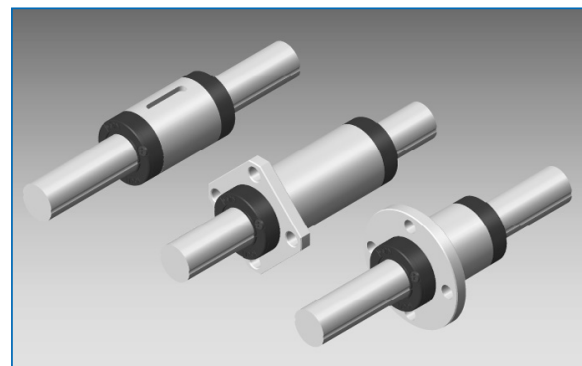


Ball Spline Contents



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1 WON Ball Spline

1. Structure and Features

WON Ball Spline consists of a nut and a shaft. The ball of the nut has a rolling linear motion along the groove of the precisely-ground spline shaft. The spline has the linear motion to deliver torque in the circumferential direction of the shaft. Based on one nut, the device exerts high performance in the radial direction, in an environment with vibration and impact load, in an environment that requires high positioning precision, or in an environment that needs high-speed motion.

2. Transmission of high torque

A spline groove is precisely ground in the shape close to a ball diameter. For this reason, if torque load is imposed on a shaft or nut, it is evenly applied to two rows of the ball in the torque load direction in the transmission of rotatory force.

3. High load capacity and long life

WON Ball Spline can be designed to be compact. It ensures high stability and long life in an environment with high load or torsional load.

4. Zero gap

Since a ball spline minimizes the gap of the rotational direction, and, if necessary, imposes preload on one spline nut to make clearance zero, it can have a small displacement value and obtain high rigidity and high positioning precision.

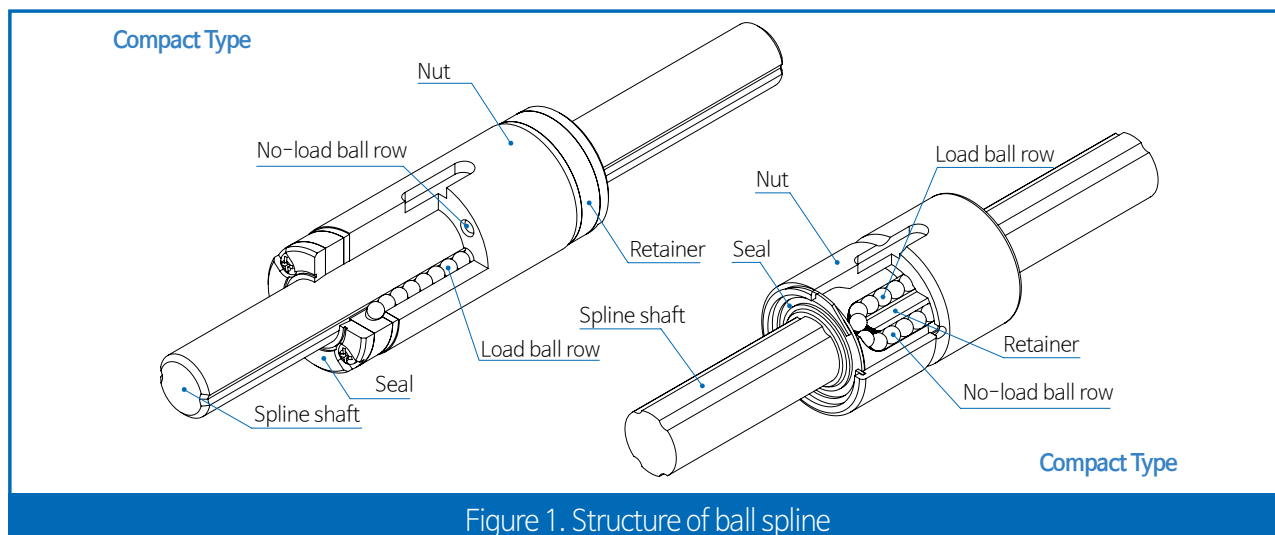


Figure 1. Structure of ball spline

Ball Spline	Compact Ball Spline	<ul style="list-style-type: none"> - 2 rows and 4 points contact type - Simple structure and very compact type
	Linear Ball Spline	<ul style="list-style-type: none"> - 4 rows and 2 points contact type - Angular contact type, and high load rating in radial direction and torque direction

2 Selection of Ball Spline

1. Overview

To select a ball spline, it is necessary to identify the details of requirements, prioritize them, and then choose the one that meets the service conditions.

2. Procedure

- | | |
|---------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 Determine service conditions |  The equipment to be used, maintenance structure, installation space, assembly state, functional requirements, service environments |
| 2 Select a type |  Determine an appropriate type in consideration of motion conditions, load magnitude, rigidity, friction, and assembly. |
| 3 Select a model number |  Determine an appropriate model number and a quantity of nuts in consideration of the assembled space, load, etc. |
| 4 Calculate load |  Calculate the vertical, horizontal, and moment load imposed on nut and shaft, a critical speed of shaft, an operating speed of shaft, etc. |
| 5 Calculate equivalent load |  Convert each load imposed on nut and shaft into equivalent load. |
| 6 Calculate mean load |  Convert each load imposed on nut and shaft and the variable load at deceleration & acceleration into mean load. |
| 7 Calculate static safety factor |  Calculate the static safety factor with basic load rating and maximum equivalent load, and check if the calculated value meets a service condition. |
| 8 Calculate life |  Calculate load rating and life, and check if the calculated values meet service conditions. |
| 9 Review preload and clearance |  Determine the preload and clearance that meet service conditions. |
| 10 Determine a class of precision |  Determine a class of precision for the travel or rotation that a ball spline needs. |
| 11 Lubrication, dust proof, and surface treatment |  Determine a grease lubricant, oil lubricant, or a special lubricant suitable for an environment. Select a dust-proof seal/ Determine the surface treatment for dust proof and low dust generation. |
| 12 Complete selection |  Determine the final specifications of a ball spline. |

3 Life Calculation

1. Life

When a ball spline runs in the course of bearing external load, the stress, which arises when the raceway surface of nut and axis and a rolling element bear continuously repeated load, causes fatigue failure and leads to flaking. Life of a ball spline refers to a total travel distance until the point that flaking arises due to initial fatigue failure.

- A ball spline can have defects earlier than the time of normal flaking caused by its wear or fatigue in the following cases

- Excess load by the imprecise assembly following a difference in temperature or tolerance
- If a ball spline is contaminated with foreign substances
- Driving with insufficient lubrication
- Reciprocating motion in a very short distance in the form of vibration or wave during halting or driving
- Excessive load or rotational torque imposed on a ball spline
- Deformation of plastic end-plate

2. Rating fatigue life L

Generally Ball Spline does not always have an equal life span even though its products are manufactured in the same way, because of the difference in scattering of original fatigue of raw material. For this reason, the reference value of life of a ball spline is defined as the rating fatigue life which is a total driving distance that 90% of ball splines in one group with the same specifications can reach without flaking at the time when all in the group run under the same conditions.

Radial load

$$L = \left(\frac{f_H \cdot f_T \cdot f_C}{f_W} \cdot \frac{C}{P_C} \right)^3 \times 50 \text{ km}$$

L : Rated life (km)

C : Basic dynamic rated load (N)

T : Basic dynamic rated torque (N · m)

P_C : Calculated load (N)

P_T : Calculated torque (N · m)

Torque load

$$L = \left(\frac{f_H \cdot f_T \cdot f_C}{f_W} \cdot \frac{T}{P_T} \right)^3 \times 50 \text{ km}$$

f_H : Hardness factor (See Figure 2.)

f_T : Temperature factor (See Figure 3.)

f_C : Contact factor (See Table 2.)

f_W : Load factor (See Table 3.)

$$L_h = \frac{10^3 \cdot L}{2 \times \ell_s \times n_1 \times 60}$$

L_h : Life time (h)

ℓ_s : Stroke length (m)

n₁ : No. of reciprocating motions per minute (min⁻¹)

- **Hardness factor (f_H)**

To implement the best performance of a ball spline, it is necessary to maintain appropriately the hardness and depth of the raceway surface of the nut and shaft that contact a ball as a rolling element.

WON Ball Spline has HRC58~64 surface hardness. There is no need to consider hardness factor. If the hardness is lowered than a baseline, load capacity of a ball spline decreases. In this case, it is necessary to apply hardness factor to life calculation

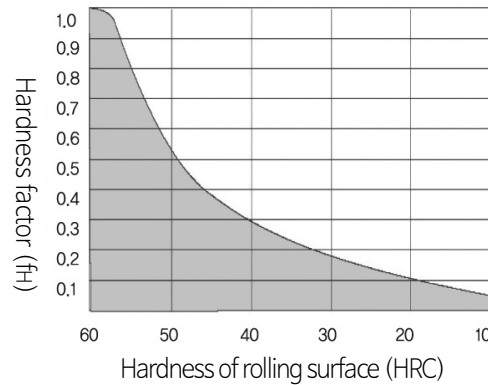


Figure 2. Hardness factor(f_H)

- **Temperature factor (f_T)**

If high temperature over 100°C is applied to a ball spline, it is necessary to take into account the temperature factor (f_T) shown in the figure at the time when a ball spline is selected. For use at over 80°C, please contact WON ST.

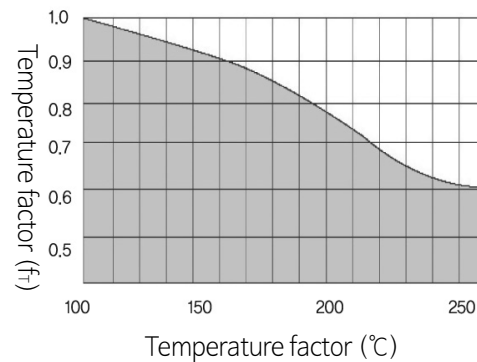


Figure 3. Temperature factor(f_T)

Note) If ambient temperature is over 80°C, it is necessary to change the material of seal, end plate, and support plate to the one which meets the specifications for high temperature.

- **Contact factor (f_c)**

If over two blocks of a ball splines are closely assembled and mounted, uniform load may not be applied to them due to difference among mounting surfaces. Therefore, it is required to multiply basic static load rating (C) and basic dynamic load rating (C_o) by the contact factor shown in Table 1.

Table 2. Contact factor (f_c)

No. of nuts in close contact	Contact factor f_c
2	0.81
3	0.72
4	0.66
5	0.61
Over 6	0.6
Common use	1.0

- Load factor (f_w)

Generally the static load applied to the nut of a linear motion guide can be calculated in formula. However, while a machine is running, the load imposed on the nut tends to come from vibration or impacts. Therefore, as for the vibration or impact load at high-speed running, it is necessary to divide the basic dynamic load rating of a ball spline by the load factor (f_w) shown in Table 3.

Table 3. Load factor (f_w)

External condition	Service conditions	Load factor(f_w)
Low	Smooth running at mild speed; no external vibration or impacts	1.0 ~ 1.3
Moderate	Moderate - Low speed; moderate external vibration or impacts	1.2 ~ 1.5
High	High - High speed; strong vibration or impacts	1.5 ~ 2.0
Very high	Very high - Very high speed; strong vibration and impacts at running	2.0 ~ 4.0

Static Safety Factor f_s

If heavy load or big impact is imposed on a ball spline, its rolling element and raceway surface have local and permanent deformation that leads to lowering its running performance. Limit of a ball spline depends on its service conditions and requirements.

In this case, the static safety factor f_s is calculated in the following formula, and its general values are presented in Table 4.

$$f_s = \frac{C_o}{P_{ro}} \quad \text{또는} \quad f_s = \frac{T_o}{P_{to}}$$

f_s : Static safety factor

C_o : Basic static rated load (N)

T_o : Basic static rated torque (N · m)

P_{ro} : Calculated load (N)

P_{to} : Calculated torque (N · m)

Table 4. Static safety factor (f_s)

Service condition	safety factor (f_s)
Vibration and impacts	3 ~ 5
High running	2 ~ 4
Normal operation	1 ~ 3

4. Basic Dynamic Load Rating (C)

Basic dynamic load rating is ability of a ball spline to bear load, which represents an applicable constant load in direction and magnitude when the rated fatigue life is 50km. The reference value of basic dynamic load rating of WON Ball Spline is 50km (ball type). It is used for calculating life of a ball spline while driving under constant load in magnitude from the center of a nut to bottom.

Each value of basic dynamic load rating (C) is described in the catalogue.

5. Basic static load rating C_0

If a ball spline is applied by excessive load or instantly by big impact load, partially permanent deformation occurs between a rolling element and the raceway surface. If deformation reaches to a certain extent, it hinders smooth driving.

