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Synchronous belt drives — Automotive belts — Determination of physical properties

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

Reference number
ISO 12046:1995(E)

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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

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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, etc. These test methods are intended to provide a means of characterizing synchronous belt properties for belts that are evaluated and qualified by dynamic laboratory and field testing.

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

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 1817:1985, *Rubber, vulcanized — Determination of the effect of liquids.*

ISO 7619:—[1], *Rubber — Determination of indentation hardness by means of pocket hardness meters.*

ISO 9010:1987, *Synchronous belt drives — Automotive belts.*

3 Principle

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

4 Tests

The tests are listed in table 1.

Table 1 — Tests

Test	Sublause 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 (25 ± 5) °C temperature, (65 ± 20) % relative humidity and 86 kPa to 106 kPa atmospheric pressure. The test conditions should be recorded.

1) To be published. (Revision of ISO 7619:1986)

5.2 Standard conditions of test specimens

The test specimens shall be tested after at least 24 h have elapsed after vulcanization, and shall be kept for not less than 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.

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) 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 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 or an equivalent apparatus.

6.1.3 Expression of results

Record the average of five different measurements along the belt, rounded off as follows.

EXAMPLES

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

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

Table 2 — Rounding off of results

Test	Unit	Measured test value	Test results to be obtained
Hardness of rubber core	Shore A	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

6.2 Tensile strength test

6.2.1 Test specimens

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

6.2.2 Procedure

Mount an endless-belt test specimen, with teeth pointing upward, on two equal-diameter flat pulleys that are between 100 mm and 175 mm in diameter and 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.

6.2.3 Expression of results

Take as the value for the tensile strength half the measured value for the endless-belt specimen or the smaller of the measured values for the two cut belts. Any data obtained when the specimen separates on the pulley surface or separates 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 with the first (No. 1) tooth root line positioned between A and B as illustrated in figure 1.

Apply a tension force to the specimen by 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 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).

