

# Timing Belts / Pulleys - Overview ①

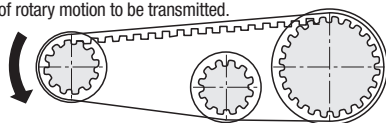
## Overview

As the means of transmitting the power of rotary motion driven by a motor, a designing approach based on timing pulleys and belts is generally and widely used. Even for machinery parts which are required to have higher positioning accuracy than ever along with improvement of the machinery in precision and speed, MISUMI Timing Pulleys and Belts can be used with a sense of security due to their thorough control of quality. Various types of Pulleys and Belts are offered. For Belts, Conventional Timing Belts for Transmission, Timing Belts with Attachments for Conveyance, Tooth Count Configurable Long Timing Belts, and Open End Belts are available. As to delivery, the first day shipping is available at earliest (if the express service is used) for pulleys machined with shaft bores and surface-treated. And for Keyless Timing Pulleys, the 5th day shipping is available. For belts, as well as In Stock products, products 3rd-day-shipped even on a made-to-order basis are added to the product lineup.

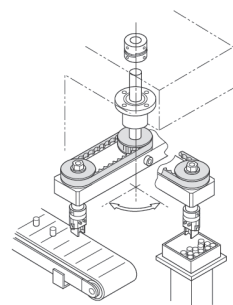
## App. Example

<App. Example 1>

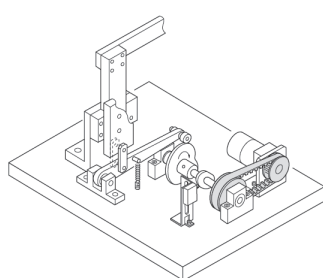
Driving: Is installed onto motors and rotary shafts to allow the driving force of rotary motion to be transmitted.



<App. Example 3>

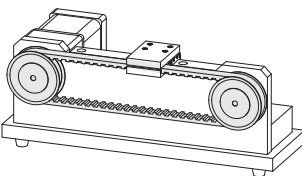


<App. Example 4>



<App. Example 2>

Conveyance: Is used for reciprocating motion with high positioning accuracy rather than for rotary motion.



## Timing Pulley Belt Selection Steps

\* When selecting timing pulleys and belts, please check each of the following steps for its details by referring to the page indicated on the right side.

[Step 1]	Determine conditions needed for designing.	P.2253
[Step 2]	Calculate the design power.	P.2253
[Step 3]	By using the simplified selection table, select the target belt types on an interim basis.	P.2255
[Step 4]	For each of Small/Large Dia. Pulley, determine the number of teeth, belt length and shaft center distance.	P.2256
[Step 5]	Determine the belt width.	P.2256
[Step 6]	Check the adjustment allowance of the shaft center distance for its adequacy.	P.2257
[Step 7]	Verify the transmission capacity.	P.2259
Others	Precautions for Use of Belts	P.2283
Technical Data	Pulleys with Teeth - JIS B 1856 (1993)	P.2285

## Cautions

- Do not bend belts too hard.
- When core wire is steel cord, avoid giving tension from the backside.
- Avoid using and storing the products in an environment of extremely high or low temperature (beyond the operating temperature) and high humidity.
- Avoid direct contact with water, solvent, oil, acid, alkali, ultra-violet light, ozone, etc. If the belt swells due to contact with oil, its service life will be considerably shortened.
- Make sure to shut down the machine and confirm the complete stop of its behavior before starting installation or maintenance check.
- Timing Pulleys and Belts (MXL, XL, L, H) for general use are compliant with JIS and ISO Standards. Timing Pulleys: JIS B 1856(ISO5294) Timing Belts: JIS K6372 (ISO5296-1), JIS K6373 (ISO5296-2)

- S Type (S□M) timing pulleys and belts are compatible with S□M type from Mitsuboshi Belting Ltd. as well as Bando Chemical Industries Ltd.
- MTS Type (MTS8M) timing belts are compatible with MTS8M from Mitsuboshi Belting Ltd.
- P Type (P□M) timing pulleys and belts are compatible with P□M Type from Tsubakimoto Chain Co.
- UP Type (UP□M) timing belts are compatible with UP□M-HC Type from Tsubakimoto Chain Co.
- MA Type timing pulleys and belts are compatible with MA□ Type from NOK Corporation.
- GT Type (□GT) and EV Type (EV5GT, EV8YU) timing pulleys and belts are compatible with □GT, EV5GT, EV8YU Types from Gates Unitta Asia Company.

