BS ISO 12046:2012

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Synchronous belt drives — Automotive belts — Determination of physical properties

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Foreword

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ISO 12046 was prepared by Technical Committee ISO/TC 41, *Pulleys and belts (including veebelts)*, Subcommittee SC 4, *Synchronous belt drives*.

This second edition cancels and replaces the first edition (ISO 12046:1995), which has been technically revised.

INTERNATIONAL STANDARD ISO 12046:2012(E)

Synchronous belt drives — Automotive belts — Determination of physical properties

1 Scope

This International Standard 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.

NOTE The dimensional characteristics of these belts are the subject of ISO 9010.

2 Normative references

The following referenced documents are indispensable for the application 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, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD)*

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

ISO 7619-1, *Rubber, vulcanized or thermoplastic — Determination of indentation hardness — Part 1: Durometer method (Shore hardness)*

ISO 7619-2, *Rubber, vulcanized or thermoplastic — Determination of indentation hardness — Part 2: IRHD pocket meter method*

3 Principle

Evaluation of the physical properties of automotive synchronous belts through standardized test methods. These test methods are independent of tooth profiles.

4 Test methods

The tests are listed in Table 1.

Table 1 — Tests

Test	Subclause No.
Hardness of rubber core	6.1
Tensile strength	6.2
Fabric adhesion	6.3
Tension-cord adhesion	6.4
Tooth shear	6.5
Resistance to high temperature	6.6
Resistance to low temperature	6.7
Resistance to oil	6.8
Resistance to ozone	6.9
Resistance to water	6.10

5 General conditions for testing

5.1 Standard environmental conditions

Standard conditions in the laboratory shall be maintained at a temperature of (25 ± 5) °C, a relative humidity of (65 ± 20) % and an atmospheric pressure of 86 kPa to 106 kPa . The test conditions should be recorded.

5.2 Standard conditions of test specimens

The test specimens shall be tested at least 24 h after vulcanization and shall be kept for at least 1 h prior to test in a room maintained under standard conditions.

5.3 Rounding off the test results

The results of each test shall be rounded off and 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	Nearest hundreds	
	3 474 → 3 470	3 440 → 3 400	
	3 475 → 3 480	3 450 → 3 500	

5.4 Test report

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

a) number of teeth, pitch, tooth profile and width of specimen;

b) constituent materials of specimen;

c) production code of specimen;

d) date of test;

e) number of specimens;

f) test temperature, relative humidity and atmospheric pressure;

g) type of test apparatus.

6 Static property tests

6.1 Test for hardness of rubber core

6.1.1 Test specimens

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

6.1.2 Procedure

Place the specimen, with teeth pointing downward, on a flat surface and measure the flat portion of the belt above a tooth, using a Shore type A durometer as described in ISO 7619-1, or an IRHD tester as described in ISO 48 or ISO 7619-2, or an equivalent apparatus.

6.1.3 Expression of results

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

EXAMPLE 1

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

EXAMPLE 2

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

6.2 Tensile strength test

6.2.1 Test specimens

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

6.2.2 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 $\pm$ 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.

6.2.3 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.

