INTERNATIONAL STANDARD

ISO 9010

Second edition
1997-04-01

Synchronous belt drives — Automotive belts

Transmissions synchrones par courroies — Courroies pour la construction automobile

Reference number
ISO 9010:1997(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 9010 was prepared by Technical Committee ISO/TC 41, *Pulleys and belts (including veebelts),* Subcommittee SC 4, *Synchronous belt drives.*

This second edition cancels and replaces the first edition (ISO 9010:1987), which has been technically revised.

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Synchronous belt drives — Automotive belts

1 Scope

This International Standard specifies the characteristics of synchronous endless belts for use in automotive applications such as engine camshaft drives.

The characteristics include

— nominal tooth dimensions;

— pitch spacing;

— width and width tolerance;

— pitch length and pitch length tolerance.

Test methods for measuring pitch length and lateral runout are also included.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was 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 edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 9011:1997, *Synchronous belt drives — Automotive pulleys.*

3 Belt types

The following types of synchronous belts for automotive application are standardized:

— type ZA: trapezoidal tooth;

— type ZB: trapezoidal tooth;

— type ZH: curvilinear tooth, "H" system;

— type YH: curvilinear tooth, "H" system;
— type ZR: curvilinear tooth, "R" system;
— type YR: curvilinear tooth, "R" system;
— type ZS: curvilinear tooth, "S" system;
— type YS: curvilinear tooth, "S" system.

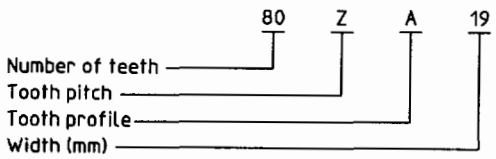
Corresponding pulleys are standardized in ISO 9011.

4 Designation

A belt is designated by a series of numbers and letters as follows:

a) the first set of numbers indicates the number of teeth;
b) the first letter indicates tooth pitch;
c) the second letter indicates tooth profile;
d) the second set of numbers indicates the width in millimetres.

EXAMPLE



5 Dimensions and tolerances

5.1 Belt tooth dimensions — Trapezoidal tooth belts of types ZA and ZB

The nominal belt tooth dimensions for trapezoidal tooth belts of types ZA and ZB are shown in figure 1 and given in table 1.

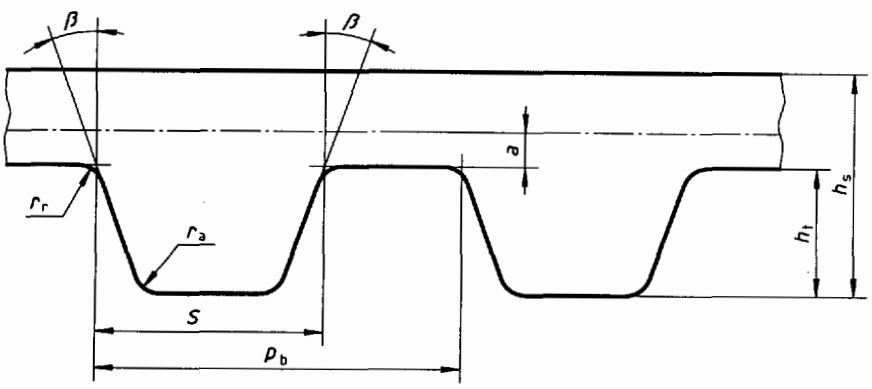


Figure 1 — Nominal tooth dimensions (profile) for types ZA and ZB

Table 1 — Nominal tooth dimensions for types ZA and ZB

Dimensions in millimetres, angles in degrees

Term	Symbol	Nominal profile	
		Type ZA	Type ZB
Tooth pitch	p_b	9,525	9,525
Tooth angle	2β	40	40
Height	h_s	4,1	4,5
Pitch line differential	a	0,686	0,686
Root radius	r_r	0,51	1,02
Tip radius	r_a	0,51	1,02
Tooth height	h_t	1,91	2,29
Tooth width	S	4,65	6,12

5.2 Belt tooth dimensions — Curvilinear tooth belts of types ZH and YH

The nominal belt tooth dimensions for curvilinear tooth belts of types ZH and YH are shown in figure 2 and given in table 2.

