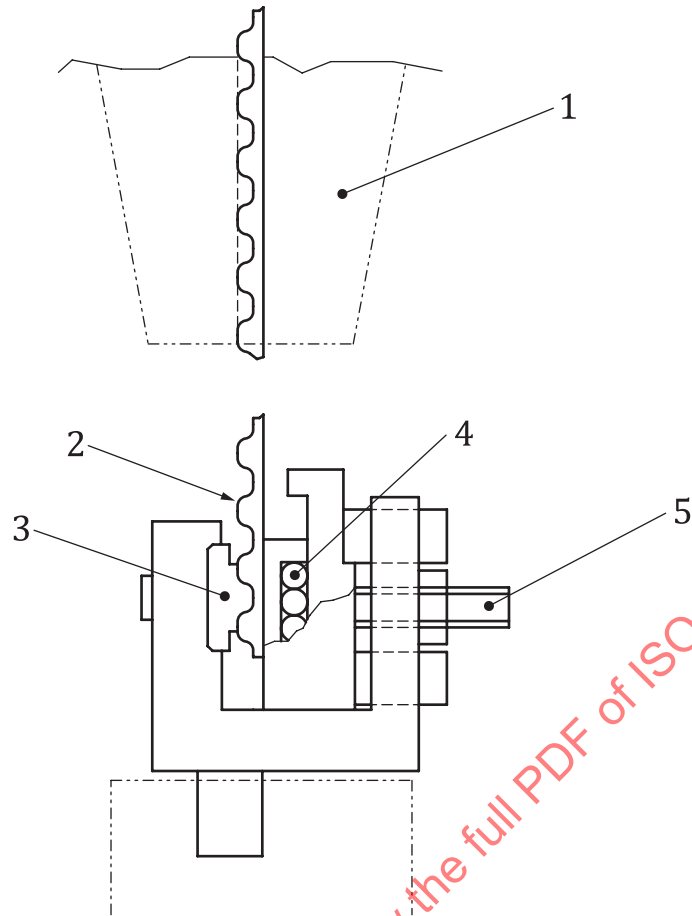
7.5 Tooth-shear test

7.5.1 Test specimens

A specimen with a minimum length of 200 mm shall be cut from a belt.

7.5.2 Apparatus

The apparatus for the tooth-shear test is illustrated in [Figure 4](#).



Key

- 1 grip of tensile-testing device
- 2 specimen
- 3 tooth-shearing chip
- 4 slide bearing
- 5 setting bolt

Figure 4 — Tooth-shearing apparatus and specimen

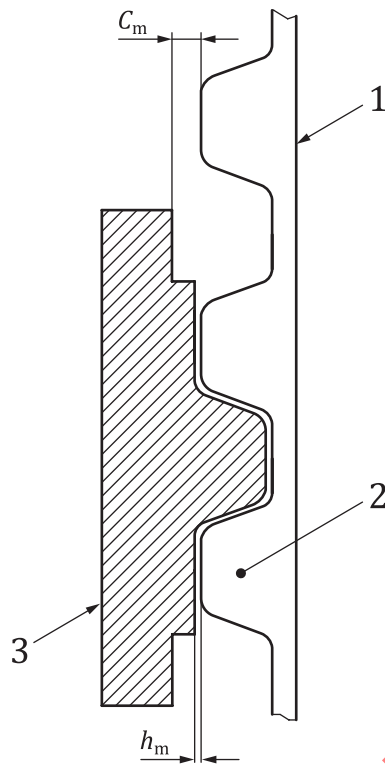
7.5.3 Tooth-shearing chip

The basic dimensions of the tooth-shearing chip are shown in [Figure 5](#) and [Table 3](#). The total length of the chip should be dimensioned to fit securely in the holding apparatus illustrated in [Figure 4](#).

Table 3 — Minimum clearance between tooth-shearing chip and belt tooth

Dimensions in millimetres

Belt type	Trapezoidal	Curvilinear
C_m	0,5	0,5
h_m	0	0,1



Key

- 1 test belt
- 2 first test tooth
- 3 tooth-shearing chip

Figure 5 — Tooth-shearing chip

The actual chip shall be designed to fit the specific type of belt being tested. The dimensions should be the same as the space between two adjacent nominal belt teeth with a $\pm 0,02$ mm tolerance band.

In setting up the test, the tooth-shearing chip should mate with the belt profile so that the chip nests between two adjacent belt teeth and conforms to the contours of the belt teeth, as illustrated in [Figure 6](#).