Basic static load rating is defined as the constant static load in direction and magnitude when the total permanent deformation of the raceway surface of nut and shaft and a ball as a rolling element is 0.0001 times bigger than the diameter of the rolling element.

In a ball spline, it refers to the load in radial direction on the center of the contact of nut and ball. Each value of basic static load rating (C_0) is described in the specification table.

6. Basic Dynamic Rated Torque T

Load rated torque refers to the constant torque in direction and size in the condition where 90% in one group of ball splines with the same specification travel 50km without material damage (flaking). See Figure 5.

7. Basic Static Rated Torque T_0 · Basic Static Rated Moment T_M

Basic static torque and basic static moment refer to the static torque and moment that can face a certain amount of contact stress at the center of the contact of the rolling element with the maximum load and the raceway surface, when torque or moment load is imposed on. The T_M described in the table of dimensions is the basic static rated moment of one sleeve and of two sleeves in close contact.

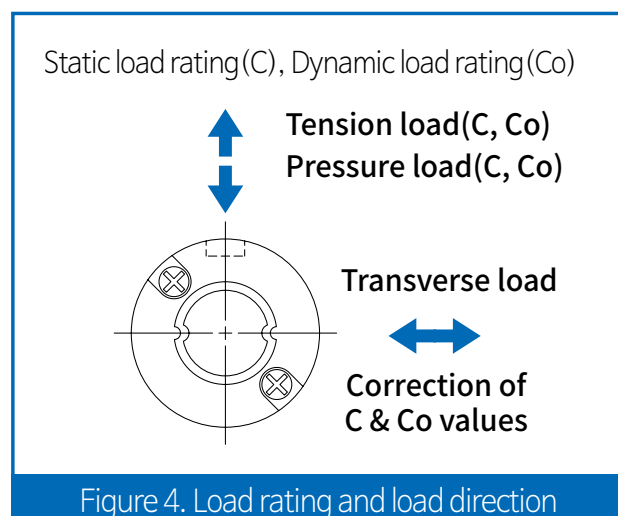


Figure 4. Load rating and load direction

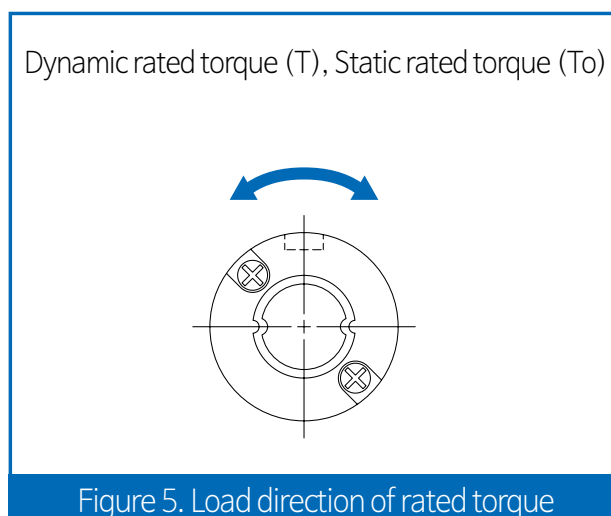


Figure 5. Load direction of rated torque

A compact-type ball spline is used after load rating is corrected in the direction of load.

The basic dynamic load rating and basic static load rating shown in the table of dimensions are corrected according to the following table.

(Basic dynamic rated torque, basic static rated torque and basic rated moment are also corrected in the same multiple.)

Size	Basic dynamic load rating			Basic static load rating		
	Pressure load	Tension load	Transverse load	Pressure load	Tension load	Transverse load
4~12	C	C	$1.73C_0$	C_0	C_0	$1.73C_0$
15~40	C	C	$1.19C_0$	C_0	C_0	$1.19C_0$

4 Preload of Ball Spline

Preload

A ball spline can be preloaded differently depending on service conditions. In order to increase rigidity of a ball spline and lessen the displacement for external load, it is possible to preload the device in the way of removing a gap with the use of the ball (as a rolling element) inserted in between a shaft and a nut, or inserting a ball larger than the gap between the shaft and nut. If vibration or variable load is imposed on and high rigidity are needed, it is necessary to determine the preload suitable for service conditions in consideration of life of a ball spline.

Table 5. Preload

External condition	Symbol	Preload (N)	Applied equipment
Zero preload	CL	$0^{(1)} \sim +$	• Mechanical equipment requiring light running with small torque
Standard	CM	$0^{(2)} \sim -$	• General mechanical equipment • Mechanical equipment requiring small motion resistance
Light preload	CT	$0.02C_0$	• Mechanical equipment requiring rigidity • Mechanical equipment to which large vibration or impact load is applied • Mechanical equipment to which big moment load or variable load is applied

Note. (1) Zero preload

(2) Zero or a little of preload

Remark: Light preload is not applied to WSP4, WSPT4, WSPTK4

5 Precision

Precision of a ball spline is related to its outside diameter of nut runout on the basis of shaft. WON Ball Spline has the precision of KS B 1422 (JIS B 1193).

The precision of ball spline is categorized into three classes: normal (no symbol), high (H), and precision (P).

A class of precision is described according to the arrangement of a model number.

The values in the tables include the precision in the case where the shaft ends are processed.

For the precision class of ball spline, see tables 6, 7, and 8.

WON ST also manufactures a product that has higher precision than in the tables, or a product with a special shape at request of a customer. If necessary, please contact us.

Table 6. Torsion of ball spline

External condition	Torsion (MAX)		
	Normal	High	Precision
Tolerance	33 μ m/100mm	13 μ m/100mm	6 μ m/100mm

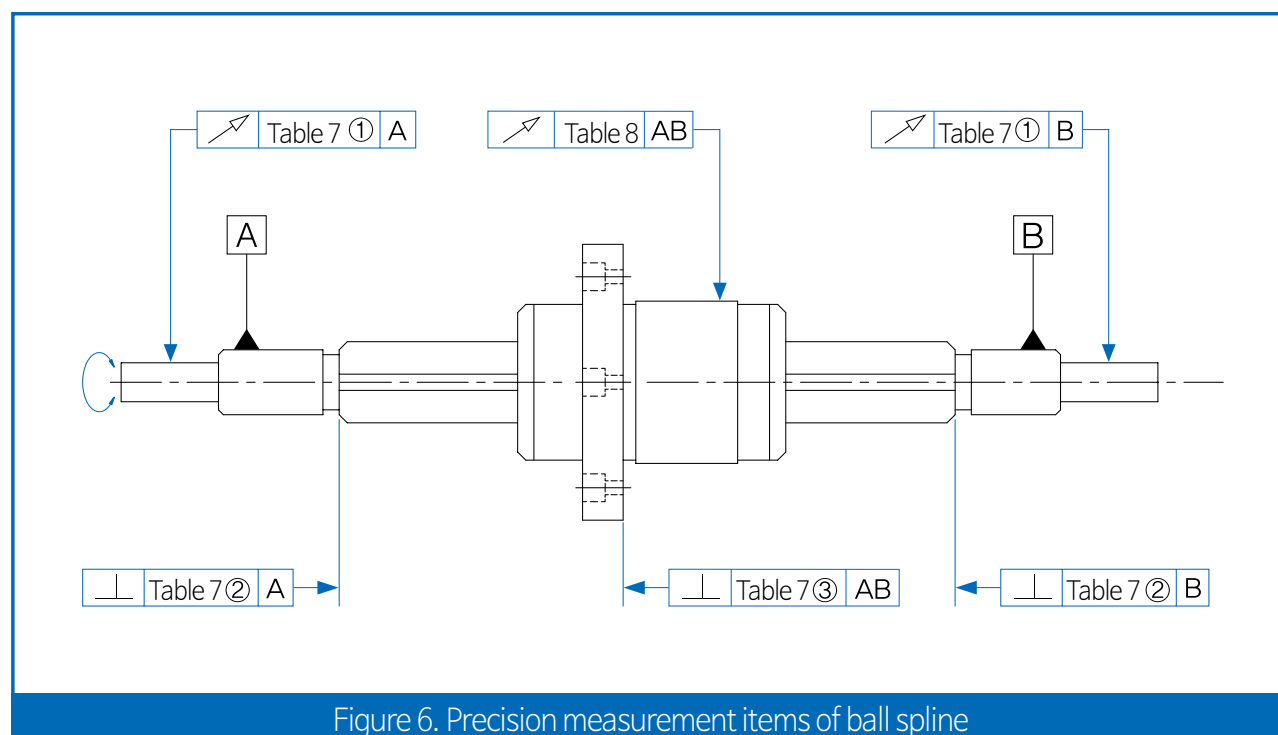


Table 7. Precision of each part of ball spline

Unit : μm

Model no.		WSP 4	WSP 5	WSP 6	WSP 8	WSP 10	WSP 12	–	WSP 15	WSP 20	WSP 25	WSP 30	WSP 40	
		–			WLS 8	WLS 10	–	WLS 13	WLS 16	WLS 20	WLS 25	WLS 30	WLS 40	
① Radial direction runout of installation part	Normal (No symbol)	33			41		46			53		62		
	High (H)	14			17		19			22		25		
	Precision (P)	8			10		12			13		15		
② Vertical angle of the cross section of spline part	Normal (No symbol)	22						27			33		39	
	High (H)	9						6			13		16	
	Precision (P)	6						8			9		11	
③ Vertical angle of the flange side from the central line of spline shaft	Normal (No symbol)	27			33						39		46	
	High (H)	11			13						16		19	
	Precision (P)	8			9						11		13	

Table 8. Radial direction runout of the central line of ball spline shaft

Unit : μm

Length of spline shaft (mm)	Above	–	200	315	400	500	630	800	1000	1250
	Below	200	315	400	500	630	800	1000	1250	1600
WSP 4 WSP 5 WSP 6 WSP 8 WLS 8	Normal (No symbol)	72	133	185	236	–	–	–	–	–
	High (H)	46	89	128	163	–	–	–	–	–
	Precision (P)	26	57	82	108	–	–	–	–	–
WSP 10 WSP 12 WLS 10	Normal (No symbol)	59	83	103	123	151	190	–	–	–
	High (H)	36	54	68	82	102	130	–	–	–
	Precision (P)	20	32	41	51	65	85	–	–	–
WSP 15 WSP 20 WLS 13 WLS 16 WLS 20	Normal (No symbol)	56	71	83	95	112	137	170	–	–
	High (H)	34	45	53	62	75	92	115	–	–
	Precision (P)	18	25	31	38	46	58	75	–	–
WSP 25 WSP 30 WLS 25 WLS 30	Normal (No symbol)	53	58	70	78	88	103	124	151	–
	High (H)	32	39	44	50	57	68	83	102	–
	Precision (P)	18	21	25	29	34	42	52	65	–
WSP 40 WLS 40	Normal (No symbol)	53	58	63	68	74	84	97	114	139
	High (H)	32	36	39	43	47	54	63	76	93
		16	19	21	24	27	32	38	47	–

Ball Spline

6 Lubrication and Dust Resistance

A ball spline has the treatment with anti-rust additives that has affinity with all mineral oils. It can be lubricated with oil or grease. Grease lubrication generates an additional sealing effect, and sticks well in a ball spline. Therefore, it is recommended to use grease. In case of grease refilling, it is necessary to use a ball spline whose nut has an oil hole. WON Ball Spline is dust resistant through its special rubber seal. Nevertheless, if a lot of foreign substances or dust float, it is recommended to attach an anti-dust device to protect a spline shaft against relatively large impurities like cutting chips or sand.

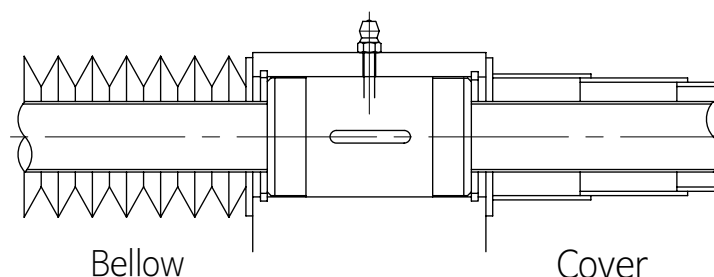


Figure 7. An example of anti-dust device

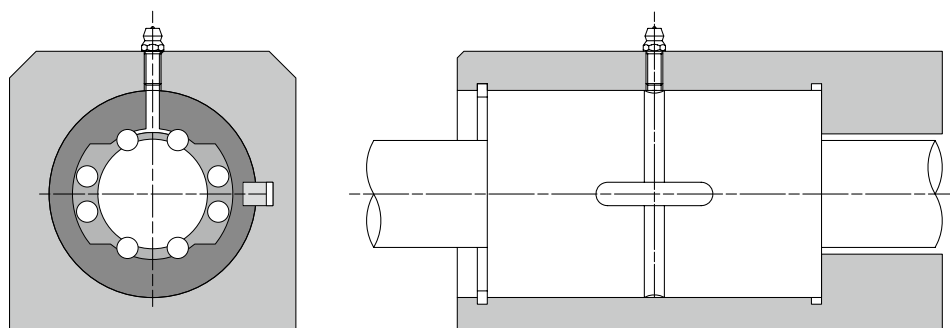


Figure 8. An example of refilling device

7 Assembly

Nut fitting

As for nut and housing fitting, WON Ball Spline has a transition fit (J7).