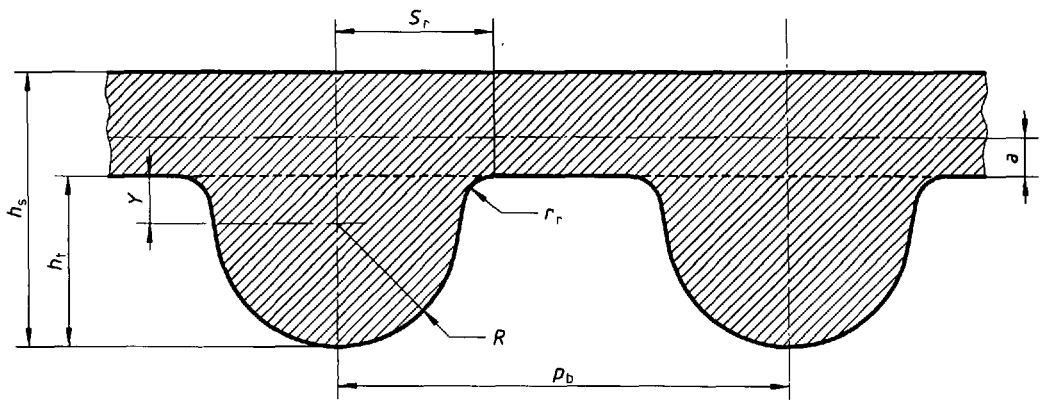


Figure 2 — Nominal tooth dimensions (profile) for types ZH and YH

Table 2 — Nominal tooth dimensions for types ZH and YH

Dimensions in millimetres

Term	Symbol	Nominal profile	
		Type ZH	Type YH
Tooth pitch	p_b	9,525	8
Height	h_s	5,5	5,2
Pitch line differential	a	0,686	0,686
Root radius	r_r	0,76	0,64
Tooth height	h_t	3,5	3,04
Tooth radius	R	2,45	2,11
Vertical offset	Y	1,05	0,93
Root radius distance	S_r	3,27	2,84

5.3 Belt tooth dimensions — Curvilinear tooth belts of types ZR and YR

The nominal tooth dimensions for curvilinear tooth belts of types ZR and YR are shown in figure 3 and given in table 3.

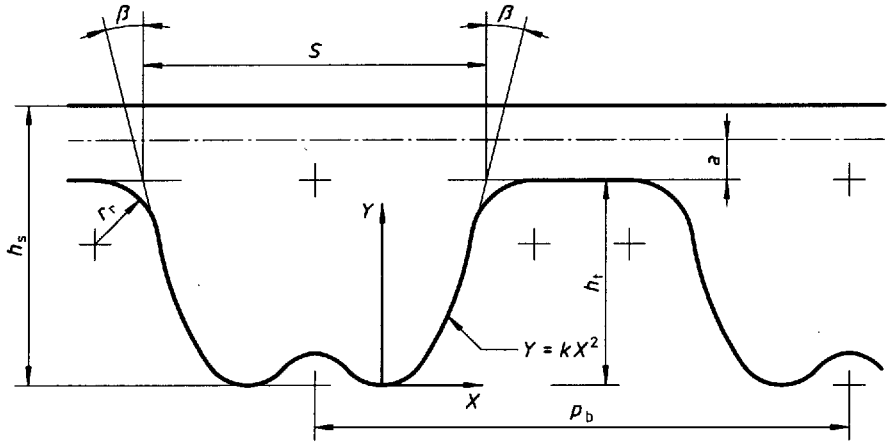


Figure 3 — Nominal tooth dimensions (profile) for types ZR and YR

Table 3 — Nominal tooth dimensions for types ZR and YR

Dimensions in millimetres, angles in degrees

Term	Symbol	Nominal profile	
		Type ZR	Type YR
Tooth pitch	p_b	9,525	8
Tooth angle	2β	32	30
Height	h_s	5,4	5,1
Pitch line differential	a	0,75	0,75
Root radius	r_r	1	0,8
Tooth height	h_t	3,2	2,8
Tooth width	S	5,5	5,3
Tooth form parameter	k	1,228	1,692

5.4 Belt tooth dimensions — Curvilinear tooth belts of types ZS and YS

The nominal tooth dimensions for curvilinear tooth belts of types ZS and YS are shown in figure 4 and given in table 4.

