

Automotive V-ribbed belts

1. Scope

This standard specifies the V-ribbed belts (hereinafter referred to as "belts") for driving the cooling fans, alternators, water pumps, compressors, power steering pumps, superchargers, etc. of automobile internal combustion engines.

Remarks :

The applicable standards to this standard are as follows.

- JIS B 0601** Definitions and designation of surface roughness
- JIS Z 8401** Rules for rounding off of numerical values
- JASO E 110** Test method for toothed belts for automobiles
- JASO E 111** Shape and dimension of V-ribbed pulley grooves for automobiles

2. Definitions

Definitions of main terms used in this standard are as follows.

(1) Effective length

The length of a line circumscribing a belt through the effective circumference of a measuring pulley when the belt is placed onto two measuring pulleys with a specified force applied.

(2) Pitch zone

A zone in a belt where any extension and retraction are not present when it is bent. It is used to calculate the speed ratio of the pulley.

(3) Normal bending

A state of a belt in which the belt is placed with its rib section faced inward.

(4) Reverse bending

A state of a belt in which the belt is placed with its rib section faced outward.

3. Classification

The belt is of PK type only.

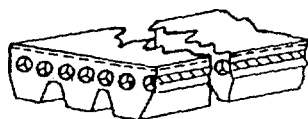
4. Quality

4.1 Performance

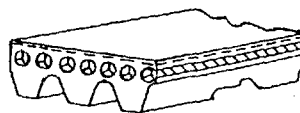
To test the performance of the belt, a test comprising normal bending only

(The test conditions are listed in A1) or a test including reverse bending (The test conditions are listed in B1) as indicated in **paragraph 9.2** shall be selected according to the pulley layout in which the belt is used. As the result of the test, any damages as shown in **Fig. 1** must not be produced, and the second re-tensioning must not be required.

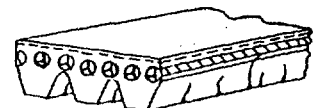
Fig. 1



Belt break down



Rib rubber chunk
(at one or more place)



Rib rubber crack
(Crack reached to
tension member)

4.2 Tensile characteristics

The test of the belt for tensile characteristics shall be carried out on the method in **paragraph**

9.3, and the tensile strength and elongation must meet the requirements in **Table 1**.

Table 1 Tensile Characteristics

Number of ribs	Tensile characteristics		
	Tensile strength	Elongation	
	Max. tensile force kN	%	Force at measurement kN
3	2.40 or over	3.0 or below	0.75
4	3.20 or over		1.00
5	4.00 or over		1.25
6	4.80 or over		1.50
7 or over	$0.80 \times n^{(1)}$ or over		$0.25 \times n$

Note (1) : n means the number of ribs

4.3 Low temperature resistance

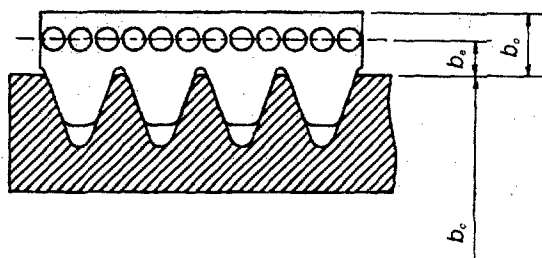
The test of the belt for low temperature resistance shall be carried out on the method in paragraph 9.4, and any crack must not be developed.

4.4 Pitch zone height and ride out

The pitch zone height and ride out of the belt are indicated by the heights b_c and b_o protruded

outward from the effective diameter d_e of the pulley as shown in Fig. 2, respectively. The ride out is measured by the method in subparagraph 9.1.3. The reference values and tolerances of pitch zone height and ride out, and the pitch zone height measuring method shall be determined in accordance with the mutual agreement between the manufacturer and the user.

Fig.2 Pitch zone height and ride out



Where b_c : Pitch zone height (mm)
 b_o : Ride out (mm)
 d_e : Pulley effective diameter (mm)

4.5 Minimum pulley diameter

For minimum pulley diameters, the minimum

recommended pulley diameters are listed in Table 2 for the durability of the belt.

Table 2 Minimum Recommended Pulley Diameters

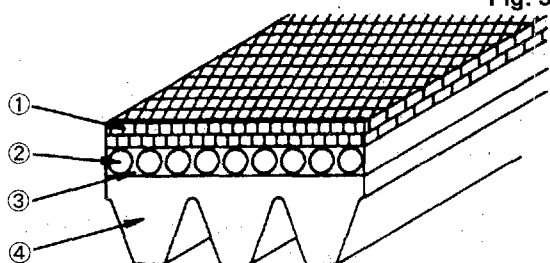
	Unit : mm	
	Normal bending pulley	Reverse bending pulley
Effective diameter	55	—
Outer diameter	—	85

5. Construction

The belt must be endless with the construction as shown in Fig. 3.

The construction with three ribs is shown in Fig. 3 as an example.

