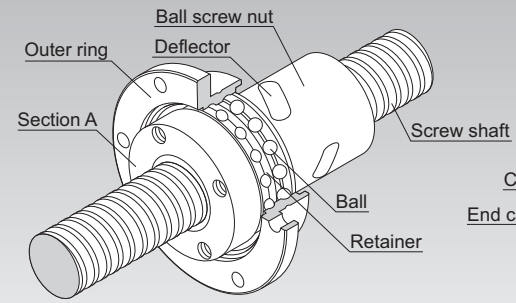
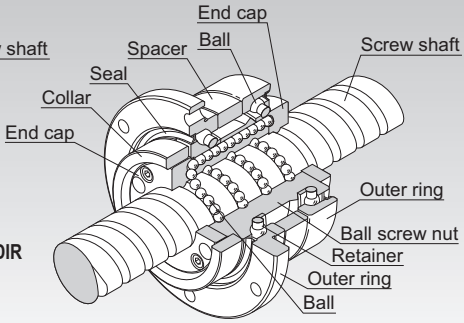
Precision Rotary Ball Screw

Models DIR and BLR



Structure of Standard-Lead Rotary Nut Ball Screw Model DIR



Structure of Large Lead Rotary Nut Ball Screw Model BLR

Structure and Features

[Model DIR]

Standard-Lead Rotary-Nut Ball Screw model DIR is a rotary-nut Ball Screw that has a structure where a simple-nut Ball Screw is integrated with a support bearing.

Its ball screw nut serves as a ball recirculation structure using deflectors. Balls travel along the groove of the deflector mounted in the ball screw nut to the adjacent raceway, and then circulate back to the loaded area to complete an infinite rolling motion.

Being an offset preload nut, the single ball screw nut provides different phases to the right and left thread in the middle of the nut, thus to set the axial clearance below zero (a preload is provided). This allows more compact, smoother motion to be achieved than the conventional double-nut type (a spacer is inserted between two nuts).

The support bearing comprises of two rows of DB type angular bearings with a contact angle of 45° to provide a preload. The collar, previously used to mount a pulley, is integrated with the ball screw nut. (See the A section.)

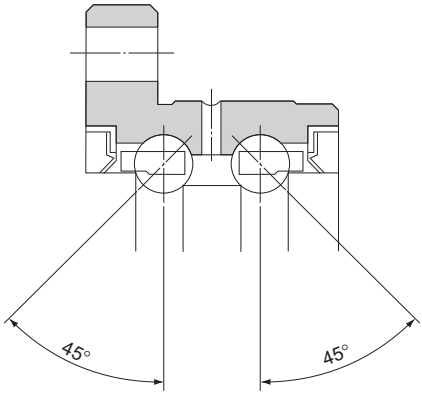


Fig.1 Structure of the Support Bearing

● Compact

Because of the internal circulation mechanism using a deflector, the outer diameter is only 70 to 80%, and the overall length is 60 to 80%, of that of the return-pipe nut, thus to reduce the weight and decrease the inertia during acceleration.

Since the nut and the support bearing are integrated, a highly accurate, and a compact design is achieved.

In addition, small inertia due to the lightweight ball screw nut ensures high responsiveness.

● Capable of Fine Positioning

Being a Standard-Lead Ball Screw, it is capable of fine positioning despite that the ball screw nut rotates.

● Accuracy can Easily be Established

As the support bearing is integrated with the outer ring, the bearing can be assembled with the nut housing on the end face of the outer ring flange. This makes it easy to center the ball screw nut and establish accuracy.

● Well Balanced

Since the deflector is evenly placed along the circumference, a superb balance is ensured while the ball screw nut is rotating.

● **Stability in the Low-speed Range**
Traditionally, motors tend to have an uneven torque and a speed in the low-speed range due to the external causes. With model DIR, the motor can be connected independently with the screw shaft and the ball screw nut, thus to allow micro feeding within the motor's stable rotation range.

[**Model BLR**]
The Rotary Ball Screw is a rotary-nut ball screw unit that has an integrated structure consisting of a ball screw nut and a support bearing. The support bearing is an angular bearing that has a contact angle of 60°, contains an increased number of balls and achieves large axial rigidity.
Model BLR is divided into two types: Precision Ball Screw and Rolled Screw Ball.

● **Smooth Motion**
It achieves smoother motion than rack-and-pinion based straight motion.

● **Low Noise even in High-speed Rotation**
Model BLR produces very low noise when the balls are picked up along the end cap. In addition, the balls circulate by passing through the ball screw nut, allowing this model to be used at high speed.

● **High Rigidity**
The support bearing of this model is larger than that of the screw shaft rotational type. Thus, its axial rigidity is significantly increased.

● **Compact**
Since the nut and the support bearing are integrated, a highly accurate, and a compact design is achieved.

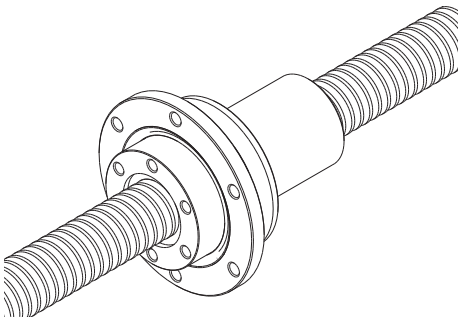
● **Easy Installation**
By simply mounting this model to the housing with bolts, a ball screw nut rotating mechanism can be obtained. (For the housing's inner-diameter tolerance, H7 is recommended.)

