



BSI Standards Publication

Belt drives — V-belts for the automotive industry — Fatigue test

National foreword

This British Standard is the UK implementation of [ISO 5287:2021](#). It supersedes [BS ISO 5287:2003](#), which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee MCE/10, Belts & Pulley Drive.

A list of organizations represented on this committee can be obtained on request to its committee manager.

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

© The British Standards Institution 2021
Published by BSI Standards Limited 2021

ISBN 978 0 539 15127 5

ICS 43.060.10

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 August 2021.

Amendments/corrigenda issued since publication

Date	Text affected
------	---------------

INTERNATIONAL
STANDARD

ISO
5287

Fourth edition
2021-07-28

**Belt drives — V-belts for the
automotive industry — Fatigue test**

*Transmission par courroies — Courroies trapézoïdales pour
l'industrie automobile — Essai de fatigue*



Reference number
ISO 5287:2021(E)



COPYRIGHT PROTECTED DOCUMENT

© ISO 2021, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO’s member body in the country of the requester.

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents		Page
Foreword		iv
1	Scope	1
2	Normative references	1
3	Terms and definitions	1
4	Symbols	1
5	Principle	2
6	Apparatus	2
	6.1 Dynamic test machine	2
	6.2 Test pulleys	3
7	Test room condition	6
8	Test method	6
	8.1 Test conditions	6
	8.2 Procedure	7
	8.2.1 Preparation	7
	8.2.2 Test	7
	8.2.3 Retensioning	8
9	Test report	8

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 documents 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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 1, *Friction*.

This fourth edition cancels and replaces the third edition ([ISO 5287:2003](http://www.iso.org/iso/5287:2003)), which has been technically revised. The main changes compared to the previous edition are as follows:

- symbols table has been added;
- cogged type has been added;
- fatigue test conditions of AV 17 type have been added;
- datum width of fatigue test pulley has been deleted.

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.

Belt drives — V-belts for the automotive industry — Fatigue test

1 Scope

This document specifies a fatigue test for the quality control of V-belts (sections AV 10, AV 10X, AV 13, AV 13X, AV 17 and AV 17X) intended for driving the auxiliaries of internal combustion engines used for automotive purposes.

NOTE The dimensional characteristics of these belts and of the corresponding pulleys are the subject of [ISO 2790](#).

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 683-1](#), *Heat-treatable steels, alloy steels and free-cutting steels — Part 1: Non-alloy steels for quenching and tempering*

[ISO 2790](#), *Belt drives — V-belts for the automotive industry and corresponding pulleys — Dimensions*

[ISO 4287](#), *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters*

[ISO 6508-1](#), *Metallic materials — Rockwell hardness test — Part 1: Test method*

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological 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 Symbols

For the purpose of this document, the following symbols apply.

Symbol	Definition	Unit
d_{e1}	effective diameter of both the driving and driven pulleys	mm
d_{e2}	effective diameter of the idler pulley	mm
E	centre distance between the driving and driven pulleys	mm
F	belt tensioning force	N
g	additional slip	%

6.1.4 Device, through which tension can be applied to the belt:

- a) in the case of the three-pulley test machine layout, an idler pulley (see [Figure 1](#));
- b) in the case of the two-pulley test machine layout, a movable pulley (see [Figure 2](#)).

6.1.5 Means of determining belt slip, to an accuracy of $\pm 1\%$.

The layout of the pulleys and the direction of rotation shall be as shown in [Figures 1](#) and [2](#).

In order to accommodate different lengths of belt, the position of the driving and driven elements, 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.