Fig. 3 Construction



No.	Name
①	Back side fabric
②	Tension member
③	Adhesive rubber
④	Rib rubber

6. Nominal dimensions

6.1 Nominal dimensions of belt cross sections

The nominal dimensions of belt cross sections are listed in Table 3.

Table 3 Belt Cross Sections

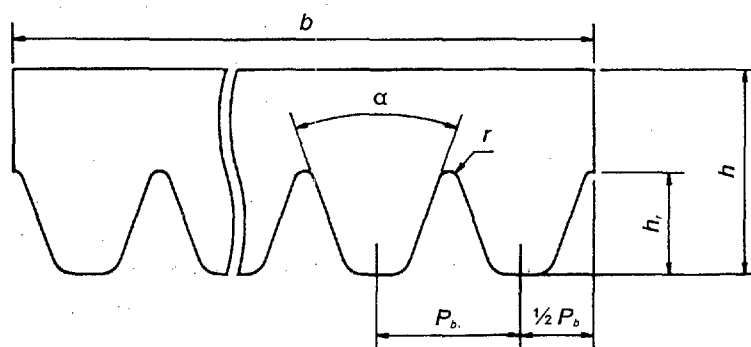


Table 3 Belt Cross Sections

Unit : mm

Items		Nominal dimension
Name	Symbol	
Rib pitch	P_b	3.56
Rib angle	α	40(°)
Radius at groove bottom	r	Max. 0.25
Belt width	b	$3.56 \times n(^1)$
Belt thickness	h	4.5 to 6 (Reference)
Rib height	h_r	2 to 3 (Reference)

6.2 Lengths

The length of a belt is indicated by the effective length and measured by the method in paragraph 9.1, and the length shall be within the

tolerance in Table 4. In general, the nominal values of the belt effective length is the multiple of 10 mm.

Table 4 Tolerances of Effective Lengths

Unit : mm

Nominal value of effective length	Tolerance
UP through 1000	± 5.0
Over 1000 to and incl. 1200	± 6.0
Over 1200 to and incl. 1500	± 8.0
Over 1500 to and incl. 2000	± 9.0
Over 2000 to and incl. 2500	± 10.0
Over 2500 to and incl. 3000	± 11.0

Remark : The tolerances of effective lengths exceeding 3000 mm shall be determined in accordance with the mutual agreement between the manufacturer and the user.

7. Appearance

The belt must be free from any visible harmful twisting, distortion, flaws, pin holes, foreign matter, etc.

8. Materials

8.1 Rubber

The adhesive rubber and rib rubber shall be uniform in composition.

8.2 Back side

The back side shall be made of cotton, synthetic plain weave fabric, or these mixed fabric, and shall be free from harmful flaws, distortion, etc. The density of its warp and weft shall be uniform.

8.3 Tension member

The tension member shall be made of synthetic fiber cords, etc., and its twist shall be uniform.

9. Test procedure

9.1 Measurement of effective belt length and ride out

9.1.1 Measuring fixture

The measuring fixture is composed of two rotatable pulleys with groove cross section dimensions as shown in Table 5. One of the pulleys is

fixed in position, and the other one is movable while a specified force is applied in forcing direction. The conceptual drawing of the fixture is shown in Fig. 4.

9.1.2 Measurement of effective belt length

To determine the effective belt length L_e , place the belt onto the measuring fixture in subparagraph 9.1.1, with $100 \times n(^1)$ N measuring force applied, and rotate the belt at least two revolutions. Then measure the center distance between the pulley shafts and calculate the effective length, L_e , of the belt using the following formula.

$$L_e = E_{max} + E_{min} + U_e$$

Where L_e : Effective belt length

E_{max} : Maximum centre distance

E_{min} : Minimum centre distance

U_e : Effective circumference of measuring pulleys

NOTE (2) : For force, the measuring force is applied with a weight calibrated by Japanese Weight and Measure Act, hydraulic pressure, or the equivalent method.

