Koyo®

High Wing Series Drive Shafts

JTEKT

JTEKT CORPORATION

JTEKT Koyo TOYODA

CAT.NO.B2022E

High wing series drive shafts that handle all kinds of environment with proven results, technology, research and development

In order to improve the reliability of our drive shafts under severe conditions, JTEKT has been continuously committed to research and development of technologies, built upon a wealth of results and experiences achieved with our customers over many years.
Our products also have high compatibility through adoption of standard mounting dimensions.
This catalogue includes dimension tables for respective model numbers, technical data, handling and failure cases, which we believe will surely help with design of construction machinery and railway rolling stocks.
We thank you in advance for your support.

CONTENTS

JTEKT deals with severe conditions with its No.1 & Only One technologies.

Our drive shafts for construction machinery and railway rolling stocks to meet your needs

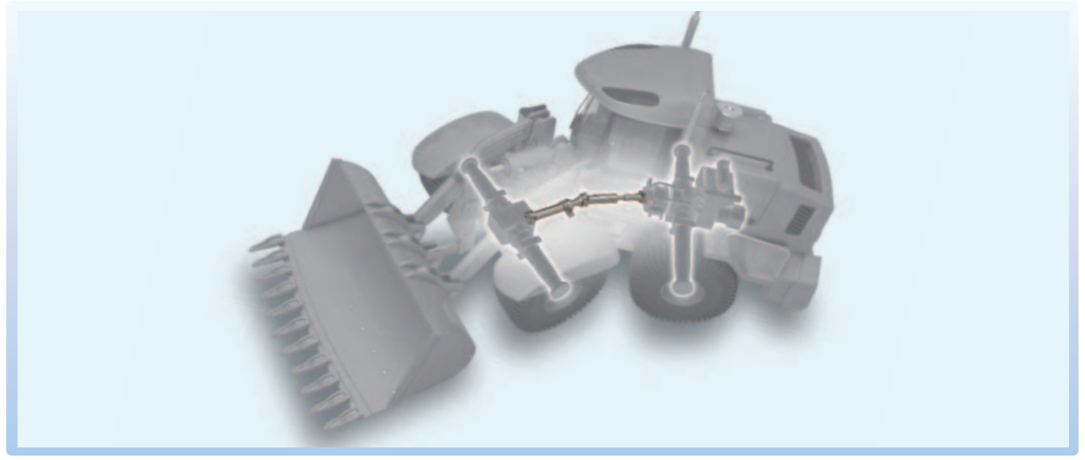
Introduction to drive shafts

Functions

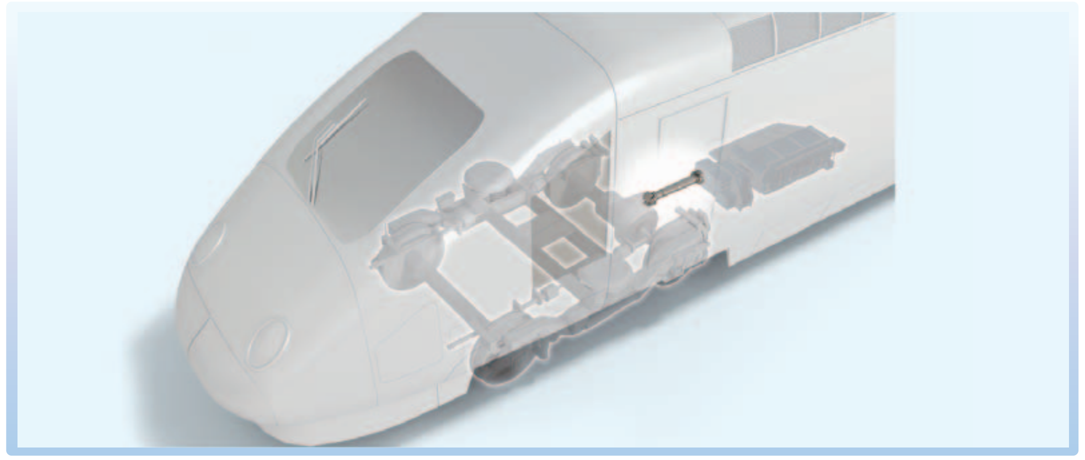
A drive shaft is a device to smoothly transmit rotation torque by connecting a driving shaft and a driven shaft that are not aligned on the same axis. Since it has two universal joints on one shaft, it can connect the driving shaft and the driven shaft flexibly.
In addition, one universal joint has four rolling bearings (cross & bearing) that can minimize torque loss with low friction.

Representative applications of drive shaft

●For wheel loaders

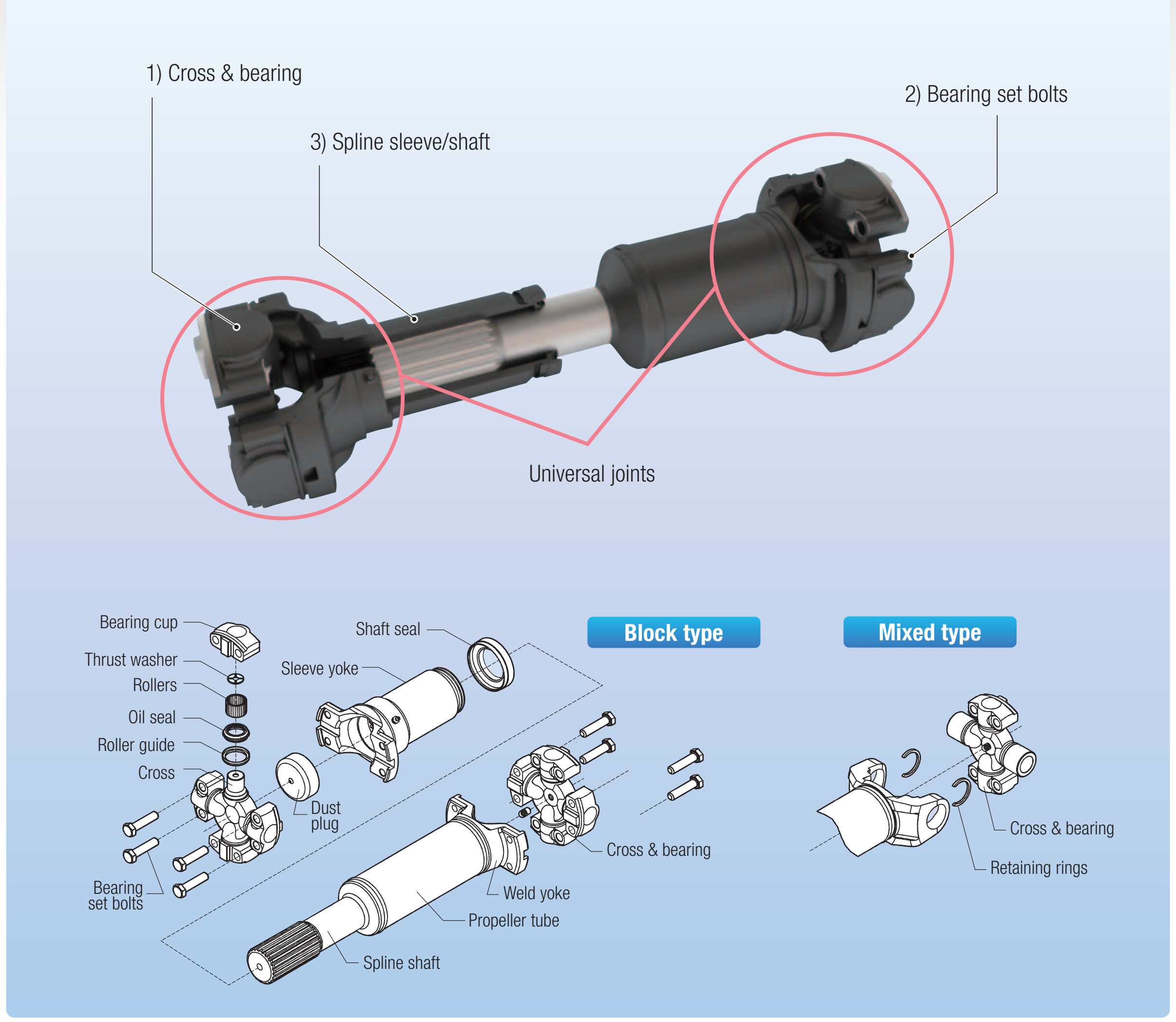


●For diesel locomotives



Appearance and configuration of drive shafts

【The appearance and component configuration of a representative drive shaft】



1) Cross & bearing

The cross & bearings are the most critical components of a drive shaft.
A cross & bearing has a cross-shaped shaft and four rolling bearings that individually support each end of the shaft.

2) Bearing set bolt

The bearing set bolt is used to connect the cross & bearing and its mating part (a retaining ring is used for mixed type).

3) Spline sleeve/shaft

The spline sleeve has a spline bore and shaft, which realize a variable drive shaft installing length.

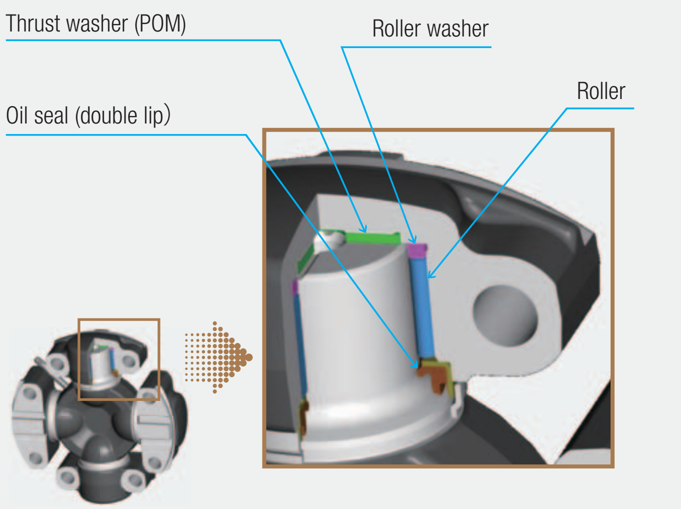
Efforts to improve reliability

1. Long-interval greasing cross & bearing

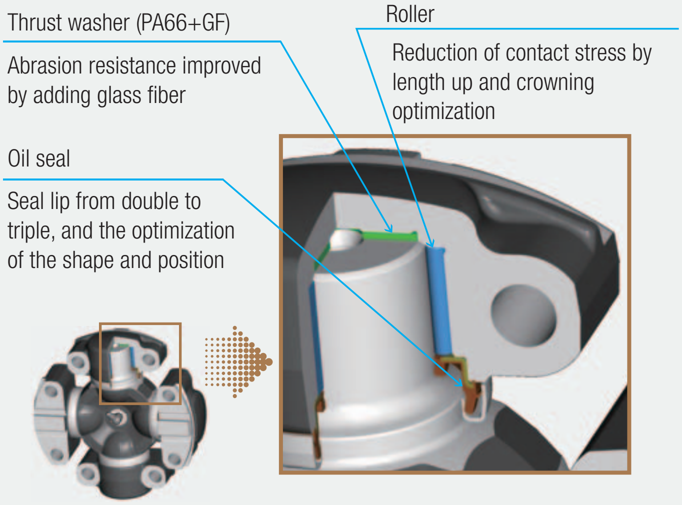
Features

(1) Oil seal lip from double to triple, and the optimization of shape and position.
(2) Reduction of roller contact stress with torque load by length up and crowning optimization
(3) Abrasion resistance improved by adding glass fiber to thrust washer
(4) Bearing cup shape reviewed and cost reduced by abolishing the roller washer