If precision and rigidity are not needed much, it is possible to apply a clearance fit (H7).

Insertion of spline nut

Inserting a spline nut into a housing may affect the operation of a device. In order to prevent any impact from being imposed on a retainer, use a jig for installation as shown in the following figure when inserting the nut.

Insertion of spline shaft

When a spline shaft is inserted into a spline nut, a ball may come out. Therefore, set raceway groove of the shaft, ball row of the spline nut, and position of a seal rightly before insertion.

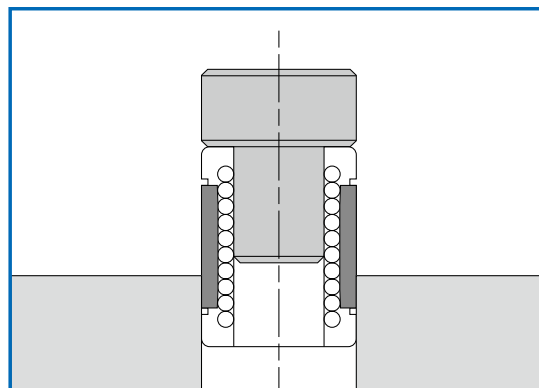


Figure 9.

Ball Spline

8 Caution for Use

- ① The working temperature of WON Ball Spline is max. 120°C in case of discontinuous use, and max. 80°C for continuous use. If above 80°C, please contact WON ST.
- ② WON Ball Spline is set to optimal precision in the condition where its spline shaft and nut mark are in the same direction and position (See Figure 10). To attach it to a machine, it is careful not to change steering of a spline shaft, arrangement of a nut, and a steering direction.
- ③ If more than two keys are used to fix the rotation direction of an outer sleeve on the basis of one shaft and over two nuts, it is required to make the position of each key groove of nut in parallel. For this case, please contact WON ST.

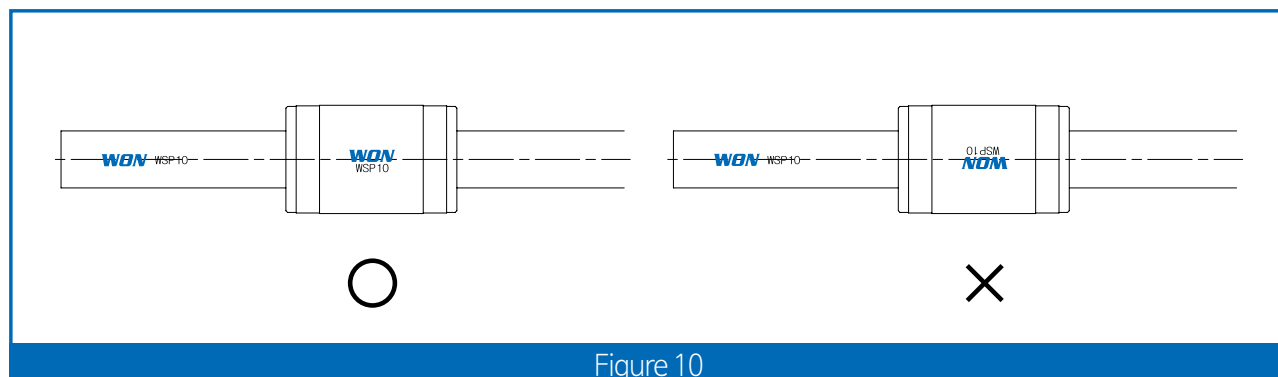


Figure 10

9 Compact Ball Spline

1. Structure and Features

WON Ball Spline is composed of a nut and a shaft. The nut has a ball as a rolling element installed in. The rolling surface of the shaft has a Gothic arch shaped groove processed. The ball of the nut rolls in a linear line along the precisely polished groove of the rolling surface. With one nut, the device can bear radial load and moment load and can transmit rotational torque in the circumferential direction of the shaft. With the use of the ball in between the raceways of nut and shaft, it is possible to apply preload. For this reason, the ball spline is strongly resistant for vibration or impact load. The linear motion system is applicable to an environment that needs high positioning precision, high-speed motion, and a long life span.

2. Transmission of high torque

A ball spline have Gothic arch shaped grooves in two rows on the rolling surface of nut and the rolling surface of shaft, which are precisely polished. Therefore, a ball can contact four points. Thanks to such a structure, it is possible to let the two rows evenly bear the rotational torque of nut and transmit rotational force.

3. High load capacity and long life

A ball spline has a linear type and has the structure of contact between the rolling surface of nut and shaft, and a ball as a rolling element. In the condition diameter of a shaft is equal, the device is capable of bearing rated load about ten times more than a ball bushing, ensuring a long life span. Therefore, it supports a compact design of equipment and bears moment load and overhang load as well as radial load.

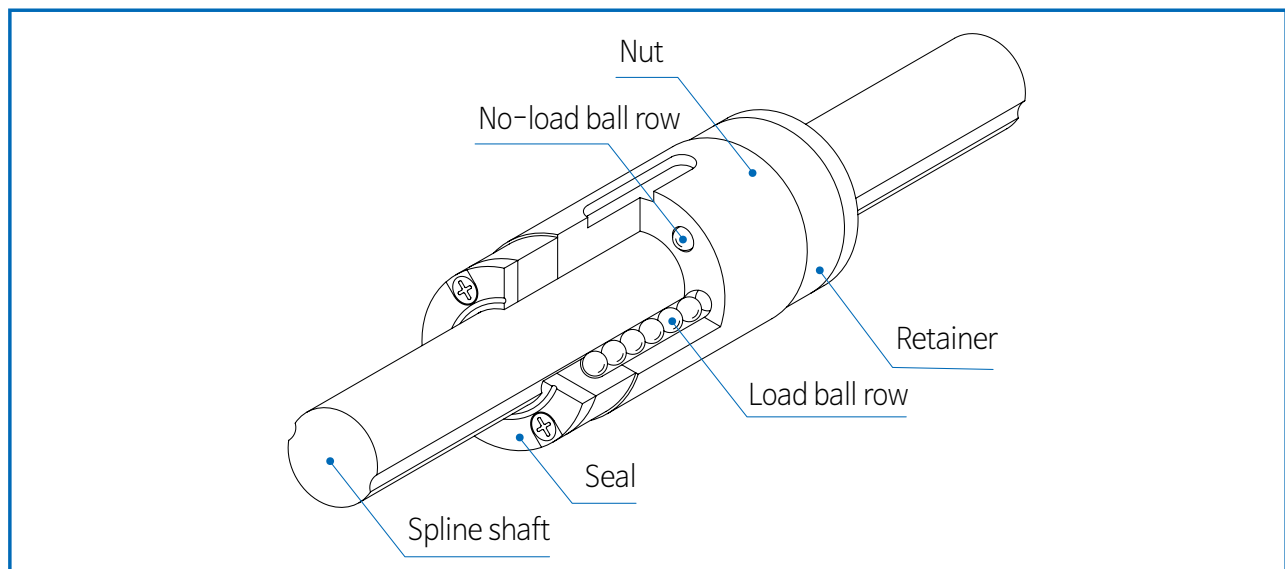

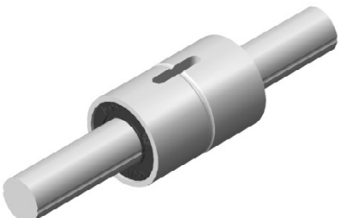
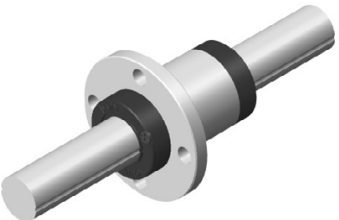
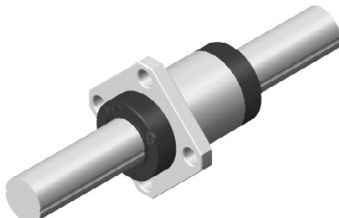
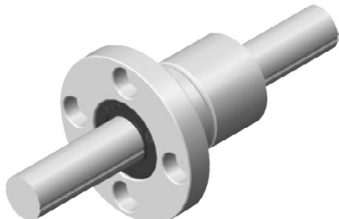
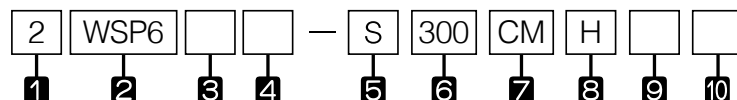


Figure 11. Structure of compact ball spline

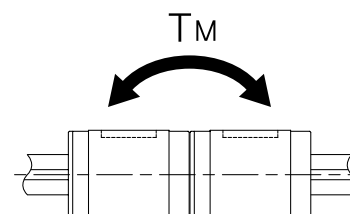
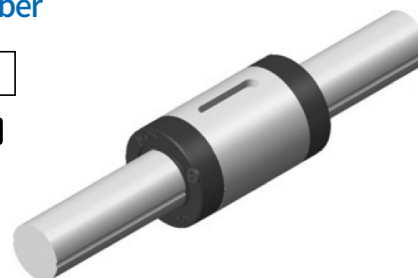
Classification	Type	Shape and Features	
Cylinder Type	WSP WSPL		It has a general spline nut that has a key groove helping to fix the position of a rotational direction accurately.
	WSPT WSPTO		Since a retainer is placed inside, this ball spline has good appearance and rigidity.
	WSPF WSPFL		As a round flange type, it can be installed easily.
	WSPK WSPKL		As a square flange type, it can be installed easily.
Flange Type	WSPTF WSPTFO		As a round flange type, it can be installed easily.

WSP Series

An example of the Composition of Model Name & Number



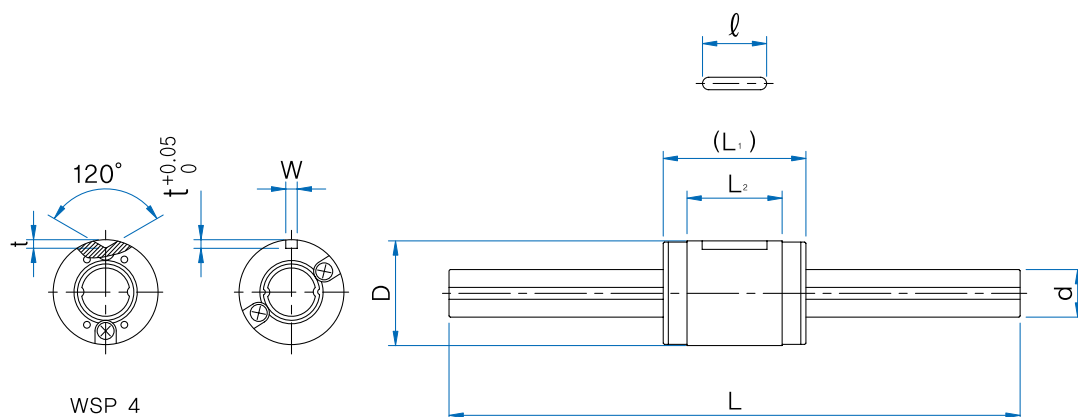
- 1** Number of nuts assembled in one shaft
- 2** Model No.
- 3** Material of nut: **No symbol**-Standard material / **M**-Stainless
- 4** **No symbol**-Standard nut / **E**-Special nut specification
- 5** Type of shaft: **S**-Solid / **H**-Hollow
- 6** Length of shaft
- 7** Symbol of clearance : **CL**-No preload / **CM**-Standard / **CT**-Light preload
- 8** Symbol of precision : **No symbol**-Normal / **H**-Precision / **P**-Super
- 9** Material of shaft : **No symbol**-Standard material / **M**-Stainless
- 10** **No symbol**-Standard shaft / **E**-Special shaft specification



Model No.	Major dimensions											
	Outside diameter		L1	L2	Dimension of key groove				Main		Length L	Max. length
	D	Tolerance			W	Tolerance	t	ℓ	d	Tolerance		
WSP 4 ⁽²⁾	8	0	12	7.9	–	+0.014 0	1	–	4	0 –0.012	100 150	200
WSP 5	10	–0.009	17.5	8.9	2		1.2	6	5		100 150	200
WSP 6	12	0	20.6	12	2		1.2	8	6		150 200	300
WSP 8	15	–0.011	24.4	14	2.5		1.5	8.5	8	0 –0.015	150 200 250	500
WSP 10	19	0 –0.013	29.6	17.8	3		1.8	11	10		200 300	600
WSP 12	21		34.7	22.7	3	1.8	15	12	0 –0.018	200 300 400	800	
WSP 15	23		40	27	3.5	+0.018 0	2	20	13.6	200 300 400	1000	
WSP 20	30	0 –0.016	50	33	4		2.5	26	18.2	0 –0.021	300 400 500 600	1200
WSP 25	37		60	39.2	5		3	29	22.6		300 400 500 600 800	
WSP 30	45		70	43	7		+0.022 0	4	35		27.2	
WSP 40	60	0 –0.019	100	70.8	10	4.5		55	37.2	0 –0.025		

Note (1) The top value of the static rated moment T_M means the value of one nut, and the bottom value represents the value of two nuts in contact.