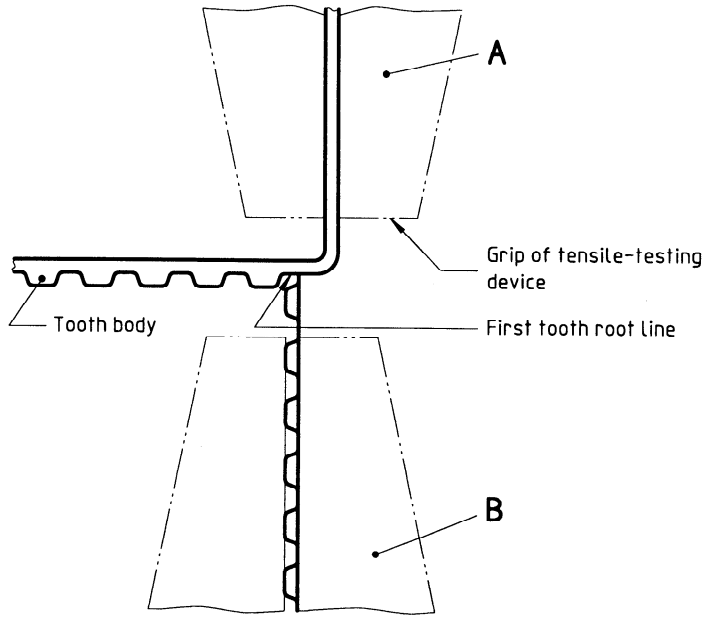

Figure 1 — Installation of the specimen

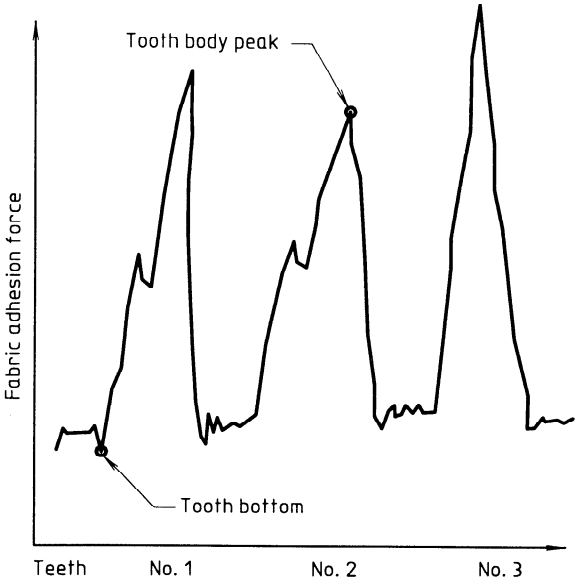

Figure 2 — Adhesion results for three consecutive teeth

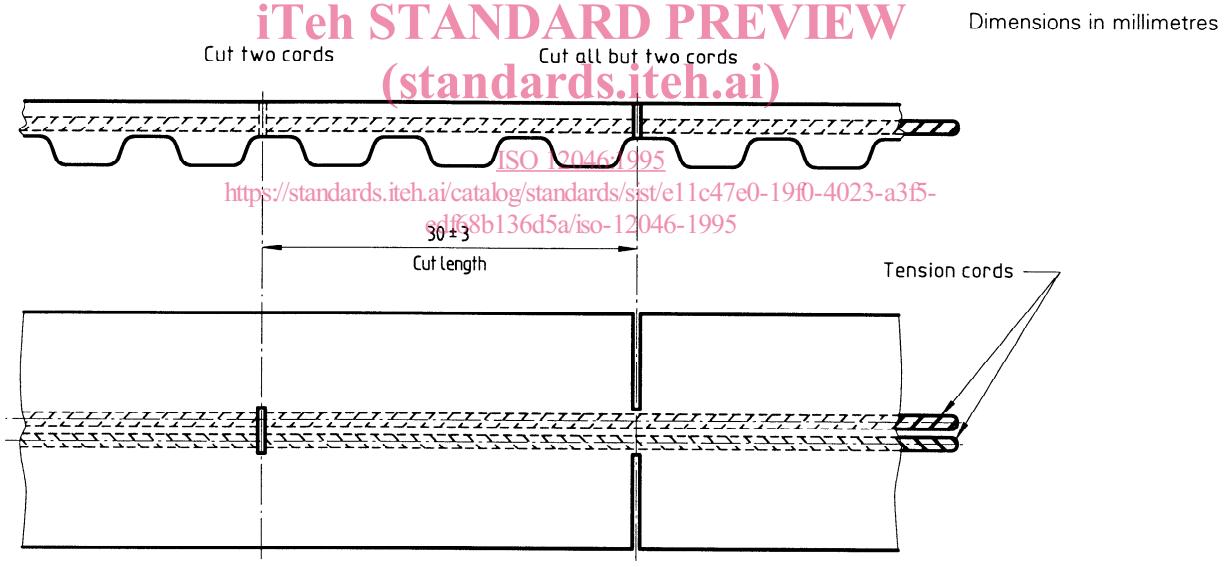

Figure 3 — Specimen for tension-cord adhesion test

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 also 6.4.2) apart to extract two cords, as illustrated in figure 3.

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.

The dimensions of a tooth-shearing chip for belt types ZA and ZB are shown in figure 5 and given in table 3 as examples. Refer to ISO 9010 for descriptions of ZA and ZB belt types.

NOTE 1 Dimensions for other tooth profiles should be obtained from the belt manufacturers.

6.5.3 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 2 The setting force of the specimen is provided by the setting bolt. Accordingly, the relationship between the setting force and the setting torque is to be determined by calibration.