## Timing Pulleys

MISUMI timing pulleys are shaft bore machined and surface-treated. In addition to regular pulleys, wide variety of pulleys including Non-Backlash Timing Pulley and MechaLock Incorporated Keyless Timing Pulleys are available.

### [List of Timing Pulleys and Idlers]

Usage	Features	Belt Type	Pitch	Timing Pulleys			Idler	
				Timing Pulleys	Keyless Timing Pulley	Clamping Timing Pulley	Idlers with Teeth	Idler
Regular Torque	General purpose timing pulleys suitable for torque transmission and light load conveyance.	MXL	2.032mm (2/25inch)	P.1389	-	-	P.1445	P.1457
		XL	5.08mm (1/5inch)	P.1391	P.1426	-	P.1447	
		L	9.525mm (3/8inch)	P.1393	P.1427, 1428	-		
		H	12.7mm (1/2inch)	P.1395	P.1429, 1430	-		
High Torque	Timing pulleys for high torque transmission.	S2M	2.0mm	P.1397	-	-	P.1449	P.1457
		S3M	3.0mm	P.1399	P.1431, 1432	-	P.1451	
		S5M	5.0mm	P.1401	P.1433, 1434	P.1443		
		S8M	8.0mm	P.1403, 1407	P.1435, 1436	-		
		S14M	14.0mm	P.1405	-	-		
		P2M	2.0mm	P.1409	-	-		
		P3M	3.0mm	P.1409	-	-		
		P5M	5.0mm	P.1411	P.1437	-		
		P8M	8.0mm	P.1413	P.1438	-		
		High Accuracy Positioning	Timing pulleys with small backlash. Suitable for positioning.	1.5GT	1.5mm	P.1381	-	
2GT	2.0mm			P.1381	-	-		
3GT	3.0mm			P.1383	-	-		
5GT	5.0mm			P.1385	-	-		
8YU	8.0mm			P.1387	-	-		
Light Load Conveyance, Regular Torque	Trapezoidal toothed timing pulleys suitable for conveyance. Also usable for transmission.	T2.5	2.5mm	P.1415	-	-	-	P.1455
		T5	5.0mm	P.1417	P.1439, 1440	-		
		T10	10.0mm	P.1419	P.1441, 1442	-		
Heavy Load Conveyance	Timing belts suitable for heavy load conveyance. Possesses 1.3 times larger allowable tension than T types.	AT5	5.0mm	P.1421	-	-	P.1455	P.1457
		AT10	10.0mm	P.1421	-	-		

⚠ Significantly reduced backlash timing pulley is available for S8M (P.1407). Special timing belts are not required.

⚠ For Belts dedicated for 1.5GT and T2.5, please contact MISUMI VONA.

## Timing Belt

MISUMI offers a wide variety of timing belts.

Conventional Timing Belts for Transmission, Timing Belts with Attachments for Conveyance, Tooth Count Configurable Long Timing Belts, and Open End Belts are available. The GT series suitable for high accuracy positioning is also offered.