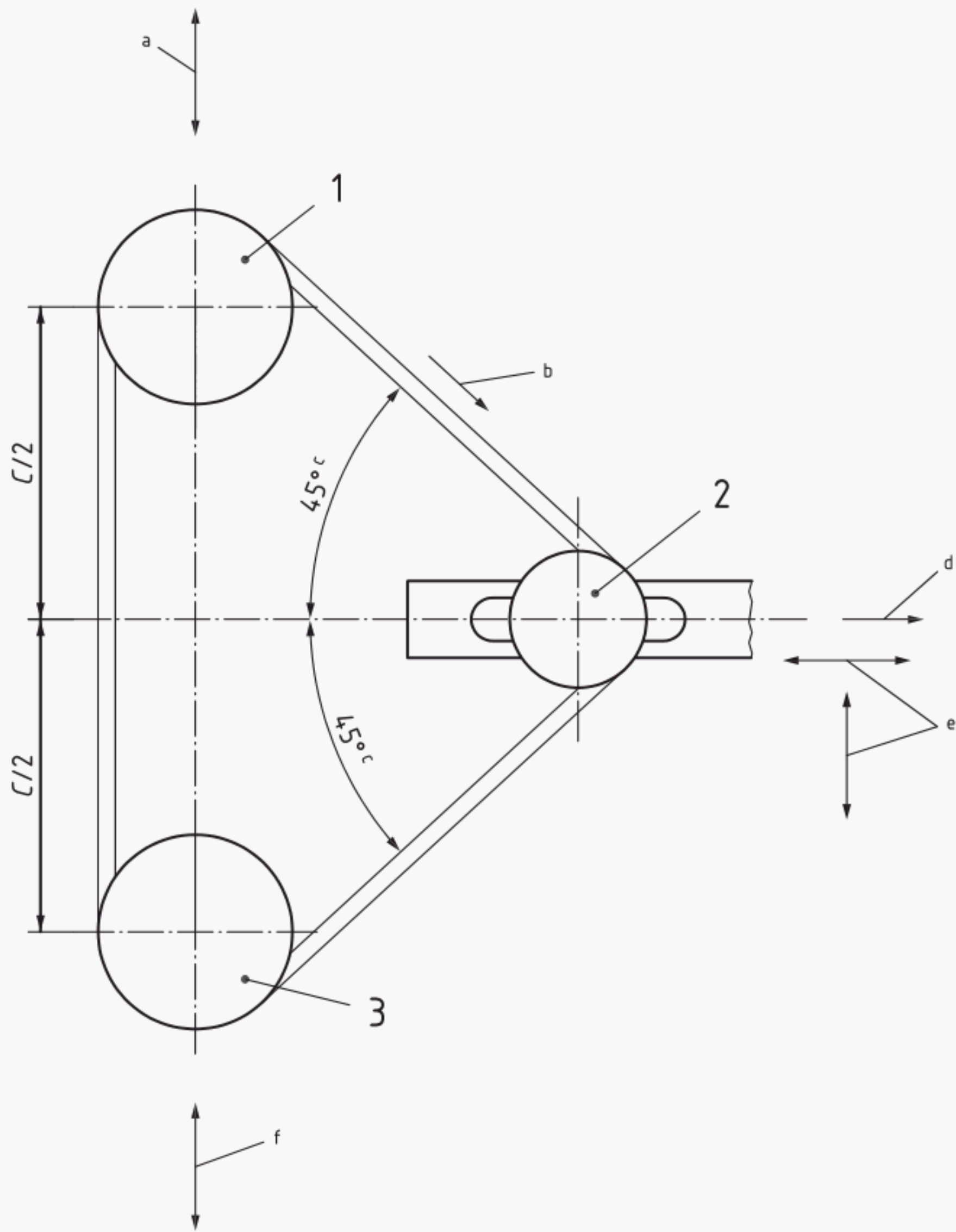
So that tension can be satisfactorily applied to the belt, and in order to allow for belt stretch, the idler pulley of the three-pulley test machine and its bearing assembly shall be free to slide, as and when necessary, in its support bracket along the line of application of the tensioning force. In 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 1](#)).

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 2](#)). A method of locking the movable unit in position, with a given tension in the V-belt, shall be provided.

6.2 Test pulleys

Test pulleys, which shall comply with the following requirements: be made of steel as defined in [ISO 683-1](#), with a surface hardness of 55 HRC, in accordance with [ISO 6508-1](#), and the pulley groove with a surface roughness such that the arithmetical mean deviation of the evaluated profile, R_a , defined by [ISO 4287](#) is lower than $0,8\text{ }\mu\text{m}$.

The characteristics of the test pulleys are given in [Figure 3](#) and [Table 1](#).