6.5.4 Expression of results

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

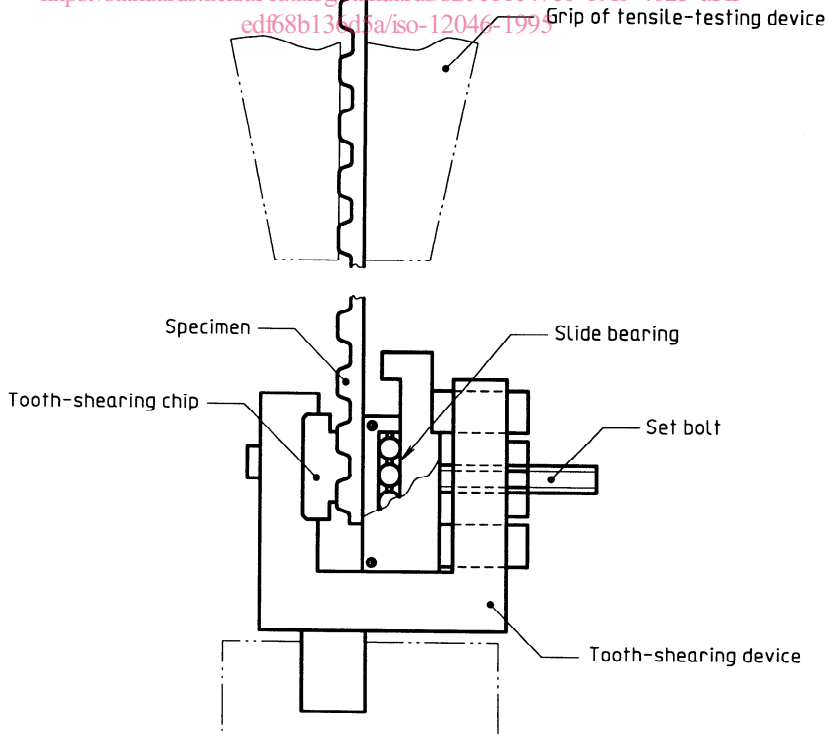

Figure 4 — Tooth-shearing apparatus and specimen

Dimensions in millimetres,
surface roughness in micrometres

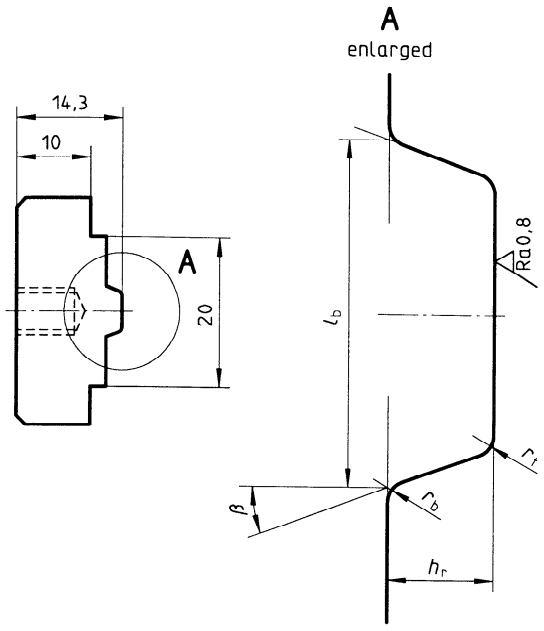

Figure 5 — Tooth-shearing chip

Table 3 — Dimensions of tooth-shearing chips

Dimensions in millimetres

Belt type	h_r ±0,02	l_b ±0,03	r_t ±0,02	r_b ±0,02	β ±0,5°
ZA	1,91	6,27	0,51	0,51	20°
ZB	2,29	5,9	1,02	1,02	20°

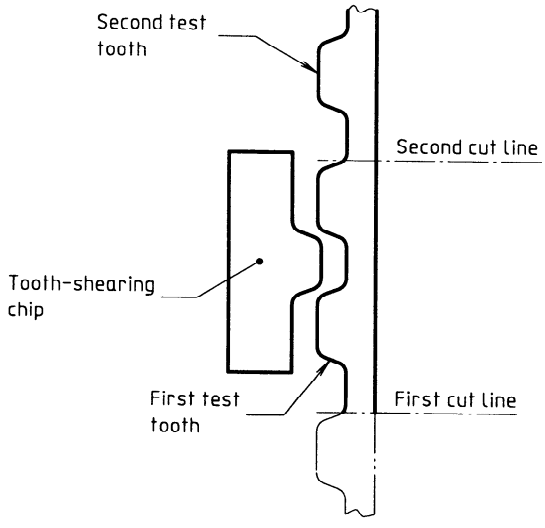

Figure 6 — Tooth preparation for shear testing

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 a circulating-air oven or similar oven 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 a minimum of 1 h prior to 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 25 mm diameter mandrel and inspect for cracks or other visible defects on the specimen. 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 1817:1985, or equivalent oil, 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 a minimum of 1 h prior to 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 50 mm diameter mandrel, and expose it to an ozone concentration of (50 ± 5) pphm at (40 ± 2) °C for 70 h in a test chamber. After 70 h of exposure, inspect for cracks on the backing of the specimen 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 the following tests:

a) tensile strength (see 6.2);

b) fabric adhesion (see 6.3);

c) tension-cord adhesion (see 6.4).