Type

[Preload Type]

Model DIR

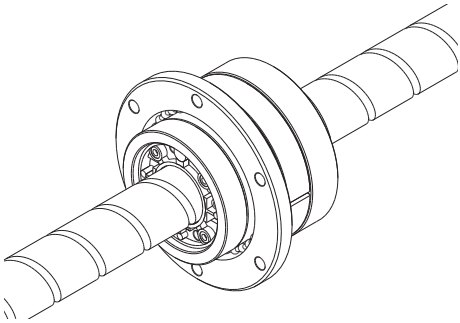
Specification Table⇒A15-258



[No Preload Type]

Model BLR

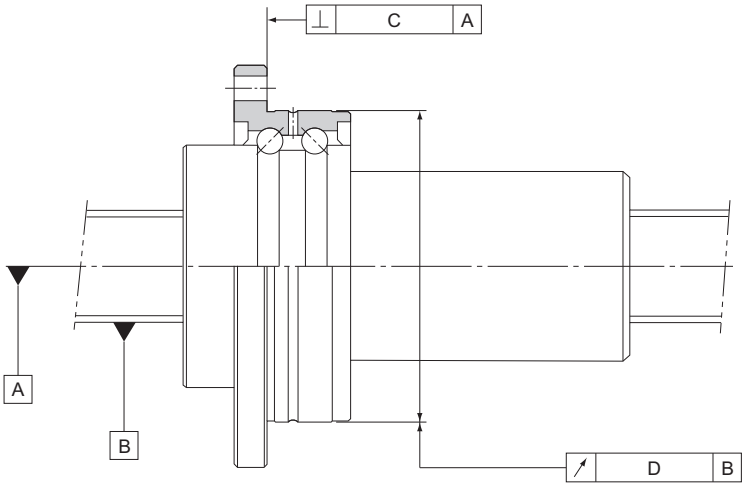
Specification Table⇒A15-260



Accuracy Standards

[Model DIR]

The accuracy of model DIR is compliant with a the JIS standard (JIS B 1192-1997) except for the radial runout of the circumference of the ball screw nut from the screw axis (D) and the perpendicularity of the flange-mounting surface against the screw axis (C).

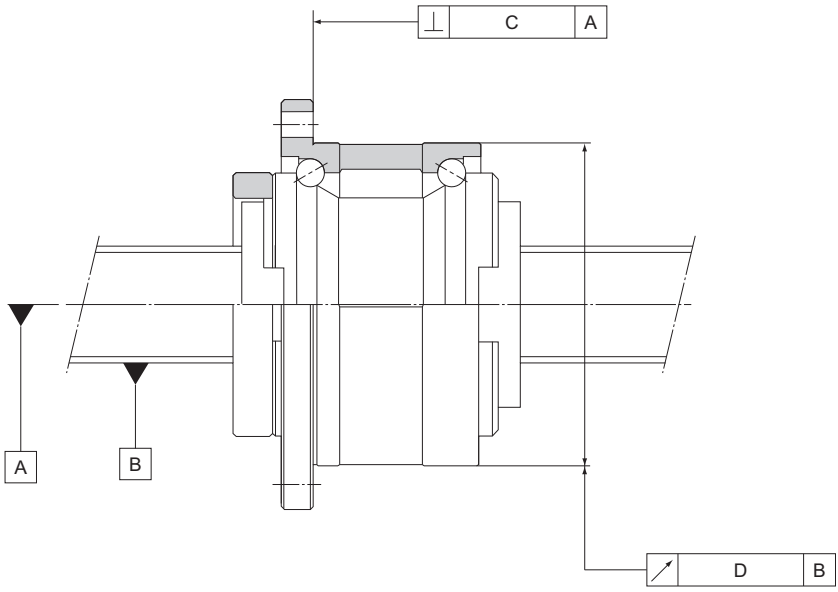


Unit: mm

Accuracy grades	C3		C5		C7	
Model No.	C	D	C	D	C	D
DIR 16□□	0.013	0.017	0.016	0.020	0.023	0.035
DIR 20□□	0.013	0.017	0.016	0.020	0.023	0.035
DIR 25□□	0.015	0.020	0.018	0.024	0.023	0.035
DIR 32□□	0.015	0.020	0.018	0.024	0.023	0.035
DIR 36□□	0.016	0.021	0.019	0.025	0.024	0.036
DIR 40□□	0.018	0.026	0.021	0.033	0.026	0.036

[Model BLR]

The accuracy of model BLR is compliant with a the JIS standard (JIS B 1192-1997) except for the radial runout of the circumference of the ball screw nut from the screw axis (D) and the perpendicularity of the flange-mounting surface against the screw axis (C).

