International Standard ISO 5287

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Narrow V-belt drives for the automotive industry — Fatigue test

Transmissions par courroies trapézoïdales étroites pour la construction automobile — Essai de fatigue

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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 5287 was prepared by Technical Committee ISO/TC 41, *Pulleys and belts (including veebelts).*

International Standard ISO 5287 was first published in 1978. This second edition cancels and replaces the first of which it constitutes a technical revision.

Narrow V-belt drives for the automotive industry — Fatigue test

1 Scope and field of application

This International Standard specifies a fatigue test for the quality control of narrow V-belts (sections AV 10 and AV 13) intended for driving the auxiliaries of internal combustion engines used for automotive purposes.

The dimensional characteristics of these belts and of the corresponding pulleys are the subject of ISO 2790.

2 References

ISO 468, *Surface roughness — Parameters, their values and general rules for specifying requirements.*

ISO 683/12, *Heat-treated steels, alloy steels and free-cutting steels — Part 12: Flame and induction hardening steels.*

ISO 2790, *Narrow V-belt drives for the automotive industry — Dimensions.*

3 Principle

Determination of the performance of a belt under specified conditions on the two- or three-pulley test machine described in this International Standard.

NOTE — The shortest V-belt which can be tested on the three-pulley test machine is approximately 800 mm. Shorter belts should be tested on the two-pulley test machine, as described in clauses 4 and 6. A number of conditions shall be agreed between the manufacturer and the user, including the power to be transmitted, the effective diameter of the idler pulley and the number of times the belt can be re-tensioned and the minimum acceptable belt life, in hours.

As a general rule, the power to be transmitted using the two-pulley test machine should be approximately 70 % of the power transmitted using the three-pulley test machine.

Belt failure occurs when the belt no longer satisfies the agreed conditions.

4 Apparatus

4.1 Dynamic test machine

The test machine shall be of robust design so that all components withstand, with virtually no deflection, the stresses to which they are subjected.

The test machine shall consist of:

a) a driving pulley and suitable mechanism for driving it;

b) a driven pulley to which a suitable power-absorption unit is connected; the power-absorption unit shall be accurate and capable of calibration, for example by dead weights;

c) an arrangement through which tension can be applied to the belt:

- in the case of the three-pulley test machine layout, an idler pulley (see figure 2),
- in the case of the two-pulley test machine layout, a movable pulley (see figure 3);

d) a means of determining belt slip to an accuracy of ± 1 %.

The layout of the pulleys and the direction of rotation shall be as shown in figures 2 and 3.

In order to accommodate different lengths of belts, the position of the relevant driving and driven members, and the position of the idler pulley and its support bracket in the case of the three-pulley test machine, shall be adjustable so that the test layout of the pulleys is attainable for each belt length.

So that tension can be satisfactorily applied to the belt, and in order to allow for belt stretch, the idler pulley of the three-pulley test machine and its bearing assembly shall be free to slide, as and when necessary, in its support bracket along the line of application of the tensioning force. In such a case, the line of action of the tensioning force shall bisect the belt layout angle at the idler pulley, shall pass through the axis centre of the idler pulley, and shall lie in the plane through the centre of the groove of the idler pulley (see figure 2).

The two-pulley test machine shall be constructed so that one of the units (driven or driving) can be moved to accommodate belt lengths up to 800 mm (see figure 3). A method of locking the movable unit in position, with a given tension in the V-belt, shall be provided.

4.2 Test pulleys

The test pulleys shall be made of type 9 steel as defined in ISO 683/12, and the pulley groove shall have a surface roughness such that the arithmetical mean deviation of the profile R_a defined by ISO 468 is lower than 0,8 µm.

The characteristics of the test pulleys are given in figure 1 and in the table.

5 Test room conditions

The ambient temperature in the test room shall be between 18 and 32 °C, and the mean ambient temperature for the duration of the test shall be given with the result of the test.

The atmosphere in the vicinity of the test drive shall be free of draughts from sources other than the belt drive itself.