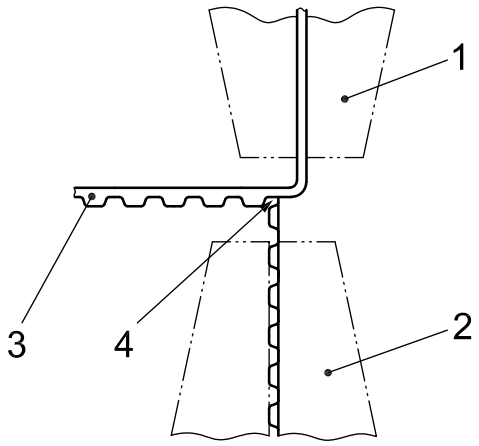
6.3 Fabric adhesion test

6.3.1 Test specimens

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

6.3.2 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

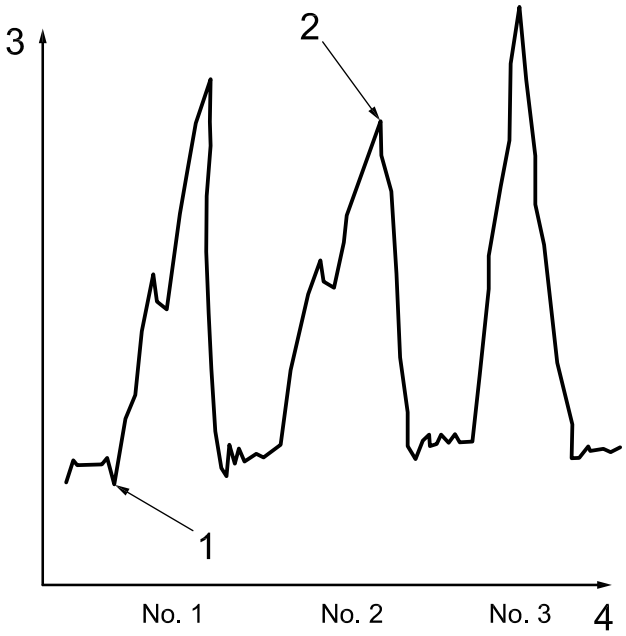
1 grip A of the tensile-testing device
2 grip B of the tensile-testing device
3 tooth body
4 root line of first tooth

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.

6.3.3 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

1 tooth bottom
2 tooth body peak
3 fabric adhesion force
4 teeth

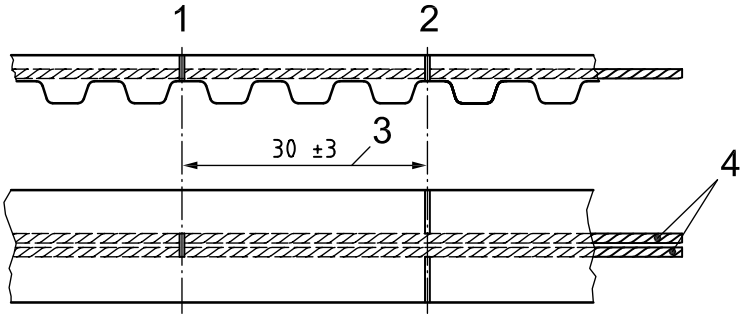
Figure 2 — Adhesion results for three consecutive teeth

6.4 Tension-cord adhesion test

6.4.1 Test specimens

Two specimens with a minimum length of 100 mm shall be taken from a belt. These shall be partially cut at two positions located 30 mm (see 6.4.2) apart to extract two cords, as illustrated in Figure 3.

Dimensions in millimetres



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

6.4.2 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.

6.4.3 Expression of results

The lower value obtained from the two specimens is taken as the tension-cord adhesion value for a 30 mm length. Any tests showing results of improper sample preparation should be repeated.