Fig. 4 Effective Length Measuring Fixture

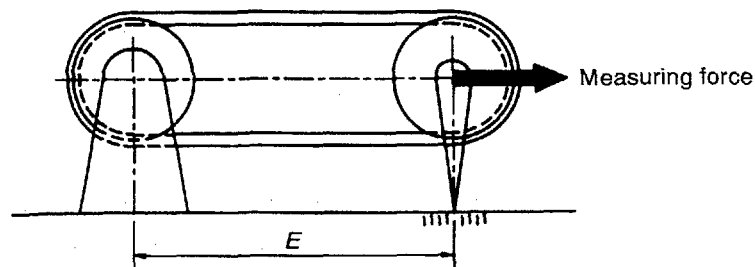


Table 5 Groove Dimensions and Tolerances of Measuring Pulley Grooves

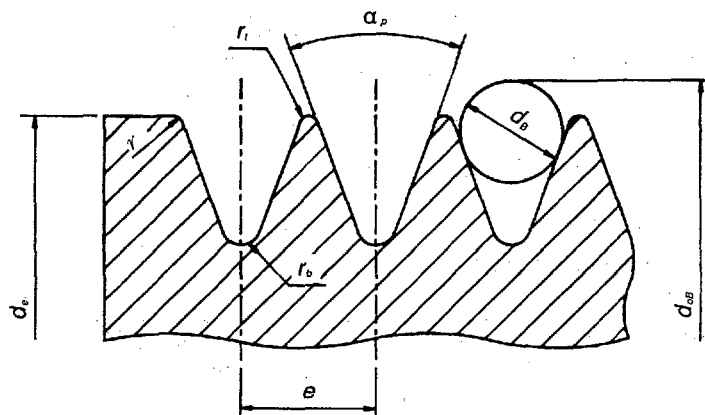


Table 5 Groove Dimensions and Tolerances of Measuring Pulley Grooves

Unit : mm

Item		Nominal dimensions	Tolerance
Name	Symbol		
Groove pitch	e	3.56	$\pm 0.05(^{\circ})$
Groove angle	α_p	40(^{\circ})	$\pm 0.25(^{\circ})$
Effective diameter	d_e	95.5	—
Checking ball or rod diameter	d_b	2.50	± 0.01
Diameter over balls or rods	d_{ob}	96.49	± 0.13
Radius at groove tip	r_t	0.25	+0.18 0
Radius at groove bottom	r_b	Max. 0.5	—
Effective circumference of measuring pulleys	U_o	300	—

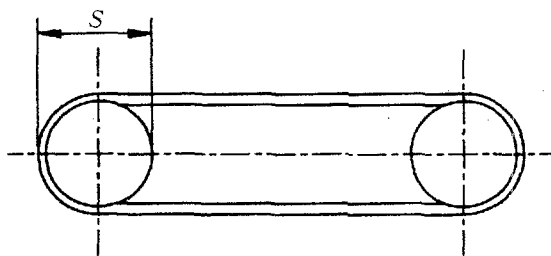
Note(³) : Even if the number of grooves is eight or over, the cumulative pitch error of any adjacent two grooves must be within $\pm 0.3\text{mm}$.

9.1.3 Measurement of ride out

To determine the ride out, b_o , of a belt, take the same procedure as in measurement of effective belt length in subparagraph 9.1.2 and measure

the dimension S , shown in Fig. 5. Then calculate the ride out b_o , of the belt using the following formula.

Fig. 5



$$b_o = S - d_e$$

Where b_o : Ride out (mm)

d_e : Pulley effective diameter (mm)

9.2 Dynamic test

9.2.1 Test belts

As test belts, the number of ribs and the effective length are shown in Table 6.

9.2.2 Test equipment

The test equipment shall consist of pulley layout shown in Fig. 6. It is composed of the pulleys shown in Table 7 and the heat chamber surrounding the drive, and is driven by an electric motor. The ambient temperature in the chamber shall be controlled.

9.2.3 Test procedure

For the test, first the belt shall be installed on the test equipment with its rib section faced inward, and with the tensioning force shown in Fig. 6 applied, and the belt is rotated manually two to three turns with the tensioning pulley shaft set in

movable condition before the shaft is fixed. Then the rotational speeds of the drive and driven pulleys are measured at no load, and the test is started at the ambient temperature of $85 \pm 5^{\circ}\text{C}$ under the conditions shown in Fig. 6.

If the slip ratio reaches 4 %, the test shall be stopped and the equipment and belt shall be allowed to cool to a temperature of 15 to 35°C . Then the belt is re-tensioned in the same conditions as stated above, and the test is re-started. The slip ratio is calculated by the following formula.

$$g = \frac{I_o - I_f}{I_o} \times 100$$

$$I_o = \frac{N_{20}}{N_{10}}$$

$$I_f = \frac{N_{2f}}{N_{1f}}$$

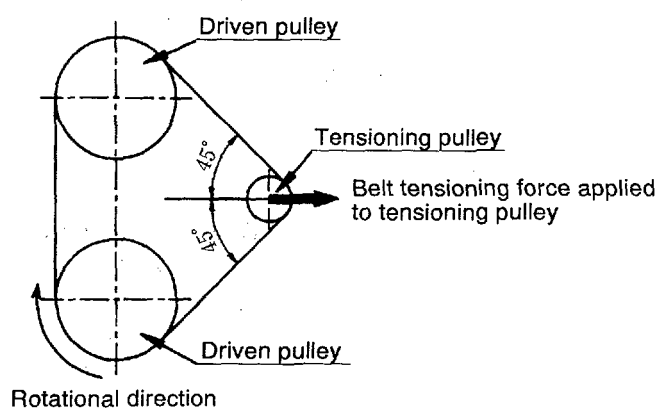
Where g :	Slip ratio (%)	N_{21} :	Final rotational frequency of driven pulley (r/min)
N_{10} :	Initial rotational frequency of driving pulley (r/min)		
N_{20} :	Initial rotational frequency of driven pulley (r/min)	Remarks :	
N_{11} :	Final rotational frequency of driving pulley (r/min)	1. In case of testing with new pulleys, the pulleys shall be run with a belt (not for test) for at least 48 hours under the conditions shown in Fig. 6 before the test is started.	
		2. The mis-alignment between the pulleys shall be at most 1/3 degree.	

