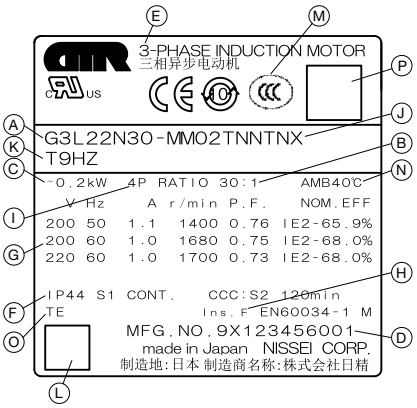
TECHNICAL DOCUMENTATION, INDEX

Technical Documentation

How to read the Nameplate



Ⓐ Product Model Name
Ⓑ Reduction Ratio
Ⓒ Motor Power
Ⓓ Manufacturing Number
Ⓔ Number of Phases
Ⓕ Protective Structure/Rating
Ⓖ Rated Values
Ⓗ Insulation Class
Ⓘ Number of Motor Poles
Ⓙ Option (X)
Ⓚ Option Code
Ⓛ QR Code (Internal Control Code)
Ⓜ Global Standards Conformance Marks
Ⓝ Ambient Temperature
Ⓞ Motor Structure
Ⓟ QR Code (for Access to Product Information)

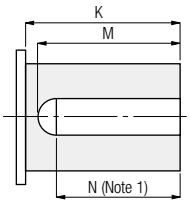
How to Read the Manufacturing Number

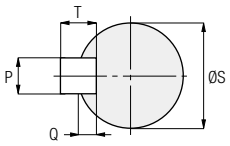
1 X 1 2 3 4 5 6 0 0 1

- Serial Number
- Our Control Number
- Month of Manufacture
  1 : January
  to
  9 : September
  X : October
  Y : November
  Z : December
- Year of Manufacture 1: 2021
  (Last digit of the year)

Output Shaft Detailed Dimensions

Parallel Shaft, Right Angle Shaft





■ G/G3/H/H2/FF/F2F/F3F/VG (Except 50W)/VH/VF3F Types

Dimension / Frame Size	K	M	N	S (h6)		Key				Q
						P (h9)		T		
12	22	20	18	12	0 -0.011	4	0 -0.030	4	0 -0.030	2.5
15	27	24	21.5	15	0 -0.011	5	0 -0.030	5	0 -0.030	3
18	30	27	24	18	0 -0.011	6	0 -0.030	6	0 -0.030	3.5
22	40	35	32	22	0 -0.013	6	0 -0.030	6	0 -0.030	3.5
28	45	40	36	28	0 -0.013	8	0 -0.036	7	0 -0.090	4
32	55	50	45	32	0 -0.016	10	0 -0.036	8	0 -0.090	5
40	65	60	54	40	0 -0.016	12	0 -0.043	8	0 -0.090	5
50	75	70	63	50	0 -0.016	14	0 -0.043	9	0 -0.090	5.5

Note 1: Dimension N is the key length for an output shaft made of stainless steel.

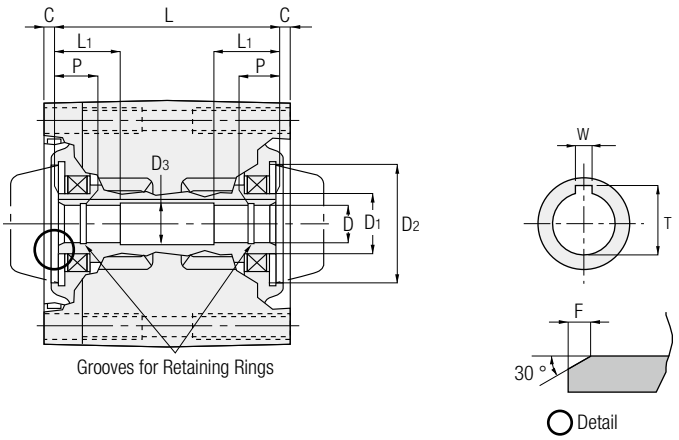
■ VG (only 50W) Type

Dimension / Frame Size	K	M	S (h7)		Key				Q
					P (h9)		T		
12	22	20	12	0 -0.018	4	0 -0.030	4	0 -0.030	2.5
15	25	22	15	0 -0.018	5	0 -0.030	5	0 -0.030	3