Cross & bearing structure



Conventional product: Greasing interval of 250 hours

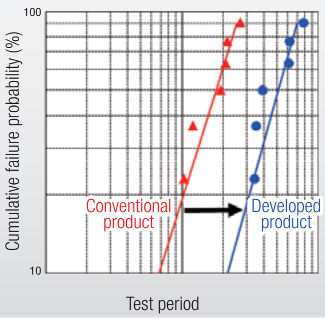


Product with long-interval greasing:
Greasing interval of 2000 - 4000 hours

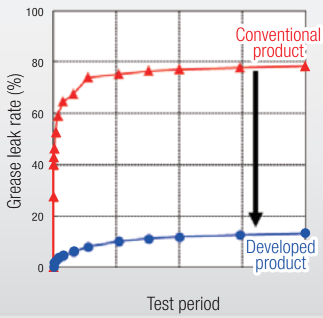
Evaluation results

Greasing interval extended 10 times or more

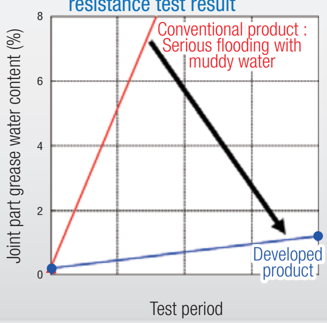
■ Cross & bearing life test result



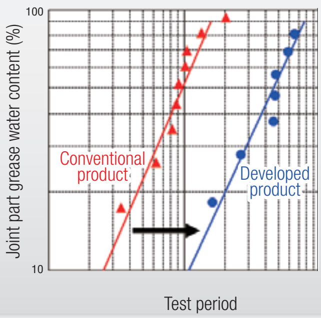
■ Grease leakage test result



■ Cross & bearing muddy water resistance test result



■ Dust resistance test result



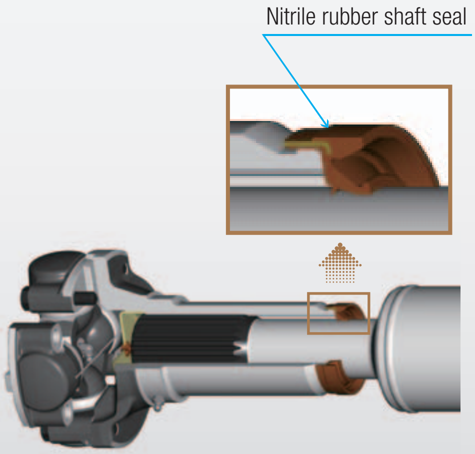
2. Spline seal structure of muddy water resistance improvement

Features

Since the cover tube type spline seal has a structure that seals the sleeve (female spline) outer diameter part,
(1) It is not necessary to surpass the male spline major diameter by deforming the seal lip at the time of assembly, so a urethane rubber seal with high rigidity can be used.
(2) The distance from the seal to the spline is long, so muddy water does not reach the spline easily.
(3) A double cover has been added to protect the seal part, improving endurance further.

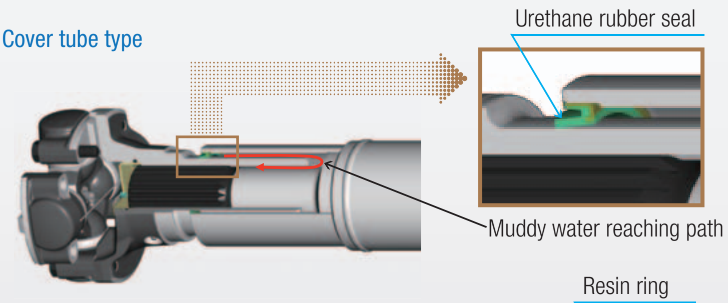
Spline seal configuration

【Standard product】

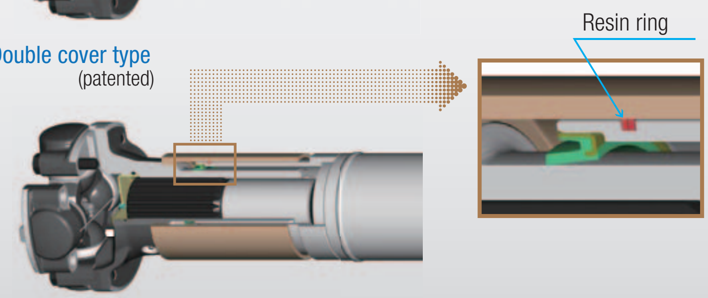


【Countermeasure product】

Cover tube type

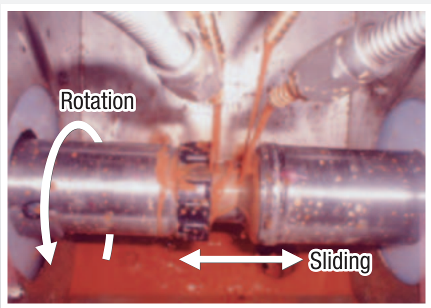


Double cover type
(patented)

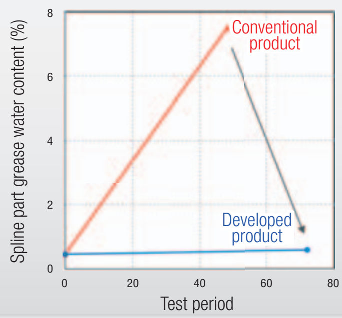


Evaluation result of spline muddy water endurance test

Muddy water resistant performance greatly improved



■ Spline muddy water endurance test result

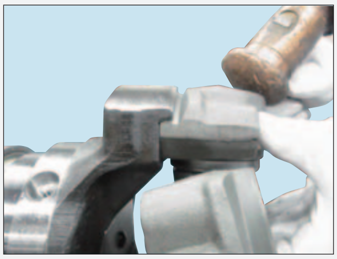


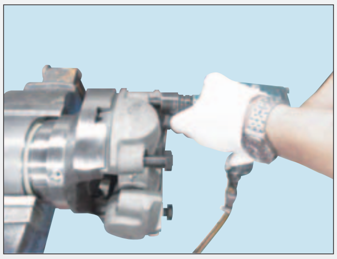
Handling explanation

High wing series features safe and secure torque transmission by a parallel key, and high torque capacity.
The following are the handling method and caution points to ensure that the drive shaft delivers its expected performance.

Handling of drive shaft

Caution points for handling





(1) Do not hit the cross & bearing part with hard metal so that a shock should be avoided.
If it is necessary at the time of assembling, hit it lightly with a non-ferrous metal (copper, etc.) or plastic hammer.

(2) Tighten the fixing bolts of the bearing cups by setting the bearing cups in the proper positions in the yoke to form an X shape.
If you fit the bearing cups with the tightening force of bolts or fix only one bearing cup with the bolt and then set the other, it may cause troubles such as scars on the spigot joint part and attaching surface, and attachment of bearing cups at a slant.

(3) Never conduct welding between the bolts and the bearing cups and between the yoke and the bearing cups.

(4) Do not disassemble the cross & bearings unless absolutely necessary.

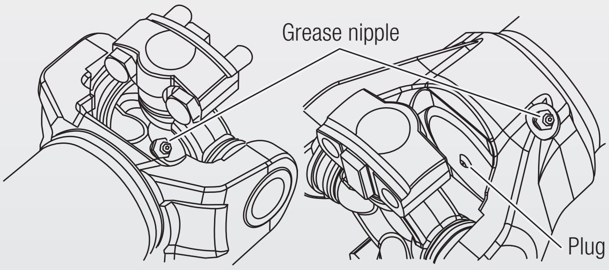
About lubrication

(1) Greasing interval
It is recommended to apply grease every 2000 - 4000 hours, though it depends on the usage environment.

(2) Grease to be used
Lithium grease with extreme-pressure additive

(3) Greasing of cross & bearings
Apply grease until it overflows from all of the four shafts of the cross. Wipe off the overflowing grease because dirt may adhere to it.

(4) Greasing of spline part
To apply grease an onboard drive shaft, move the vehicle body so that the spline should be compressed to the minimum. When grease leaks out of the center of the plug attached to the sleeve yoke, greasing is complete.
If the drive shaft is removed from the vehicle because of overhaul, etc., apply grease with the spline compressed to the minimum.



About cross & bearing attaching bolt

(1) Bolt
Use the attached bolt or part for repair specified by JTEKT.

(2) Torque wrench
Use a calibrated torque wrench.

(3) Specified tightening torque
Tighten with the specified torque.

Cases of failures

Flaking

Failures example Flaking has occurred in the raceway surface of rolling contact surface of the cross and cup.