Table 6 Belts for Dynamic Test

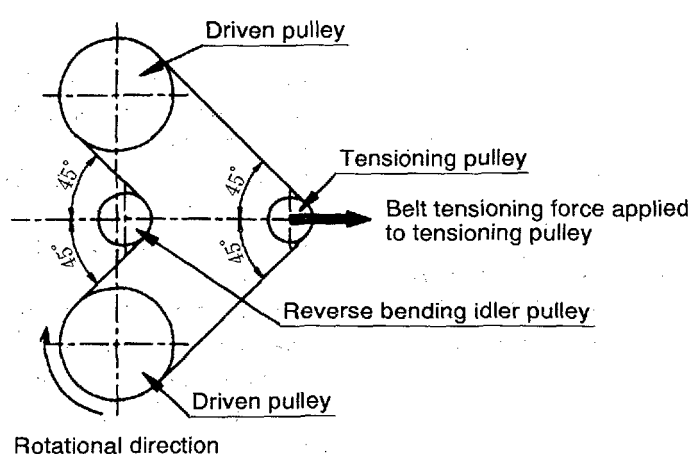
Test conditions	Number of ribs	Belt length range mm
Test condition A1	3	850-1000
Test condition B1	3	1050-1300

Fig. 6 Dynamic Test Conditions

Test condition A1



Test condition B1



Driving pulley speed r/min	Load kW	Tensioning force N	Test time h
4800 ± 100	8	680 ± 30	50

Table 7 Groove Dimensions of Dynamic Test Pulleys

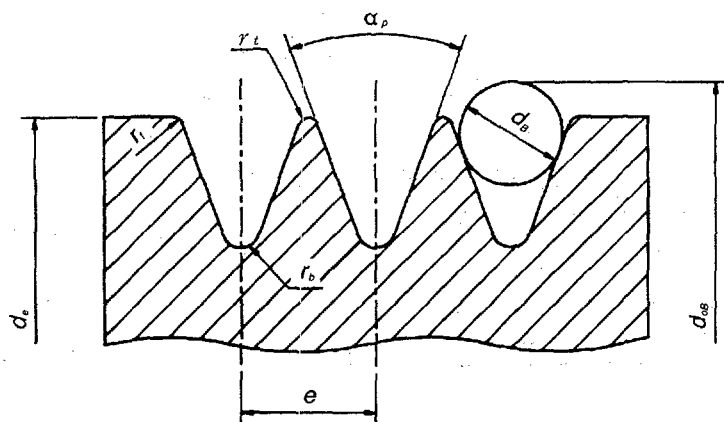


Table 7 Groove Dimensions of Dynamic Test Pulleys

Unit : mm

Symbol	Driving & driven pulley	Tensioning pulley	Reverse bending idler pulley
e	3.56 ± 0.05	3.56 ± 0.05	—
α_p	$40 \pm 1(^{\circ})$	$40 \pm 1(^{\circ})$	—
d_e	120.0	55.0	—
$d_o (^{*})$	—	—	80.0×0.1
d_g	2.50 ± 0.01	2.50 ± 0.01	—
d_{os}	120.99 ± 0.25	55.99 ± 0.25	—
r_t	$0.25^{+0.18}_0$	$0.25^{+0.18}_0$	—
r_b	Max. 0.50	Max. 0.50	—

Note (*): The d_o is the outer diameter of the reverse bending idler pulley, and used for the test condition B1.

Remark: The other data and dimensions must be in accordance with JASO E 111.

The surface roughness of the reverse bending idler pulley must be 3.2a specified in JIS B 0601

9.3 Tensile test

9.3.1 Specimen

As specimens, three test pieces of at least 250 mm long are cut off from one belt, and a bench mark of 100 mm apart for measurement of elongation is drawn on the center of them. If three test pieces cannot be sampled from one product, the number of samples shall be determined in accordance with the agreement between the manufacturer and the user.

9.3.2 Test procedure

The test shall be carried out by the tensile tester at the ambient temperature of $25 \pm 5^{\circ}\text{C}$ and the test speed shall be 50 ± 5 mm/min.

To determine elongation, measure the bench mark distance when the force shown in Table 1 in paragraph 4.2 applied, and calculate the percentage elongation.

The tensile strength is the maximum tensile force at which the test piece breaks.

In general, the standard measured value is determined by averaging the three measurements and rounding off to two decimals in accordance with JIS Z 8401.

The measured values for the test piece broken at the gripped section must be excluded. In this case, another test pieces shall be sampled from the same product and the test shall be carried out for compensation of the measured values.

9.4 Low temperature test

9.4.1 Specimen

As specimens, some test pieces are sampled from a product in the same manner as in paragraph 9.3, and pre-treated for 70% hours at the ambient temperature of $100 \pm 2^{\circ}\text{C}$.