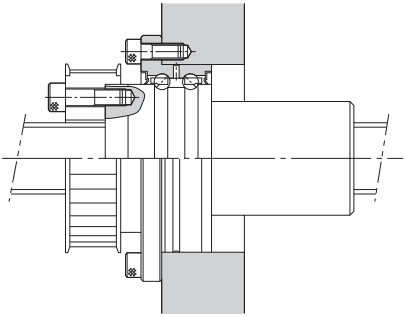


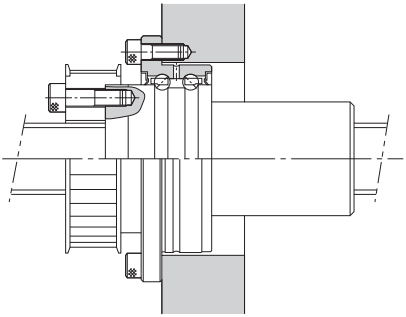
Unit: mm

Lead angle accuracy	C3		C5		C7	
Accuracy grades	C3		C5		C7	
Model No.	C	D	C	D	C	D
BLR 1616	0.013	0.017	0.016	0.020	0.023	0.035
BLR 2020	0.013	0.017	0.016	0.020	0.023	0.035
BLR 2525	0.015	0.020	0.018	0.024	0.023	0.035
BLR 3232	0.015	0.020	0.018	0.024	0.023	0.035
BLR 3636	0.016	0.021	0.019	0.025	0.024	0.036
BLR 4040	0.018	0.026	0.021	0.033	0.026	0.046
BLR 5050	0.018	0.026	0.021	0.033	0.026	0.046

Example of Assembly

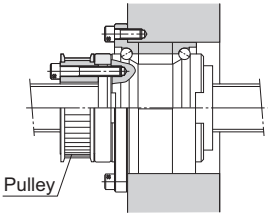
[Example of Mounting Ball Screw Nut Model DIR]



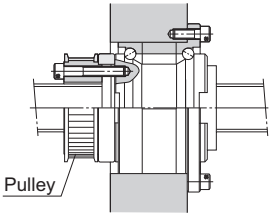


Installation to the housing can be performed on the end face of the outer ring flange.

[Example of Mounting Ball Screw Nut Model BLR]



Standard installation method



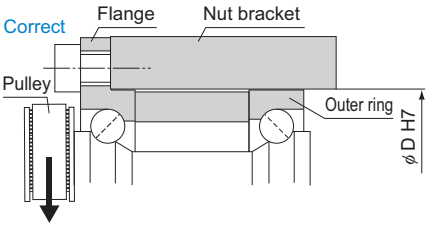
Inverted flange

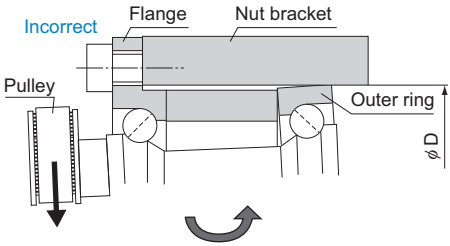
Note) If the flange is to be inverted, indicate “K” in the model number. (applicable only to model BLR)

Example: BLR 2020-3.6 K UU

Symbol for inverted flange (No symbol for standard flange orientation)

[Important note concerning model BLR]





Note) Since the outer rings are separable, it is necessary to include an internal diameter tolerance in the nut bracket so that the outer ring on the side opposite from the flange does not shift. (H7 is recommended.)

[Example of Mounting Model BLR on the Table]

(1) Screw shaft free, ball screw nut fixed
(Suitable for a long table)

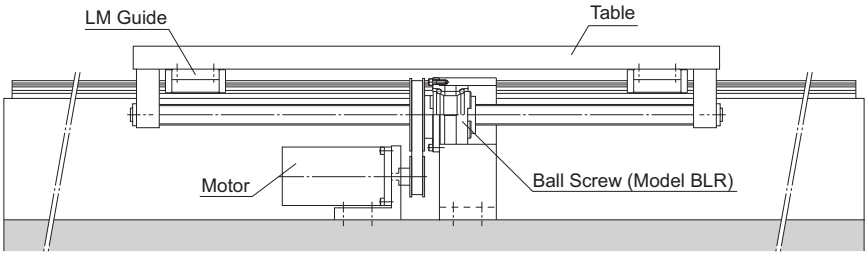


Fig.2 Example of Installation on the Table (Ball Screw Nut Fixed)

(2) Ball screw nut free, screw shaft fixed
(Suitable for a short table and a long stroke)

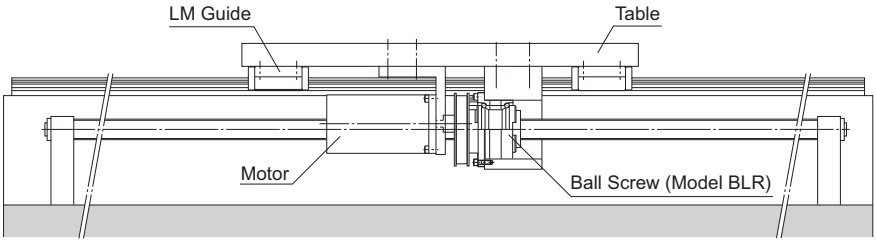
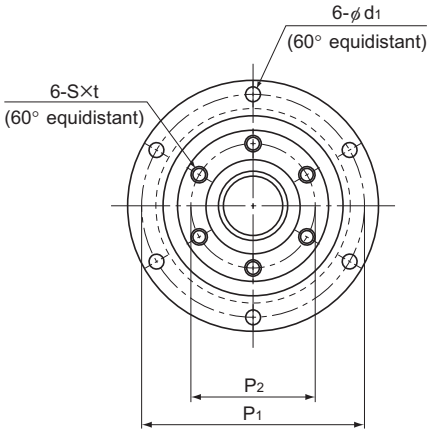