■ APG/AG3/AH2/AF3F Types

Dimension / Frame Size	K	M	S (h6)		Key				Q
					P (h9)		T		
12	20	18	12	0 -0.011	4	0 -0.030	4	0 -0.030	2.5
15	30	24	15	0 -0.011	5	0 -0.030	5	0 -0.030	3
18	30	27	18	0 -0.011	6	0 -0.030	6	0 -0.030	3.5
22	40	35	22	0 -0.013	6	0 -0.030	6	0 -0.030	3.5
28	45	40	28	0 -0.013	8	0 -0.036	7	0 -0.090	4
32	55	50	32	0 -0.016	10	0 -0.036	8	0 -0.090	5
40	65	60	40	0 -0.016	12	0 -0.043	8	0 -0.090	5
50	75	70	50	0 -0.016	14	0 -0.043	9	0 -0.090	5.5

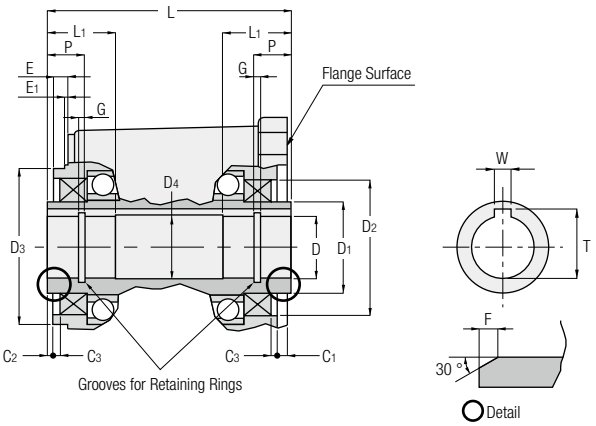
■ F2 (F2S) Type



Frame Size	D (H8)	D_1	D_2 (H8)	D_3	W	T	L	L_1	P	C	F
12	Ø12	Ø20	Ø39	Ø13	4	13.8	70	20	8	5.5	2
15	Ø15	Ø24	Ø39	Ø16	5	17.3	88	21	9	4	2

Note 1: The key groove dimensions and tolerances for output shafts comply with JIS B1301-1996 parallel keys (plain form).
Note 2: The key for the output shaft is not included.
Note 3: The retaining rings comply with JIS B2804-2010.
Note 4: The retaining rings are not included.