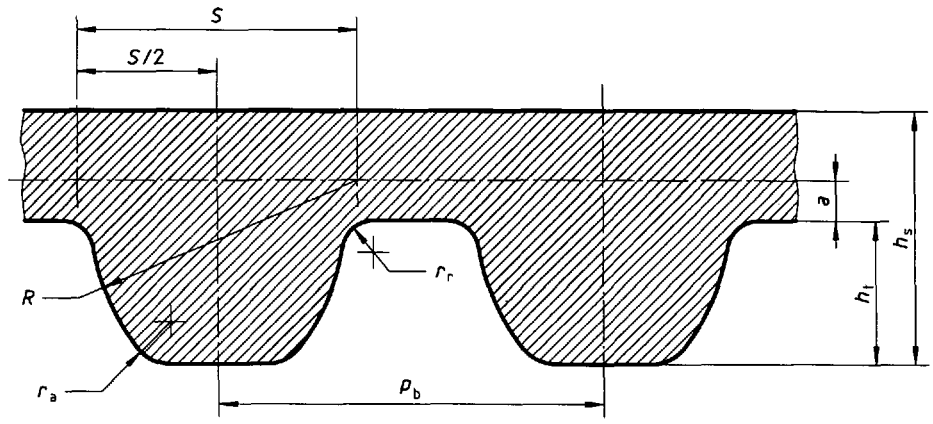


Figure 4 — Nominal tooth dimensions (profile) for types ZS and YS

Table 4 — Nominal tooth dimensions for types ZS and YS

Dimensions in millimetres

Term	Symbol	Nominal profile	
		Type ZS	Type YS
Tooth pitch	p_b	9,525	8
Height	h_s	5,7	5,2
Pitch line differential	a	0,686	0,686
Root radius	r_r	0,95	0,8
Tip radius	r_a	0,95	0,8
Tooth height	h_t	3,53	2,95
Tooth width	S	6,19	5,2
Tooth radius	R	6,19	5,2

5.5 Belt pitch length and tolerances

Belt pitch length is defined by the number of teeth multiplied by tooth pitch, p_b. The belt pitch length, L_p, shall be agreed between the parties concerned. Pitch length tolerances are given in table 5.

Table 5 — Pitch length tolerances

Dimensions and tolerances in millimetres

Pitch length L_p	
Range	**Tolerance**
$L_p \leqslant 381$	± 0,45
$382 \leqslant L_p \leqslant 505$	± 0,5
$506 \leqslant L_p \leqslant 762$	± 0,6
$763 \leqslant L_p \leqslant 991$	± 0,65
$992 \leqslant L_p \leqslant 1\,220$	± 0,75
$1\,221 \leqslant L_p \leqslant 1\,524$	± 0,8
$1\,525 \leqslant L_p \leqslant 1\,782$	± 0,85
$1\,783 \leqslant L_p \leqslant 2\,030$	± 0,9
$2\,031 \leqslant L_p \leqslant 2\,286$	± 0,95
$2\,287 \leqslant L_p \leqslant 2\,544$	± 1

5.6 Belt widths and tolerances

The belt width, b_s, shall be agreed between the parties concerned. Width tolerances are given in table 6.

Table 6 — Width tolerances

Dimensions and tolerances in millimetres

Range	Width, b_s	
	Tolerance	
	Pitch length	
	$L_p < 840$	$L_p \geqslant 840$
$b_s < 40$	± 0,8	± 0,8
$b_s \geqslant 40$	± 0,8	+ 0,8 − 1,3
NOTE — For special applications, smaller tolerances may be used.		

6 Pitch length measurement

6.1 Measuring fixture

The pitch length of a synchronous belt shall be determined by placing the belt on a measuring fixture composed of the following elements. (See figure 5.)

6.1.1 Two pulleys of equal diameter, as specified in table 7 and ISO 9011 of the proper belt type and having standard tooth space dimensions. These pulleys should be made to the tolerances shown in table 7 and tables 8, 9 or 10, as appropriate. One pulley shall be free to rotate on a fixed-position shaft, while the other shall be free to rotate on a movable shaft to permit the centre distance to change.

6.1.2 Means of applying a total measuring force to the movable pulley.

6.1.3 Means of measuring the centre distance between the two pulleys with the necessary degree of accuracy to check the allowed tolerances (tolerances for centre distance measurement should be one-half of the allowed length tolerances in table 5).