Fig.3 Example of Installation on the Table (Screw Shaft Fixed)

Model DIR Standard-Lead Rotary-Nut Ball Screw



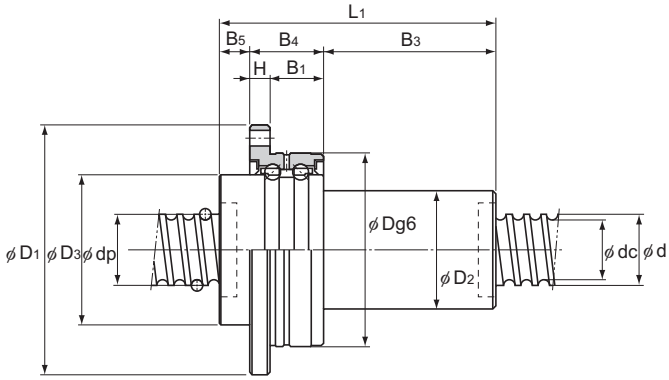
Model No.	Screw shaft outer diameter	Thread minor diameter	Lead	Ball center-to-center diameter	Basic load rating		Rigidity				
							K	Outer diameter	Flange diameter	Overall length	D_3
	d	dc	Ph	dp	Ca kN	C_0a kN	N/μm	D	D_1	L_1	h7
DIR 1605-6	16	13.2	5	16.75	7.4	13	310	48	64	79	36
DIR 2005-6	20	17.2	5	20.75	8.5	17.3	310	56	72	80	43.5
DIR 2505-6	25	22.2	5	25.75	9.7	22.6	490	66	86	88	52
DIR 2510-4		21.6	10	26	9	18	330	66	86	106	52
DIR 3205-6	32	29.2	5	32.75	11.1	30.2	620	78	103	86	63
DIR 3206-6		28.4	6	33	14.9	37.1	630	78	103	97	63
DIR 3210-6		26.4	10	33.75	25.7	52.2	600	78	103	131	63
DIR 3610-6	36	30.5	10	37.75	28.8	63.8	710	92	122	151	72
DIR 4010-6	40	34.7	10	41.75	29.8	69.3	750	100	130	142	79.5
DIR 4012-6		34.4	12	41.75	30.6	72.3	790	100	130	167	79.5

Model number coding

DIR2005-6 RR G0 +520L C1

- DIR2005-6: Model number
- RR: Seal symbol (*1)
- G0: Symbol for clearance in the axial direction (*2)
- +520L: Overall screw shaft length (in mm)
- C1: Accuracy symbol (*3)

(*1) See A15-352. (*2) See A15-19. (*3) See A15-12.



Unit: mm

Ball screw dimensions												Support bearing basic load rating		Nut inertial moment	Nut mass	Shaft mass
	D_2	B_5	B_4	B_3	P_1	P_2	H	B_1	S	t	d_1	Ca kN	C_0a kN	kg•cm²	kg	kg/m
	30	8	21	50	56	30	6	15	M4	6	4.5	8.7	10.5	0.61	0.49	1.24
	34	9	21	50	64	36	6	15	M5	8	4.5	9.7	13.4	1.18	0.68	2.05
	40	13	25	50	75	43	7	18	M6	10	5.5	12.7	18.2	2.65	1.07	3.34
	40	11	25	70	75	43	7	18	M6	10	5.5	12.7	18.2	2.84	1.16	3.52
	46	11	25	50	89	53	8	17	M6	10	6.6	13.6	22.3	5.1	1.39	5.67
	48	11	25	61	89	53	8	17	M6	10	6.6	13.6	22.3	5.68	1.54	5.47
	54	11	25	95	89	53	8	17	M6	10	6.6	13.6	22.3	8.13	2.16	4.98
	58	14	33	104	105	61	10	23	M8	12	9	20.4	32.3	14.7	3.25	6.51
	62	14	33	95	113	67	10	23	M8	12	9	21.5	36.8	20.6	3.55	8.22
	62	14	33	120	113	67	10	23	M8	12	9	21.5	36.8	22.5	3.9	8.5

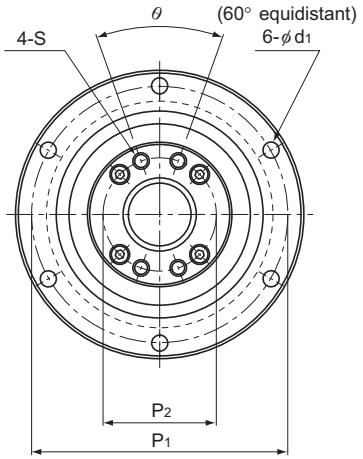
Note) The rigidity values in the table represent spring constants each obtained from the load and the elastic deformation when providing a preload 10% of the basic dynamic load rating (Ca) and applying an axial load three times greater than the preload.
These values do not include the rigidity of the components related to mounting the ball screw nut. Therefore, it is normally appropriate to regard roughly 80% of the value in the table as the actual value.
If the applied preload (Fa_0) is not 0.1 Ca, the rigidity value (K_N) is obtained from the following equation.

$$K_N = K \left(\frac{Fa_0}{0.1Ca} \right)^{\frac{1}{3}}$$

K: Rigidity value in the dimensional table.