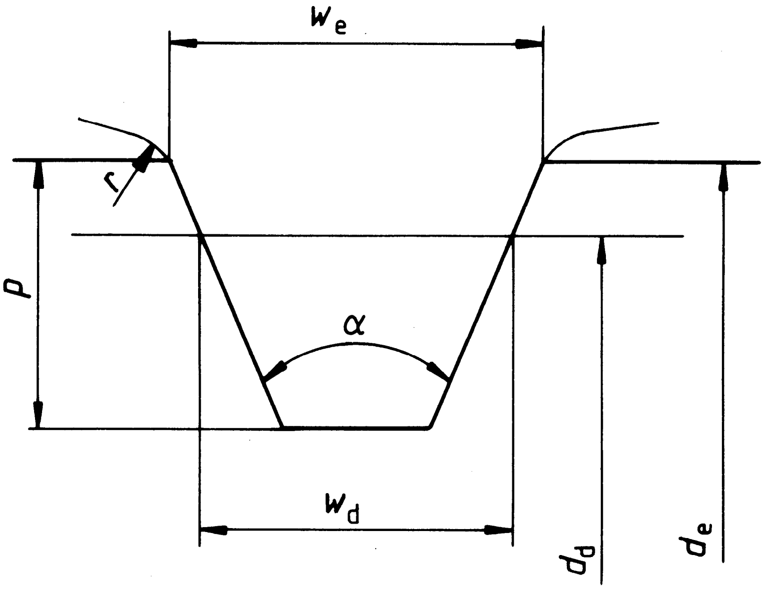

Figure 1 — Test pulley groove

Table — Dimensions of test pulleys

Dimensions in millimetres, angle in degres

Designation	Symbol	Section	
		AV 10	AV 13
Difference between effective diameter and datum diameter	$d_e - d_d = 2Y$	3,69	5,23
Datum width of groove	w_d	8,5	11
Effective diameter of the driving pulley and of the driven pulley (three-pulley test machine)	d_{e1}	121 ± 0,2	127 ± 0,2
Effective diameter of the driving pulley and of the driven pulley (two-pulley test machine)	d_{e1}	63 ± 0,2	76 ± 0,2
Effective diameter of the idler pulley[1)] (three-pulley test machine)	d_{e2}	57 – 63 – 76 ± 0,2	70 – 76 – 89 ± 0,2
Effective width	w_e	9,7	12,7
Groove angle	α	36° ± 30′	36° ± 30′
Minimum groove depth	p	11	13,75
Minimum curve radius of the sides at the top of the groove	r	0,8	0,8

1) When the idler pulley effective diameter is reduced, it should be understood that the life of the belt will be reduced too.

6 Test method

6.1 Test conditions

For each test, the general layout of the pulleys relative to each other shall be as shown in figures 2 and 3. The centre distance between the driving and driven pulleys for the three-pulley test machine shall be within ± 2 mm of the value determined from the formula:

$$2{,}414\,C = L_e - 0{,}785\,(3\,d_{e1} + d_{e2}) - (d_{e1} - d_{e2})$$

where

C is the centre distance between the driving and driven pulleys;

L_e is the effective length of the belt, measured in accordance with ISO 2790;

d_{e1} is the effective diameter of both the driving and driven pulleys;

d_{e2} is the effective diameter of the idler pulley.

The rotational frequency of the driving pulley, to within ± 2 %, shall be 4 900 min^{-1} for AV 10 belts and 4 700 min^{-1} for AV 13 belts.

In the case of the three-pulley test machine, the belt tensioning force applied to the idler pulley, and in the case of the two-pulley test machine, that applied to the driven unit, shall be such that

$$F = K \times P$$

where

F is the belt tensioning force, in newtons;

P is the transmitted power, in kilowatts;

K = 60 N/kW, in the case of the three-pulley test machine;

K = 110 N/kW, in the case of the two-pulley test machine.

6.2 Procedure

6.2.1 Preparation

6.2.1.1 Three-pulley test machine

After mounting the belt on the pulleys, apply the specified belt tensioning force (see 6.1) to the idler pulley, and, leaving the idler pulley support bracket free to move in its slide, bring the drive up to the specified rotational frequency (see 6.1). Then apply the relevant load to the driven pulley as quickly as possible. Run the drive under these conditions for 5 min ± 15 s, not including the starting and stopping time. Stop the machine and leave it to stand for at least 10 min.

Then turn the drive manually for several revolutions of the belt and, by means of a dial indicator mounted in contact with the idler pulley support bracket, note the maximum limits of travel of the idler pulley.

Immediately lock the idler pulley support bracket in the position midway between the two limits of travel.

6.2.1.2 Two-pulley test machine

Use the same procedure as in 6.2.1.1 with the movable unit taking the place of the idler pulley support.

6.2.2 Test

Re-start the machine, bring the drive up to the specified rotational frequency, apply the test load to the driven pulley and measure the slip between the driving and driven pulleys.

The drive shall run continuously under these conditions until either the belt fails or the additional slip (g) exceeds the slip measured initially by 4 %.