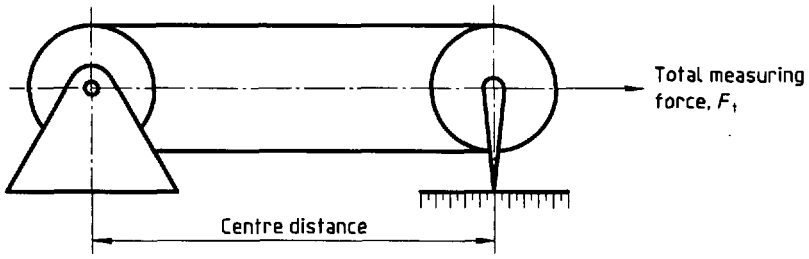


Figure 5 — Pitch length measuring fixture

Table 7 — Belt pitch length measuring pulleys

Dimensions and tolerances in millimetres

Belt type	Number of teeth	Pitch circumference	Outside diameter	Runout		
	z	$p_b \times z$	d_o	radial	axial	$2a$
ZA, ZB, ZH, ZS	20	190,5	59,266 ± 0,013	0,013	0,025	1,372
YH, YS	22	176	54,651 ± 0,013	0,013	0,025	1,372
ZR	20	190,5	59,138 ± 0,013	0,013	0,025	1,5
YR	22	176	54,522 ± 0,013	0,013	0,025	1,5
NOTE — Pulleys of other diameters may be used provided that the diameters of the two pulleys are equal and that they are larger than those specified in table 7.						

6.2 Total measuring force

The total measuring force, F_t, to be applied for measuring belts shall be calculated as follows:

— Types ZA, ZB, ZH, YH, ZR and YR:

$$F_t = (b_s \times 29) - 100$$

— Types ZS and YS:

$$F_t = 1\,020 \times (b_s/25)^{1,14}$$

where

b_s is the width in millimetres;

F_t is the total force, in newtons.

6.3 Procedure

When measuring the pitch length of a synchronous belt, the belt should be rotated at least two revolutions to seat it properly and to divide the total force equally between the two strands of the belt.

The pitch length shall be calculated by adding the pitch circumference of one of the pulleys to twice the measured centre distance.

6.4 Dimensions and clearance between measuring pulley and belt, and measuring pulley grooves

See figures 6 to 11 and tables 8 to 11.

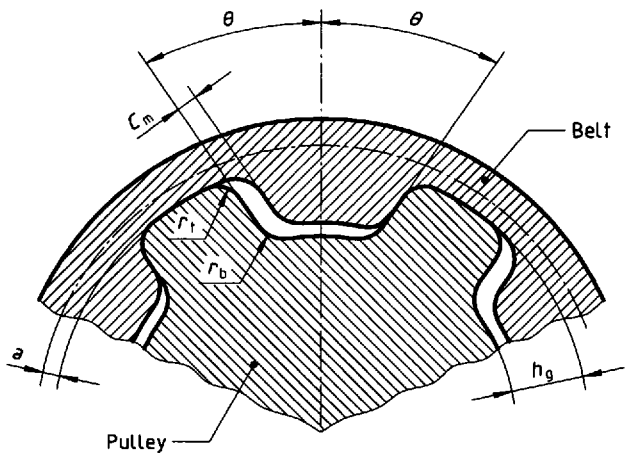


Figure 6 — Dimensions and clearance between measuring pulley and belt for types ZA and ZB (see table 8)

Table 8 — Dimensions of measuring pulley grooves for types ZA and ZB (see figure 6)

Dimensions in millimetres, angle in degrees

Type	Minimum clearance C_m	h_g	r_b	r_t	θ	a
ZA	0,33	2,68 ± 0,1	0,85 ± 0,1	0,85 ± 0,1	20 ± 1,5	0,686
ZB	0,38	3 ± 0,1	1,23 ± 0,1	1,23 ± 0,1	20 ± 1,5	0,686

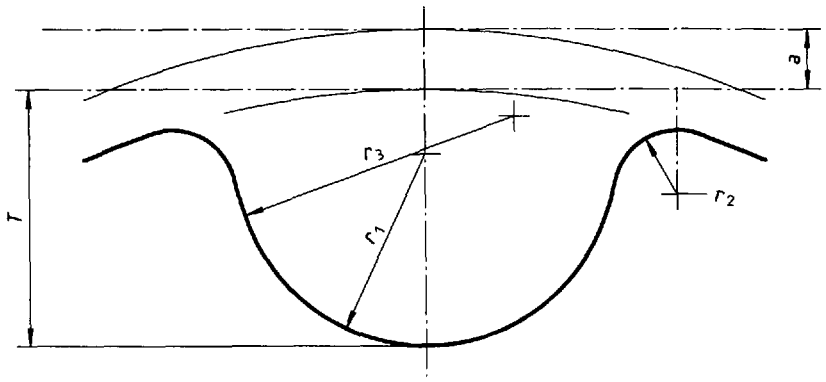


Figure 7 — Measuring pulley grooves for types ZH and YH (see table 9)