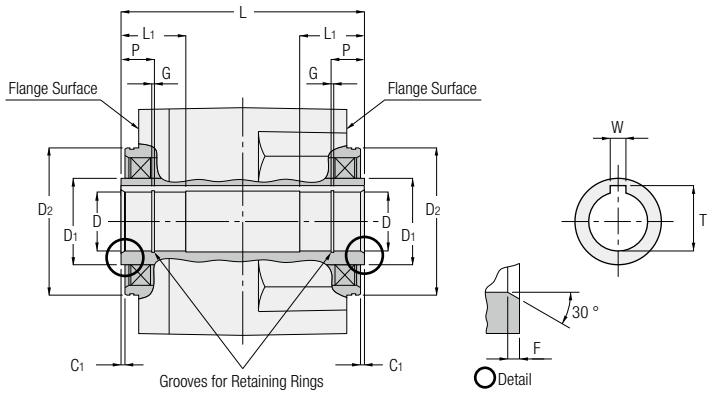
■ FS Type



Frame Size	D (H8)	D_1	D_2 (H8)	D_3 (h8)	D_4	W	T	L	L_1	P	C_1	C_2	C_3	E	E_1	F	G
20	Ø20	Ø29	Ø46	Ø53	Ø21	6	22.8	91	24	13	1	2	3	8	0	2	1.15
25	Ø25	Ø39	Ø58	Ø66	Ø26	8	28.3	108	27	14	6	2	3	6	0	2	1.35
30	Ø30	Ø44	Ø65	Ø75	Ø31	8	33.3	117	33	17	5	2	3	7	0	2	1.35
35	Ø35	Ø49	Ø72	Ø85	Ø36	10	38.3	124	38	20	3	2	3	7	0	2	1.75
45	Ø45	Ø64	Ø85	Ø100	Ø46	14	48.8	140	50	26	3	2	3	6	0	2	1.95
55	Ø55	Ø79	Ø100	Ø120	Ø56	16	59.3	181	61	32	5	2	5	10	2	2	2.20

Note 1: The key groove dimensions and tolerances for output shafts comply with JIS B1301-1996 parallel keys (plain form).
Note 2: The key for the output shaft is not included.
Note 3: The retaining rings comply with JIS B2804-2010.
Note 4: The retaining rings are not included.

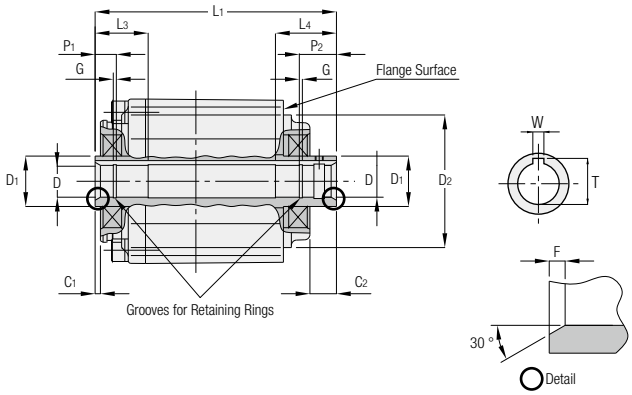
■ F3S Type/VF3S Type



Frame Size	D (H8)	D_1	D_2 (h7)	W	T	L	L_1	P	C_1	F	G
20	Ø20	Ø29	Ø53	6	22.8	96	24	13	2	2	1.15
25	Ø25	Ø39	Ø66	8	28.3	118	27	14	2	2	1.35
30	Ø30	Ø44	Ø75	8	33.3	124	33	17	2	2	1.35
35	Ø35	Ø49	Ø85	10	38.3	142	38	20	2	2	1.75
45	Ø45	Ø64	Ø100	14	48.8	168	50	26	2	2	1.95

Note 1: The key groove dimensions and tolerances for output shafts comply with JIS B1301-1996 parallel keys (plain form).
Note 2: The key for the output shaft is not included.
Note 3: The retaining rings comply with JIS B2804-2010.
Note 4: The retaining rings are not included.