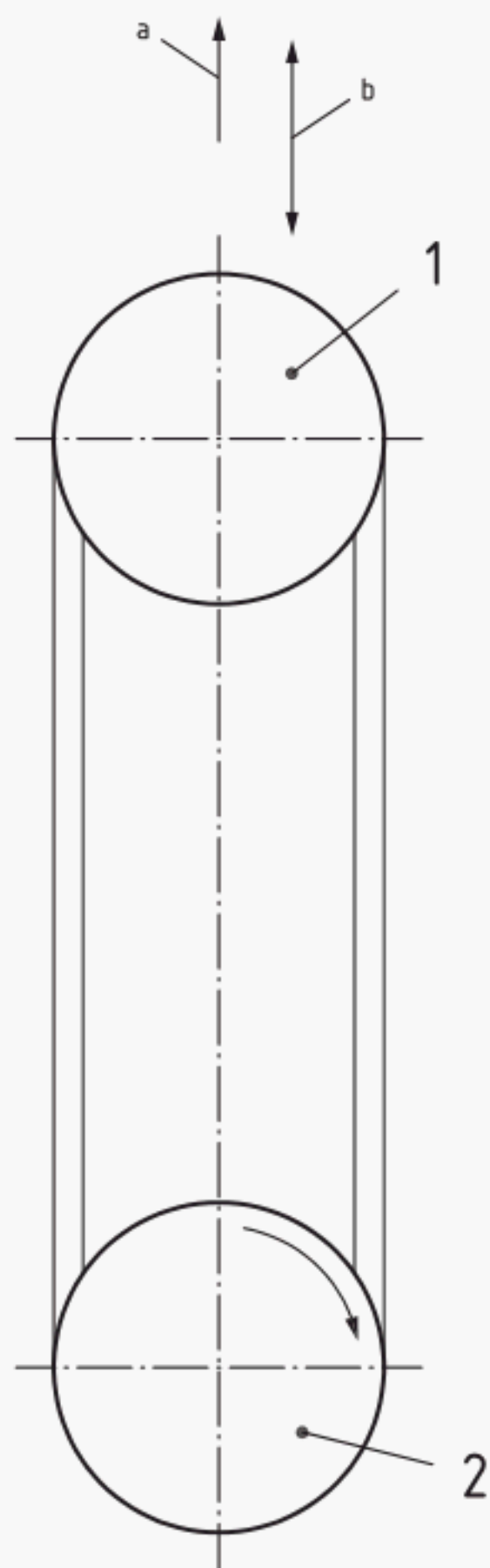
Key

- 1 driven pulley (power-absorption unit)
- 2 idler pulley — set in slide
- 3 driving pulley

The belt, mounted on the test pulleys, should be aligned to within $\pm 0,25^\circ$ in relation to the plane through the centre of each pulley groove.

- a Direction of adjustment of driven pulley.
- b Direction of rotation.
- c 45° is specified for the initial test layout, and may change slightly with retensioning during the course of the test.
- d Belt tensioning force applied to the idler pulley.
- e Directions of adjustment of idler pulley assembly and its support bracket.
- f Direction of adjustment of driving pulley.

Figure 1 — Three-pulley test machine layout



Key

- 1 driven pulley (power-absorption unit)
- 2 driving pulley

The belt, mounted on the test pulleys, should be aligned to within $\pm 0,25^\circ$ in relation to the plane through the centre of each pulley groove.

- a Belt tensioning force applied to the movable pulley.
- b Direction of adjustment of the movable pulley (method of locking in place).