(2) WSP4 has no seal.



Ball Spline

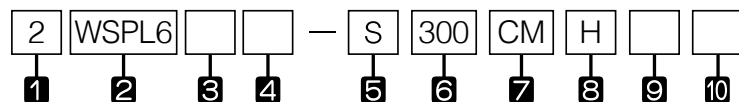
Unit : mm

Basic dynamic load rating	Basic static load rating	Basic dynamic rated torque	Basic static rated torque	Basic static rated moment ⁽¹⁾	Spline nut		Model No.
C N	Co N	T N·m	To N·m	T _M N·m	Spline nut g	Spline shaft g/100mm	
304	382	0.686	0.882	0.49 2.94	2.5	9.6	WSP 4
588	637	1.764	1.96	1.078 7.84	4.8	14.9	WSP 5
715	853	2.45	3.038	1.764 11.76	8.9	19	WSP 6
1176	1372	5.488	6.174	3.234 21.56	15.9	39	WSP 8
1862	2156	10.78	12.74	6.958 41.16	31.5	60.5	WSP 10
2156	2646	14.7	18.62	10.78 58.80	44	87.5	WSP 12
4241	6076	31.36	45.08	27.44 151.90	59.5	111	WSP 15
6566	9016	65.66	90.6	49.00 287.14	130	202	WSP 20
11196	14294	138.94	177.93	92.76 550.78	220	310	WSP 25
15394	19392	230.91	291.88	146.94 873.65	430	450	WSP 30
21291	31587	425.83	631.75	363.85 1939.22	760	808	WSP 40

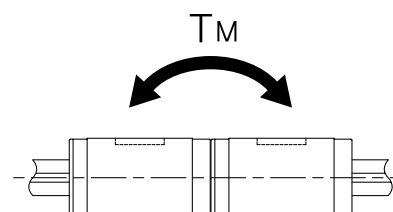
1N≒0.102kgf

WSPL Series

An example of the Composition of Model Name & Number

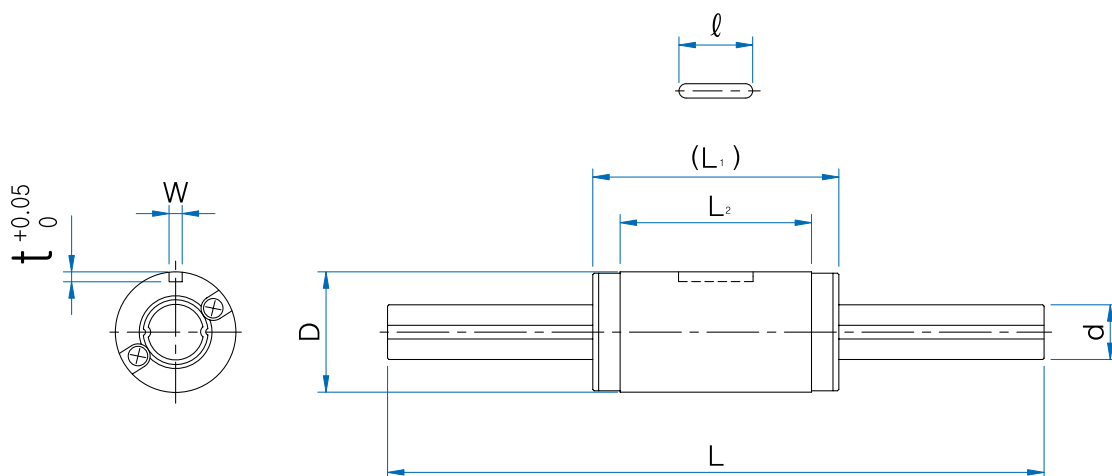


- 1** Number of nuts assembled in one shaft
- 2** Model No.
- 3** Material of nut: **No symbol**-Standard material/**M**-Stainless
- 4** **No symbol**-Standard nut / **E**-Special nut specification
- 5** Type of shaft: **S**-Solid / **H**-Hollow
- 6** Length of shaft
- 7** Symbol of clearance : **CL**-No preload / **CM**-Standard / **CT**-Light preload
- 8** Symbol of precision : **No symbol**-Normal / **H**-Precision / **P**-Super
- 9** Material of shaft : **No symbol**-Standard material / **M**-Stainless
- 10** **No symbol**-Standard shaft / **E**-Special shaft specification



Model No.	Major dimensions											
	Outside diameter		L1	L2	Dimension of key groove				Main		Length L	Max. length
	D	Tolerance			W	Tolerance	t	ℓ	d	Tolerance		
WSPL 5	10	$\begin{smallmatrix} 0 \\ -0.009 \end{smallmatrix}$	26	17.4	2	$\begin{smallmatrix} +0.014 \\ 0 \end{smallmatrix}$	1.2	6	5	$\begin{smallmatrix} 0 \\ -0.012 \end{smallmatrix}$	100 150	200
WSPL 6	12	$\begin{smallmatrix} 0 \\ -0.011 \end{smallmatrix}$	29.8	21.2	2		1.2	8	6	$\begin{smallmatrix} 0 \\ -0.015 \end{smallmatrix}$	150 200	300
WSPL 8	15	$\begin{smallmatrix} 0 \\ -0.013 \end{smallmatrix}$	36.7	26.3	2.5		1.5	8.5	8		150 200 250	500
WSPL 10	19		47	34.9	3		1.8	11	10	$\begin{smallmatrix} 0 \\ -0.018 \end{smallmatrix}$	200 300	600
WSPL 12	21		53.1	41.1	3	$\begin{smallmatrix} +0.018 \\ 0 \end{smallmatrix}$	1.8	15	12	$\begin{smallmatrix} 0 \\ -0.018 \end{smallmatrix}$	200 300 400	800
WSPL 15	23	$\begin{smallmatrix} 0 \\ -0.016 \end{smallmatrix}$	65	52	3.5		2	20	13.6		200 300 400	1000
WSPL 20	30		71	54	4		2.5	26	18.2	$\begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$	300 400 500 600	1000
WSPL 25	37		84	63.2	5	$\begin{smallmatrix} +0.022 \\ 0 \end{smallmatrix}$	3	29	22.6		300 400 500 600 800	1200
WSPL 30	45		98	71	7		4	35	27.2		400 500 600 700 1100	

Note (1) The top value of the static rated moment T_M means the value of one nut, and the bottom value represents the value of two nuts in contact.



Ball Spline

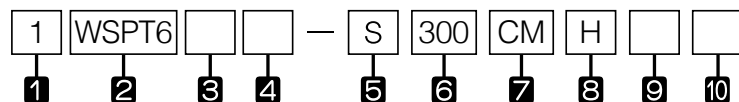
Unit : mm

Basic dynamic load rating	Basic static load rating	Basic dynamic rated torque	Basic static rated torque	Basic static rated moment ⁽¹⁾	Spline nut		Model No.
C N	Co N	T N·m	To N·m	Tm N·m	Spline nut g	Spline shaft g/100mm	
882	1176	2.646	3.528	3.136 19.60	7.9	14.9	WSPL 5
1078	1470	3.626	5.194	4.998 27.44	14.5	19	WSPL 6
1764	2450	8.33	11.76	9.80 56.84	26.5	39	WSPL 8
2842	4018	16.66	23.52	22.54 115.64	56.5	60.5	WSPL 10
3234	4802	21.56	33.32	32.34 156.80	76.8	87.5	WSPL 12
6370	11564	48.02	86.24	94.08 447.86	110	111	WSPL 15
9310	15092	93.10	150.92	127.40 619.36	198	202	WSPL 20
15394	23191	192.92	289.88	228.91 1189.52	336	310	WSPL 25
21291	31587	319.87	473.81	363.85 1899.24	634	450	WSPL 30

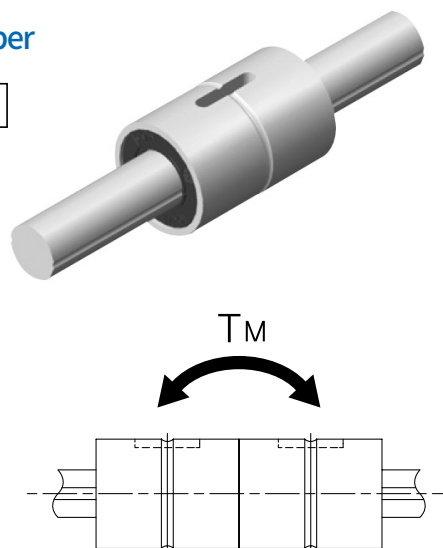
1N≒0.102kgf

WSPT Series

An example of the Composition of Model Name & Number

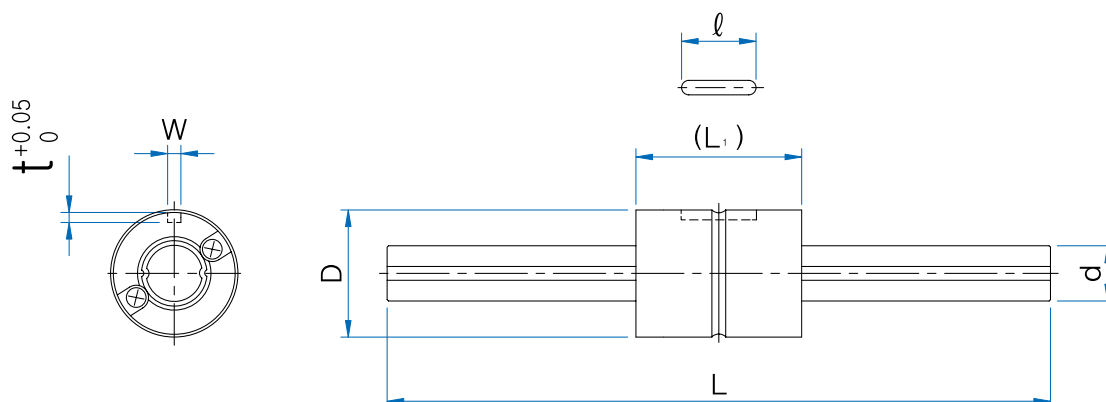


- 1** Number of nuts assembled in one shaft
- 2** Model No.
- 3** Material of nut: **No symbol**-Standard material/**M**-Stainless
- 4** **No symbol**-Standard nut / **E**-Special nut specification
- 5** Type of shaft: **S**-Solid / **H**-Hollow
- 6** Length of shaft
- 7** Symbol of clearance : **CL**-No preload / **CM**-Standard / **CT**-Light preload
- 8** Symbol of precision : **No symbol**-Normal / **H**-Precision / **P**-Super
- 9** Material of shaft : **No symbol**-Standard material / **M**-Stainless
- 10** **No symbol**-Standard shaft / **E**-Special shaft specification



Model No.	Major dimensions										
	Outside diameter		L ₁	Dimension of key groove				Main		Length L	Max. length
	D	Tolerance		W	Tolerance	t	ℓ	d	Tolerance		
WSPT 4	10	$\begin{smallmatrix} 0 \\ -0.009 \end{smallmatrix}$	16	2	$\begin{smallmatrix} +0.014 \\ 0 \end{smallmatrix}$	1.2	6	4	$\begin{smallmatrix} 0 \\ -0.012 \end{smallmatrix}$	100 150	200
WSPT 5	12	$\begin{smallmatrix} 0 \\ -0.011 \end{smallmatrix}$	20	2.5		1.2	8	5	$\begin{smallmatrix} 0 \\ -0.015 \end{smallmatrix}$	100 150	200
WSPT 6	14		25	2.5		1.2	10.5	6		150 200	300
WSPT 8	16		25	2.5		1.2	10.5	8		150 200 250	500
WSPT 10	21	$\begin{smallmatrix} 0 \\ -0.013 \end{smallmatrix}$	33	3		1.5	13	10		200 300	600
WSPT 12	24		36	3	$\begin{smallmatrix} +0.018 \\ 0 \end{smallmatrix}$	1.5	15	12	$\begin{smallmatrix} 0 \\ -0.018 \end{smallmatrix}$	200 300 400	800
WSPT 15	31		50	3.5		2	17.5	13.6	$\begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$	200 300 400	1000
WSPT 20	35	$\begin{smallmatrix} 0 \\ -0.016 \end{smallmatrix}$	63	4		2.5	29	18.2		300 400 500 600	1000

Note (1) The top value of the static rated moment T_M means the value of one nut, and the bottom value represents the value of two nuts in contact.