■ AFC Type

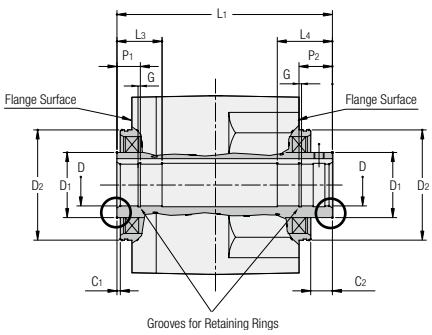


Dimension / Frame Size	Reduction Ratio	Power Class	D (H8)	D1	D2 (h7)	W	T	L1	L3	L4	P1	P2	C1	C2	F	G
12	1/3 to 1/10	100 W, 200 W	Ø12	Ø19	Ø50	4	13.8	91	20	23	8	14	2	10	2	1.15
15	1/3 to 1/10	200 W, 400 W	Ø15	Ø24	Ø60	5	17.3	106	21	25	9	16	2	10	2	1.15
	1/10 to 1/30	100 W						102								
18	1/3 to 1/10	400 W, 750 W	Ø18	Ø29	Ø70	6	20.8	119	23	27	12	17	2	13	2	1.15
	1/10 to 1/60	100 W, 200 W						113								
22	1/3 to 1/5	1000 W	Ø22	Ø34	Ø90	6	24.8	138	25	33	14	20	2	13	2	1.15
	1/7.5 to 1/10	750 W														
	1/10 to 1/60	200 W, 400 W						126								
28	1/3 to 1/5	2000 W	Ø28	Ø44	Ø110	8	31.3	161	30	37	16	22	2	13	2	1.35
	1/7.5 to 1/10	1000 W														
	1/10 to 1/60	400 W, 750 W						137.5								
	1/15 to 1/30	0.75 kW *														
32	1/3 to 1/5	3000 W	Ø32	Ø49	Ø120	10	35.3	161	35	43	18	27	2	13	2	1.35
	1/7.5 to 1/10	2000 W														
	1/10 to 1/30	1000 W						154								
	1/40 to 1/60	750 W														
		0.75 kW *														

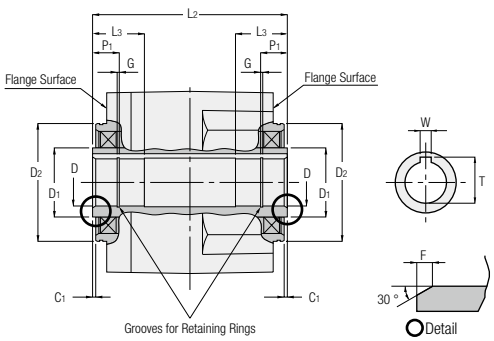
Note: The values marked with * are the values of a battery powered gearmotor.

■ AF3S Type

1 arc min and 3 arc min Specifications



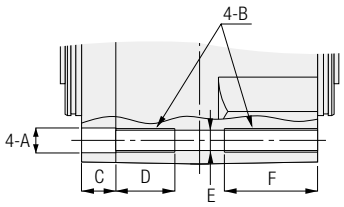
Low Backlash Specification



Frame Size	D (H8)	D1	D2 (h7)	W	T	L1	L2	L3	L4	P1	P2	C1	C2	F	G
20	Ø20	Ø29	Ø53	6	22.8	—	96	24	—	13	—	2	—	2	1.15
25	Ø25	Ø39	Ø66	8	28.3	129	118	27	33	14	20	2	13	2	1.35
30	Ø30	Ø44	Ø75	8	33.3	135	124	33	40	17	23	2	13	2	1.35
35	Ø35	Ø49	Ø85	10	38.3	153	142	38	47	20	26	2	13	2	1.75
45	Ø45	Ø64	Ø100	14	48.8	183	168	50	63	26	39	2	17	2	1.95

Note 1: Frame size 20 is available only for low backlash specifications.
Note 2: Frame size 15 is available only for 1 arc min and 3 arc min specifications. The shape of this frame size is different from shapes of the other frame sizes. Check it with the dimension diagram shown on page 766.