Measure Compare the calculated life and the required life and increase the size as necessary

Breakage

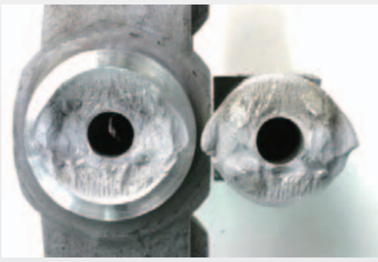
Failures example Breakage is caused from the fillet radius part of the neck of the cross and the fracture surface has no beach mark

Cause Brittle fracture due to excessive load

Measures Check the usage conditions
Increase the size as necessary

Failures example Breakage is caused from the fillet radius part of the neck of the cross, and the fracture surface has a beach mark

Cause Fatigue fracture caused by excessive load applied repeatedly



Measures Check the usage conditions
Increase the size as necessary

Failures example The tube has a crack near the border of the tube and weld bead

Cause Fatigue fracture caused by excessive load applied repeatedly

Measures Check the usage conditions
Increase the size as necessary

Failures example The bearing set bolts are broken near the yoke interface

Cause Bolt fatigue fracture caused by looseness of the bolts

Measure Check that the tightening torque has the specified value

Failures example Bending near the center of the drive shaft

Cause Brittle fracture caused by use around the dangerous rotational speed

Measures Decrease the maximum rotational speed. If it is impossible, reduce the length or increase the tube size

General characteristics of universal joint

Single universal joints

The driving shaft and driven shaft intermediated by a universal joint has the following relationship between their rotational angles:

$$\tan\phi_2 = \cos\theta \cdot \tan\phi_1 \quad \cdots(1)$$

where ϕ_1 : Rotational angle of driving shaft

ϕ_2 : Rotational angle of driven shaft

θ : Shaft operating angle (**Fig. 1**)

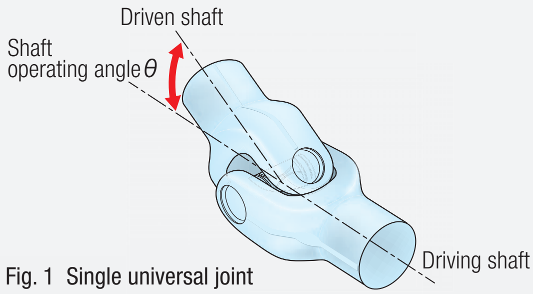


Fig. 1 Single universal joint

This means that, even if the rotational speed and torque of the driving shaft are constant, the driven shaft is subject to fluctuation in rotational speed and torque.
The speed ratio between the driving shaft and driven shaft can be obtained by differentiating equation (1) with respect to time (t), where ϕ_1 is by $\omega_1 \cdot t$ and ϕ_2 by $\omega_2 \cdot t$:

$$\frac{\omega_2}{\omega_1} = \frac{\cos\theta}{1-\sin^2\phi_1 \cdot \sin^2\theta} \quad \cdots(2)$$

where ω_1 : Rotational angular velocity of driving shaft (rad/s)

ω_2 : Rotational angular velocity of driven shaft (rad/s)

ω_2/ω_1 : Angular velocity ratio

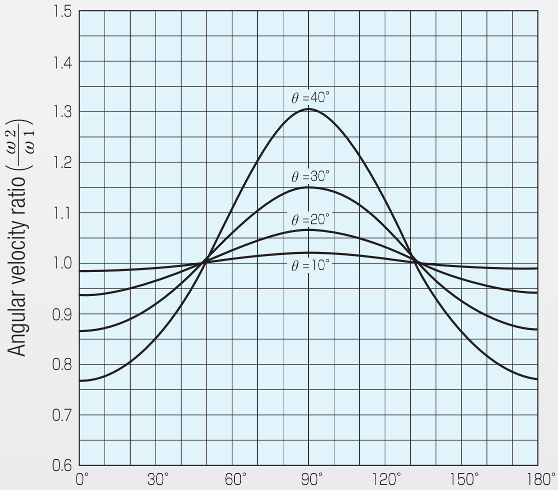


Fig. 2 Angular velocity fluctuation

Equation (2) can be expressed in diagram form as shown in **Fig. 2**. The maximum value and minimum value of the angular velocity ratio can be expressed as follows:

$$(\omega_2/\omega_1)\ \text{max.} = 1/\cos\theta \quad \cdots\cdots \quad \phi_1 = 90°$$
$$(\omega_2/\omega_1)\ \text{min.} = \cos\theta \quad \cdots\cdots \quad \phi_1 = 0°$$

The maximum fluctuation rate of angular velocity in a universal joint can be expressed by the following equation:

$$\frac{(\omega_2\,\text{max.} - \omega_2\,\text{min.})}{\omega_1} = \frac{1}{\cos\theta} - \cos\theta$$

The torque ratio between input and output can be expressed by the diagram shown in **Fig. 3**. The maximum value and minimum value can be obtained as shown below, respectively:

$$(T_2/T_1)\ \text{max.} = 1/\cos\theta \quad \cdots\cdots \quad \phi_1 = 0°$$
$$(T_2/T_1)\ \text{min.} = \cos\theta \quad \cdots\cdots \quad \phi_1 = 90°$$

where T_1 : Input torque

T_2 : Output torque

T_2/T_1: Torque ratio

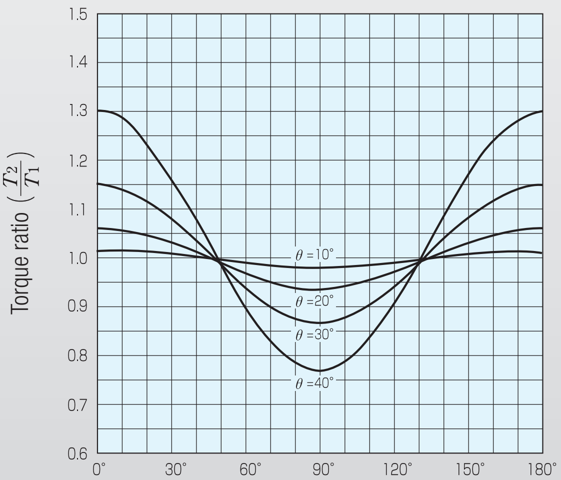


Fig. 3 Torque fluctuation

Double universal joints

Universal joints are usually installed in pairs. When assembled as shown in **Fig. 4**, that is,

(1) With equal operating angles in both joints

(2) Yokes connected to the same shaft in line

(3) Central lines of all three shafts (driving shaft, intermediate shaft, and driven shaft) in the same plane, the driven shaft rotates exactly in the same way as the driving shaft.

Therefore, they should be attached as shown in the figure on the right as far as possible.

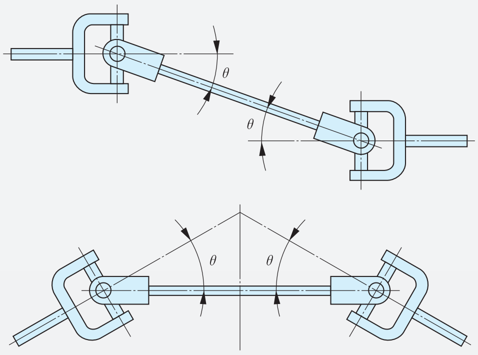


Fig. 4 Installation of double universal joints

Secondary couple

It is often necessary to consider the secondary couples imposed by universal joints operating at an angle; especially under high angle or large torque. These couples must be taken into account in designing the shafts and supporting bearings.

The secondary couples in the universal joints are in the planes of the yoke. These couples are about the intersection of the shaft axis. They impose a load on the bearings and a bending stress in the shaft connecting the joints, and they fluctuate from maximum to zero every 90° of shaft revolution. The broken lines in **Fig. 5** indicate the effect of these secondary couples on the shafts and bearings.

The equation for maximum secondary couple is as follows:

M_1 max. $= T \tan\theta$ (for driving shaft)

M_2 max. $= T \sin\theta$ (for driven shaft)

where M_1: Secondary couple on driving shaft $(\mathrm{N \cdot m})$

M_2: Secondary couple on driven shaft $(\mathrm{N \cdot m})$

T : Driving torque $(\mathrm{N \cdot m})$

θ : Shaft operating angle

The ratio of the secondary couple to the driving torque is shown in **Fig. 6**.

The secondary couple M_1 and M_2 can be obtained by multiplying M_1/T or M_2/T by the driving torque T.

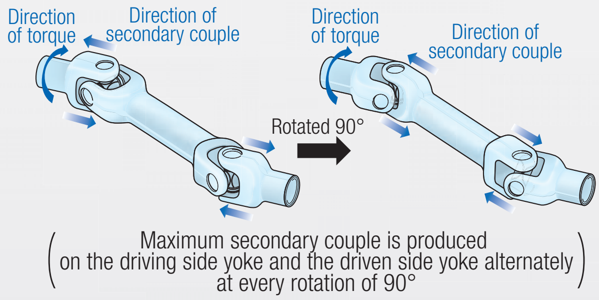


Fig. 5 Effect of secondary couple

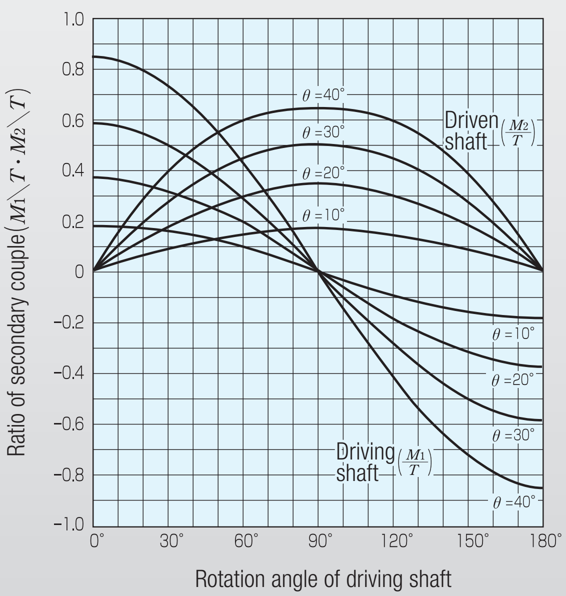


Fig. 6 Fluctuation of secondary couple to driving torque

Drive shaft selection

A drive shaft should be selected so as to satisfy the required strength, service life, operating angle and dimensions necessitated by its purpose. Especially, a drive shaft can be selected if it meets conditions of both strength and life of the universal joint, except for special cases.

Load torque of drive shaft

To decide the size of the drive shaft, it is necessary to grasp the load torque first.
A maximum torque including an impact torque and a mean torque should be known, and it is essential for selecting an appropriate drive shaft to understand the correct maximum torque and mean torque.