The additional slip, g, expressed as a percentage, is given by the formula:

$$g = (i_0 - i_f) \times 100$$

where

$$i_0 = \frac{n_0}{N_0} \text{ and } i_f = \frac{n_f}{N_f}$$

and

n_0 is the initial rotational frequency of the driven shaft;

n_f is the final rotational frequency of the driven shaft;

N_0 is the initial rotational frequency of the driving shaft;

N_f is the final rotational frequency of the driving shaft.

All rotational frequencies shall be measured under the test load.

6.2.3 Re-tensioning

If additional belt slip reaches 4 % before belt failure, stop the machine and leave it to stand for at least 20 min. In the case of the three-pulley test machine, unlock the idler pulley support bracket, apply the test tension to the belt, turn the drive manually two or three times, re-lock the idler support bracket in the mid-position as described in 6.2.1 and repeat the test specified in 6.2.2.

Repeat this procedure whenever the additional slip reaches 4 % before failure, until the belt fails.

7 Test report

The test report shall include at least the following information:

a) a reference to this International Standard;

b) the identification of the belt tested;

c) the type of machine used;

d) the number of running hours under test to satisfy the agreed conditions;

e) the transmitted power;

f) in the case of a three-pulley test machine, the diameter of the idler pulley;

g) the number of times and the running hours at which the belt was re-tensioned;

h) the mean ambient temperature during the test;

j) the date of the test.