### [List of Timing Belts]

Usage	Belt Type	Pitch	Timing Belt								
			Timing Belt	Timing Belt with Attachment	Long Timing Belt - Number of Teeth Configurable	Long Timing Belt - Number of Teeth Configurable, Cloth	Open End Belt				
Regular Torque	MXL	2.032mm (2/25inch)	P.1463	P.1463	P.1473	P.1474	P.1473	P.1474	P.1476	P.1475	P.1476
	XL	5.08mm (1/5inch)									
High Torque	L	9.525mm (3/8inch)	P.1465	P.1465	-	-	-	-	P.1476	-	P.1476
	H	12.7mm (1/2inch)									
	S2M	2.0mm									
	S3M	3.0mm									
	S5M	5.0mm									
	S8M	8.0mm									
High Accuracy Positioning	S14M	14.0mm	P.1467	-	-	-	-	-	P.1476	-	-
	P2M	2.0mm									
	P3M	3.0mm									
	P5M	5.0mm									
Super High Torque	P8M	8.0mm	P.1469	-	-	-	-	-	-	-	-
	2GT	2.0mm									
	3GT	3.0mm									
	EV5GT	5.0mm									
	EV8YU	8.0mm									
Light Load Conveyance, Regular Torque	MA3	3.0mm	P.1470	P.1471	P.1473	P.1474	P.1473	P.1474	-	P.1475	P.1476
	MA5	5.0mm									
	MA8	8.0mm									
	MTS8M	8.0mm									
Heavy Load Conveyance	UP5M	5.0mm	-	-	-	-	-	-	-	-	-
	UP8M	8.0mm									
	T5	5.0mm									
Heavy Load Conveyance	T10	10.0mm	-	-	-	-	-	-	-	-	-
	AT5	5.0mm									
Heavy Load Conveyance	AT10	10.0mm	-	-	-	-	-	-	-	-	-
	AT10	10.0mm									

⚠ MTS8M belts are applicable to S8M timing pulleys and idlers. ⚠ UP5M, UP8M belts are applicable to P5M, P8M timing pulleys and idlers.

⚠ EV5GT belts are applicable to 5GT and EV8YU belts are applicable to 8YU timing pulleys and idlers.

⚠ Iron Rubber® is a registered trademark of NOK Corp.

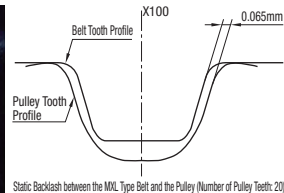
# Timing Pulleys and Belts - Overview ②

# Timing Pulley Alteration - Overview

## Features of GT Belts

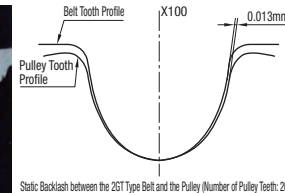
- The tooth engagements occur based on involute motion that closely assimilates the profiles of both teeth, thus minimizing backlash and making the scheme suitable for high accuracy positioning applications.
- \* Backlash means the clearances between the belt tooth surface and the pulley tooth surface when engaged.

### MXL (10 Toothed, Ø6.47mm)



Static Backlash between the MXL Type Belt and the Pulley (Number of Pulley Teeth: 20)

### 2GT (10 Toothed, Ø6.37mm)

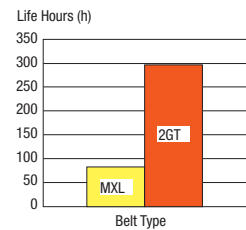


Static Backlash between the 2GT Type Belt and the Pulley (Number of Pulley Teeth: 20)

## Performance Comparison between MXL and 2GT Belts

### Reference ①: Durability

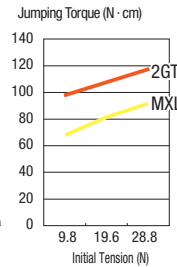
<Performance Conditions>  
 Number of belt teeth: 126  
 Belt Width: 9.5mm  
 Number of Pulley Teeth: 12 (2GT)  
 : 14 (MXL)  
 Speed: 7,900rpm  
 Load Torque: 24.3Nm



### Reference ②: Jumping Torque Capability

<Performance Conditions>  
 Number of belt teeth: 126  
 Belt Width: 4.8mm  
 Number of Pulley Teeth: 20 (2GT)  
 : 20 (MXL)  
 Speed: 1,130rpm  
 Tooth Height  
 MXL: 0.51mm 2GT: 0.75mm

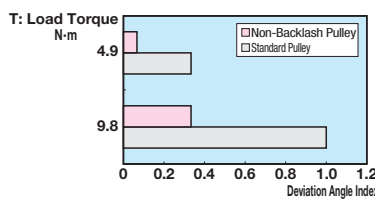
\*Jumping Torque represents the max. torque when a jumping occurs.



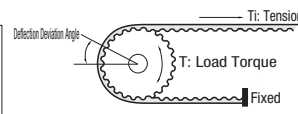
## Features of Non-backlash Pulleys (S8M)

- Non-backlash pulley has reduced backlash compared to conventional type to work with high accuracy positioning mechanism.
- Backlash is significantly smaller than standard S8M pulleys. (The amount reduced depends on applications.)
- Use regular S8M timing belt.