Maximum torque:
Value to determine if the strength of each part is sufficient.
Mean torque:
Value necessary to calculate the service life

Mean torque

It is apparent that all kinds of machines are not operating thoroughly by their maximum torque. Therefore, if a drive shaft is selected according to a service life calculated from the maximum torque, it results in being uneconomically larger than necessary.
So, it is reasonable to set up a longer expected service life, if the application condition are severe; and shorter, if the conditions are easy.
If, for instance, a job is expressed as in the table below,

Drive stage	1	2	3・・・・・Z
Torque (N・m)	T_1	T_2	$T_3 \cdots\cdots T_Z$
Rotational speed (min^{-1})	n_1	n_2	$n_3 \cdots\cdots n_Z$
Time ratio (%)	t_1	t_2	$t_3 \cdots\cdots t_Z$

the cube root of mean torque (T_m) and the arithmetical mean of rotational speed (n_m) are yielded from the following equations.

$$T_m = \sqrt[3]{\frac{(T_1^3 \cdot n_1 \cdot t_1 + \cdots\cdots\cdots T_Z^3 \cdot n_Z \cdot t_Z)}{(n_1 \cdot t_1 + \cdots\cdots\cdots + n_Z \cdot t_Z)}}$$

$$n_m = \frac{(n_1 \cdot t_1 + \cdots\cdots\cdots + n_Z \cdot t_Z)}{(t_1 + \cdots\cdots\cdots + t_Z)}$$

Strength of drive shaft

A drive shaft should be selected so that the normal maximum torque shall not exceed the "T_D torque." However, it is difficult to determine the true maximum torque, and the engine capacity or motor capacity is used as the maximum torque in many cases, so the safety factor (f_S) of no less than 1.0 should be considered as the most desirable.

$$f_S = T_D \text{/maximum torque under normal operating conditions} > 1.0$$

The maximum torque that may occur in an emergency should be determined using "T_S torque." The safety factor (f_S) of no less than 1.5 should be considered as desirable in this case as well.

$$f_S = T_S \text{/breaking torque under emergency conditions} > 1.5$$

To select a drive shaft based on a safety factor of 1.5 or less, consult JTEKT as close examination is required in consideration of previous performance records.

Life of drive shaft

There is no worldwide standard for service life calculation of universal joint bearings (cross & bearings) and the service life is calculated according to the unique method developed by each manufacturer.
JTEKT employs the following empirical equation based on extensive experimentation (conforming to SAE).
The service life L_h is defined as the expected number of operating hours before a flaking occurs on the rolling contact surface of the bearing. The use of the bearings over the service life L_h may be practical on a low speed machine.

$$L_h = 3000\ Ke \left(\frac{T_R \cdot K_n \cdot K_\theta}{T_m} \right)^{2.907}$$

Where, L_h: Average calculated bearing life (h)
Ke : Experimental correction coefficient (=2)
T_R: Rated torque (N・m)
T_m: Mean torque (N・m)
K_n: Speed factor = $10.2/n^{0.336}$
K_θ: Angle factor = $1.46/\theta^{0.344}$
n : Rotational speed = (min^{-1})
θ : Shaft operating angle (°)

Note) A drive shaft should be selected by considering the type of the machine, peripheral equipment, particular operating conditions, and other factors. The method outlined in this catalog is a common rough guide. It is recommended to consult JTEKT for details.

Balance quality of drive shaft

If a rotating drive shaft is unbalanced, it may adversely influence the equipment and ambient conditions, thus posing a problem. JTEKT designs and manufactures drive shafts to satisfy the balance quality requirements specified in JIS B 0905.

Expression of balance quality

The balance quality is expressed by the following equation:

Balance quality $= e\omega$

or

Balance quality $= en/9.55$

where e: Amount of specific unbalance (mm)
This amount is the quotient of the static unbalance of a rigid rotor by the rotor mass. The amount is equal to the deviation of the center of the rotor mass from the center line of the shaft.
ω: Maximum service angular velocity of the rotor (rad/s)
n: Rotational speed (min^{-1})

Balance quality grades

The JIS specifies the balance quality grades from G0.4 to G4000. Generally, the three grades described in Table 1 below are commonly used.

Correction of the unbalance of drive shafts

JTEKT corrects the unbalance of drive shafts to the optimal value by the two plane balancing method, using the latest balance system.
To correct the balance of a drive shaft, it is critical to correct the balance between two planes each near the two individual universal joints, instead of by the one plane balancing as used to balance car wheels.
Especially in the case of a long drive shaft, this two plane balancing method is the only way to acquire good results.

Table 1 Recommended balance quality grades (excerpt from JIS B 0905)

Balance quality grade	Upper limit value of balance quality ($e\omega$)	Recommended applicable machines
G40	40	Car wheels, wheel rims, wheel sets and drive shafts Crankshaft systems of elastically mounted high speed four stroke engines (gasoline or diesel) with six or more cylinders Crankshaft systems of the engines of automobiles, trucks and rolling stock
G16	16	Drive shafts with special requirements (propeller shafts and diesel shafts) Components of crushing machines Components of agricultural machines Components of the engines of automobiles, trucks and rolling stock (gasoline or diesel) Crankshaft systems with six or more cylinders with special requirements
G 6.3	6.3	Devices of processing plants Ship engine turbine gears (for merchant ships) Centrifugal drums Papermaking rolls and printing rolls Fans Assembled aerial gas turbine rollers Flywheels Pump impellers Components of machine tools and general industrial machines Medium or large electric armatures (of electric motors having at least 80 mm in the shaft center height) without special requirements Small electric armatures used in vibration insensitive applications and/or provided with vibration insulation (mainly mass produced models) Components of engines with special requirements

Composition of identification numbers

Drive shaft

2 A 70 Z 000 065 1 □

- □: Identification code: Given in alphabetic order if design is changed
- 1: Configuration code: Refer to pages 15 - 27.
- 065: Length code: The distance between centers of the cross & bearings is rounded off to cm (Example) 652 mm→ 065, 657 mm→ 066
- 000: Serial number: Given by JTEKT
- Z: Z is given to the mixed types of #5 and #6, and no code is given for others
- 70: Size code: Represented in two digits

Model No.	Size code
#4 - #9	Size x 10
#10, #12	The size is used as it is

- A: Type code

Type code	Type
A	Block (smaller than #10)
Z	Block (#10 or larger)
M	Mixed

- 2: Quantity of cross & bearings

Drive shaft service parts

*Confirm with JTEKT about correspondence to each drive shaft.

(1) Cross & bearing

BA M 070 0 5 1 B W

- W: Thrust washer code: Given if a washer is used
- B: Grease nipple code: Given by JTEKT according to the type of grease nipple
- 1: Bearing cup mounting hole shape: Given by JTEKT
- 5: Cross female screw code: Given by JTEKT
- 0: Identification code: Given in alphanumeric characters
- 070: Size code: Represented in three digits Size x 10
- M: Bolt code

M	For metric screw thread
U	For unified screw thread

- BA: Type code

Type code	Type
BA	Block
BM	Mixed

(2) Sleeve shaft assembly

SPA 070 000 □

- □: Identification code: Given in alphabetical order if design is changed
- 000: Serial number: The number same as that of the parent drive shaft is given
- 070: Size code: Represented in three digits Size x 10
- SPA: Type code

Type code	Type
SPA	Block
SPR	Mixed

(3) Bearing fixing bolt

MM 12X53X1.25 □

- □: Identification code: Given in alphabetical order if design is changed
- 1.25: Pitch
- 53: Shank length
- 12: Nominal diameter
- MM: Screw type

MM	For metric screw thread
NF	For unified screw thread

The model numbers of standard bolts are as follows.

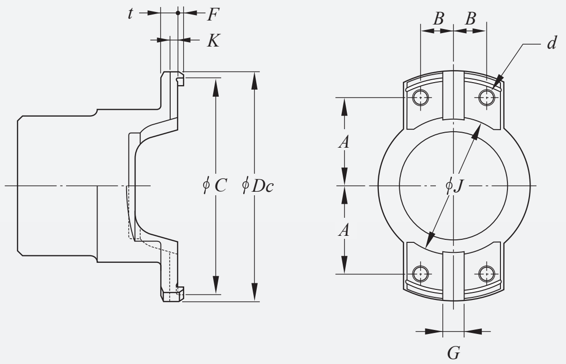
Size	Screw type	Nominal No.
#4	Metric screw thread	MM8 X 38 X 1.25
	Unified screw thread	NF5/16 X 38 X 24
#5, #6	Metric screw thread	MM10 X 45 X 1.25Z
	Unified screw thread	NF3/8 X 044 X 24
#7, #8	Metric screw thread	MM12 X 53 X 1.25
	Unified screw thread	NF1/2 X 51 X 20
#8.5, #9	Metric screw thread	MM12 X 60 X 1.25
	Unified screw thread	NF1/2 X 60 X 20
#10, #12	Metric screw thread	MM14 X 080 X 1.5
	Unified screw thread	—

Specifications

Torque capacity

Model No.	Torque capacity (N·m)			Model No.	Torque capacity (N·m)		
	Rated T_R	Normal maximum T_D	Emergency maximum T_S		Rated T_R	Normal maximum T_D	Emergency maximum T_S
4	466	1 280	3 310	8.5	2 570	7 520	13 500
5	851	1 770	4 470	9	3 450	9 980	18 900
6	1 090	2 240	6 400	10	5 580	13 600	38 900
7	1 650	3 760	9 190	12	8 060	19 300	47 400
8	2 200	5 380	12 200	—	—	—	—

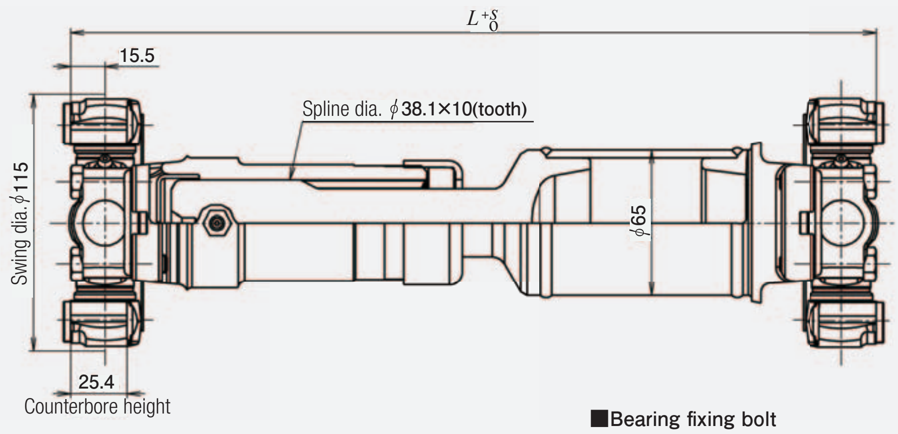
Recommended dimensions of coupling yokes