Figure 2 — Two-pulley test machine layout

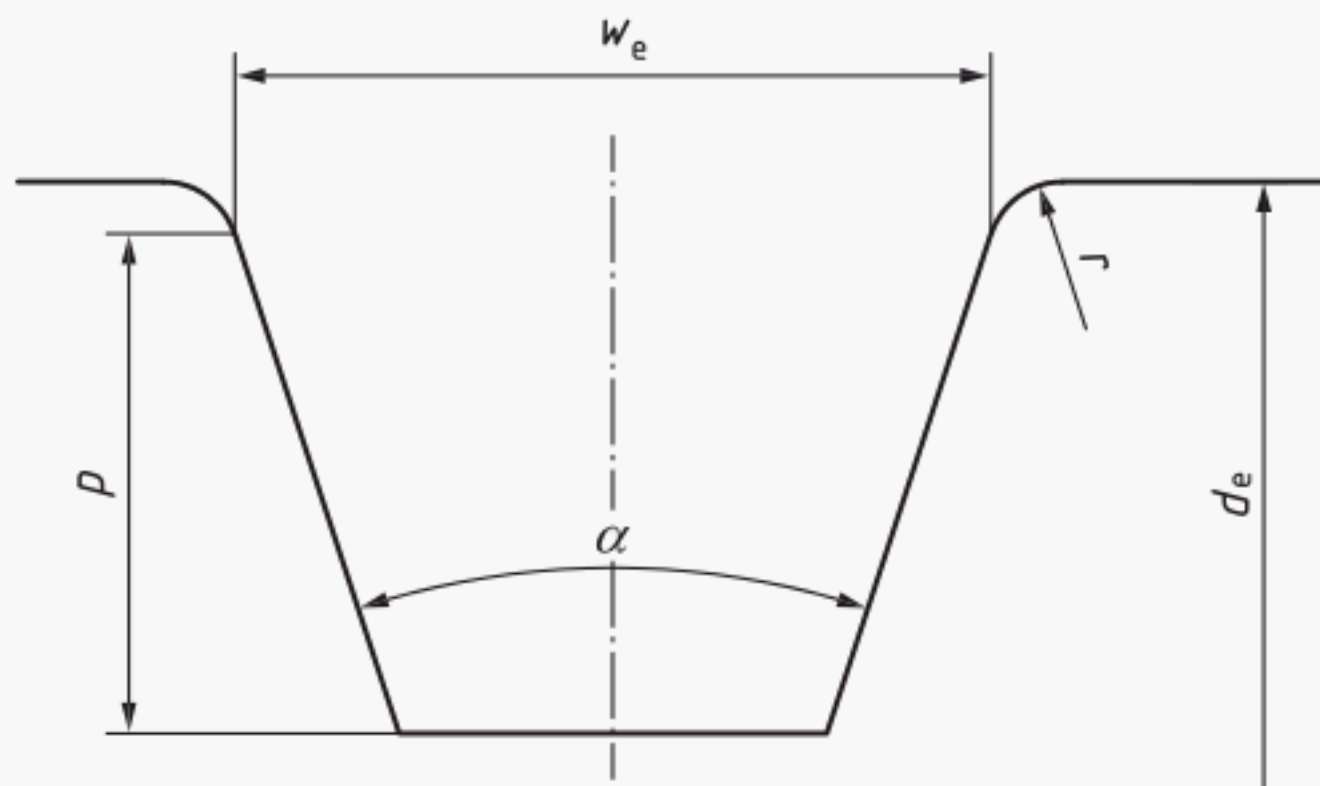


Figure 3 — Test pulley groove

Table 1 — Characteristics of test pulley groove

Dimensions in millimetres

Designation	Symbol	Section		
		AV 10	AV 13	AV 17
Effective diameter of the driving pulley and of the driven pulley (three-pulley test machine)	d_{e1}	$121 \pm 0,2$	$127 \pm 0,2$	$127 \pm 0,2$
Effective diameter of the driving pulley and of the driven pulley (two-pulley test machine)	d_{e1}	$63 \pm 0,2$	$76 \pm 0,2$	$85 \pm 0,2$
Effective diameter of the idler pulley ^a (three-pulley test machine)	d_{e2}	$57 - 63 - 76 \pm 0,2$	$70 - 76 - 89 \pm 0,2$	$90 - 100 \pm 0,2$
Effective width	w_e	9,7	12,7	16,8
Groove angle of the driving pulley and of the driven pulley	α	$36^\circ \pm 0,5^\circ$	$36^\circ \pm 0,5^\circ$	$36^\circ \pm 0,5^\circ$
Groove angle of the idler pulley (three-pulley test machine)		$36^\circ \pm 0,5^\circ$	$36^\circ \pm 0,5^\circ$	$34^\circ \pm 0,5^\circ$
Minimum groove depth	p	11	13,75	16
Minimum curve radius of the sides as the top of the groove	r	0,8	0,8	1,5
^a When the idler pulley effective diameter is reduced, it should be understood that the life of the belt is reduced too.				