Options⇒A15-351

Model BLR Large Lead Rotary-Nut Precision Ball Screw



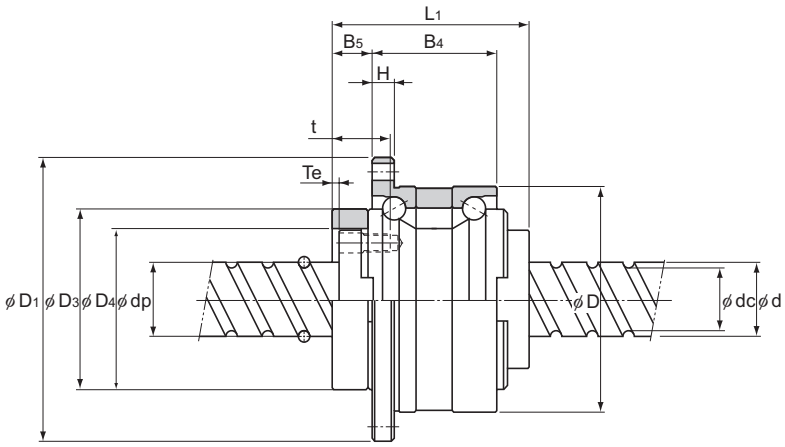
Model No.	Screw shaft outer diameter	Thread minor diameter	Lead	Ball center-to-center diameter	Basic load rating					
					Ca	C0a	Outer diameter	Flange diameter	Overall length	
	d	dc	Ph	dp	kN	kN	D	D1	L1	D3
BLR 1616-3.6	16	13.7	16	16.65	7.1	14.3	52 $^{0}_{-0.007}$	68	43.5	40 $^{0}_{-0.025}$
BLR 2020-3.6	20	17.5	20	20.75	11.1	24.7	62 $^{0}_{-0.007}$	78	54	50 $^{0}_{-0.025}$
BLR 2525-3.6	25	21.9	25	26	16.6	38.7	72 $^{0}_{-0.007}$	92	65	58 $^{0}_{-0.03}$
BLR 3232-3.6	32	28.3	32	33.25	23.7	59.5	80 $^{0}_{-0.007}$	105	80	66 $^{0}_{-0.03}$
BLR 3636-3.6	36	31.7	36	37.4	30.8	78	100 $^{0}_{-0.008}$	130	93	80 $^{0}_{-0.03}$
BLR 4040-3.6	40	35.2	40	41.75	38.7	99.2	110 $^{0}_{-0.008}$	140	98	90 $^{0}_{-0.035}$
BLR 5050-3.6	50	44.1	50	52.2	57.8	155	120 $^{0}_{-0.008}$	156	126	100 $^{0}_{-0.035}$

Model number coding

BLR2020-3.6 K UU G1 +1000L C5

- BLR2020-3.6: Model number
- K: Flange orientation symbol (*1)
- UU: Symbol for support bearing seal (*2)
- G1: Symbol for clearance in the axial direction (*3)
- +1000L: Overall screw shaft length (in mm)
- C5: Accuracy symbol (*4)

(*1) See A15-256. (*2) UU: Seal attached on both ends No symbol: Without seal. (*3) See A15-19. (*4) See A15-12.



Unit: mm

Ball screw dimensions												Support bearing basic load rating		Nut inertial moment	Nut mass	Shaft mass
	D_4	H	B_4	B_5	Te	P_1	P_2	S	t	d_1	θ°	Ca	C_0a			
												kN	kN	kg•cm²	kg	kg/m
	$32^{+0.025}_{0}$	5	27.5	9	2	60	25	M4	12	4.5	40	19.4	19.2	0.48	0.38	1.41
	$39^{+0.025}_{0}$	6	34	11	2	70	31	M5	16	4.5	40	26.8	29.3	1.44	0.68	2.25
	$47^{+0.025}_{0}$	8	43	12.5	3	81	38	M6	19	5.5	40	28.2	33.3	3.23	1.1	3.52
	$58^{+0.03}_{0}$	9	55	14	3	91	48	M6	19	6.6	40	30	39	6.74	1.74	5.83
	$66^{+0.03}_{0}$	11	62	17	3	113	54	M8	22	9	40	56.4	65.2	16.8	3.2	7.34
	$73^{+0.03}$	11	68	16.5	3	123	61	M8	22	9	50	59.3	74.1	27.9	3.95	9.01
	$90^{+0.035}_{0}$	12	80	25	4	136	75	M10	28	11	50	62.2	83	58.2	6.22	14.08

Options⇒A15-351

Permissible Rotational Speeds for Rotary Ball Screws

The permissible rotational speeds for models DIR and BLR and rotary ball screws is restricted to whichever is lower of the support bearing permissible rotational speed, the DN value (70,000) and the critical speed of the screw. When using the product, do not exceed the permissible rotational speed.