Detailed Diagram of Tapped Holes for Face Mount Installation



■ F3F/F3S Types

Frame Size	Power	Reduction Ratio	A	B	C	D	E	F
20 (18)	0.2 kW (Note 1)	1/5 to 1/30	Ø10.5	M10 × P1.5	12	25	Ø8.6	37
	0.1 kW	1/5 to 1/60	Ø10.5	M10 × P1.5	12	25	Ø8.6	37
25 (22)	0.4 kW (Note 1)	1/5 to 1/30	Ø10.5	M10 × P1.5	14.5	25	Ø8.6	39.5
	0.2 kW	1/5 to 1/60	Ø10.5	M10 × P1.5	14.5	25	Ø8.6	39.5
	0.1 kW	1/80 to 1/240	Ø10.5	M10 × P1.5	14.5	25	Ø8.6	39.5
30 (28)	0.75 kW (Note 1)	1/5 to 1/30	Ø10.5	M10 × P1.5	15.5	25	Ø8.6	40.5
	0.4 kW	1/5 to 1/60	Ø10.5	M10 × P1.5	15.5	25	Ø8.6	40.5
	0.2 kW	1/80 to 1/240	Ø12.5	M12 × P1.75	15.5	30	Ø10.6	45.5
35 (32)	1.5 kW (Note 1)	1/5 to 1/30	Ø12.5	M12 × P1.75	18	30	Ø10.6	48
	0.75 kW	1/5 to 1/60	Ø12.5	M12 × P1.75	18	30	Ø10.6	48
	0.4 kW	1/50 to 1/240	Ø16.5	M16 × P2	18	40	Ø14	58
45 (40)	2.2 kW	1/5 to 1/30	Ø16.5	M16 × P2	23	40	Ø14	63
	1.5 kW	1/5 to 1/60	Ø16.5	M16 × P2	23	40	Ø14	63
	0.75 kW	1/80 to 1/240	Ø20.5	M20 × P2.5	23	50	Ø17.5	73

Note 1: The powers are available only for induction gearmotors.
Note 2: The values in parenthesis in Frame Size are for the F3F (concentric right angle shaft).
Note 3: For the required engagement allowance for bolts, we recommend a value twice the nominal size of the screw (bolt diameter). (Example: For an M10 bolt, an engagement allowance of 20 mm or more is recommended.)

■ VF3F/VF3S Types

Frame Size	Power	Reduction Ratio	A	B	C	D	E	F
15 (18)	0.1 kW	1/10 to 1/160	Ø10.5	M10 × P1.5	13	25	Ø8.6	38
25 (22)	0.2 kW	1/10 to 1/60	Ø10.5	M10 × P1.5	14.5	25	Ø8.6	39.5
30 (28)	0.4 kW	1/10 to 1/60	Ø10.5	M10 × P1.5	15.5	25	Ø8.6	40.5
	0.2 kW	1/80 to 1/240	Ø12.5	M12 × P1.75	15.5	30	Ø10.6	45.5
35 (32)	0.4 kW	1/80 to 1/240	Ø16.5	M16 × P2	18	40	Ø14	58

Note 1: The values in parenthesis in Frame Size are for the VF3F (concentric right angle shaft).
Note 2: For the required engagement allowance for bolts, we recommend a value twice the nominal size of the screw (bolt diameter). (Example: For an M10 bolt, an engagement allowance of 20 mm or more is recommended.)

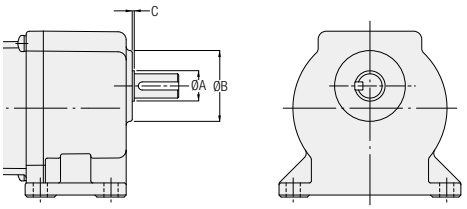
■ AF3F/AF3S Types

Frame Size	Power Class	Reduction Ratio	A	B	C	D	E	F
15 (18) (Note 1)	100 W	10 to 1/120	Ø10.5	M10 × P1.5	13	25	Ø8.6	38
20 (18) (Note 2)	100 W	1/5 to 1/60	Ø10.5	M10 × P1.5	12	25	Ø8.6	37
25 (22)	200 W	1/5 to 1/60	Ø10.5	M10 × P1.5	14.5	25	Ø8.6	39.5
	100 W	1/75 to 1/240	Ø10.5	M10 × P1.5	14.5	25	Ø8.6	39.5
30 (28)	400 W	1/5 to 1/60	Ø10.5	M10 × P1.5	15.5	25	Ø8.6	40.5
	200 W	1/75 to 1/240	Ø12.5	M12 × P1.75	15.5	30	Ø10.6	45.5
35 (32)	750 W	1/5 to 1/60	Ø12.5	M12 × P1.75	18	30	Ø10.6	48
	1000 W	1/5 to 1/60	Ø12.5	M12 × P1.75	18	30	Ø10.6	48
	400 W	1/75 to /240	Ø16.5	M16 × P2	18	40	Ø14	58
45 (40)	2000 W	1/5 to 1/60	Ø16.5	M16 × P2	23	40	Ø14	63
	750 W	1/75 to 1/240	Ø20.5	M20 × P2.5	23	50	Ø17.5	73