7 Test room condition

The ambient temperature in the test room shall be between 18 °C 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.

8 Test method

8.1 Test conditions

For each test, the general layout of the pulleys relative to each other shall be as shown in [Figures 1](#) and [2](#). 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 [Formula \(1\)](#).

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

(1)

where

- E is the centre distance between the driving and driven pulleys;
- L_e is the effective length of the belt, which shall be 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:

- for AV 10 and AV 10X belts: 4 900 min⁻¹;
- for AV 13, AV 13X, AV 17 and AV 17X belts: 4 700 min⁻¹.

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 the force applied to the driven pulley, shall be in accordance with [Formula \(2\)](#).

$$F = K \times P \quad (2)$$

where

- F is the belt tensioning force, in newtons;
- P is the transmitted power, in kilowatts;
- K is equal to:
 - 60 N/kW, in the case of the three-pulley test machine;
 - 110 N/kW, in the case of the two-pulley test machine.

8.2 Procedure

8.2.1 Preparation

8.2.1.1 Three-pulley test machine

After mounting the belt on the pulleys, apply the specified belt tensioning force (see 8.1) to the idler pulley while the idler pulley support bracket is moved in its slide, bring the drive up to the specified rotational frequency (see 8.1). Then apply the relevant load to the driven pulley as quickly as possible. Run the drive under these conditions for $5 \text{ min} \pm 15 \text{ s}$, 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.

8.2.1.2 Two-pulley test machine

Use the same procedure as in 8.2.1.1 with the movable unit taking the place of the idler pulley support.

8.2.2 Test

Restart 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 Formula (3).

$$g = (i_0 - i_f) / i_0 \times 100 \quad (3)$$

with

$$i_0 = \frac{n_0}{N_0}$$

and

$$i_f = \frac{n_f}{N_f}$$

where

- 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.

8.2.3 Retensioning

If the 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, relock the idler support bracket in the mid-position as described in [8.2.1](#) and repeat the test specified in [8.2.2](#).

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

9 Test report

The test report shall include at least the following information:

- a) a reference to this document, i.e. [ISO 5287](#);
- b) the identity 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 retensioned;
- h) the mean ambient temperature during the test;
- i) the date of the test.

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards-based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Copyright in BSI publications

All the content in BSI publications, including British Standards, is the property of and copyrighted by BSI or some person or entity that owns copyright in the information used (such as the international standardization bodies) and has formally licensed such information to BSI for commercial publication and use.

Save for the provisions below, you may not transfer, share or disseminate any portion of the standard to any other person. You may not adapt, distribute, commercially exploit or publicly display the standard or any portion thereof in any manner whatsoever without BSI's prior written consent.

Storing and using standards

Standards purchased in soft copy format:

- A British Standard purchased in soft copy format is licensed to a sole named user for personal or internal company use only.
- The standard may be stored on more than one device provided that it is accessible by the sole named user only and that only one copy is accessed at any one time.
- A single paper copy may be printed for personal or internal company use only.

Standards purchased in hard copy format:

- A British Standard purchased in hard copy format is for personal or internal company use only.
- It may not be further reproduced – in any format – to create an additional copy. This includes scanning of the document.

If you need more than one copy of the document, or if you wish to share the document on an internal network, you can save money by choosing a subscription product (see 'Subscriptions').

Reproducing extracts

For permission to reproduce content from BSI publications contact the BSI Copyright and Licensing team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email cservices@bsigroup.com.

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Useful Contacts

Customer Services

Tel: +44 345 086 9001

Email: cservices@bsigroup.com

Subscriptions

Tel: +44 345 086 9001

Email: subscriptions@bsigroup.com

Knowledge Centre

Tel: +44 20 8996 7004

Email: knowledgecentre@bsigroup.com

Copyright & Licensing

Tel: +44 20 8996 7070

Email: copyright@bsigroup.com

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

