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

同步带传动 汽车同步带 物理性能试验方法

(ISO 12046:2012, MOD)

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Table of Contents

Foreword	3
1 Scope.....	5
2 Normative references	5
3 Test principle.....	5
4 Test items	5
5 Test conditions	6
6 Static test.....	7

Synchronous belt drives - Automotive belts - Determination of physical properties

1 Scope

This Standard specifies the test principle, items, conditions, and static test for physical properties test of automotive synchronous belts.

This Standard applies to automotive synchronous belt drives.

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.

GB/T 531.1, *Rubber, vulcanized or thermoplastic - Determination of indentation hardness - Part 1: Durometer method (Shore hardness)* (GB/T 531.1:2008, ISO 7619-1:2004, IDT)

GB/T 531.2, *Rubber, vulcanized or thermoplastic - Determination of indentation hardness - Part 2: IRHD pocket meter method* (GB/T 531.2 2009, ISO 7619-2:2004, IDT)

GB/T 1690-2010, *Rubber, vulcanized or thermoplastic - Determination of the effect of liquids* (ISO 1817:2005, MOD)

GB/T 6031, *Rubber, vulcanized or thermoplastic - Determination of hardness (hardness between 10 IRHD and 100IRHD)* (GB/T 6031:1998, idt ISO 48:1994)

3 Test principle

Evaluate the physical properties of automotive synchronous belts by the test methods specified in this Standard. The test method is independent of the tooth form.

4 Test items

See Table 1 for the test items.

The test report for each test shall include the following:

- a) Number of teeth, tooth pitch, type, and width of the sample belt;
- b) Main raw material of the sample belt;
- c) Production batch of the sample belt;
- d) Test date;
- e) Quantity of sample belts;
- f) Test temperature, relative humidity, and atmospheric pressure;
- g) Model of testing machine.

6 Static test

6.1 Test for hardness of rubber core

6.1.1 Specimen

The specimen can be a complete endless belt, or a belt segment with a length greater than 100mm cut from the sample belt.

6.1.2 Test procedure

Use Shore A hardness tester conforming to GB/T 531.1 or IRHD hardness tester conforming to GB/T 531.2, GB/T 6031, or other hardness testers with similar functions to test. Place the specimen on the platform (toothed side down). Measure the hardness value of rubber core above the 5 different tooth-bodies in the longitudinal direction.

6.1.3 Result representation

As shown in the following example, calculate the average value of hardness measurements at 5 different locations along the longitudinal direction of the belt and round it off.

Example:

$$\frac{74 + 75 + 75 + 74 + 74}{5} = 74.4 \rightarrow 74$$

$$\frac{75 + 75 + 75 + 74 + 74}{5} = 74.6 \rightarrow 75$$

6.2 Tensile strength test

6.2.1 Specimen

The specimen can be a complete endless belt, or two belt segments with a length greater than 2500mm cut from the sample belt.

6.2.2 Test procedure

If an endless belt is used as a specimen, hang the endless belt toothed surface on two flat pulleys of equal diameter. The diameter of the pulley is (100~175) mm. It can rotate freely. Apply tension to the sample belt at a separation speed of (50±5) mm/min until the sample belt breaks.

If two cut segments are used as the specimen, the length of the specimen clamped in each gripper shall be greater than 50mm during the test. The distance between the two grippers shall be greater than 150mm. Apply tensile force to the sample at a separation speed of (50 ± 5) mm/min until the specimen breaks. The second test specimen shall be tested in the same manner.

6.2.3 Result representation

When an endless belt is used as the specimen, half of the measured value is used as the calculated tensile force. The test is invalid when the rupture occurs at the wrapping pulley of the sample belt. When the cut segment is used as the specimen, the minimum of the two measured values is used as the calculated tensile force of the specimen. When the fracture occurs in the clamped part of the specimen, the test is invalid.

The test report shall indicate that the test shall be carried out with an endless belt specimen or a belt segment specimen.

6.2.4 Result calculation

The tensile strength is calculated according to formula (1):

$$T = \frac{F_1}{b} \dots\dots\dots (1)$$

Where,

T - Tensile strength, in Newton per millimeter (N/mm);

F₁ - Calculated tensile force of the specimen, in Newton (N);

b - Specimen width, in millimeters (mm).

6.3 Adhesive strength test of tooth-wrapping fabric

6.3.1 Specimen

Clamp the specimen on the gripper and tooth-shearing device of the tensile testing machine. The shearing device clamps the specimen with a clamping force in Newtons equivalent to 157 times the specimen width in millimeters. Start the testing machine. Apply tensile force to the specimen at a separation speed of (50 ± 5) mm/min until the tooth shear failure occurs in the specimen. Then do the same test on the next tooth. Typically, 3 teeth shall be tested. Specimens with joints on the wrapping fabric shall not be used for the test.

6.5.5 Result representation

Take the shear force on the unit width of the specimen as the shear value of the tooth-body. Take the minimum value among the three measured values as the test result. The shear of the tooth-body is calculated according to formula (4):

$$S = \frac{F_3}{b} \dots\dots\dots (4)$$

Where,

S - Tooth shear, in Newton per millimeter (N/mm);

F₃ - Minimum shear force, in Newton (N);

b - Specimen width, in millimeters (mm).

6.6 High temperature resistance test

6.6.1 Specimen

Cut out a belt segment with a length of more than 100mm from the sample belt as a specimen.

6.6.2 Test procedure

Place the specimen in a hot air cycle aging box or other equipment with similar performance. Conduct aging for 70h at $(125 \pm 2)^\circ\text{C}$. For the heat-resistant belt, it shall be aged for 70h at a temperature of $(150 \pm 2)^\circ\text{C}$. The specimen is then allowed to cool for at least 1h under standard ambient conditions (see 5.1). Then the following tests are carried out:

- a) Hardness of rubber core (see 6.1);
- b) Adhesive strength of tooth-wrapping fabric (see 6.3).

6.7 Low temperature resistance test

6.7.1 Specimen

Cut out a belt segment with a length of more than 150mm from the sample belt as a specimen.

6.7.2 Test procedure

Place a specimen and a cylinder of which the diameter is 25mm in a freezer. Freeze at $(-40\pm 2)^{\circ}\text{C}$ for at least 5h. The specimen is then wrapped around a cylinder (with toothed side inwards) in the freezer. Observe the specimen for cracks or other defects.

6.8 Oil resistance test

6.8.1 Specimen

Cut out a belt segment with a length of more than 200mm from the sample belt as a specimen.

6.8.2 Test procedure

Immerse the specimen in No. 1 oil conforming to GB/T 1690-2010 at a temperature of $(100\pm 2)^{\circ}\text{C}$ for 70h. Remove the specimen from the oil. Cool it at standard ambient conditions (see 5.1) for at least 1h. Then the following tests are carried out:

- a) Hardness of rubber core (see 6.1);
- b) Tooth shear (see 6.5).

6.9 Ozone resistance test

6.9.1 Specimen

Cut out a belt segment with a length of more than 200mm from the sample belt as a specimen.

6.9.2 Test procedure

Wrap the specimen around a cylinder with a diameter of 50mm in the natural bending direction. Then put them together in ozone with a concentration of $(50\pm 5)\times 10^{-8}$ and a temperature of $(40\pm 2)^{\circ}\text{C}$ for 70h. After taking them out, use a tenfold magnifying glass to observe whether there are cracks on the back of the specimen.

6.10 Water resistance test

6.10.1 Specimen

The specimen is an endless sample belt.

6.10.2 Test procedure

Immerse the specimen in boiling water for 3h in its natural state. Immerse in water at

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