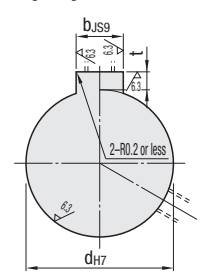
### Reference: Comparison of Deviation Angles between Non-Backlash Pulleys and Standard Pulleys



<Test Conditions>  
 Belt Type :S8M  
 Belt Width :25mm  
 Pulley Size : 30 Toothed (P.D.76.39mm)  
 Tension T<sub>i</sub> :382N



## Keyway Dimensions N: New JIS (B1301) Keyway Dimensions



Nominal	dH7	bJS9	t Tolerance
N 8	8	3	±0.0125
N10	10	4	±0.0125
NK10	10	0	
N11	11	4	±0.0125
N12	12	4	±0.0125
N13	13	4	±0.0125
N14	14	5	±0.0150
N15	15	5	±0.0150
N16	16	5	±0.0150
N17	17	5	±0.0150
N18	18	5	±0.0150
N19	19	5	±0.0150
N20	20	6	±0.0150
N21	21	6	±0.0150
N22	22	6	±0.0150
N23	23	6	±0.0150
N24	24	6	±0.0150
N25	25	6	±0.0150
N26	26	6	±0.0150
N27	27	6	±0.0150
N28	28	6	±0.0150
N29	29	6	±0.0150
N30	30	6	±0.0150
N31	31	6	±0.0150
N32	32	6	±0.0150
N33	33	6	±0.0150
N34	34	6	±0.0150
N35	35	6	±0.0150
N36	36	6	±0.0150
N37	37	6	±0.0150
N38	38	6	±0.0150

Nominal	dH7	bJS9	t Tolerance
N39	39	6	±0.0150
N40	40	6	±0.0150
N41	41	6	±0.0150
N42	42	6	±0.0150
N43	43	6	±0.0150
N44	44	6	±0.0150
N45	45	6	±0.0150
N46	46	6	±0.0150
N47	47	6	±0.0150
N48	48	6	±0.0150
N49	49	6	±0.0150
N50	50	6	±0.0150
N55	55	6	±0.0150
N60	60	6	±0.0150
N61	61	6	±0.0150
N62	62	6	±0.0150
N63	63	6	±0.0150
N64	64	6	±0.0150
N65	65	6	±0.0150
N66	66	6	±0.0150
N67	67	6	±0.0150
N68	68	6	±0.0150
N69	69	6	±0.0150
N70	70	6	±0.0150

## Keyway Dimensions C: Old JIS Keyway Dimensions

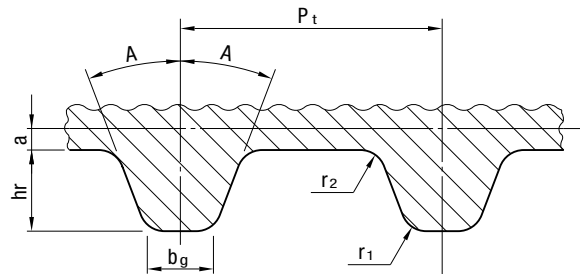
DH7 Shaft Bore Dia. and Code	bF7	t Tolerance
C10	4	±0.015
C12	4	±0.015
C15	5	±0.020
C16	5	±0.020
C18	5	±0.020
C19	5	±0.020
C20	5	±0.020
C30	7	±0.025
C33	7	±0.025
C34	7	±0.025
C35	7	±0.025
C36	7	±0.025
C37	7	±0.025
C38	7	±0.025
C39	7	±0.025
C40	7	±0.025
C41	7	±0.025
C42	7	±0.025
C43	7	±0.025
C44	7	±0.025
C45	7	±0.025
C50	10	±0.030
C55	10	±0.030
C60	10	±0.030
C61	10	±0.030
C62	10	±0.030
C63	10	±0.030
C64	10	±0.030
C65	10	±0.030
C66	10	±0.030
C67	10	±0.030
C68	10	±0.030
C69	10	±0.030
C70	10	±0.030

For alterations for S14M Type, see the relevant product page (P.1406).