Table1 Model DIR permissible rotational speed

Unit:min^{-1}

Model No.	Permissible Rotational Speed			
	Ball Screw Unit		Support bearing	
	Calculated using shaft length	Calculated using DN value	Grease Lubrication	Oil Lubrication
DIR1605	see A15-32.	4179	4200	5600
DIR2005		3373	3500	4700
DIR2505		2718	2900	3900
DIR2510		2692	2900	3900
DIR3205		2137	2400	3300
DIR3206		2121	2400	3300
DIR3210		2074	2400	3300
DIR3610		1854	2100	2800
DIR4010		1676	1900	2600
DIR4012		1676	1900	2600

Table2 Model BLR permissible rotational speed

Unit:min^{-1}

Model No.	Permissible Rotational Speed			
	Ball Screw Unit		Support bearing	
	Calculated using shaft length	Calculated using DN value	Grease Lubrication	Oil Lubrication
BLR1616	see A15-32.	4204	4000	5600
BLR2020		3373	3200	4300
BLR2525		2692	2800	3700
BLR3232		2105	2400	3300
BLR3636		1871	2000	2700
BLR4040		1676	1800	2400
BLR5050		1340	1600	2200

Rolled Rotary Ball Screw

Model BLR

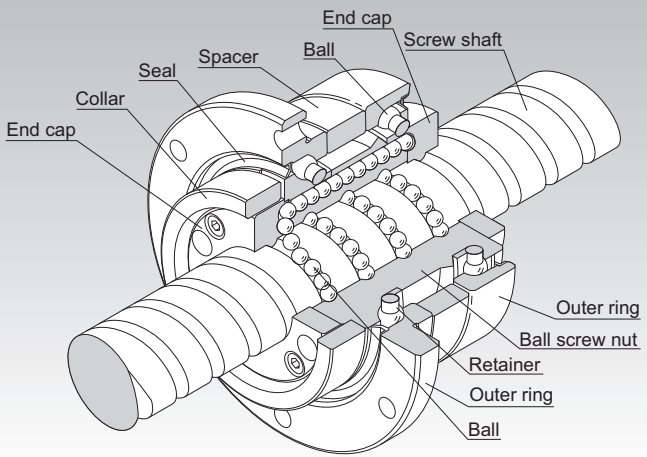


Fig.1 Structure of Large Lead Rotary Nut Ball Screw Model BLR

Structure and Features

The Rotary Ball Screw is a rotary-nut ball screw unit that has an integrated structure consisting of a ball screw nut and a support bearing. The support bearing is an angular bearing that has a contact angle of 60°, contains an increased number of balls and achieves a large axial rigidity.
Model BLR is divided into two types: the Precision Ball Screw and the Rolled Screw Ball.

[Smooth Motion]
It achieves smoother motion than rack-and-pinion based straight motion.

[Low Noise even in High-speed Rotation]
Model BLR produces very low noise when the balls are picked up along the end cap. In addition, the balls circulate by passing through the ball screw nut, allowing this model to be used at high speed.

[High Rigidity]
The support bearing of this model is larger than that of the screw shaft rotational type. Thus, its axial rigidity is significantly increased.

[Compact]
Since the nut and the support bearing are integrated, a highly accurate, and a compact design is achieved.

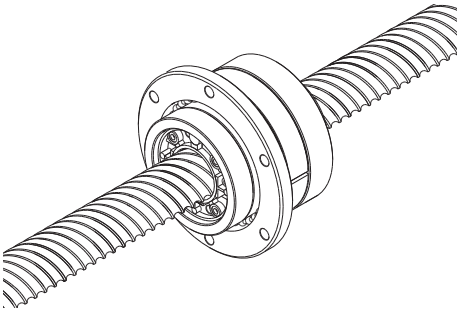
[Easy Installation]
By simply mounting this model to the housing using bolts, a ball screw nut rotating mechanism can be obtained. (For the housing's inner-diameter tolerance, H7 is recommended.)

Type

[No Preload Type]

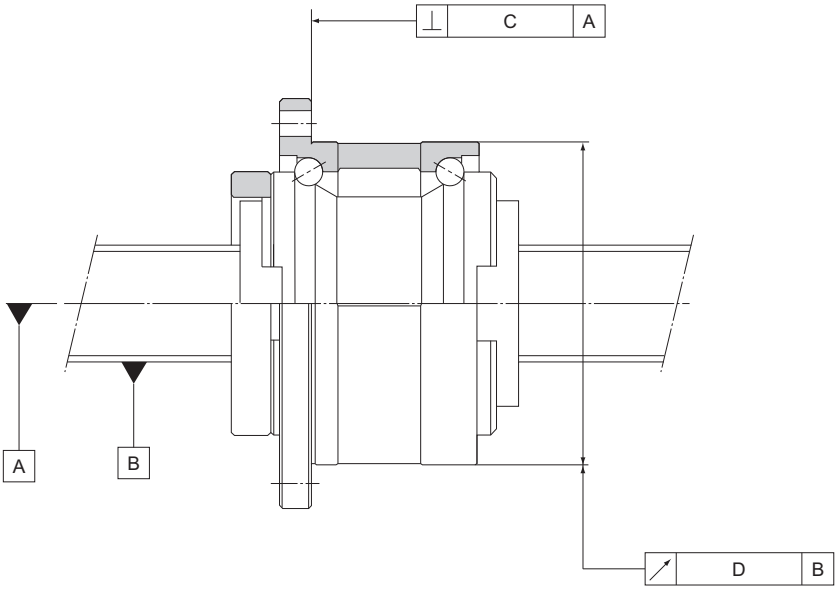
Model BLR

Specification Table⇒A15-310



Accuracy Standards

The accuracy of model BLR is compliant with the JIS standard (JIS B 1192-1997) except for the radial runout of the circumference of the ball screw nut from the screw axis (D) and the perpendicularity of the flange-mounting surface against the screw axis (C).