Ball Spline

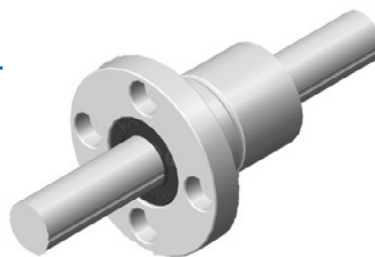
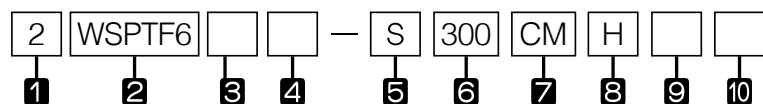
Unit : mm

Basic dynamic load rating	Basic static load rating	Basic dynamic rated torque	Basic static rated torque	Basic static rated moment ⁽¹⁾	Spline nut		Model No.
C N	Co N	T N·m	To N·m	Tm N·m	Spline nut g	Spline shaft g/100mm	
441	637	0.588	0.784	0.882 6.272	2.5	9.6	WSPT 4 ⁽²⁾
686	882	0.882	1.372	1.47 11.368	4.8	14.9	WSPT 5
1176	2156	0.98	1.96	4.9 35.57	8.9	19	WSPT 6
1470	2548	1.96	2.94	5.88 43.12	15.9	39	WSPT 8
2842	4900	3.92	7.84	15.68 96.04	31.5	60.5	WSPT 10
3528	5782	5.88	10.78	19.20 135.24	44	87.5	WSPT 12
7056	12642	31.36	34.30	66.84 385.14	59.5	111	WSPT 30
10192	17836	56.84	55.86	115.64 686.0	130	202	WSPT 40

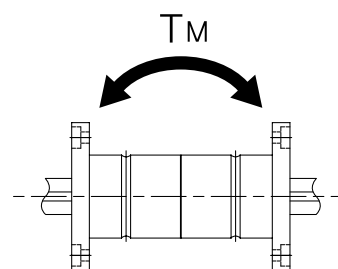
1N≒0.102kgf

WSPTF Series

An example of the Composition of Model Name & Number

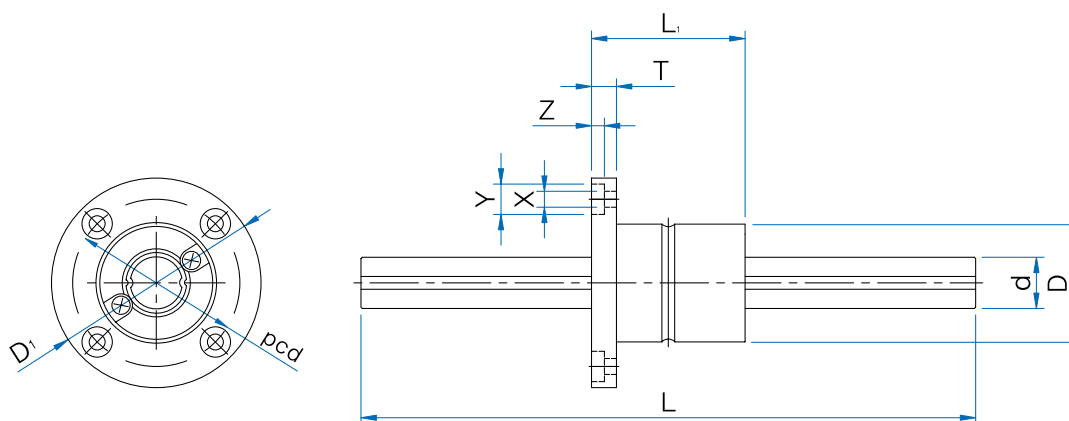


- 1** Number of nuts assembled in one shaft
- 2** Model No.
- 3** Material of nut: **No symbol**-Standard material / **M**-Stainless
- 4** **No symbol**-Standard nut / **E**-Special nut specification
- 5** Type of shaft: **S**-Solid / **H**-Hollow
- 6** Length of shaft
- 7** Symbol of clearance : **CL**-No preload / **CM**-Standard / **CT**-Light preload
- 8** Symbol of precision : **No symbol**-Normal / **H**-Precision / **P**-Super
- 9** Material of shaft : **No symbol**-Standard material / **M**-Stainless
- 10** **No symbol**-Standard shaft / **E**-Special shaft specification



Model No.	Major dimensions										
	Outside diameter		L ₁	D ₁	T	pcd	X×Y×Z	Axial diameter		Length L	Max. length
	D	Tolerance						d	Tolerance		
WSPTF 6	14	0 -0.011	25	30	5	22	3.4×6.5×3.3	6	0 -0.012	150 200	300
WSPTF 8	16	0 -0.013	25	32	5	24	3.4×6.5×3.3	8		150 200 250	500
WSPTF 10	21		33	42	6	32	4.5×8×4.4	10		200 300	600
WSPTF 12	24	0 -0.016	36	44	7	33	4.5×8×4.4	12	0 -0.015	200 300 400	800
WSPTF 15	31		50	51	7	40	4.5×8×4.4	13.6	200 300 400	1000	
WSPTF 20	35		63	58	9	45	5.5×9.5×5.4	18.2	0 -0.018	300 400 500 600	1000

Note (1) The top value of the static rated moment T_M means the value of one nut, and the bottom value represents the value of two nuts in contact.



Ball Spline

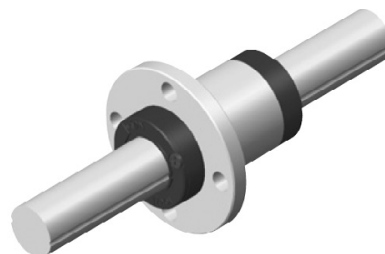
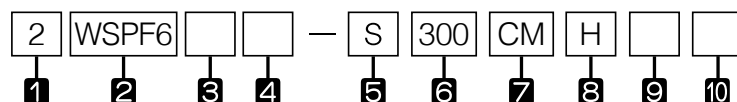
Unit : mm

Basic dynamic load rating	Basic static load rating	Basic dynamic rated torque	Basic static rated torque	Basic static rated moment ⁽¹⁾	Spline nut		Model No.
C N	Co N	T N·m	To N·m	T _M N·m	Spline nut g	Spline shaft g/100mm	
1176	2156	0.98	1.96	4.9 35.57	37.2	19	WSPTF 6
1470	2548	1.96	2.94	5.88 43.12	39.5	39	WSPTF 8
2842	4900	3.92	7.84	15.68 96.04	64.2	60.5	WSPTF 10
3528	5782	5.88	10.78	19.20 135.24	124.7	87.5	WSPTF 12
7056	12642	31.36	34.30	66.64 385.14	265.7	111	WSPTF 15
10192	17836	56.84	55.86	115.64 686	392.5	202	WSPTF 20

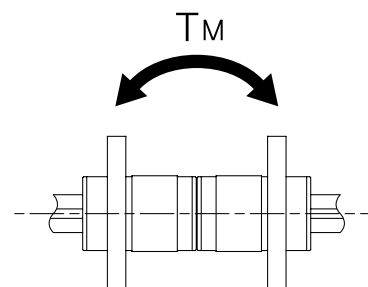
1N≒0.102kgf

WSPF Series

An example of the Composition of Model Name & Number

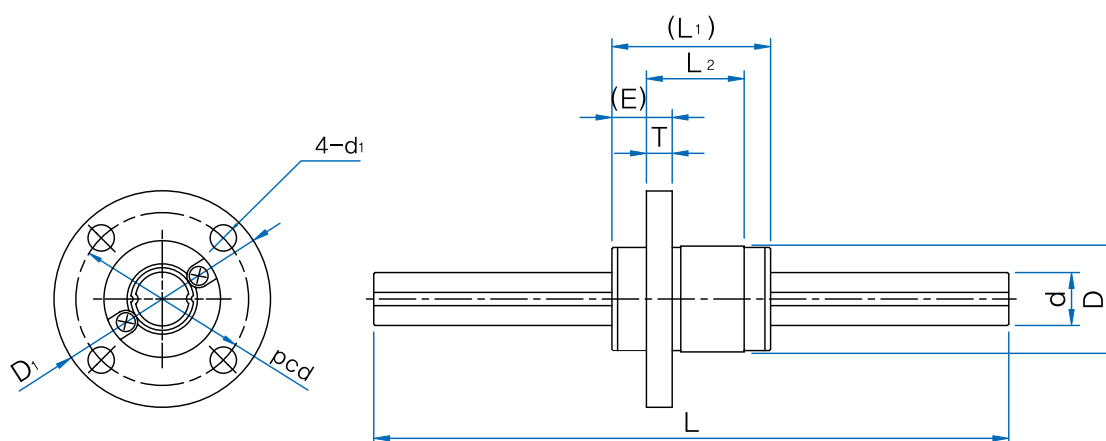


- 1** Number of nuts assembled in one shaft
- 2** Model No.
- 3** Material of nut: **No symbol**-Standard material / **M**-Stainless
- 4** **No symbol**-Standard nut / **E**-Special nut specification
- 5** Type of shaft: **S**-Solid / **H**-Hollow
- 6** Length of shaft
- 7** Symbol of clearance : **CL**-No preload / **CM**-Standard / **CT**-Light preload
- 8** Symbol of precision : **No symbol**-Normal / **H**-Precision / **P**-Super
- 9** Material of shaft : **No symbol**-Standard material / **M**-Stainless
- 10** **No symbol**-Standard shaft / **E**-Special shaft specification



Model No.	Major dimensions												
	Outside diameter		L ₁	L ₂	D ₁	E	T	pcd	d ₁	Axial diameter		Length L	Max. length
	D	Tolerance								d	Tolerance		
WSPF 5	10	$\begin{smallmatrix} 0 \\ -0.009 \end{smallmatrix}$	17.5	8.9	23	7	2.7	17	3.4	5	$\begin{smallmatrix} 0 \\ -0.012 \end{smallmatrix}$	100 150	200
WSPF 6	12	$\begin{smallmatrix} 0 \\ -0.011 \end{smallmatrix}$	20.6	12	25	7	2.7	19	3.4	6		150 200	300
WSPF 8	15		$\begin{smallmatrix} 0 \\ -0.015 \end{smallmatrix}$	24.4	14	28	9	3.8	22	3.4	8	150 200 250	500
WSPF 10	19	$\begin{smallmatrix} 0 \\ -0.018 \end{smallmatrix}$		29.6	17.8	36	10	4.1	28	4.5	10	200 300	600
WSPF 12	21		$\begin{smallmatrix} 0 \\ -0.013 \end{smallmatrix}$	34.7	22.7	38	10	4	30	4.5	12	200 300 400	800
WSPF 15	23			40	27	40	11	4.5	32	4.5	13.6	200 300 400	1000
WSPF 20	30	$\begin{smallmatrix} 0 \\ -0.016 \end{smallmatrix}$	50	33	46	14	5.5	38	4.5	18.2	$\begin{smallmatrix} 0 \\ -0.021 \end{smallmatrix}$	300 400 500 600	1000
WSPF 25	37		60	39.2	57	17	6.6	47	5.5	22.6		300 400 500 600 800	1200
WSPF 30	45		70	43	65	21	7.5	54	6.6	27.2		400 500 600 700 1100	
WSPF 40	60		$\begin{smallmatrix} 0 \\ -0.019 \end{smallmatrix}$	100	70.8	93	26.6	12	73	9		37.2	

Note (1) The top value of the static rated moment T_M means the value of one nut, and the bottom value represents the value of two nuts in contact.