9.4.2 Test procedure

The specimen is taken out after being soaked for 70% hours at the ambient temperature of $-30 \pm 1^\circ\text{C}$. Then it is bent immediately to the contact angle of at least 90° around the cylinder

under the bending conditions as shown in **Table 8** to check for the existence of cracks.

For the test, either the test conditions A2 or B2 is selected according to the pulley layout in which the belt is used.

Table 8 Bending Conditions

Conditions	Test condition A2	Test condition B2
Temperature in test room $^\circ\text{C}$	25 ± 5	25 ± 5
Diameter of cylinder mm	40	70
Bending direction of belt	Normal bending	Reverse bending

10. Designation of belts

The belts are designated in the order of name,

number of belt ribs, belt profile, and effective length (mm).

Example :

V-ribbed belt	3	PK	920
Name	Number of belt ribs	Belt profile	Effective length

11. Indication

The following items shall be indicated on the belt back. The items other than those indicated below may be used in mutual agreement between the manufacturer and the user.

- (1) Number of belt ribs, belt profile, and effective length
- (2) Name of manufacturer or its abbreviation
- (3) Date of manufacture or its abbreviation

Explanatory note on JASO E 109-94 Automotive V-ribbed belts

This explanatory note explains the items specified in the main body and their related items, and is not a part of the standards.

1. Purpose

The purpose of this standards is to standardize automotive V-ribbed belts and maintain the proper quality of them.

2. Object

The primary object of this revision is listed as follows.

- (1) The actual use condition in Japan is reviewed, and the standards are conformed to **ISO 9981**.
- (2) The dynamic test items corresponding to increase in the number of pulley layouts including reverse bending are specified.
The dynamic test method is made basically in accordance with **DIS 11749**.
- (3) The groove forms of V-ribbed pulleys and their tolerances which are described for reference in the **explanatory note** of the existing standards are deleted after **JASO E 111-93** has been established.
- (4) The form, terminology, and symbols used in the standards are changed to those that can be judged appropriate at the present.

3. Major review points

The following points were reviewed in the meeting for revision.

- (1) Though only life time is specified as durability in the existing standards, it was reviewed this time, and the item name was changed to performance and the content was also changed.
- (2) The durability test is made in the test conditions specified in **DIS 11749** because these conditions are similar to those used in Japan.
- (3) The minimum pulley diameter was specified because it is necessary for drive design. Since the limitation of the minimum pulley diameter depends on load conditions, pulley layout, etc., however, a value that can be

accepted generally to a large extent was studied and specified as the minimum recommended effective diameter.

- (4) Though there was an opinion that the belt profiles for normal and reverse bending could be specified according to the thickness (total thickness) of belt, it was judged that they could not be specified according to the total thickness only because the characteristics of rubber itself affects largely on the performance, it was judged that they could not be specified by the total thickness only and this opinion was not adopted.
- (5) To cope with the requirements for the narrower tolerance in belt length, the accuracy of the existing belt in length was reviewed and, in the range of belt length where the belt length was longer, the tolerance was reviewed to be narrower than that specified in the existing standards.
- (6) The test conditions for reverse bending were also added to the low temperature test corresponding to addition of pulley layouts including reverse bending to the test conditions for durability so that the test conditions could be selected according to the pulley layout.
- (7) The static high temperature test was deleted based on the judgment that the static high temperature test was no longer necessary because the dynamic test was changed to a test at high temperature.

4. Supplementary note for each specified item

The items in this standards that require supplementary explanation are explained according to the item numbers of the main body as follows.

The comparison between the existing and new standards and the conformity of them to **ISO** standards including **DIS 11749** now under discussion are explained in the applicable items, and shown in **Explanatory Table 1** as Comparison Table.

4.1 Terminology (Section 2. of main body)

To help understand this standards, effective length, pitch zone, normal bending, and reverse bending were newly specified. To prevent the "belt length" from becoming ambiguous, the effective length was specially specified.

4.2 Classification (Section 3. of main body)

Though there are five types of rib belts with different rib pitches such as PH, PJ, PK, PL, and PM, PK type only is specified in **ISO 9981**. In Japan, PK type only is used for automobiles and, therefore, this section of the standards was not revised.

4.3 Quality (Section 4. of main body)**4.3.1 Performance (Paragraph 4.1 of main body)**

- (1) Though only life time on durability test is specified in the existing standards, the item name was changed from durability to performance in this standards and it was specified in the standards that there shall not occur any damage and the second tension adjustment shall not be required in 50 hours running to confirm that any premature failure shall not occur in the field.

The test time for failure and/or second re-tension is recommended to be determined in accordance with the agreement between the manufacturer and the user.

In **DIS 11749**, the test time for dynamic test is not specified, and is to be determined according to the agreement between the manufacturer and the user.