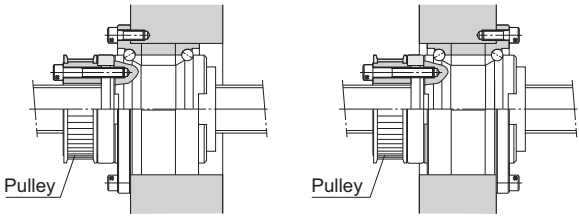


Unit: mm

Lead angle accuracy	C7, C8, C10	
Accuracy grades	C10	
Model No.	C	D
BLR 1616	0.035	0.065
BLR 2020	0.035	0.065
BLR 2525	0.035	0.065
BLR 3232	0.035	0.065
BLR 3636	0.036	0.066
BLR 4040	0.046	0.086
BLR 5050	0.046	0.086

Example of Assembly

[Example of Mounting Ball Screw Nut Model BLR]



Standard installation method　　Inverted flange

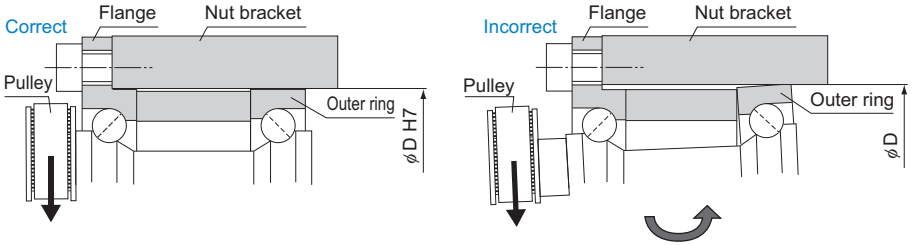
Note) If the flange is to be inverted, indicate “K” in the model number. (applicable only to model BLR)

Example: BLR 2020-3.6 K UU

Symbol for inverted flange

(No symbol for standard flange orientation)

[Important note concerning model BLR]



Note) Since the outer rings are separable, it is necessary to include an internal diameter tolerance in the nut bracket so that the outer ring on the side opposite from the flange does not shift. (H7 is recommended.)

[Example of Mounting Model BLR on the Table]

(1) Screw shaft free, ball screw nut fixed
(Suitable for a long table)

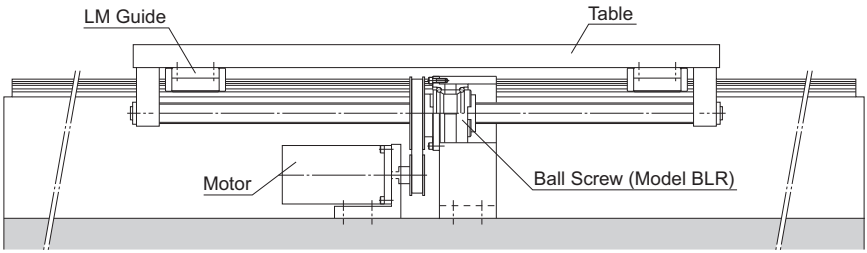


Fig.2 Example of Installation on the Table (Ball Screw Nut Fixed)

(2) Ball screw nut free, screw shaft fixed
(Suitable for a short table and a long stroke)

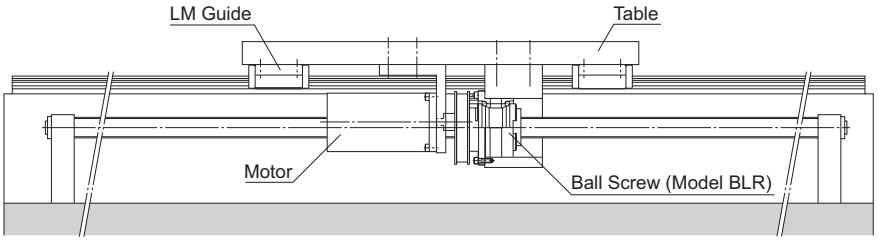
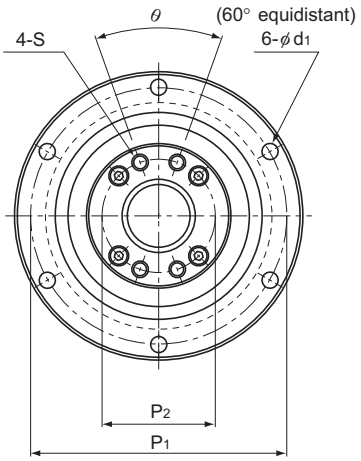


Fig.3 Example of Installation on the Table (Screw Shaft Fixed)