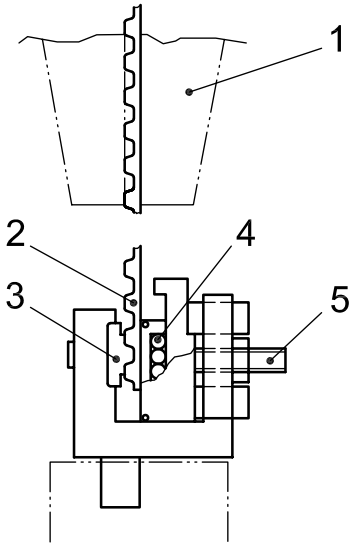
6.5 Tooth-shear test

6.5.1 Test specimens

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

6.5.2 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

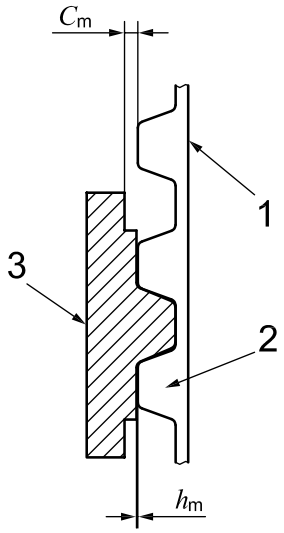
6.5.3 Tooth-shearing chip

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



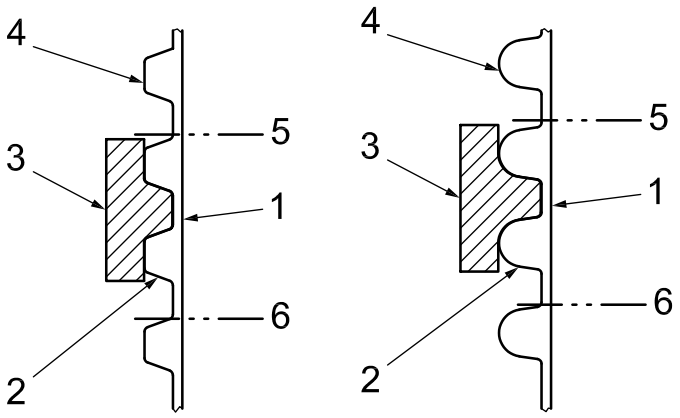
Key

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 ±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.



Key

1 test belt
2 first test tooth
3 tooth-shearing chip
4 second test tooth
5 second cut line
6 first cut line

Figure 6 — Tooth preparation for shear testing

6.5.4 Procedure

Place the specimen in the tooth-shearing apparatus mounted on a tensile-testing device and tighten it with a setting force, in newtons, equal to 157 times the belt width in millimetres. Apply a tension force to the specimen at the speed of (50 ± 5) mm/min until tooth-shearing rupture occurs. During the test, the next tooth shall be cut off as illustrated in Figure 6 and, as a rule, three teeth shall be tested. Any specimen which has a splice in the fabric shall be excluded from the test.

NOTE The setting force of the specimen is provided by the setting bolt. Accordingly, the relationship between the setting force and the setting torque is determined by calibration.

6.5.5 Expression of results

Record, in terms of force per millimetre width, the minimum value of the observed data.

6.6 Test for resistance to high temperature

6.6.1 Test specimens

The specimen shall be a cut belt with a minimum length of 100 mm.

6.6.2 Procedure

Age the specimen in an air-circulating oven, or similar, for 70 h at (125 ± 2) °C or 70 h at (150 ± 2) °C for heat-resistant belts. After ageing, allow the specimen to cool under standard conditions (see 5.1) for at least 1 h prior to carrying out the following tests:

a) hardness of rubber core (see 6.1);

b) fabric adhesion (see 6.3).

6.7 Test for resistance to low temperature

6.7.1 Test specimens

The specimen shall be a cut belt with a minimum length of 150 mm.

6.7.2 Procedure

Place the test specimen in a cold chamber for a minimum of 5 h at (−40 ± 2) °C. In this cold chamber, bend the specimen, with the teeth on the inside, around a mandrel measuring 25 mm in diameter and inspect the specimen for cracks or other visible defects. The mandrel shall be kept in the cold chamber at the same time.

6.8 Test for resistance to oil

6.8.1 Test specimens

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

6.8.2 Procedure

Immerse the test specimen in oil No. 1 of ISO 1817, or equivalent, for 70 h at (100 ± 2) °C. Then remove the specimen from the oil, allow it to cool under standard conditions (see 5.1) for at least 1 h prior to carrying out the following tests:

a) hardness of rubber core (see 6.1);

b) tooth shear (see 6.5).

6.9 Test for resistance to ozone

6.9.1 Test specimens

The test specimen shall be a cut belt with a minimum length of 200 mm.

6.9.2 Procedure

Secure the test specimen in the natural direction of curvature around a mandrel measuring 50 mm in diameter and expose it to an ozone concentration of (50 ± 5) pphm at (40 ± 2) °C for 70 h inside a test chamber. After 70 h of exposure, inspect the back of the specimen for cracks using a magnification of ×10.

6.10 Test for resistance to water

6.10.1 Test specimens

The specimen shall be an endless belt.

6.10.2 Procedure

Immerse the specimen in its natural shape in boiling water for 3 h. After this immersion, allow the specimen to cool in water at (25 ± 5) °C for 30 min. Then dry it under standard conditions (see 5.1) from 1 h to 24 h prior to carrying out the following tests:

a) tensile strength (see 6.2);

b) fabric adhesion (see 6.3);

c) tension-cord adhesion (see 6.4).

Bibliography

[1] ISO 9010, *Synchronous belt drives — Automotive belts*

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