- (2) Since the use of pulley layout including reverse bending has been increasing recently and it is severer in use condition than the use of pulley layout constituted with normal bending only, exclusive-test conditions including reverse bending were added to the existing test conditions including normal bending only and one of the test conditions shall be selected based on the practical pulley layout.
- (3) To specify the judgment for damage in dynamic test, the figure showing the configuration of damage was added.
- (4) Though dynamic test is to be made at the room temperature in the existing standards, it was changed to be made at the ambient temperature of 85 °C which is considered to

represent the actual conditions.

4.3.2 Pitch zone height and ride out (Paragraph 4.4 of main body)

The values of pitch zone height and ride out are used to calculate the rotational ratio of pulleys and the effective belt length for actual pulley layout. Since this value is determined by the combination with the belts and the pulleys, positions and symbols only are shown here, and the actually used values are determined in accordance with the agreement between the manufacturer and the user.

Also, since the pitch zone is defined as the surface of belt not extended and retracted (surface on which any stress is not produced) when the belt is bent, for the belt in this standards, it may be considered to be equivalent to the centre line of the tension member (centre line of the core in cross-section).

Accordingly, the height of the centre line of the tension member can be obtained from the cross-section dimensions to substitute it for the height of the pitch zone.

4.3.3 Minimum pulley diameter (Paragraph 4.5 of main body)

In the market, pulleys of smaller diameter are requested for compact drive and the rotational ratio increase. For example, some pulleys for normal bending (for alternator) of approx. 50 mm in diameter and those for reverse bending (for back side idler) of approx. 80 mm are now in use. Though pulleys of small diameter have effect largely on the service life of the belt, the degree of affection varies according to the conditions such as belt specifications, pulley layout, load, etc. This time, therefore, it was specified as the minimum value that can be recommended generally.

If pulleys with smaller diameter than that is required, the diameter is determined in mutual consultation between the manufacturer and the user.

In **ISO 9981**, the minimum diameter of pulleys for normal bending is specified as 45 mm, but that of pulleys for reverse bending is not specified.

4.4 Nominal dimensions (Section 6. of main body)

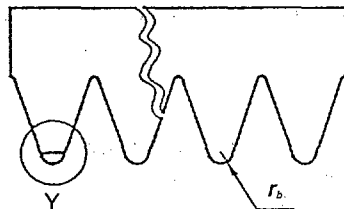
4.4.1 Nominal dimensions of belt cross-sections (Paragraph 6.1 of main body)

- (1) Though the thickness h of most belts was originally approx. 6 mm, it has been reduced to increase the flexibility, particularly, in reverse bending use and, at present, a thickness of approx. 4.5 mm is also put into practical use. Similarly, though the rib height h_r of most belts was approx. 3 mm, at present, a height of approx. 2 mm is also put into practical use. This time, it was reviewed to classify and specify the thickness h and rib heights h_r of belts. However,

the standard values was not determined because the values are still changeable. The values specified in existing standards are shown for reference.

- (2) Though the form of rib tip is not specified in this standards, in **ISO 9981**, it is specified in arc shape as shown in **Explanatory Drawing 1**. The flat shape of rib tip is also specified as an alternative shape. Though, at present, the flat shape of the rib tip becomes popular in the world including Japan, it was judged that the standardization of the rib tip was not required because the shape of rib tip does not have serious effect on the quality of the belt.

Explanatory Drawing 1 Belt Rib Tip in ISO 9981

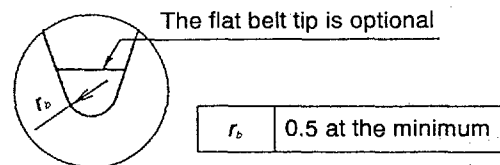


4.4.2 Lengths (Paragraph 6.2 of main body)

In the existing standards, the tolerance of the lengths of belt exceeding 2000 mm in effective length is constant. Since the Serpentine Drive has been adopted recently, however, the number of belts with effective length exceeding 2000 mm has been increasing and the requirement of the belt length tolerance has been clear, and narrower tolerance in effective belt length has been required. For these reasons, the present length tolerance was reviewed and revised as follows.

- (1) The effective belt length range from 2000 mm to 3000 mm were divided into 500 mm each. The lengths exceeding 3000 mm were not standardized due to no use of such belts at present, and they shall be determined in accordance with the agreement between the manufacturer and the user.
- (2) The tolerance of the effective belt lengths exceeding 1500 mm was changed to be narrower.

Alternative : Belt rib tip



Enlarged view of Y

4.5 Test procedure (Section 9. of main body)

4.5.1 Measurement of effective belt length and ride out (Paragraph 9.1 of main body)

4.5.1.1 Measurement of effective belt length (Subparagraph 9.1.2 of main body)

- (1) Though the measurement procedure for belt length is the same as that specified in the existing standards, the centre distance calculation formula and symbols were changed into those now used in various ISO standards on belts.

Though, in **ISO 9981**, fluctuation of centre distance is not taken into consideration in the calculation formula, it is expected to be changed to the same formula as that in this standards at the next revision.