Alterations	Code	Spec.		Ordering Code
		Description	Type-by-Type Condition Formula and Caution	
Set Screw Angle	KC90	Changes an angle of set screw to 90°.	For A-Shape pulley, the screw holes are set at around 90° to keep away from peaks.	KC90
	KC120	Changes angle layout of set screws to 120°.	For A-Shape pulley, the screw holes are set at around 120° to keep away from peaks.	KC120
Flange Swaging	NFC	Flange is not installed. (Flange 2 pcs. Included)	Not applicable to Shape K.	NFC
	RFC	Flange installed by swaging only on either hub side (RFC) or the opposite side (LFC) at the time of shipment. (Flange 1 pc. Included)	Not applicable to Shapes K and D.	RFC
	LFC	Flange installed by swaging only on either hub side (RFC) or the opposite side (LFC) at the time of shipment. (Flange 1 pc. Included)	Not applicable to Shapes K and D.	LFC
	FC	Lowers flange by cutting.	No surface treatment is applied on flange circumference. Not available for Stainless Steel Type. FC: 0.5mm Increment	FC33
Adds taper for retaining bearing	BTC	Adds taper for retaining bearing inner ring.	Surface treatment may not be applied to shaft bores on the tapered area. Applicable to Shape A only. Applicable to Shaft Bore Specs. H and P only. Not available for GT and YU.	BTC4-TL1.5
	SLH	Changes the length of the included set screws.	Set Screws SLH M3x3 6 M4x3 5, 8 M5x4 6, 10 M6x5 10 M8x6 10, 12 M10x8 12, 15	SLH10
Hub Shortening	BC	Cuts the hub length in 0.5mm increment.	Applicable to Shape B only. Clear anodized products may not have surface treatment on machined hub surfaces. Not available for P2M, P3M	BC6.5

Alterations	Code	Spec.		Ordering Code		
		Description	Type-by-Type Condition Formula and Caution			
Side Hole Machining	KSC	Machines through hole on the side surface.	Applicable to Shaft Bore Specs. H and V only. Not available for P2M, P3M. Not applicable to Shape K.	KSC20 -K5		
	KFC	Machines tapped hole on the side surface of hub side.	Minimum Thickness: 2mm Shape A: d+K+4<K C-E-(K+4) Shape B: d+K+4<K C-D-(K+4) (Shape D: d+K+4<K C-D-(K+4)) When the Shaft Bore Specs. is V, Z+K+4<K C-D-(K+4)	Specify KC90 when selecting KFC for Shaft Bore Specs. P, N and C. Not available for P2M, P3M. Not applicable to Shape K. Not applicable to Shaft Bore Specs. F or Y.	KFC20 -K5	
	KTC	Machines side through holes and tooth face tapped holes might interfere with each other. For details, see the relevant CAD data.	Side through holes and tooth face tapped holes might interfere with each other. For details, see the relevant CAD data.	Not available for P2M, P3M. Not applicable to Shape K. Not applicable to Shaft Bore Specs. F or Y.	KTC20 -K5	
	QSC	Machines tapped hole on the side surface of hub side.	Minimum Thickness: 2mm Shape A: d+M+4<Q C-E-(M+4) Shape B: d+M+4<Q C-D-(M+4) (Shape D: d+M+4<Q C-D-(M+4)) When the Shaft Bore Specs. is V, Z+K+4<Q C-D-(K+4)	Applicable to Shaft Bore Specs. H and V only. Not available for P2M, P3M. Not applicable to Shape K. Combination with KC90 is not available.	QSC28 -M4	
	QFC	Machines side through holes and tooth face tapped holes might interfere with each other. For details, see the relevant CAD data.	Minimum Thickness: 2mm Shape A: d+M+4<Q C-E-(M+4) Shape B: d+M+4<Q C-D-(M+4) (Shape D: d+M+4<Q C-D-(M+4)) When the Shaft Bore Specs. is V, Z+K+4<Q C-D-(K+4)	Specify KC90 when selecting QFC for Shaft Bore Specs. P, N and C. When QFC is selected for Shaft Bore Specs. P, N and C of P3M Type, KC120 is not available. The pilot hole for tapping might go through, or side through holes might interfere with each other. For details, see the relevant CAD data.	QFC28 -M4	
	QTC	Machines side through holes and tooth face tapped holes might interfere with each other. For details, see the relevant CAD data.	Minimum Thickness: 2mm Shape A: d+M+4<Q C-E-(M+4) Shape B: d+M+4<Q C-D-(M+4) (Shape D: d+M+4<Q C-D-(M+4)) When the Shaft Bore Specs. is V, Z+K+4<Q C-D-(K+4)	Specify KC90 when selecting QTC for Shaft Bore Specs. P, N and C. When QTC is selected for Shaft Bore Specs. P, N and C of P3M Type, KC120 is not available. The pilot hole for tapping might go through, or side through holes might interfere with each other. For details, see the relevant CAD data.	QTC28 -M4	
	TPC	Changes the tapped hole dimension.	M TPC M3 M4 M4 M3, M5 M5 M4, M6 M6 M5, M8 M8 M6, M10 M10 M8	Applicable to Shaft Bore Specs. P, N, C only. Not available for GT, YU, P2M, P3M. Not applicable to MXL Type - Shape K.	TPC5	
	Changes the length of the included set screws	SLH	Changes the length of the included set screws.	Set Screws SLH M3x3 6 M4x3 5, 8 M5x4 6, 10 M6x5 10 M8x6 10, 12 M10x8 12, 15	Applicable to Shaft Bore Specs. P, N, C only. Not available for GT, YU, P2M, P3M	SLH10