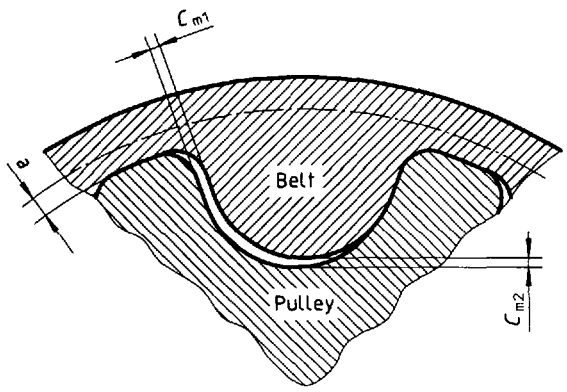


Figure 8 — Clearance between measuring pulley and belt types ZH and YH (see table 9)

Table 9 — Dimensions of measuring pulley grooves for types ZH and YH (see figures 7 and 8)

Dimensions in millimetres

Type	a	Minimum clearance C_{m1}	Minimum clearance C_{m2}	r_1 ± 0,05	r_2 ± 0,05	r_3 ± 0,05	T ± 0,05
ZH	0,686	0,34	0,11	2,78	0,89	—[1]	3,61
YH	0,686	0,3	0,11	2,22	0,69	3,45	3,16

1) Blend radius r_3 is not used on ZH section.

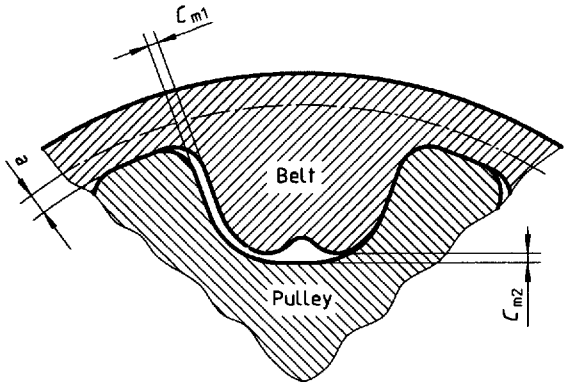


Figure 9 — Clearance between measuring pulley and belt types ZR and YR (see table 10)

Table 10 — Clearance between measuring pulley and belt types ZR and YR (see figure 9)

Dimensions in millimetres

Type	Number of teeth	Minimum clearance		
	z	C_{m1}	C_{m2}	a
ZR	20	0,34	0,11	0,75
YR	22	0,3	0,11	0,75
NOTE — The pulley groove profile dimensions are determined by the generating tool rack described in ISO 9011:1997, figure 5 and table 3.				

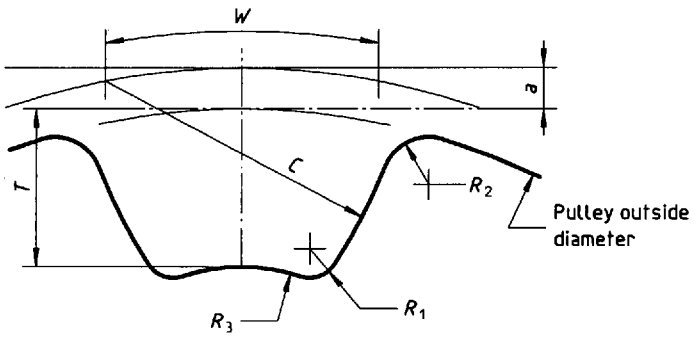


Figure 10 — Measuring pulley grooves for types ZS and YS (see table 11)

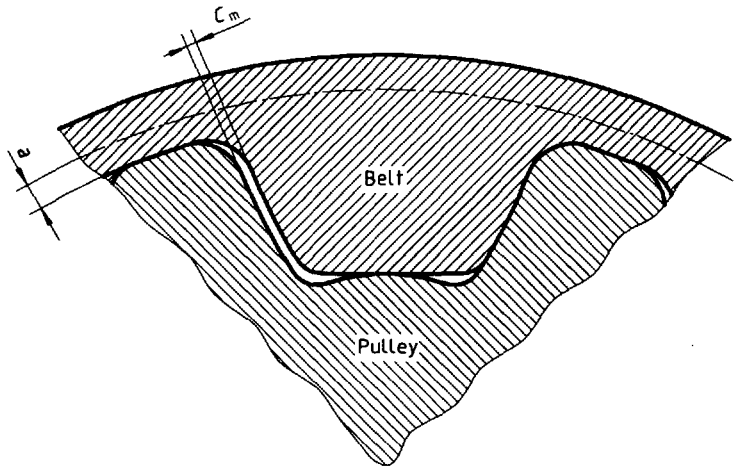


Figure 11 — Clearance between measuring pulley and belt for types ZS and YS (see table 11)