Note 1: The frame size is available only for backlash 1 arc min/3 arc min specifications
Note 2: The frame size is available only for low backlash specifications.
Note 3: The values in parenthesis in Frame Size are for the AF3F (concentric right angle shaft).
Note 4: For the required engagement allowance for bolts, we recommend a value twice the nominal size of the screw (bolt diameter). (Example: For an M10 bolt, an engagement allowance of 20 mm or more is recommended.)

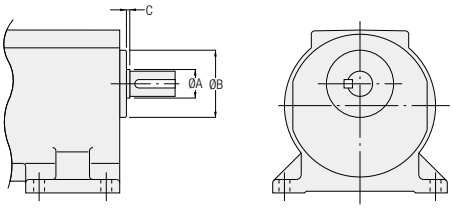
Output Shaft Peripheral Dimensions

■ VGL (50 W, frame sizes 12 to 15) Type



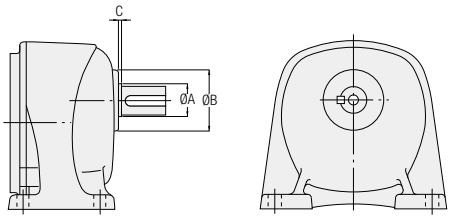
Dimension / Frame Size	A	B	C
12	15	35	1
15	17	40	1

■ VGL (0.1 kW, frame size 15) Type



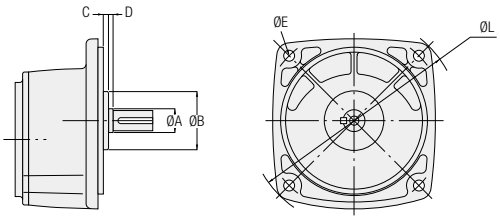
Dimension / Frame Size	A	B	C
15	17	40	2

■ G3L/VGL (frame sizes 18 to 32)/AG3L Types



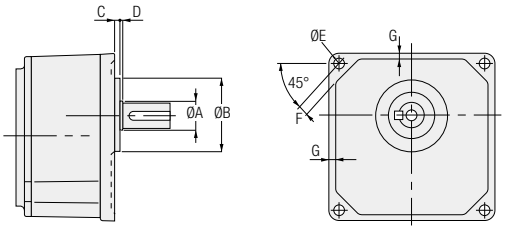
Dimension / Frame Size	A	B	C
18	20	43	2
22	24	50	2
28	30	60	2
32	34	68	3
40	42	90	3
50	53	105	3

■ G3F/AG3F Types



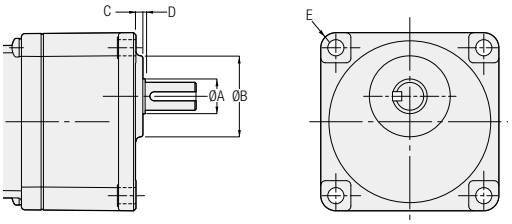
Dimension / Frame Size	A	B	C	D	E	L
18	20	50	0	2	R14	198
22	24	60	+1	2	R12.5	214
28	30	80	-1	2	R12.5	214
32	34	88	-2	3	R15	282
40	42	100	-2	3	R19	350
50	53	120	0	3	R20	412