Model No.	Boundary dimensions (mm)									Bolt holes d	
	Dc	C	J	F	G	K	A	B	t	Metric screw thread	Unified screw thread
4	114.3	$107.93^{+0.05}_{0}$	70	3.2	$9.5^{+0.05}_{0}$	$3.5^{+0.5}_{0}$	43.63	18.24	11.8	M 8×1.25	5/16-24UNF
5	121.4	$115.06^{+0.05}_{0}$	70	4	$14.26^{+0.05}_{0}$	$4.9^{+0.5}_{0}$	44.45	21.43	12.6	M10×1.25	3/8-24UNF
6	148.4	$140.46^{+0.05}_{0}$	90	4	$14.26^{+0.05}_{0}$	$4.9^{+0.5}_{0}$	57.15	21.43	12.6		
7	158	$148.38^{+0.05}_{0}$	92	4.8	$15.85^{+0.05}_{0}$	$5.7^{+0.5}_{0}$	58.73	24.61	15.8	M12×1.25	1/2-20UNF
8	215.9	$206.32^{+0.05}_{0}$	150	4.8	$15.85^{+0.05}_{0}$	$5.7^{+0.5}_{0}$	87.3	24.61	17.4		
8.5	174.6	$165.07^{+0.05}_{0}$	96	4.8	$15.85^{+0.05}_{0}$	$5.7^{+0.5}_{0}$	61.91	35.72	19		
9	219.1	$209.52^{+0.05}_{0}$	135	4.8	$15.85^{+0.05}_{0}$	$5.7^{+0.5}_{0}$	84.14	35.72	19		
10	225.4	$212.699^{+0.051}_{0}$	141	6.4	$25.35^{+0.07}_{0}$	$9.3^{+0.5}_{0}$	82.55	46.05	30	M14×1.5	—
12	301.6	$288.90^{+0.1}_{0}$	205	6.4	$25.35^{+0.07}_{0}$	$9.3^{+0.5}_{0}$	120.65	46.05	30		

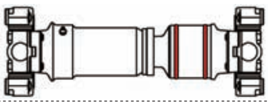
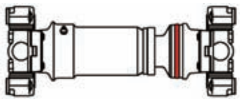
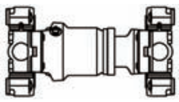
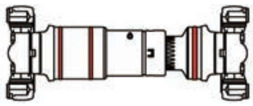
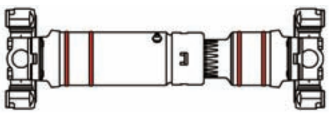
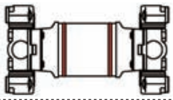
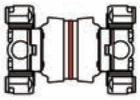
Specifications

Model No. 4 Block type



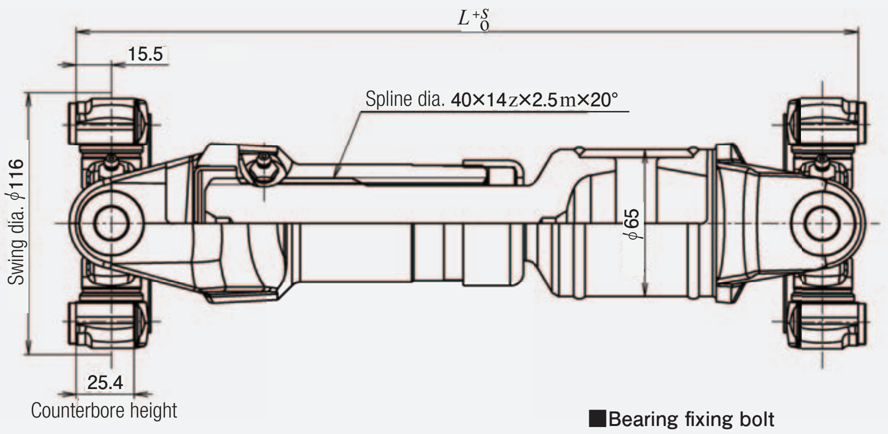
■Bearing fixing bolt

Type	Size	Tightening torque N·m
Metric screw thread	M8×1.25	36 - 40
Unified screw thread	5/16-24UNF	30 - 36

Structure code	Structure sketch (The red lines indicate welding parts.)	Length between attaching surfaces L (mm)	Allowable telescoping stroke S (mm)	Max operating angle (°)	Features
1		327 (min.)	45	25	Telescoping type (with tube)
		277			Telescoping type (without tube)
2		*	*	*	Telescoping type (integrated structure on shaft side)
3	 	*	*	25	Long telescoping type
5		176 (min.)	—	25	Fixed type (with tube)
		144			Fixed type (without tube)
6		98.4 / 104.8	—	10	Fixed type (integrated structure)

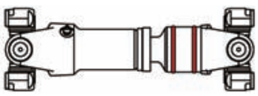
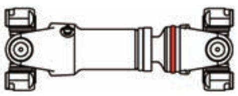
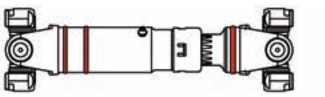
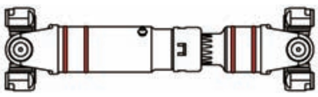
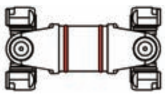
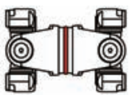
Remark Check with us about *parts as they are designed individually.

Model No. 4 Mixed type



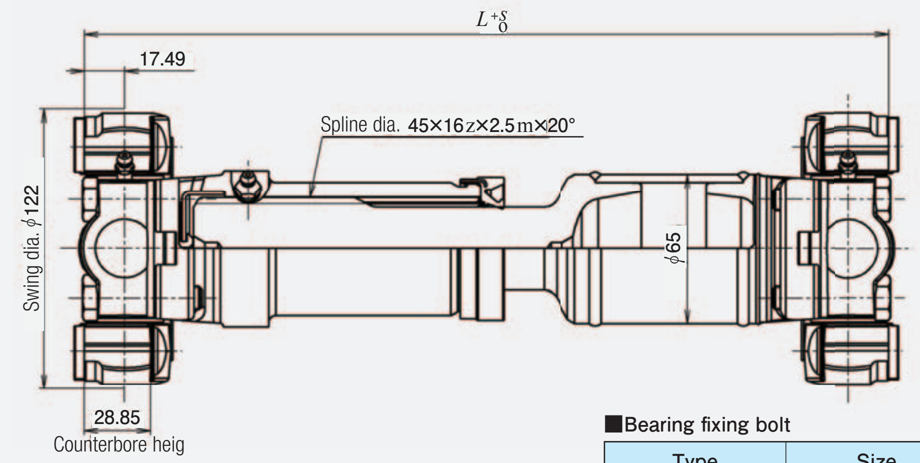
■Bearing fixing bolt

Type	Size	Tightening torque N·m
Metric screw thread	M8×1.25	36 - 40
Unified screw thread	5/16-24UNF	30 - 36

Structure code	Structure sketch (The red lines indicate welding parts.)	Length between attaching surfaces L (mm)	Allowable telescoping stroke S (mm)	Max operating angle (°)	Features
1		344 (min.)	45	25	Telescoping type (with tube)
		294			Telescoping type (without tube)
3	 	573	240	25	Long telescoping type
5		195 (min.)	—	25	Fixed type (with tube)
		145			Fixed type (without tube)
6		97	—	12	Fixed type (integrated structure)
		100		15	
		108.5			

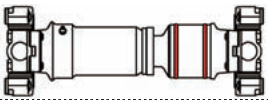
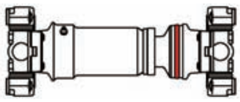
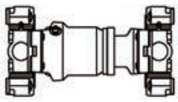
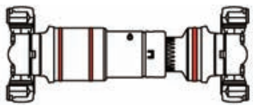
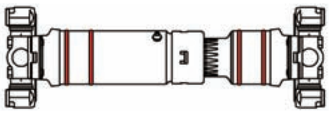
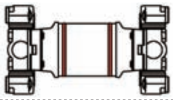
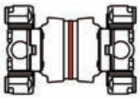
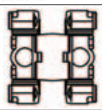
Specifications

Model No. 5 Block type



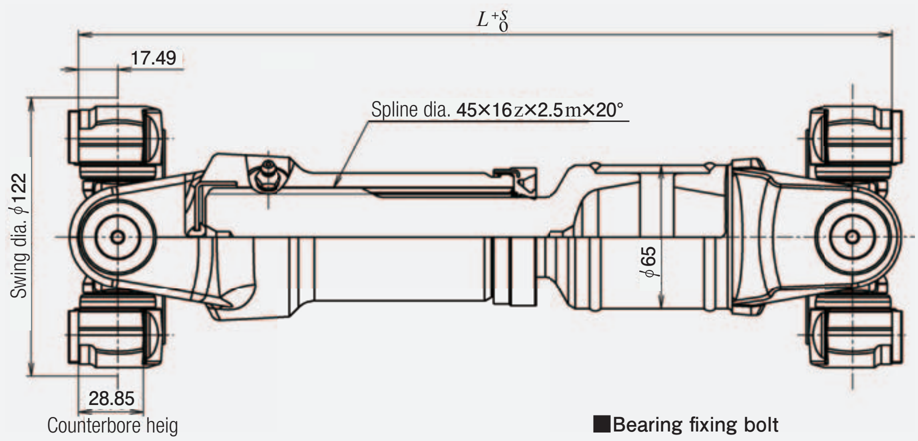
■Bearing fixing bolt

Type	Size	Tightening torque N·m
Metric screw thread	M10×1.25	71 - 77
Unified screw thread	3/8-24UNF	50 - 60

Structure code	Structure sketch (The red lines indicate welding parts.)	Length between attaching surfaces L (mm)	Allowable telescoping stroke S (mm)	Max operating angle (°)	Features
1		336 (min.)	42	10	Telescoping type (with tube)
		288			Telescoping type (without tube)
2		263	42	10	Telescoping type (integrated structure on shaft side)
3	 	*	*	10	Long telescoping type
5		178 (min.)	—	10	Fixed type (with tube)
		129.56			Fixed type (without tube)
6		112	—	7	Fixed type (integrated structure)

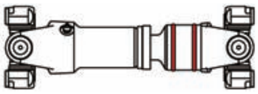
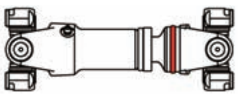
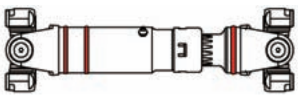
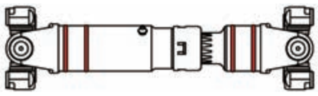
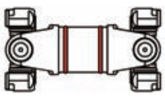
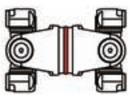
Remark Check with us about *parts as they are designed individually.