Ball Spline

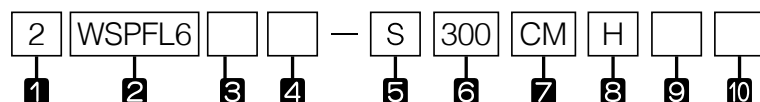
Unit : mm

Basic dynamic load rating	Basic static load rating	Basic dynamic rated torque	Basic static rated torque	Basic static rated moment ⁽¹⁾	Splinenut		Model No.
C N	Co N	T N·m	To N·m	Tm N·m	Spline nut g	Spline shaft g/100mm	
588	637	1.764	1.96	1.078 7.84	8.9	14.9	WSPF 5
715.4	853	2.45	3.038	1.764 11.76	13.9	19	WSPF 6
1176	1372	5.488	6.174	3.234 21.56	23.5	39	WSPF 8
1862	2156	10.78	12.74	6.958 41.16	45	60.5	WSPF 10
2156	2646	14.70	18.62	10.78 58.80	59	87.5	WSPF 12
4214	6076	31.36	45.08	27.44 151.90	77	111	WSPF 15
6566	9016	65.66	90.16	49.00 287.14	150	202	WSPF 20
11196	14294	138.94	177.93	92.76 550.78	255	310	WSPF 25
15349	19392	230.91	291.88	146.94 873.65	476	450	WSPF 30
21291	31587	425.83	631.75	363.85 1939.22	962	808	WSPF 40

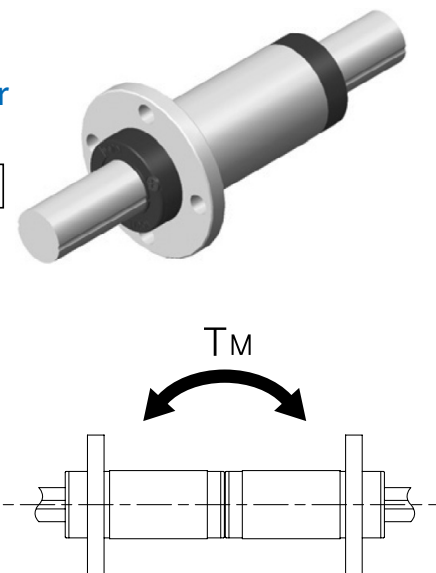
1N≒0.102kgf

WSPFL Series

An example of the Composition of Model Name & Number

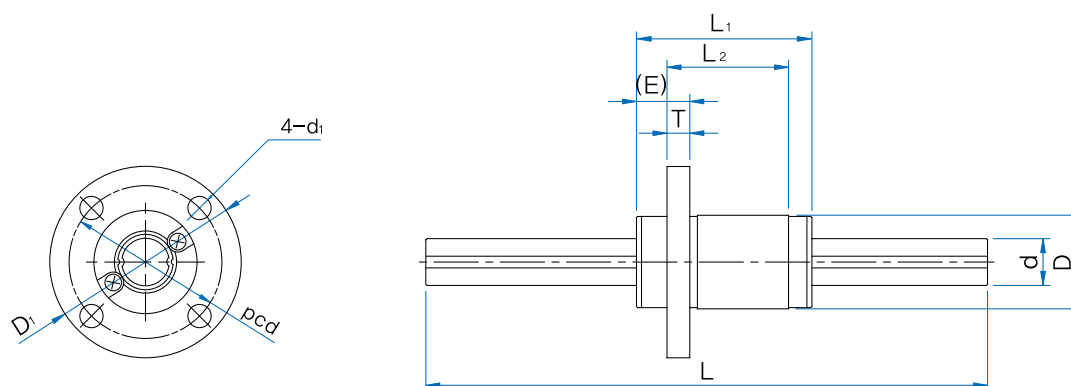


- 1** Number of nuts assembled in one shaft
- 2** Model No.
- 3** Material of nut: **No symbol**-Standard material / **M**-Stainless
- 4** **No symbol**-Standard nut / **E**-Special nut specification
- 5** Type of shaft: **S**-Solid / **H**-Hollow
- 6** Length of shaft
- 7** Symbol of clearance : **CL**-No preload / **CM**-Standard / **CT**-Light preload
- 8** Symbol of precision : **No symbol**-Normal / **H**-Precision / **P**-Super
- 9** Material of shaft : **No symbol**-Standard material / **M**-Stainless
- 10** **No symbol**-Standard shaft / **E**-Special shaft specification



Model No.	Major dimensions												
	Outside diameter		L ₁	L ₂	D ₁	E	T	pcd	d _i	Axial diameter		Length L	Max. length
	D	Tolerance								d	Tolerance		
WSPFL 5	10	0 -0.009	26	17.4	23	7	2.7	17	3.4	5	0 -0.012	100 150	200
WSPFL 6	12	0 -0.011	29.8	21.2	25	7	2.7	19	3.4	6	0 -0.015	150 200	300
WSPFL 8	15	0 -0.013	36.7	26.3	28	9	3.8	22	3.4	8	0 -0.018	150 200 250	500
WSPFL 10	19	0 -0.016	47	34.9	36	10	4.1	28	4.5	10	0 -0.021	150 200 250	600
WSPFL 12	21	0 -0.013	53.1	41.1	38	10	4	30	4.5	12	0 -0.018	200 300	800
WSPFL 15	23	0 -0.016	65	52	40	11	4.5	32	4.5	13.6	0 -0.021	200 300 400	1000
WSPFL 20	30	0 -0.016	71	54	46	14	5.5	38	4.5	18.2	0 -0.021	300 400 500 600	1000
WSPFL 25	37	0 -0.016	84	63.2	57	17	6.5	47	5.5	22.6	0 -0.021	300 400 500 600 800	1200
WSPFL 30	45	0 -0.016	98	71	65	21	7.5	54	6.5	27.2	0 -0.021	400 500 600 700 1100	

Note (1) The top value of the static rated moment T_M means the value of one nut, and the bottom value represents the value of two nuts in contact.



Ball Spline

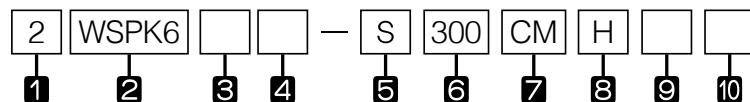
Unit : mm

Basic dynamic load rating	Basic static load rating	Basic dynamic rated torque	Basic static rated torque	Basic static rated moment ⁽¹⁾	Spline nut		Model No.
C N	Co N	T N·m	To N·m	Tm N·m	Spline nut g	Spline shaft g/100mm	
882	1176	2.646	3.528	3.136 19.60	12	14.9	WSPFL 5
1078	1470	3.626	5.194	4.998 27.44	19.5	19	WSPFL 6
1764	2450	8.33	11.76	9.80 56.84	34.1	39	WSPFL 8
2842	4018	16.66	23.52	22.54 115.64	70	60.5	WSPFL 10
3234	4802	21.56	33.32	32.34 156.80	91.8	87.5	WSPFL 12
6370	11564	48.02	86.24	94.08 447.86	127.5	111	WSPFL 15
9310	15092	93.10	150.92	127.40 619.36	218	202	WSPFL 20
15394	23191	192.92	289.88	228.91 1189.52	371	310	WSPFL 25
21291	31587	319.84	473.81	363.85 1899.24	680	450	WSPFL 30

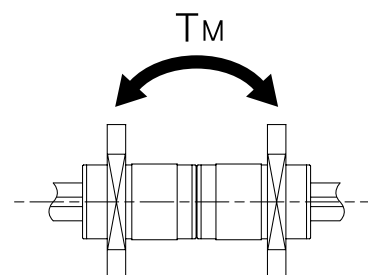
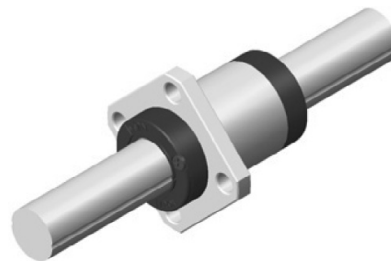
1N≒0.102kgf

WSPK Series

An example of the Composition of Model Name & Number



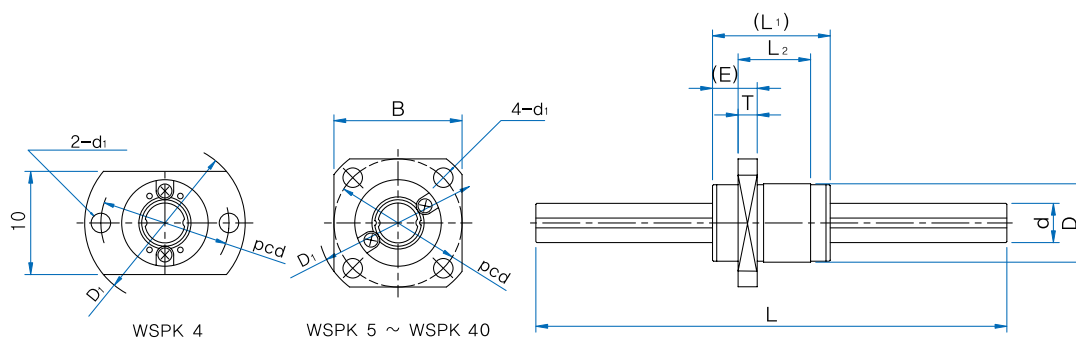
- 1** Number of nuts assembled in one shaft
2 Model No.
3 Material of nut: No symbol-Standard material / M-Stainless
4 No symbol-Standard nut / E-Special nut specification
5 Type of shaft: S-Solid / H-Hollow
6 Length of shaft
7 Symbol of clearance : CL-No preload / CM-Standard / CT-Light preload
8 Symbol of precision : No symbol-Normal / H-Precision / P-Super
9 Material of shaft : No symbol-Standard material / M-Stainless
10 No symbol-Standard shaft / E-Special shaft specification



Model No.	Major dimensions													
	Outside diameter		L ₁	L ₂	D ₁	B	E	T	pcd	d ₁	Axial diameter		Length L	Max. length
	D	Tolerance									d	Tolerance		
WSPK 4 ⁽²⁾	8	0	12	7.9	21	10	4.6	2.5	15	3.4	4		100 150	200
WSPK 5	10	-0.009	17.5	8.9	23	18	7	2.7	17	3.4	5	0 -0.012	100 150	200
WSPK 6	12	0	20.6	12	25	20	7	2.7	19	3.4	6		150 200	300
WSPK 8	15	-0.011	24.4	14	28	22	9	3.8	22	3.4	8	0 -0.015	150 200 250	500
WSPK 10	19		29.6	17.8	36	28	10	4.1	28	4.5	10		200 300	600
WSPK 12	21	0 -0.013	34.7	22.7	38	30	10	4	30	4.5	12	0 -0.018	200 300 400	800
WSPK 15	23		40	27	40	31	11	4.5	32	4.5	13.6		200 300 400	1000
WSPK 20	30		50	33	46	35	14	5.5	38	4.5	18.2		300 400 500 600	1000
WSPK 25	37	0 -0.016	60	39.2	57	43	17	6.6	47	5.5	22.6	0 -0.021	300 400 500 600 800	1200
WSPK 30	45		70	43	65	50	21	7.5	54	6.6	27.2		400 500 600 700 1100	
WSPK 40	60	0 -0.019	100	70.8	93	73	26.6	12	73	9	37.2	0 -0.025		

Note (1) The top value of the static rated moment T_M means the value of one nut, and the bottom value represents the value of two nuts in contact.

(2) WSPK4 has no seal.