■ G3K/VGK/AG3K Types



Dimension / Frame Size	A	B	C	D	E	F	G
18	20	50h7	4	2	R9	9	5
22	24	60h7	5	2	R9	9	5
28	30	80h7	5	2	R11	11	7
32	34	88h7	5	3	R13	13	8

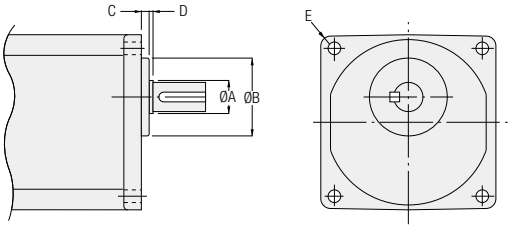
■ VGK (50 W, frame sizes 12 to 15) Type



Dimension / Frame Size	A	B	C	D	E
12	15	35	3	1	R6.5
15	17	40	3	1	R7.5

Note 1: Dimension B indicates area with remaining casting surface, and so please add 0.5 mm or more to dimension B for the diameter of the mating hole.

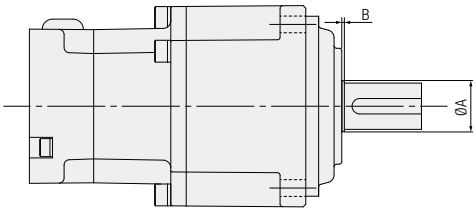
■ VGK (0.1 kW, frame size 15) Type



Dimension / Frame Size	A	B	C	D	E
15	17	40	4	2	R5

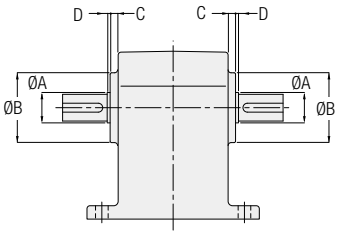
Note 1: Dimension B indicates area with remaining casting surface, and so please add 0.5 mm or more to dimension B for the diameter of the mating hole.

■ APG Type



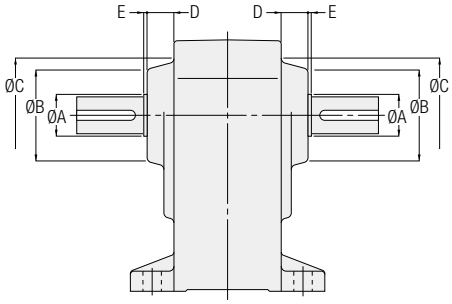
Dimension / Frame Size	A	tolerances	B
12	14	0 -0.027	1
18	20	0 -0.033	1
22	29	0 -0.033	1
28	34	0 -0.039	2.5

■ VHL (frame size 18) Type



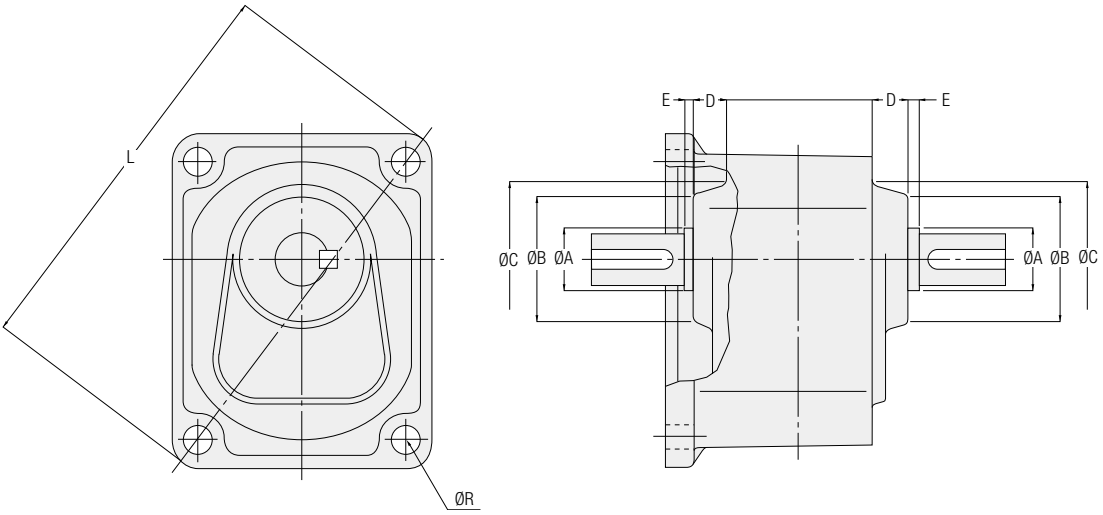
Frame Size \ Dimension	A	B	C	D
18	20	47	5	2