Model No. 5 Mixed type



■Bearing fixing bolt

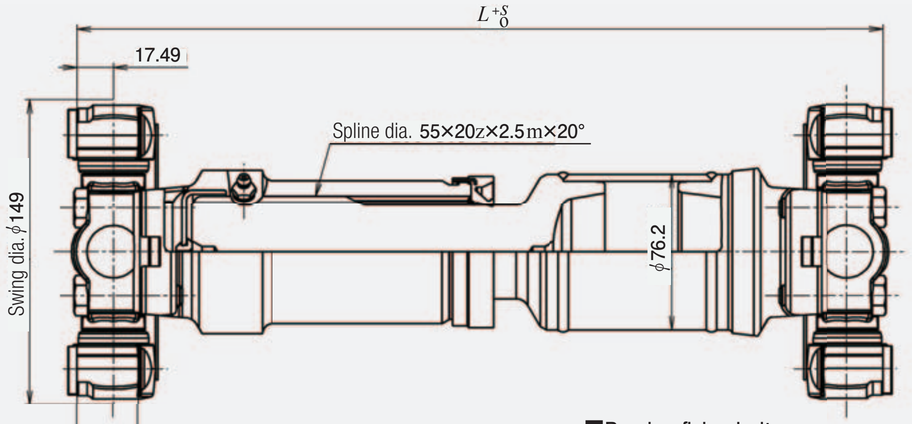
Type	Size	Tightening torque N·m
Metric screw thread	M10×1.25	71 - 77
Unified screw thread	3/8-24UNF	50 - 66

Structure code	Structure sketch (The red lines indicate welding parts.)	Length between attaching surfaces L (mm)	Allowable telescoping stroke S (mm)	Max operating angle (°)	Features
1		364 (min.)	54	25	Telescoping type (with tube)
		314			Telescoping type (without tube)
3	 	＊	＊	25	Long telescoping type
5		213 (min.)	—	25	Fixed type (with tube)
		160			Fixed type (without tube)
		164			
6		105	—	10	Fixed type (integrated structure)
		150			

Remark Check with us about ＊parts as they are designed individually.

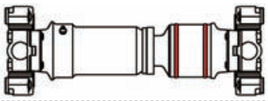
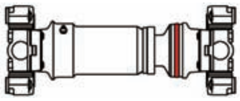
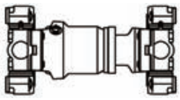
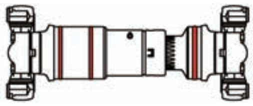
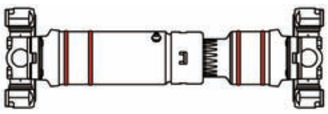
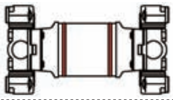
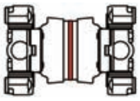
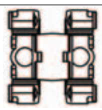
Specifications

Model No. 6 Block type

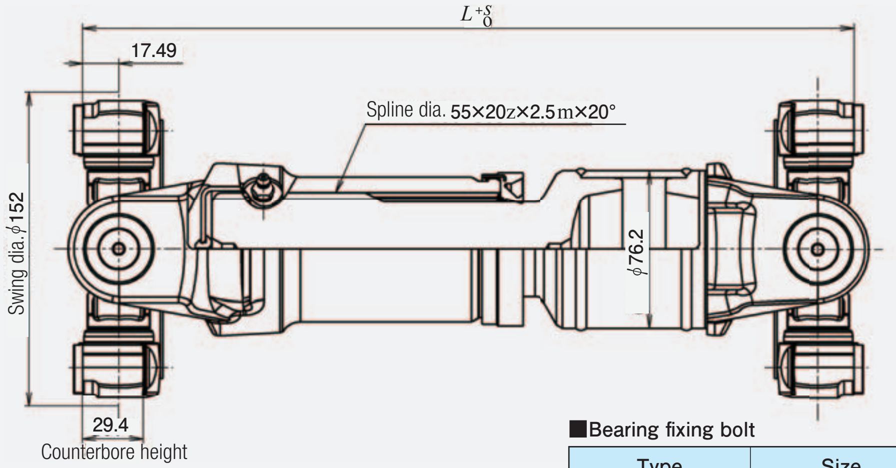


■Bearing fixing bolt

Type	Size	Tightening torque N·m
Metric screw thread	M10×1.25	71 - 77
Unified screw thread	3/8-24UNF	50 - 66

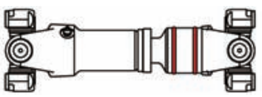
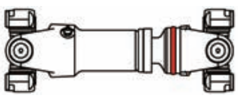
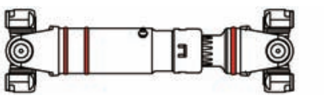
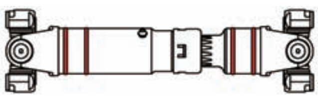
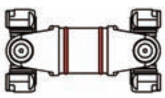
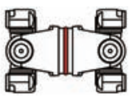
Structure code	Structure sketch (The red lines indicate welding parts.)	Length between attaching surfaces L (mm)	Allowable telescoping stroke S (mm)	Max operating angle (°)	Features
1		369 (min.)	47	25	Telescoping type (with tube)
		319			Telescoping type (without tube)
2		211	15	20	Telescoping type (integrated structure on shaft side)
		273	35		
3	 	610 (min.)	259	25	Long telescoping type
5		216 (min.)	—	25	Fixed type (with tube)
		165.96			Fixed type (without tube)
6		113	—	5	Fixed type (integrated structure)
		117.1			
		120		10	

Model No. 6 Mixed type



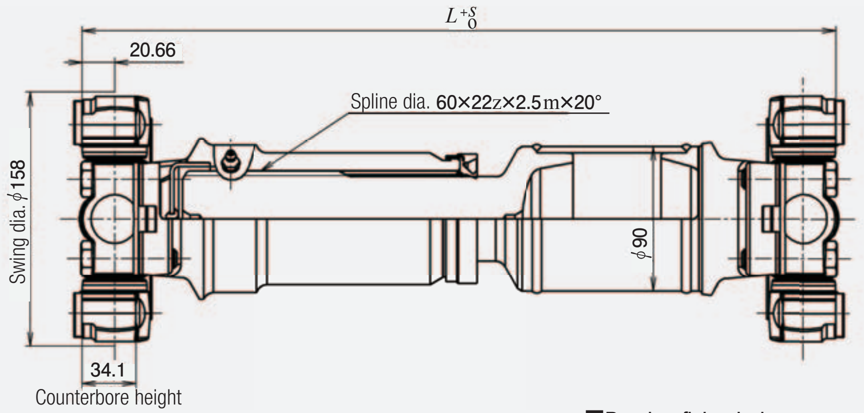
■Bearing fixing bolt

Type	Size	Tightening torque N·m
Metric screw thread	M10×1.25	71 - 77
Unified screw thread	3/8-24UNF	50 - 66

Structure code	Structure sketch (The red lines indicate welding parts.)	Length between attaching surfaces L (mm)	Allowable telescoping stroke S (mm)	Max operating angle (°)	Features
1		381 (min.)	52	25	Telescoping type (with tube)
		413 (min.)	85		
		289	16		Telescoping type (without tube)
		332	52		
		363	85		
3	 	615 (min.)	265	25	Long telescoping type
5		227 (min.)	—	25	Fixed type (with tube)
		176.98			Fixed type (without tube)
6		103.88	—	10	Fixed type (integrated structure)
		187.98			

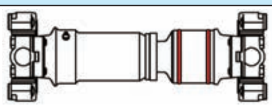
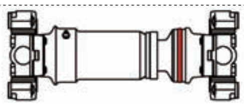
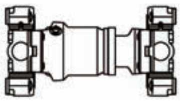
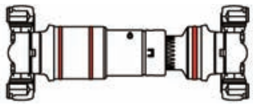
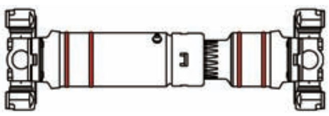
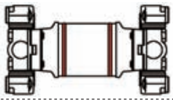
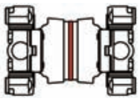
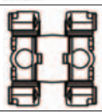
Specifications

Model No. 7 Block type

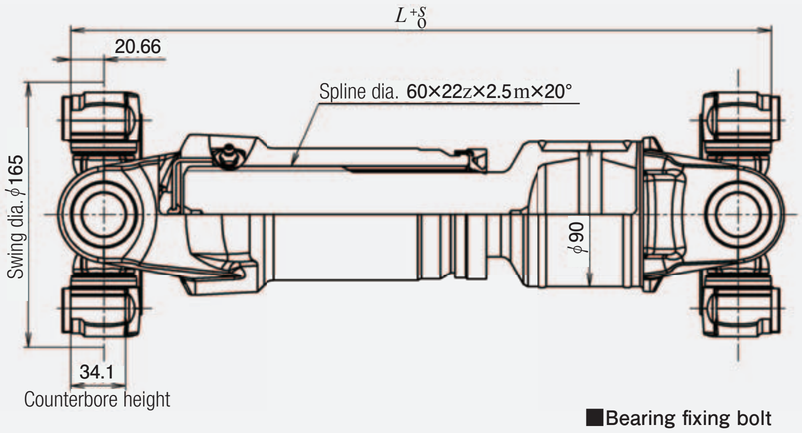


■Bearing fixing bolt

Type	Size	Tightening torque N·m
Metric screw thread	M12×1.25	132 - 155
Unified screw thread	1/2-20UNF	95 - 108

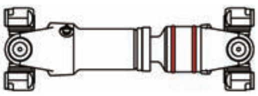
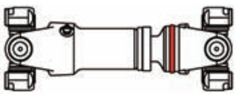
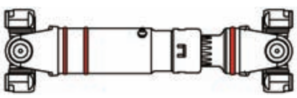
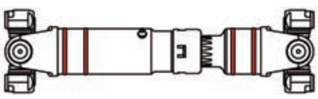
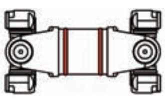
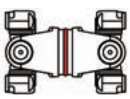
Structure code	Structure sketch (The red lines indicate welding parts.)	Length between attaching surfaces L (mm)	Allowable telescoping stroke S (mm)	Max operating angle (°)	Features
1		435 (min.)	65	20	Telescoping type (with tube)
		409	47		
		385	65		Telescoping type (without tube)
		359	47		
2		276	21	18	Telescoping type (integrated structure on shaft side)
		290	27		
3	 	528 (min.)	160	20	Long telescoping type
5		241 (min.)	—	20	Fixed type (with tube)
		187.5		15	Fixed type (without tube)
		195		20	
		212			
6		123.8	—	5	Fixed type (integrated structure)