Ball Spline

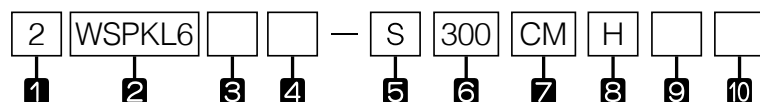
Unit : mm

Basic dynamic load rating	Basic static load rating	Basic dynamic rated torque	Basic static rated torque	Basic static rated moment ⁽¹⁾	Spline nut		Model No.
					Spline nut g	Spline shaft g/100mm	
C N	Co N	T N·m	To N·m	T _M N·m			
303	382	0.686	0.882	0.49 2.94	5.1	9.6	WSPK 4 ⁽²⁾
588	637	1.764	1.96	1.078 7.84	8.9	14.9	WSPK 5
715.4	852.6	2.45	3.038	1.764 11.76	13.9	19	WSPK 6
1176	1372	5.488	6.174	3.234 21.56	23.5	39	WSPK 8
1862	2156	10.78	12.74	6.958 41.16	45	60.5	WSPK 10
2156	2646	14.70	18.62	10.78 58.80	59	87.5	WSPK 12
4214	6076	31.36	45.08	27.44 151.90	77	111	WSPK 15
6566	9016	65.66	90.16	49.00 287.14	150	202	WSPK 20
11196	14294	138.94	177.93	92.76 550.78	255	310	WSPK 25
15394	19392	230.91	291.88	146.94 873.65	476	450	WSPK 30
21291	31587	425.83	631.75	363.85 1939.22	962	808	WSPK 40

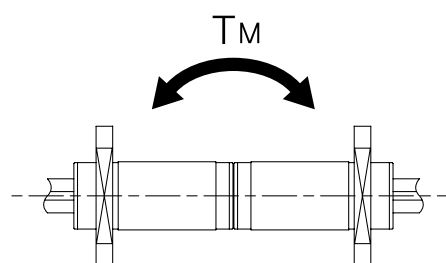
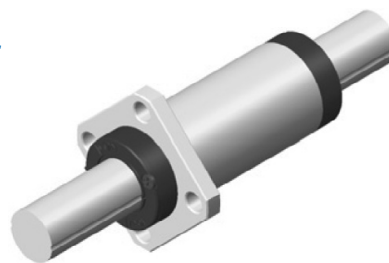
1N≒0.102kgf

WSPKL Series

An example of the Composition of Model Name & Number

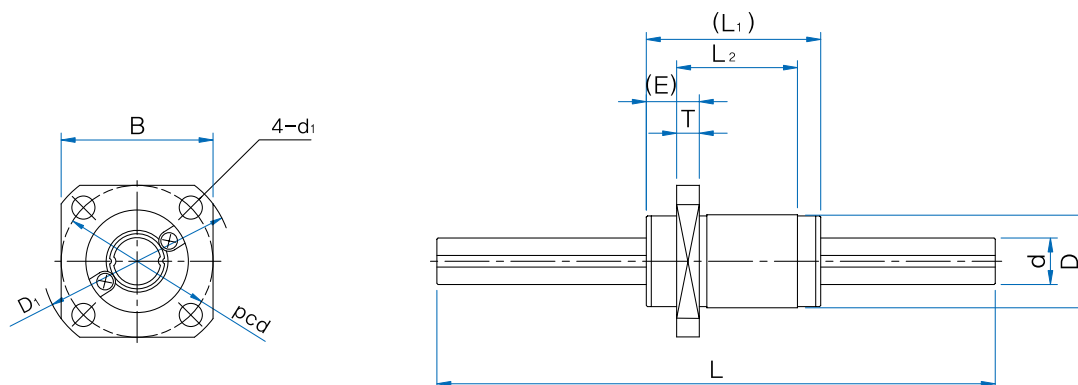


- 1** Number of nuts assembled in one shaft
- 2** Model No.
- 3** Material of nut: **No symbol**-Standard material / **M**-Stainless
- 4** **No symbol**-Standard nut / **E**-Special nut specification
- 5** Type of shaft: **S**-Solid / **H**-Hollow
- 6** Length of shaft
- 7** Symbol of clearance : **CL**-No preload / **CM**-Standard / **CT**-Light preload
- 8** Symbol of precision : **No symbol**-Normal / **H**-Precision / **P**-Super
- 9** Material of shaft : **No symbol**-Standard material / **M**-Stainless
- 10** **No symbol**-Standard shaft / **E**-Special shaft specification



Model No.	Major dimensions													
	Outside diameter		L ₁	L ₂	D ₁	E	B	T	pcd	d ₁	Axial diameter		Length L	Max. length
	D	Tolerance									d	Tolerance		
WSPKL 5	10	0 -0.009	26	17.4	23	7	18	2.7	17	3.4	5	0 -0.012	100 150	200
WSPKL 6	12	0 -0.011	29.8	21.2	25	7	20	2.7	19	3.4	6	0 -0.015	150 200	300
WSPKL 8	15	0 -0.013	36.7	26.3	28	9	22	3.8	22	3.4	8	0 -0.018	150 200 250	500
WSPKL 10	19	0 -0.016	47	34.9	36	10	28	4.1	28	4.5	10	0 -0.021	200 300	600
WSPKL 12	21	0 -0.013	53.1	41.1	38	10	30	4	30	4.5	12	0 -0.018	200 300 400	800
WSPKL 15	23	0 -0.016	65	52	40	11	31	4.5	32	4.5	13.6	0 -0.021	200 300 400	1000
WSPKL 20	30	0 -0.016	71	54	46	14	35	5.5	38	4.5	18.2	0 -0.021	300 400 500 600	1000
WSPKL 25	37	0 -0.016	84	63.2	57	17	43	6.6	47	5.5	22.6	0 -0.021	300 400 500 600 800	1200
WSPKL 30	45	0 -0.016	98	71	65	21	50	7.5	54	6.6	27.2	0 -0.021	400 500 600 700 1100	

Note (1) The top value of the static rated moment T_M means the value of one nut, and the bottom value represents the value of two nuts in contact.



Ball Spline

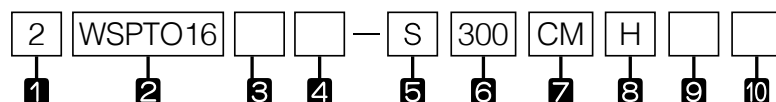
Unit : mm

Basic dynamic load rating	Basic static load rating	Basic dynamic rated torque	Basic static rated torque	Basic static rated moment ⁽¹⁾	Spline nut		Model No.
C N	Co N	T N·m	To N·m	Tm N·m	Spline nut g	Spline shaft g/100mm	
882	1176	2.646	3.528	3.136 19.60	12	14.9	WSPKL 5
1078	1470	3.626	5.194	4.998 27.44	19.5	19	WSPKL 6
1764	2450	8.33	11.76	9.80 56.84	34.1	39	WSPKL 8
2842	4010	16.66	23.52	22.54 115.64	70	60.5	WSPKL 10
3234	4802	21.56	33.32	32.34 156.80	91.8	87.5	WSPKL 12
6370	11564	48.02	86.24	94.08 447.86	127.5	111	WSPKL 15
9310	15092	93.10	150.92	127.40 619.36	218	202	WSPKL 20
15394	23191	192.92	289.88	228.91 1189.52	371	310	WSPKL 25
21291	31587	319.87	473.81	363.85 1899.24	680	450	WSPKL 30

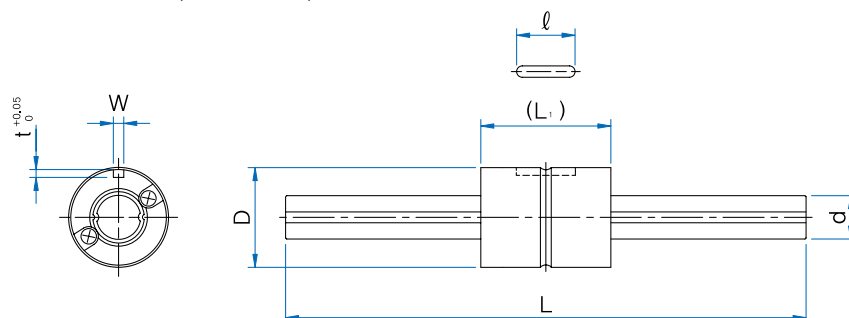
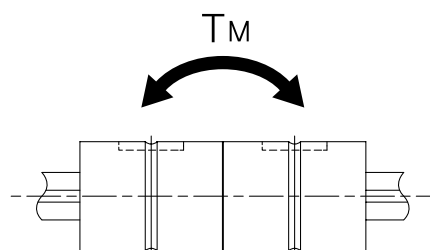
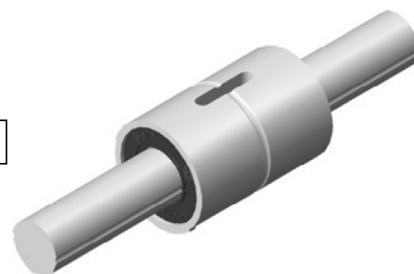
1N≒0.102kgf

WSPTO Series

An example of the Composition of Model Name & Number



- 1 Number of nuts assembled in one shaft
- 2 Model No.
- 3 Material of nut: No symbol-Standard material / M-Stainless
- 4 No symbol-Standard nut / E-Special nut specification
- 5 Type of shaft: S-Solid / H-Hollow
- 6 Length of shaft
- 7 Symbol of clearance: CL-No preload / CM-Standard / CT-Light preload
- 8 Symbol of precision: No symbol-Normal / H-Precision / P-Super
- 9 Material of shaft: No symbol-Standard material / M-Stainless
- 10 No symbol-Standard shaft / E-Special shaft specification



단위 : mm

Model No.	Major dimensions										Max. length
	Outside diameter		L ₁	Dimension of key groove				Axial diameter		Length L	
	D	Tolerance		W	Tolerance	t	ℓ	d	Tolerance		
WSPTO 16	31	$\begin{smallmatrix} 0 \\ -0.013 \end{smallmatrix}$	50	3.5	$\begin{smallmatrix} +0.018 \\ 0 \end{smallmatrix}$	2	17.5	16	$\begin{smallmatrix} 0 \\ -0.017 \end{smallmatrix}$	200 300 400	1000
WSPTO 20	35	$\begin{smallmatrix} 0 \\ -0.016 \end{smallmatrix}$	63	4		2.5	29	20	$\begin{smallmatrix} 0 \\ -0.020 \end{smallmatrix}$	300 400 500 600	1000

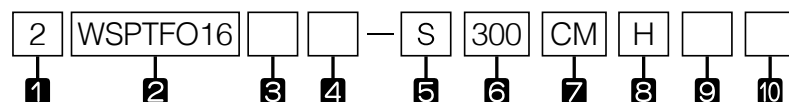
Model No.	Basic dynamic load rating	Basic static load rating	Basic dynamic rated torque	Basic static rated torque	Basic static rated moment ⁽¹⁾	Spline nut	
	C N	Co N	T N · m	To N · m	T _M N · m	Spline nut g	Spline shaft g/100mm
WSPTO 16	7060	12600	31.4	34.3	$\begin{smallmatrix} 67.6 \\ 393 \end{smallmatrix}$	165	160
WSPTO 20	10200	17800	56.9	55.9	$\begin{smallmatrix} 118 \\ 700 \end{smallmatrix}$	225	250

1N≒0.102kgf

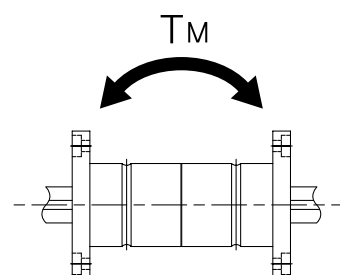
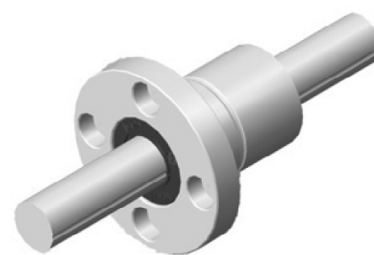
Note (1) The top value of the static rated moment T_M means the value of one nut, and the bottom value represents the value of two nuts in contact.

WSPTFO Series

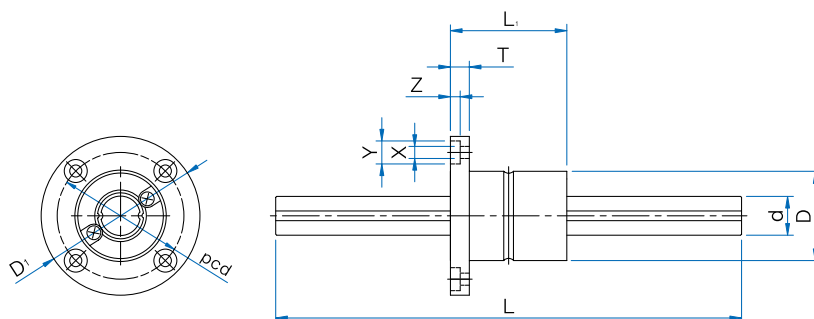
An example of the Composition of Model Name & Number



- 1** Number of nuts assembled in one shaft
- 2** Model No.
- 3** Material of nut: **No symbol**-Standard material / **M**-Stainless
- 4** **No symbol**-Standard nut / **E**-Special nut specification
- 5** Type of shaft: **S**-Solid / **H**-Hollow
- 6** Length of shaft
- 7** Symbol of clearance : **CL**-No preload / **CM**-Standard / **CT**-Light preload
- 8** Symbol of precision : **No symbol**-Normal / **H**-Precision / **P**-Super
- 9** Material of shaft : **No symbol**-Standard material / **M**-Stainless
- 10** **No symbol**-Standard shaft / **E**-Special shaft specification



Ball Spline



Unit : mm

Model No.	Major dimensions										
	Outside diameter		L ₁	D ₁	T	pcd	X xYxZ	Axial diameter		Length L	Max. length
	D	Tolerance						d	Tolerance		
WSPTFO 16	31	0 -0.013	50	51	7	40	4.5x8x4.4	16	0 -0.017	200 300 400	1000
WSPTFO 20	35	0 -0.016	63	58	9	45	5.5x9.5x5.4	20	0 -0.020	300 400 500 600	1000

Model No.	Basic dynamic load rating	Basic static load rating	Basic dynamic rated torque	Basic static rated torque	Basic static rated moment ⁽¹⁾	Spline nut	
	C N	C ₀ N	T N·m	T ₀ N·m	T _M N·m	Spline nut g	Spline shaft g/100mm
WSPTFO 16	7060	12600	31.4	34.3	67.6 393	165	160
WSPTFO 20	10200	17800	56.9	55.9	118 700	225	250

1N≒0.102kgf

Note (1) The top value of the static rated moment T_M means the value of one nut, and the bottom value represents the value of two nuts in contact.