Table 11 — Dimensions of measuring pulley grooves for types ZS and YS (see figures 10 and 11)

Dimensions in millimetres

Type	a	Minimum clearance C_m	W $^{+0,1}_{0}$	C $^{+0,1}_{0}$	T ± 0,03	R_1 ± 0,05	R_2 $^{+0,05}_{0}$	R_3 ± 0,05
ZS	0,686	0,2	6,19	6,31	3,37	0,48	0,89	4,81
YS	0,686	0,24	5,2	5,3	2,83	0,4	0,75	4,04

7 Lateral runout measurement

7.1 Fixture

7.1.1 Belt

The lateral run out of a synchronous belt shall be measured using the same machine described in clause 6 and shown in figure 5. The total force shall be as specified in 6.2.

7.1.2 Pulleys

The number of grooves and groove dimensions shall be as specified in 6.1.1 and table 7 for pitch length measuring.

The fixed position pulley (driving pulley) shall be flanged on both sides. The width between flanges shall be at least 2 mm wider than the belt being measured. The movable pulley shall be unflanged and of width at least 25 mm wider than the flanged pulley face. (See figure 12.)

7.2 Measuring device

Sensors of either mechanical or optical type are positioned at a point 125 mm from the centreline of the unflanged pulley and on the strand of the belt entering the unflanged pulley. A single sensor may be used or sensors may be placed on each side of the belt.

NOTE — Belts of 690 mm length or shorter may require optional sensor location as agreed between customer and supplier.

7.3 Procedure

Place the belt on the measuring device as shown in figure 12 with the label as shown, readable from the front of the fixture.

Position the sensor(s) at the edge of the belt at a position of 125 mm from the centreline of the unflanged, movable pulley. Rotate the belt clockwise at least two revolutions after reaching a stable position against a flange.

As the belt rotates the edge of the belt moves axially with respect of the sensor(s). The lateral runout is measured at the sensor on the edge of the belt which is in contact with the flange.

7.4 Results

The sensor shall measure full indicator movement (FIM) and shall be manually or automatically recorded to the nearest 0,1 mm. This measurement method provides a single lateral runout measurement for the belt.

NOTE — It should be understood that the reading which is taken as lateral runout is a combination of the static or dimensional characteristic "width variation" and the dynamic characteristic "lateral runout". Values should be agreed upon between customer and supplier.

Dimensions in millimetres

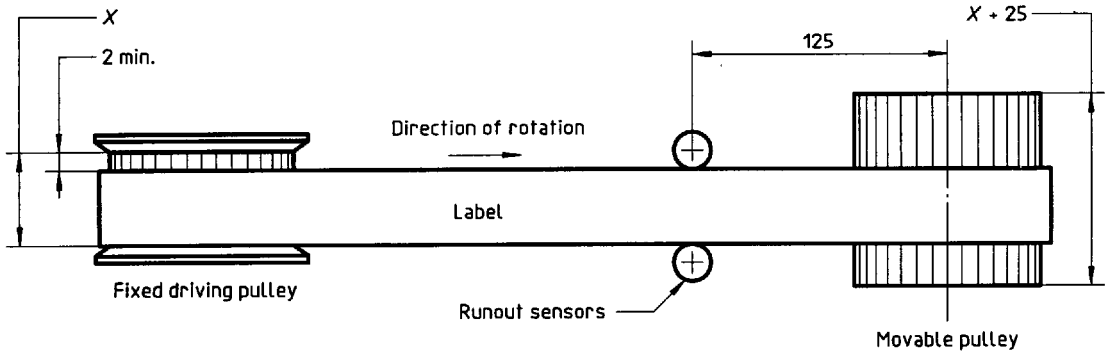


Figure 12 — Lateral runout measuring fixture (top view)

ICS 21.220.10; 43.060.10

Descriptors: automotive engineering, internal combustion engines, synchronous transmission, belt drives, belts, synchronous belts, characteristics, dimensions, dimensional tolerances, tests, dimensional measurements, designation.

Price based on 12 pages