Model BLR Large Lead Rotary Nut Rolled Ball Screw



Model No.	Screw shaft outer diameter d	Thread minor diameter dc	Lead Ph	Ball center-to-center diameter dp	Basic load rating Ca kN	Basic load rating C_0a kN	Outer diameter D	Flange diameter D_1	Overall length L_1	D_3
BLR 1616-3.6	16	13.7	16	16.65	5.8	12.9	52 $^{0}_{-0.007}$	68	43.5	40 $^{0}_{-0.025}$
BLR 2020-3.6	20	17.5	20	20.75	7.7	22.3	62 $^{0}_{-0.007}$	78	54	50 $^{0}_{-0.025}$
BLR 2525-3.6	25	21.9	25	26	12.1	35	72 $^{0}_{-0.007}$	92	65	58 $^{0}_{-0.03}$
BLR 3232-3.6	32	28.3	32	33.25	17.3	53.9	80 $^{0}_{-0.007}$	105	80	66 $^{0}_{-0.03}$
BLR 3636-3.6	36	31.7	36	37.4	22.4	70.5	100 $^{0}_{-0.008}$	130	93	80 $^{0}_{-0.03}$
BLR 4040-3.6	40	35.2	40	41.75	28.1	89.8	110 $^{0}_{-0.008}$	140	98	90 $^{0}_{-0.035}$
BLR 5050-3.6	50	44.1	50	52.2	42.1	140.4	120 $^{0}_{-0.008}$	156	126	100 $^{0}_{-0.035}$

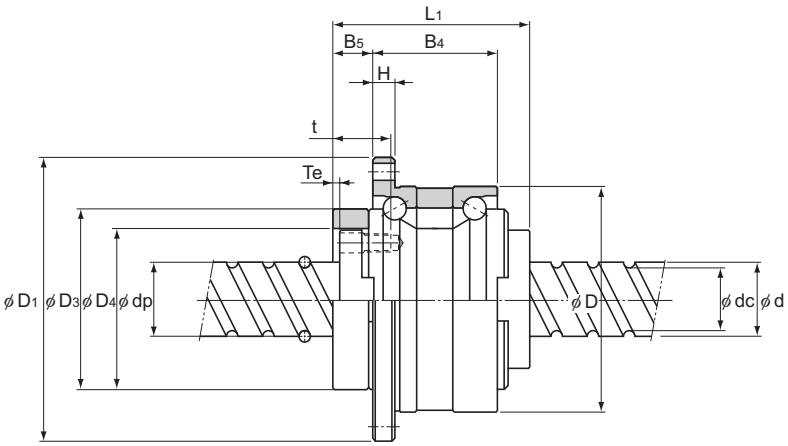
Model number coding

BLR2020-3.6 K UU +1000L C7 T

- BLR2020-3.6: Model number
- K: Flange orientation symbol (*1)
- UU: Symbol for support bearing seal (*2)
- +1000L: Overall screw shaft length (in mm)
- C7: Accuracy symbol (*3)
- T: Symbol for rolled Ball Screw

(*1) See A15-307. (*2) UU: seal attached on both ends; No symbol: without seal. (*3) See A15-12.

Note) For clearance in the axial direction, see A15-19.



Unit: mm

Ball screw dimensions												Support bearing basic load rating		Nut inertial moment	Nut mass	Shaft mass
	D_4	H	B_4	B_5	Te	P_1	P_2	S	t	d_1	θ°	Ca kN	C_0a kN	kg•cm²	kg	kg/m
	32 +0.025 0	5	27.5	9	2	60	25	M4	12	4.5	40	19.4	19.2	0.48	0.38	1.35
	39 +0.025 0	6	34	11	2	70	31	M5	16	4.5	40	26.8	29.3	1.44	0.68	2.17
	47 +0.025 0	8	43	12.5	3	81	38	M6	19	5.5	40	28.2	33.3	3.23	1.1	3.41
	58 +0.03 0	9	55	14	3	91	48	M6	19	6.6	40	30	39	6.74	1.74	5.69
	66 +0.03 0	11	62	17	3	113	54	M8	22	9	40	56.4	65.2	16.8	3.2	7.12
	73 +0.03	11	68	16.5	3	123	61	M8	22	9	50	59.3	74.1	27.9	3.95	8.76
	90 +0.035 0	12	80	25	4	136	75	M10	28	11	50	62.2	83	58.2	6.22	13.79

Options⇒A15-351

Maximum Length of the Ball Screw Shaft

Table1 shows the manufacturing limit lengths of precision Ball Screws by accuracy grades, Table2 shows the manufacturing limit lengths of precision Ball Screws compliant with DIN standard by accuracy grades, and Table3 shows the manufacturing limit lengths of rolled Ball Screws by accuracy grades.
If the shaft dimensions exceed the manufacturing limit in Table1, Table2 or Table3, contact THK.

Table1 Maximum Length of the Precision Ball Screw by Accuracy Grade

Unit: mm

Screw shaft outer diameter	Overall screw shaft length					
	C0	C1	C2	C3	C5	C7
4	90	110	120	120	120	120
6	150	170	210	210	210	210
8	230	270	340	340	340	340
10	350	400	500	500	500	500
12	440	500	630	680	680	680
13	440	500	630	680	680	680
14	530	620	770	870	890	890
15	570	670	830	950	980	1100
16	620	730	900	1050	1100	1400
18	720	840	1050	1220	1350	1600
20	820	950	1200	1400	1600	1800
25	1100	1400	1600	1800	2000	2400
28	1300	1600	1900	2100	2350	2700
30	1450	1700	2050	2300	2570	2950
32	1600	1800	2200	2500	2800	3200
36	2000	2100	2550	2950	3250	3650
40		2400	2900	3400	3700	4300
45		2750	3350	3950	4350	5050
50		3100	3800	4500	5000	5800
55		3450	4150	5300	6050	6500
63		4000	5200	5800	6700	7700
70			6300	6450	7650	9000
80				7900	9000	10000
100				10000	10000	