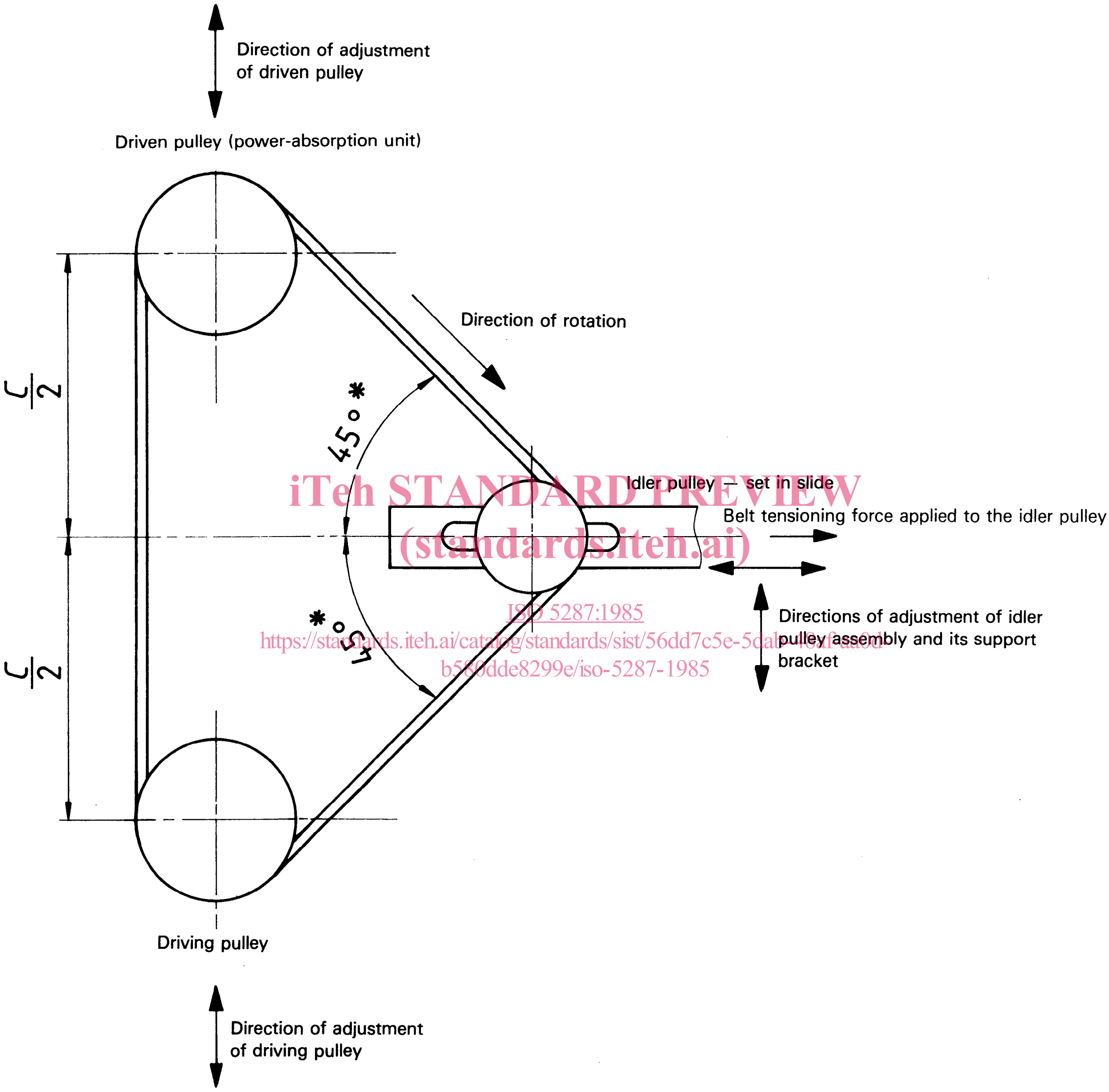

Figure 2 — Three-pulley test machine layout

* 45° is specified for the initial test layout, and may change slightly with re-tensioning during the course of the test.

NOTE — The belt, mounted on the test pulleys, should be aligned to within ± 15′ in relation to the plane through the centre of each pulley groove.

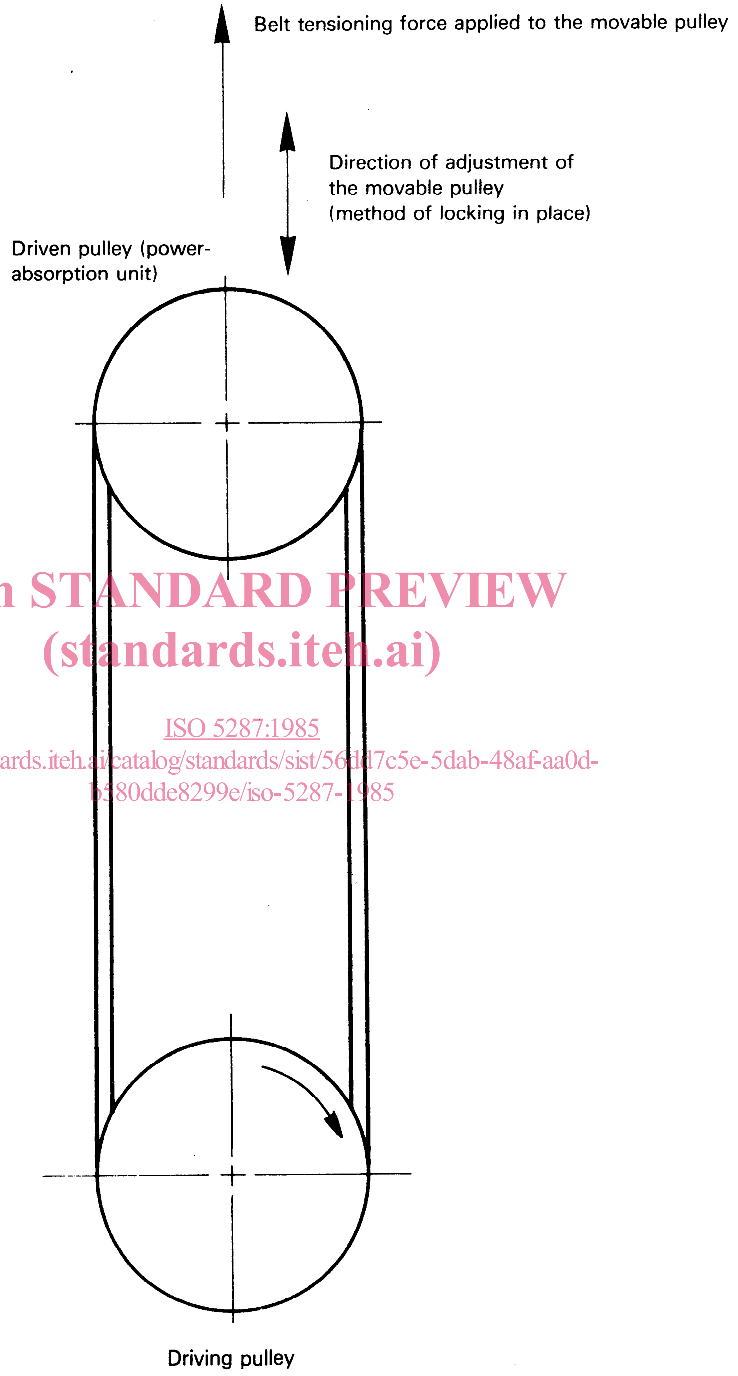

Figure 3 — Two-pulley test machine layout

NOTE — The belt mounted on the test pulleys should be aligned to within ± 15′ in relation to the plane through the centre of each pulley groove.

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