1. Cutter Rack Dimensions and Tolerances



The pulley should have involute tooth, which are created and shaped by the cutter. For the cutter rack dimensions and tolerance, when the rack shape of the tooth profile generating cutter is measured by using a projector, shape measuring instrument, etc. the measurement results must meet the following conditions indicated on the table below:

Unit: mm

Type	Number of Teeth of the Pulley Z	Pt	A ±0.12	hr +0.05 0	bg +0.05 0	r1 ±0.03	r2 ±0.03	2a <sup>(1)</sup> (Reference)
MXL	10 ≤ Z ≤ 23	2.032 ± 0.008	28°	0.64	0.61	0.30	0.23	0.508
	24 ≤ Z		20°		0.67			
XL	10 ≤ Z	5.080 ± 0.010	25°	1.40	1.27	0.61	0.61	0.508
L	10 ≤ Z	9.525 ± 0.012	20°	2.13	3.10	0.86	0.53	0.762
H	14 ≤ Z ≤ 19	12.700 ± 0.016	20°	2.59	4.24	1.47	1.04	1.372
	20 ≤ Z						1.42	

Note (1) : a indicates the position equivalent to the pitch line (Centerline of the Core Line of the Belt) of the belt corresponding to the cutter rack shape.

2. Tolerance of Adjacent Pitch Error and Cumulative Pitch Error Unit: mm

Addendum Circle Diameter of Pulley do	Allowable Value	
	Tolerance of Adjacent Pitch Error	Accumulated Pitch Error
5.96 ≤ do ≤ 25.40	0.03	0.05
25.40 < do ≤ 50.80	0.03	0.08
50.80 < do ≤ 101.60	0.03	0.10
101.60 < do ≤ 177.80	0.05	0.13
177.80 < do ≤ 304.80	0.05	0.15
304.80 < do ≤ 508.00	0.08	0.18
508.00 < do ≤ 762.00	0.08	0.20
762.00 < do ≤ 967.16	0.08	0.23

3. Tolerance of Side Deflection Unit: mm

Addendum Circle Diameter of Pulley do	Tolerance of Deflection (TIR) <sup>(2)</sup>
5.96 ≤ do ≤ 101.60	0.10
101.60 < do ≤ 254.00	Addendum Circle Dia. do × 0.001
254.00 < do ≤ 967.16	0.25 + [(Addendum Circle Dia. do - 254.00) × 0.0005]

Note (2) : TIR is an abbreviation for Total Indicator Reading and refers to the difference between the max. deflection reading and the min. deflection reading.