Model No. 7 Mixed type



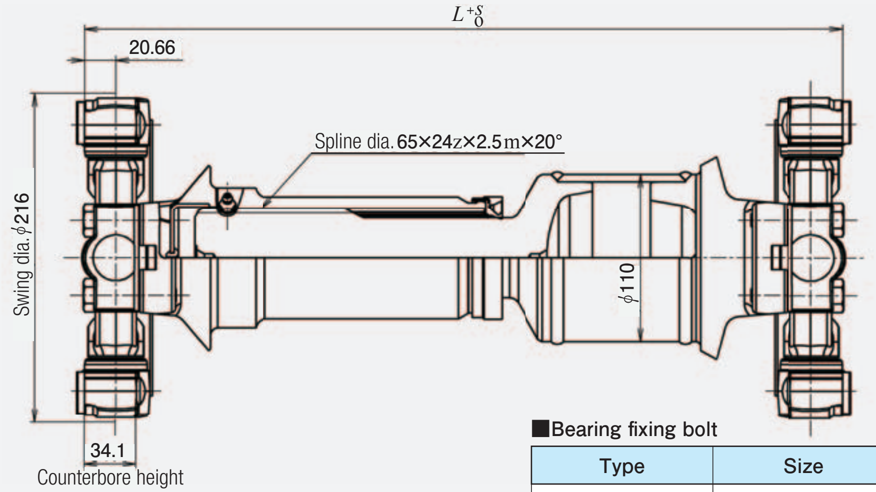
■Bearing fixing bolt

Type	Size	Tightening torque N·m
Metric screw thread	M12×1.25	132 - 155
Unified screw thread	1/2-20UNF	95 - 108

Structure code	Structure sketch (The red lines indicate welding parts.)	Length between attaching surfaces L (mm)	Allowable telescoping stroke S (mm)	Max operating angle (°)	Features
1		439 (min.)	65	25	Telescoping type (with tube)
		389			Telescoping type (without tube)
		365	35		
3	 	520 (min.)	160	25	Long telescoping type
5		230 (min.)	—	25	Fixed type (with tube)
		179.32			Fixed type (without tube)
6		140	—	10	Fixed type (integrated structure)
		200			

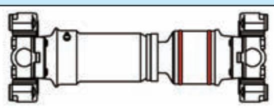
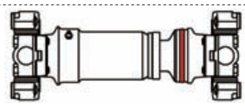
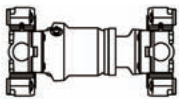
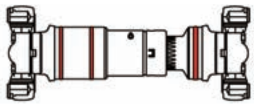
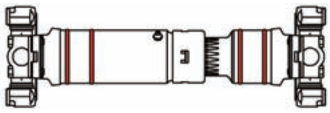
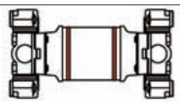
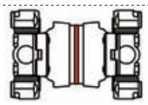
Specifications

Model No. 8 Block type



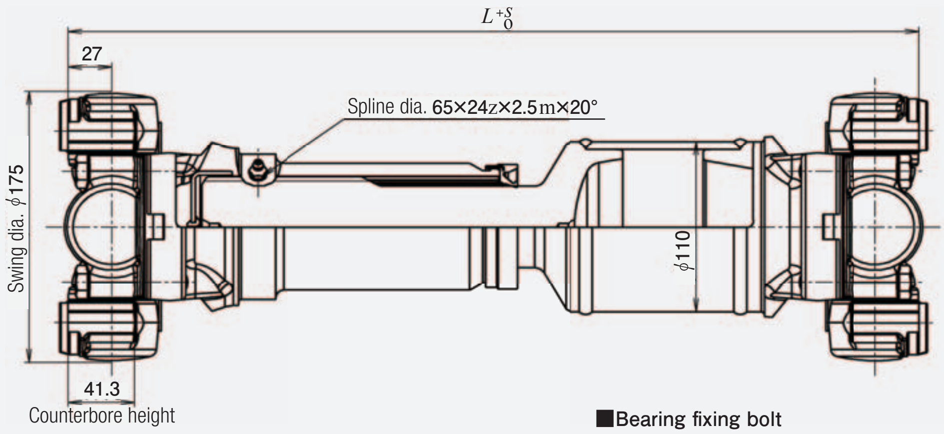
■Bearing fixing bolt

Type	Size	Tightening torque N·m
Metric screw thread	M12×1.25	132 - 155
Unified screw thread	1/2-20UNF	95 - 108

Structure code	Structure sketch (The red lines indicate welding parts.)	Length between attaching surfaces L (mm)	Allowable telescoping stroke S (mm)	Max operating angle (°)	Features
1		475 (min.)	76	25	Telescoping type (with tube)
		415			Telescoping type (without tube)
2		＊	＊	＊	Telescoping type (integrated structure on shaft side)
3	 	600 (min.)	190	25	Long telescoping type
5		267 (min.)	—	25	Fixed type (with tube)
		210 206.64			Fixed type (without tube)

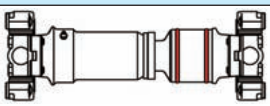
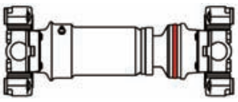
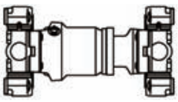
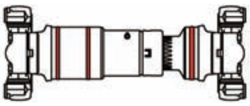
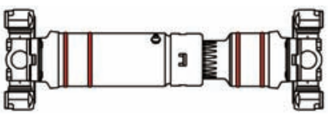
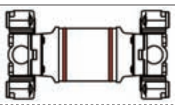
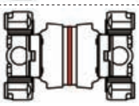
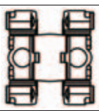
Remark Check with us about ＊parts as they are designed individually.

Model No. 8.5 Block type



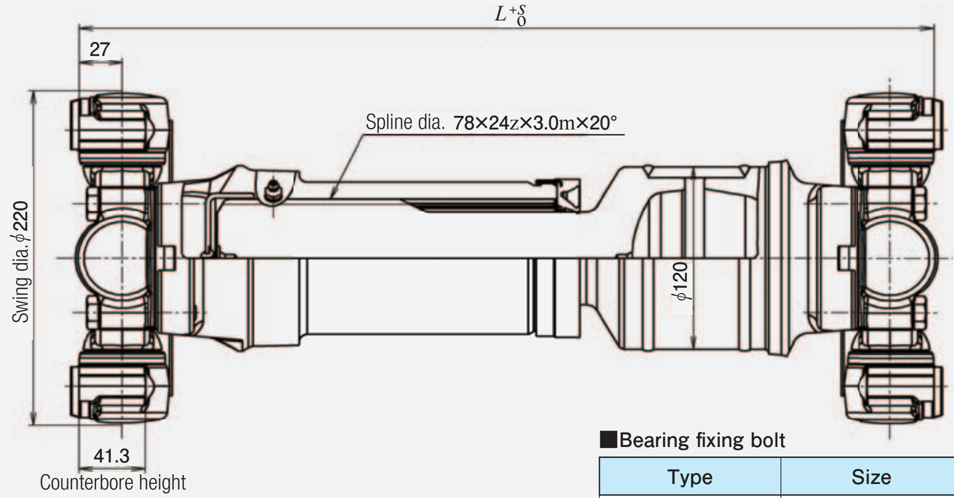
■Bearing fixing bolt

Type	Size	Tightening torque N·m
Metric screw thread	M12×1.25	132 - 155
Unified screw thread	1/2-20UNF	149 - 162

Structure code	Structure sketch (The red lines indicate welding parts.)	Length between attaching surfaces L (mm)	Allowable telescoping stroke S (mm)	Max operating angle (°)	Features
1		494 (min.)	70	25	Telescoping type (with tube)
		512 (min.)	85		
		436	70		Telescoping type (without tube)
2		305	20	17	Telescoping type (integrated structure on shaft side)
		361	40		
3	 	610 (min.)	190	25	Long telescoping type
5		282 (min.)	—	25	Fixed type (with tube)
		241.5		17	Fixed type (without tube)
		231			
		224		25	
6		158.8	—	10	Fixed type (integrated structure)
		164			
		172			

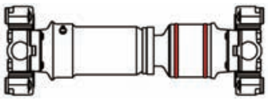
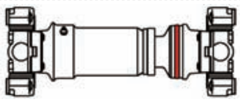
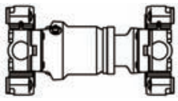
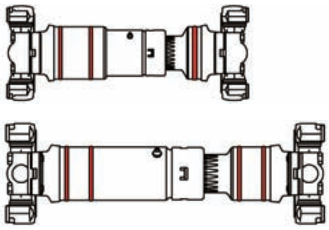
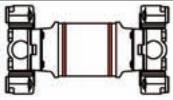
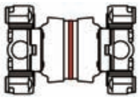
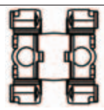
Specifications

Model No. 9 Block type

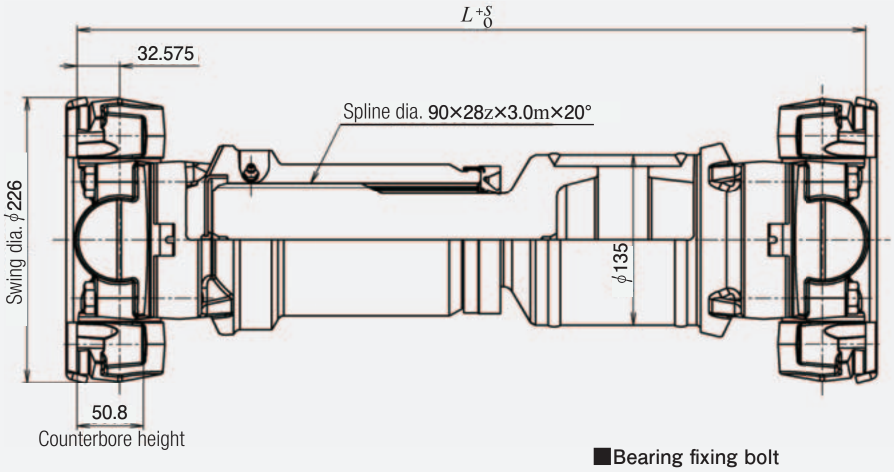


■Bearing fixing bolt

Type	Size	Tightening torque N·m
Metric screw thread	M12×1.25	132 - 155
Unified screw thread	1/2-20UNF	149 - 162