10 Linear Ball Spline

1. Structure and Features

WON Linear Ball Spline is composed of a spline shaft with a groove and a nut. The spline nut has a retainer, a seal, and a ball installed in. It supports smooth motion.

2. High load capacity and long life

The raceway surface an R-shape similar to diameter of a ball. Since it is precisely polished, it has a wide area of contact with a ball. Therefore, the device a high load capacity and a long life span.

3. Torque transmission with high precision

The groove of shaft and cylinder adjusts a ball at an appropriate contact angle. Therefore, with one shaft, it is possible to transmit torque.

In addition, by setting the gap of the rotation direction for preload to zero, it is possible to increase rigidity and determine an accurate position of rotation.

4. High speed movement and high speed rotation

The cylinder of a linear ball spline is compact and is balanced well. Therefore, it has good performance in high-speed motion or high-speed rotation.

5. Product components

WON Linear Ball Spline has eight different types (8 to 40) of sizes, and has two different types of nut shapes (cylinder type: WLS, flange type: WLSF).

※ If you need a linear ball spline with a different material, please contact us.

6. Easy further processing

WON Linear Ball Spline has a groove installed in its round shaft. Therefore, the device supports multiple types of processing easily and is applicable in wide areas.

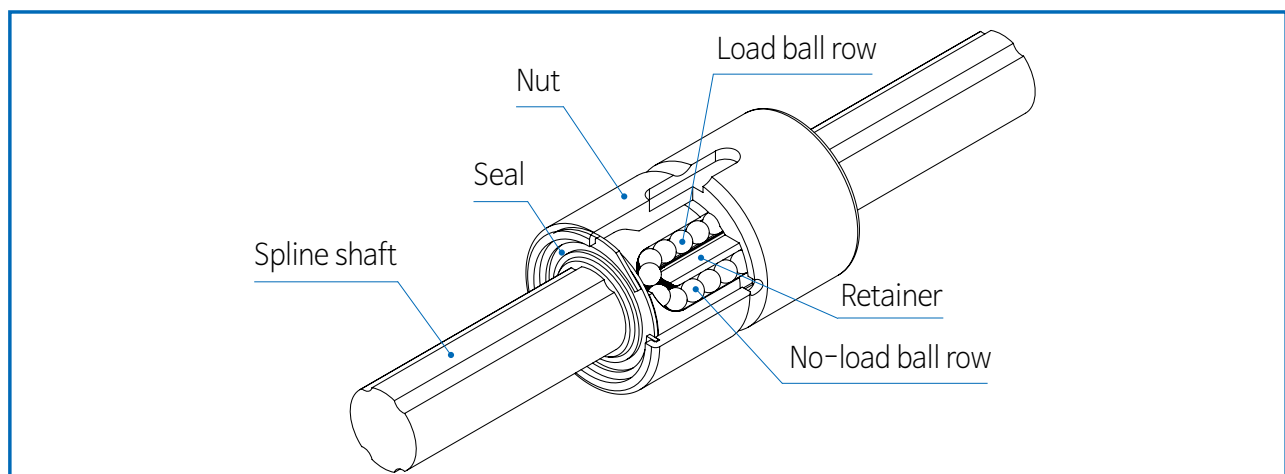

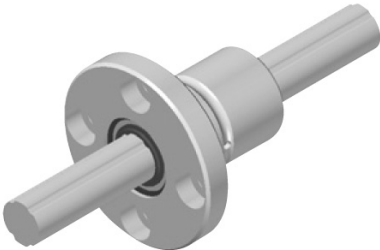


Figure 12. Structure of linear ball spline

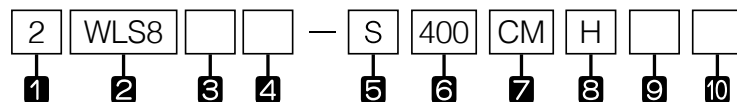
Classification	Type	Shape and Features	
Cylinder Type	WLS		It has a general spline nut that has a key groove helping to fix the position of a rotational direction accurately.
Flange Type	WLSF		Flange Type – As a round flange type, it can be installed easily.

Ball Spline

※ It is possible to select a different type of WON Linear Ball Spline depending on a use. A seal is basically installed in any type of nut.

WLS Series

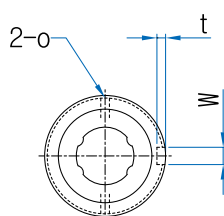
An example of the Composition of Model Name & Number



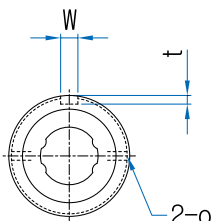
- 1** Number of nuts assembled in one shaft
- 2** Model No.
- 3** Material of nut: **No symbol**-Standard material/**M**-Stainless
- 4** **No symbol**-Standard nut / **E**-Special nut specification
- 5** Type of shaft: **S**-Solid / **H**-Hollow
- 6** Length of shaft
- 7** Symbol of clearance : **CL**-No preload / **CM**-Standard / **CT**-Light preload
- 8** Symbol of precision : **No symbol**-Normal / **H**-Precision / **P**-Super
- 9** Material of shaft : **No symbol**-Standard material / **M**-Stainless
- 10** **No symbol**-Standard shaft / **E**-Special shaft specification



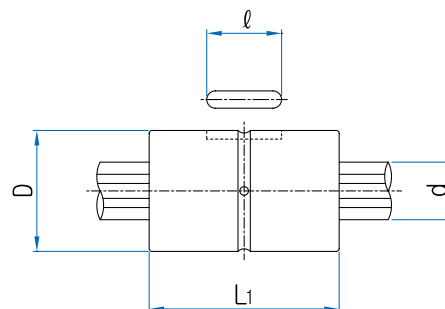
Model No.	Major dimensions										
	Outside diameter		Length		Dimension of key groove				O	Axial diameter	
	D	Tolerance	L ₁	Tolerance	W	Tolerance	t	ℓ		d	Tolerance
WLS 8	16	0 -0.011	25	0 -0.011	2.5	+0.014 0	1.2	10.5	1.5	8	0 -0.015
WLS 10	21	0 -0.013	33		3		1.5	13	1.5	10	
WLS 13	24		36		3		1.5	15	1.5	13	0 -0.018
WLS 16	31	0 -0.016	50		3.5	+0.018 0	2	17.5	2	16	
WLS 20	35		63	0 -0.019	4		2.5	29	2	20	0 -0.021
WLS 25	42		71		4		2.5	36	3	25	
WLS 30	47		80		4		2.5	42	3	30	
WLS 40	64	0 -0.019	100		6		3.5	52	4	40	0 -0.025



WLS 8~13



WLS 16~40



Ball Spline

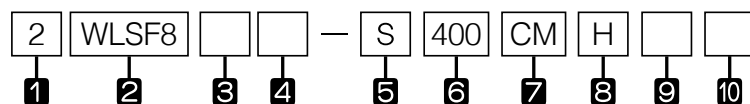
Unit : mm

Basic dynamic load rating	Basic static load rating	Basic dynamic rated torque	Basic static rated torque	Basic static rated torque	Spline nut		Model No.
					Spline nut g	Spline shaft g/100mm	
C N	Co N	T N·m	To N·m	Tm N·m			
1,450	2,870	2.1	3.7	7.4	23	38	WLS 8
2,730	5,070	4.4	8.2	18.0	54	60	WLS 10
2,670	4,890	21	39.2	13.7	70	100	WLS 13
6,120	11,200	60	110	46	150	150	WLS 16
8,900	16,300	105	194	110	220	240	WLS 20
12,800	23,400	189	346	171	330	370	WLS 25
18,600	23,200	307	439	181	360	540	WLS 30
30,800	37,500	647	934	358	950	960	WLS 40

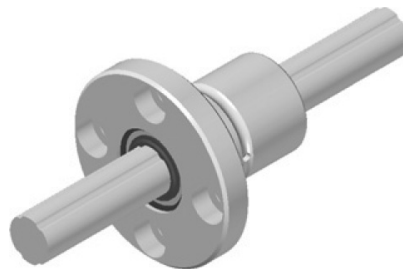
1N≒0.102kgf

WLSF Series

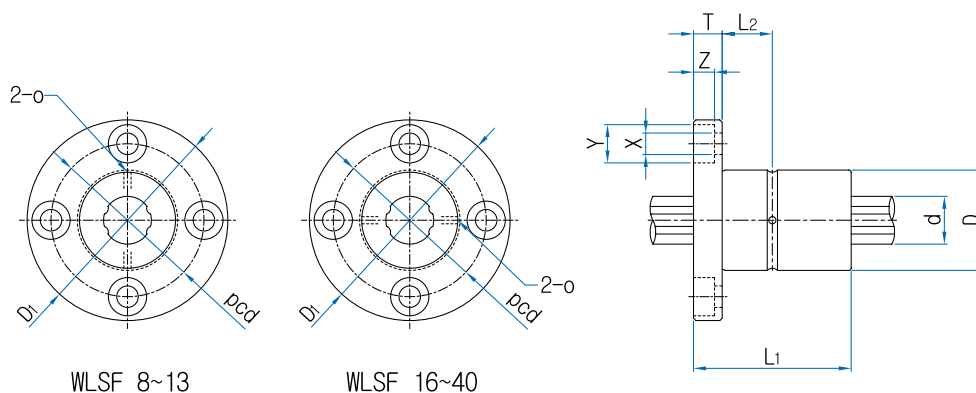
An example of the Composition of Model Name & Number



- 1** Number of nuts assembled in one shaft
- 2** Model No.
- 3** Material of nut: **No symbol**-Standard material/**M**-Stainless
- 4** **No symbol**-Standard nut / **E**-Special nut specification
- 5** Type of shaft: **S**-Solid / **H**-Hollow
- 6** Length of shaft
- 7** Symbol of clearance : **CL**-No preload / **CM**-Standard / **CT**-Light preload
- 8** Symbol of precision : **No symbol**-Normal / **H**-Precision / **P**-Super
- 9** Material of shaft : **No symbol**-Standard material / **M**-Stainless
- 10** **No symbol**-Standard shaft / **E**-Special shaft specification



Model No.	Major dimensions											
	Outside diameter		Length		D ₁	T	PCD	X×Y×Z	L ₂	o	Axial diameter	
	D	Tolerance	L ₁	Tolerance							d	Tolerance
WLSF 8	16	0 -0.011	25	0 -0.2	32	5	24	34×6.5×3.3	7.5	1.5	8	0 -0.015
WLSF 10	21	0 -0.013	33		42	6	32	4.5×8×4.4	10.5	1.5	10	
WLSF 13	24		36		44	7	33	4.5×8×4.4	11	1.5	13	0 -0.018
WLSF 16	31	0 -0.016	50		50	7	40	4.5×8×4.4	18	2	16	
WLSF 20	35		63	0 -0.3	58	9	45	5.5×9.5×5.4	22.5	2	20	0 -0.021
WLSF 25	42		71		65	9	52	5.5×9.5×5.4	26.5	3	25	
WLSF 30	47		80		75	10	60	6.6×11×6.5	30	3	30	
WLSF 40	64	0 -0.019	100		100	14	82	9×14×8.6	36	4	40	0 -0.025



Ball Spline

Unit : mm

Basic dynamic load rating	Basic static load rating	Basic dynamic rated torque	Basic static rated torque	Basic static rated torque	Spline nut		Model No.
					Spline nut g	Spline shaft g/100mm	
C N	Co N	T N · m	To N · m	T _M N · m			
1,450	2,870	2.1	3.7	7.4	42	38	WLSF 8
2,730	5,070	4.4	8.2	18.0	94	60	WLSF 10
2,670	4,890	21	39.2	13.7	100	100	WLSF 13
6,120	11,200	60	110	46	200	150	WLSF 16
8,900	16,300	105	194	110	330	240	WLSF 20
12,800	23,400	189	346	171	450	370	WLSF 25
18,600	23,200	307	439	181	550	540	WLSF 30
30,800	37,500	647	934	358	1,410	960	WLSF 40

1N≒0.102kgf