4. Tolerances of Addendum Circle Diameter Unit: mm

Addendum Circle Diameter of Pulley do	Tolerance
5.96 ≤ do ≤ 25.40	+0.05 0
25.40 < do ≤ 50.80	+0.08 0
50.80 < do ≤ 101.60	+0.10 0
101.60 < do ≤ 177.80	+0.13 0
177.80 < do ≤ 304.80	+0.15 0
304.80 < do ≤ 508.00	+0.18 0
508.00 < do ≤ 762.00	+0.20 0
762.00 < do ≤ 967.16	+0.23 0

5. Tolerance of Circumferential Deflection of Addendum Circle Unit: mm

Addendum Circle Diameter of Pulley do	Tolerance of Circumferential Deflection
5.96 ≤ do ≤ 203.20	0.13
203.20 < do ≤ 967.16	0.13 + [(Addendum Circle Dia. do - 203.20) × 0.0005]

6. Tolerance of Cylindricity and Parallelism Unit: mm

Nominal Widths of Pulley	Cylindricity Tolerance	Parallelism Tolerance
025-050	0.01	0.03
075-150	0.02	
200-300	0.04	0.04
400-500	0.06	0.05

1. Regular Cut Dimension Tolerance B 0405—1991

Tolerances in Respect of Length Excluding Chamfered Portion

Unit: mm

Tolerance Class		Classification of Reference Dimension							
Symbol	Description	0.5 (1) or More 3 or Less	More than 3 6 or Less	More than 6 30 or Less	More than 30 120 or Less	More than 120 400 or Less	More than 400 1000 or Less	More than 1000 2000 or Less	More than 2000 4000 or Less
		Tolerance							
f	Precision Grade	±0.05	±0.05	±0.1	±0.15	±0.2	±0.3	±0.5	—
m	Medium	±0.1	±0.1	±0.2	±0.3	±0.5	±0.8	±1.2	±2
c	Coarse	±0.2	±0.3	±0.5	±0.8	±1.2	±2	±3	±4
v	Extremely Coarse	—	±0.5	±1	±1.5	±2.5	±4	±6	±8

Note (1) : A reference dimension less than 0.5 mm is followed by a tolerance.

2. Tolerances in Respect of the Length of the Chamfered Portion (Radius of rounding for edges and edge chamfering dimension)

Unit: mm

Tolerance Class		Classification of Reference Dimension		
Symbol	Description	0.5 (2) or More 3 or Less	More than 3 6 or Less	More than 6
		Tolerance		
f	Precision Grade	±0.2	±0.5	±1
m	Medium	±0.2	±0.5	±1
c	Coarse	±0.4	±1	±2
v	Extremely Coarse	±0.4	±1	±2

Note (2) : A reference dimension less than 0.5 mm is followed by a tolerance.

3. Angle Tolerance

Tolerance Class		Length of Shorter Side (Unit: mm)				
Symbol	Description	10 or Less	More than 10 50 or Less	More than 50 120 or Less	More than 120 400 or Less	More than 400
		Tolerance				
f	Precision Grade	±1°	±30'	±20'	±10'	±5'
m	Medium	±1°	±30'	±20'	±10'	±5'
c	Coarse	±1°30'	±1°	±30'	±15'	±10'
v	Extremely Coarse	±3°	±2°	±1°	±30'	±20'

4. Regular Perpendicularity Tolerance B 0419—1991

Unit: mm

Tolerance Class	Nominal Length of Shorter Side			
	100 or Less	More than 100 300 or Less	More than 300 1000 or Less	More than 1000 3000 or Less
Perpendicularity Tolerance				
H	0.2	0.3	0.4	0.5
K	0.4	0.6	0.8	1
L	0.6	1	1.5	2

5. Regular Straightness and Flatness Tolerance

Unit: mm

Tolerance Class	Nominal Length					
	10 or Less	More than 10 30 or Less	More than 30 100 or Less	More than 100 300 or Less	More than 300 1000 or Less	More than 1000 3000 or Less
Regular Straightness and Flatness Tolerance						
H	0.02	0.05	0.1	0.2	0.3	0.4
K	0.05	0.1	0.2	0.4	0.6	0.8
L	0.1	0.2	0.4	0.8	1.2	1.6

6. Regular Symmetry Tolerance

Unit: mm

Tolerance Class	Nominal Length			
	100 or Less	More than 100 300 or Less	More than 300 1000 or Less	More than 1000
Symmetry Tolerance				
H	0.5			
K	0.6	0.8	1	1
L	0.6	1	1.5	2