- (2) The effective circumference U_e of length measuring pulley can be calculated by the following formula.

$$U_e = p \times d_e$$

Where d_e : Pulley effective diameter (mm)

Though there was an opinion that, if there is some manufacturing deviation in the measuring pulley as listed in **Table 6** within the tolerance, the pulley effective circum-

ference, U_s , should be adjusted, it was considered that the nominal value of 300 mm can be used as a typical value without any adjustment because of small degree of affection with such deviation.

- (3) Though the nominal dimensions of length measuring pulleys are determined in accordance with JASO E 111, the tolerances are partly smaller values than those specified in JASO E 111.

4.5.1.2 Measurement of ride out (Subparagraph 9.1.3 of main body)

Since the back side of belt is used in the pulley layout including reverse bending, ride out value is required to calculate the belt length. For this, the measurement method for it is specified in accordance with Paragraph 9.2 (Ride out measurement) of JASO E 107.

In ISO 9981, the measurement method for the ride out is not specified.

4.5.2 Dynamic test (Paragraph 9.2 of main body)

4.5.2.1 Test belts (Subparagraph 9.2.1 of main body)

In the existing standards, the number of ribs is specified from three to six.

Since a difference in number of ribs has less effect on the test results, however, the number of ribs was changed to three only at this revision in accordance with DIS 11749.

If any product with the belt lengths as listed in Table 6 is not available, products with the same lengths as listed in Table 6 must be produced in the same construction and with the same material for use as specimens.

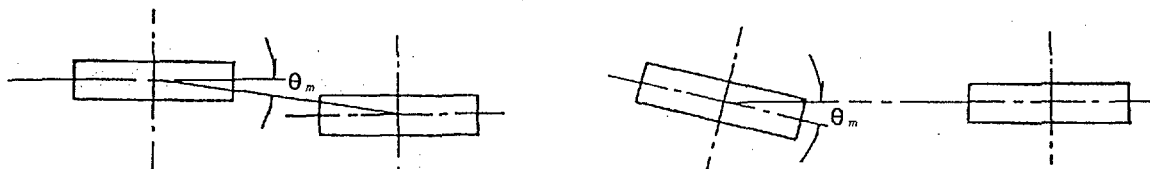
4.5.2.2 Test equipment (Subparagraph 9.2.2 of main body)

The test condition A1 constituted with normal bending only is the same pulley layout as in the existing standards, and the test condition B1 including reverse bending is the pulley layout by adding reverse bending idler pulley to the test condition A1 using DIS 11749 as a reference.

Though, in DIS 11749, two-axis dynamic test is also specified, it was not adopted in this standards because the test condition A1 can be substituted for it.

Also, since a mis-alignment between pulleys may cause uneven wear and has effect on the test results, the allowable limit of it was specified. The mis-alignment between pulleys is shown in Explanatory Drawing 2.

Explanatory Drawing 2



θ_m : Mis-alignment between pulleys

4.5.2.3 Test procedure (Subparagraph 9.2.3 of main body)

- (1) Though, in the existing standards, the test is to be carried out at the temperature of $20 \pm 10^\circ\text{C}$ at this revision, the test procedure was reviewed and revised to the test temperature which represents the actual condition. Though, in DIS 11749, the temperature of $80 \pm 5^\circ\text{C}$ is used, the temperature of $85 \pm 5^\circ\text{C}$ was adopted because it is often used in Japan.
- (2) The calculation formula for slip ratio as a reference for tension adjustment was specified. This calculation formula is used generally in Japan, and it is considered that there

is no slippage in no-load condition at the start of the test, and the rotational ratio of the drive pulleys and driven pulleys measured in loaded condition is adjusted by the rotational ratio at no-load to obtain the slip ratio (%).

On the other hand, though the conditions in which tension adjustment is required are specified in DIS 11749, it is different from the slip ratio in this standards. Based on the rotational ratio of the drive and driven pulleys measured with load applied at the start of the test, the amount of variation (usually increases) in rotational ratio according to collapse of test time is obtained

as the slip ratio increased amount (%), and 4 % or more is specified for re-tensioning. Accordingly, with idea of slip ratio specified in this standards, the slip ratio for re-tensioning becomes slightly larger than 4 %.

At around the slip ratio of 4 %, however, the frictional transmission belt is generally unstable, and it is judged that slippage is increased at high rate. Therefore, a difference in test time for re-tensioning required is considered to be small. For reference, the slip ratio increase amount calculation formula in DIS 11749 is shown below.

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

$$i_o = \frac{n_o}{N_o} \quad \bullet \quad i_f = \frac{n_f}{N_f}$$

Where g : Slip ratio increase amount (%)
 n_o : Initial rotational frequency of driven pulley
 n_f : Final rotational frequency of driven pulley
 N_o : Initial rotational frequency of driving pulley
 N_f : Final rotational frequency of driving pulley

4.5.3 Tensile test (Paragraph 9.3 of main body)

There are two types of specimens for tensile test : one is the product itself not processed and the other is the test piece cut off from the product. Since the test piece cut off from the product is popular in Japan for the tensile test, the existing test method was carried over.