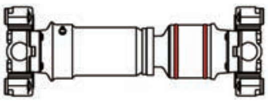
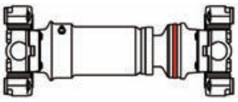
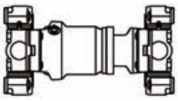
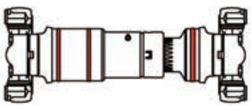
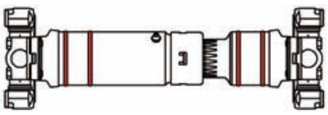
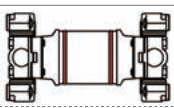
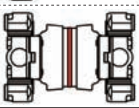
Structure code	Structure sketch (The red lines indicate welding parts.)	Length between attaching surfaces L (mm)	Allowable telescoping stroke S (mm)	Max operating angle (°)	Features
1		543 (min.)	78	25	Telescoping type (with tube)
		483			Telescoping type (without tube)
2		398	56	25	Telescoping type (integrated structure on shaft side)
3		638 (min.)	180	25	Long telescoping type
5		295 (min.)	—	25	Fixed type (with tube)
		235			Fixed type (without tube)
6		158.8	—	25	Fixed type (integrated structure)

Model No. 10 Block type



■Bearing fixing bolt

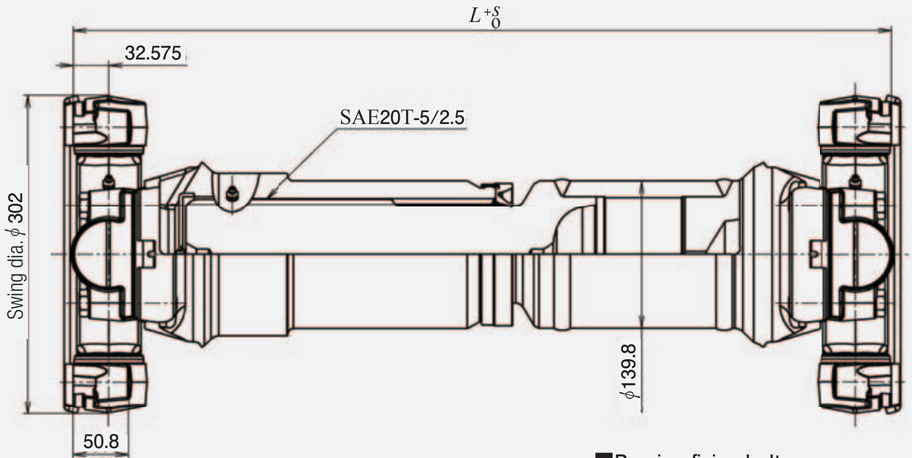
Type	Size	Tightening torque N•m
Metric screw thread	M14×1.5	206 - 220

Structure code	Structure sketch (The red lines indicate welding parts.)	Length between attaching surfaces L (mm)	Allowable telescoping stroke S (mm)	Max operating angle (°)	Features
1		579 (min.)	70	25	Telescoping type (with tube)
		509			Telescoping type (without tube)
2		489	70	25	Telescoping type (integrated structure on shaft side)
3	 	*	*	25	Long telescoping type
5		353 (min.)	—	25	Fixed type (with tube)
		280			Fixed type (without tube)
		269			

Remark Check with us about *parts as they are designed individually.

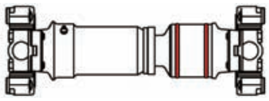
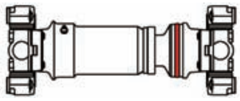
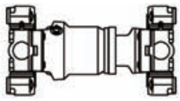
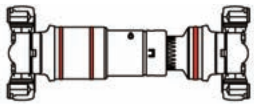
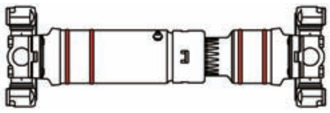
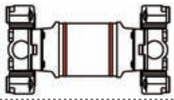
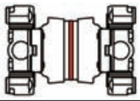
Specifications

Model No. 12 Block type



■Bearing fixing bolt

Type	Size	Tightening torque N·m
Metric screw thread	M14×1.5	206 - 220

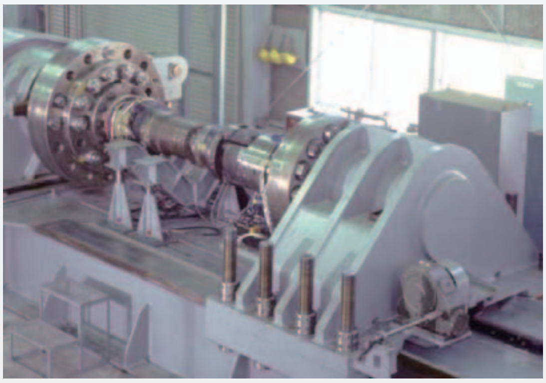
Structure code	Structure sketch (The red lines indicate welding parts.)	Length between attaching surfaces L (mm)	Allowable telescoping stroke S (mm)	Max operating angle (°)	Features
1		676 (min.)	82	25	Telescoping type (with tube)
		606			Telescoping type (without tube)
2		*	*	*	Telescoping type (integrated structure on shaft side)
3	 	*	*	*	Long telescoping type
5		369 (min.)	—	25	Fixed type (with tube)
		306.3			Fixed type (without tube)

Remark Check with us about *parts as they are designed individually.

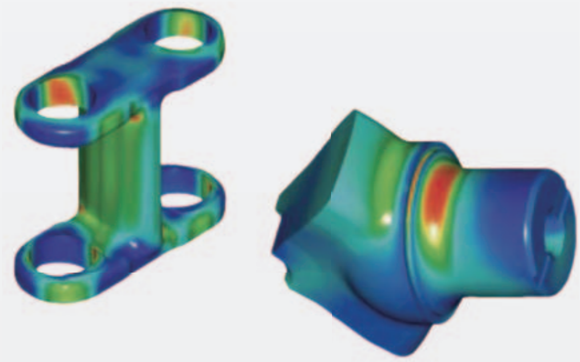
Analysis/evaluation equipment

With improvement with FEM using a 3D model and review of the allowable differential angle based on our achievement in the market over more than 40 years, JTEKT proposes optimal design and products suitable for applications.
We also implement evaluation with actual products as necessary.

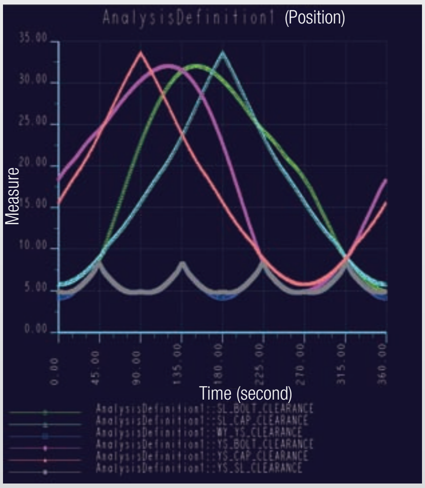
Large-sized torsion testing machine

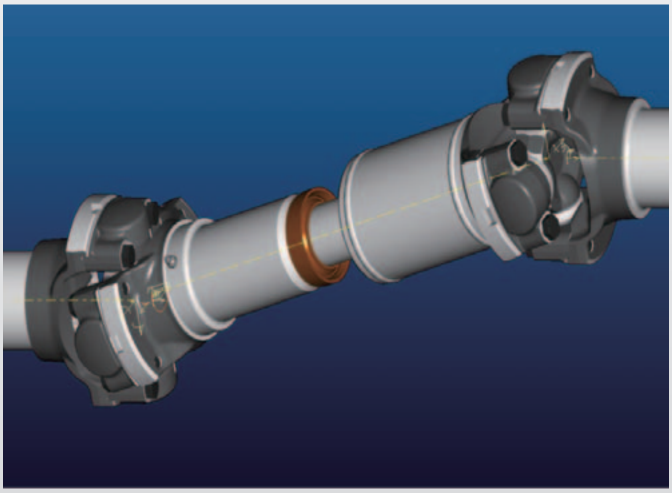


Example of FEM analysis



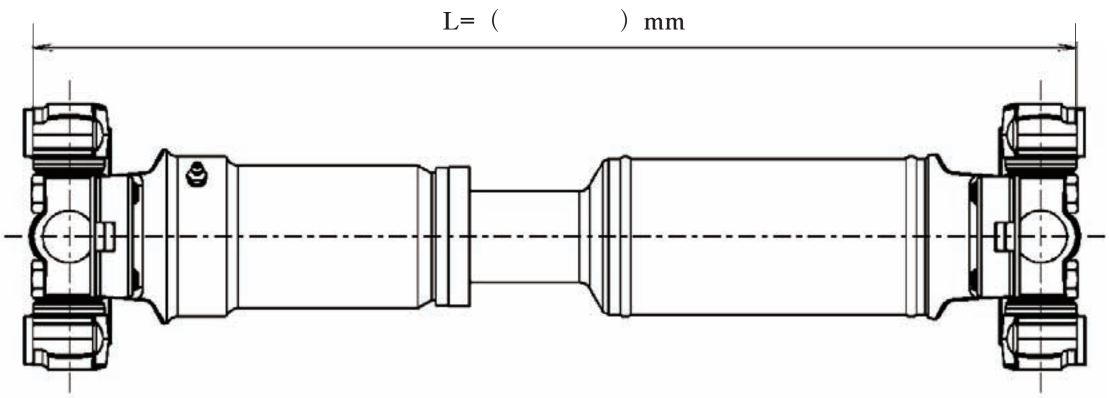
Example of review of allowable differential angle





Drive shaft selection sheet

	Item		Necessity	Description			Remarks
Name of the machine			◎				
Location of installation			◎				
(1)	Size/type		○				
(2)	Torque transmission	(N·m)	◎	Normal	Max.	Emergency max.	
(3)	Rotational speed	(min^{-1})	◎	Normal	Max.		
(4)	Operating angle	(deg)	◎	Normal	Max.		
(5)	Required telescoping	(mm)	◎				
(6)	Limited swing diameter	(mm)	△				
(7)	Paint color		△				Black if not specified
(8)	Ambient temperature	(℃)	△				
(9)	Special environmental conditions		△				
(10)	Service life requirement	(h)	○				
(11)	Attaching dimension						



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