The tensile speed was changed to 50 ± 5 mm/min. to conform to that in Subparagraph 4.4.2 (Tensile Test) of JASO E 110 in which the similar items are included.

4.5.4 Low temperature test (Paragraph 9.4 of main body)

In the existing standards, a belt soaked in a specified time at a specified temperature is bent around a cylinder with a diameter of 40 mm with its rib surface faced inward. In this revision, however, the test condition B2 corresponding to the pulley layout including reverse bending was added.

Explanatory Table 1 Comparison with ISO Standards

Item	JASO E 109-94	ISO 9981:1990 Automotive V-ribbed pulleys and belts	ISO/DIS 11749(Reference) Automotive V-ribbed belt Fatigue test
Durability	The dynamic test is performed in accordance with Paragraph 9.2 and there must be no damage as shown in Fig. 1 or no second tension adjustment required.	—	In accordance with the agreement between the manufacturer and the user.
Tensile characteristics	In accordance with Tensile characteristics in Table 2 .	—	—
Pitch zone height and ride out	For pitch zone height, positions and symbols are specified and, for ride out, positions, symbols, and measurement method are specified.	The position of pitch zone height and symbols are specified, but the ride out is not specified.	—
Minimum pulley diameter mm	Minimum recommended pulley diameter. Normal bending 55 Reverse bending 85	Normal bending 45 Reverse bending is not specified.	—
Nominal dimensions of belt cross-sections	In accordance with nominal dimensions of belt cross-sections in Table 3 (Unit : mm) Rib pitch P_r 3.56 Rib angle α 40(°) Radius at rib bottoms r Max. 0.25 Belt width b 3.56 × n Belt thickness h 4.5~6 (Reference) Rib height h_r 2~3 (Reference)	Differs slightly. P_r 3.56 Angle is not specified. r_r Max. 0.25 b n × p_r h 4.5~6 (Reference) h_r is not specified. Radius at rib tip Min. 0.5	—
Tolerance of effective length mm	Up through 1000 ± 5.0 Over 1000 to and incl. 1200 ± 6.0 Over 1200 to and incl. 1500 ± 8.0 Over 1500 to and incl. 2000 ± 9.0 Over 2000 to and incl. 2500 ± 10.0 Over 2500 to and incl. 3000 ± 11.0 For over 3000, the tolerance shall be determined in accordance with the agreement between the manufacturer and the user.	The range of effective length and its tolerance are not specified.	—
Calculation formula for effective length	$L_e = E_{max} - E_{min} + U_e$	$L_e = 2E + U_e$ (Reference) In ISO 4184 , the following formula is used. $L_d = E_{max} + E_{min} + C_d$	—
Types of dynamic tests	Normal bending (3-axis) test (Test condition A1) Reverse bending (4-axis) test (Test condition B1) —	— — —	Normal bending test (3-axis test) Reverse bending test (4-axis test) 2-axis test (applicable when belt is short)

Explanatory Table 1 Comparison with ISO Standards (To Be Continued)

Item	JASO E 109-94	ISO 9981:1990 Automotive V-ribbed pulleys and belts	ISO/DIS 11749(Reference) Automotive V-ribbed belt Fatigue test
Conditions of dynamic tests			(The 2-axis test conditions are omitted.)
•Ambient temperature in test °C	85 ± 5	—	80 ± 5
•Driving and driven pulley diameters mm	120	—	121
•Tensioning pulley diameter mm	55	—	45 or 55
•Reverse bending idler pulley diameter mm	80	—	60 or 76
•Load kW	8	—	In accordance with the agreement between the manufacturer and the user
•Driving pulley rotation speed r/min	4800 ± 100	—	4900 ± 2%
•Number of belt ribs	3	—	3
•Belt tensioning force N	—	—	60 × kW
(When run-in is carried out)	680 ± 30	—	60 × kW
(When run-in is not carried out)	50	—	—
•Test time h	50	—	—
•Slip ratio for re-tensioning %	4	—	4(Slip ratio increase amount)
High temperature test (Static) Test conditions and method	—	—	—
Low temperature test (Static) Test conditions and method	After the specimen has been heataged for 70 hours at a temperature of 100 ± 2°C and then soaked for 70 hours at a temperature of -30 ± 1°C, it is taken out and tested immediately in the A2 or B2 condition indicated below for existence of cracks. Condition A2 : The specimen is bent around the cylinder of 40 mm in diameter to a contact angle of min. 90° with its rib side faced inward. Condition B2 : The specimen is bent around the cylinder of 70 mm in diameter to a contact angle of min. 90° with its rib side faced outward. The condition B2 is the test condition used for reverse bending drive.		—

Remark : The calculation expression for effective length in ISO 9981 is to be revised to that in JASO E 109-94 at the next revision of ISO 9981.

In the event of any doubt, the original standards in Japanese should be referred.

SI : THIRD PHASED STANDARD

(The standard where SI units and newly values are given and do not using customary units, but it is excepted that the standards are represented in only accustomed metric units as m, A, Hz etc.)

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