■ H2L/VHL (frame sizes 22 to 32)/AH2L Types



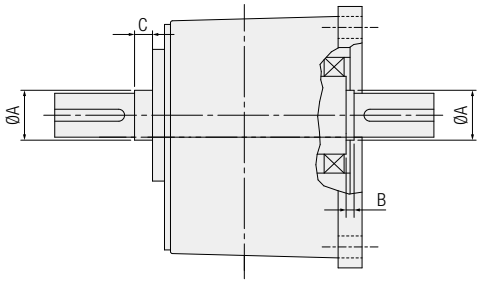
Frame Size \ Dimension	A	B	C	D	E
22	25	55	63.5	16	2
28	30	67	76	16	2
32	35	78	88	17	3
40	45	92	104	21	2
50	55	110	122	22	3

■ H2F Type



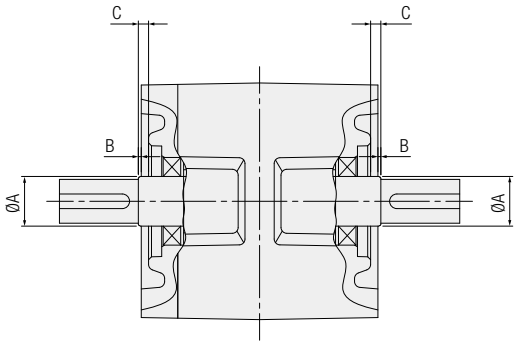
Frame Size \ Dimension	A	B	C	D	E	R	L
22	25	55	63.5	16	2	11	174

■ FF Type



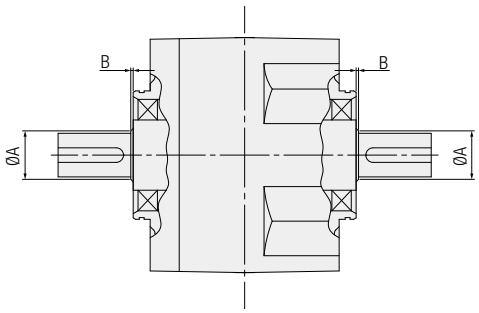
Dimension / Frame Size	ØA	B	C
22	25	3	9
28	30	3	13
32	35	3	18
40	45	3	22

■ F2F Type



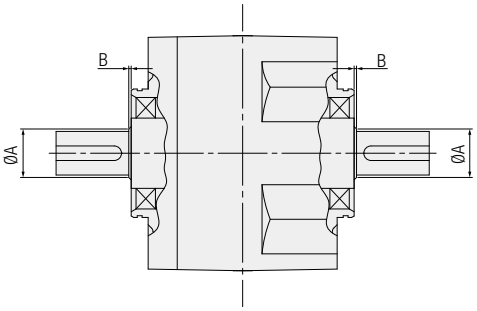
Dimension / Frame Size	A	tolerances	B	C
15	17	-0.022 -0.033	1	3.5
18	20	-0.024 -0.037	1	2

■ F3F Type



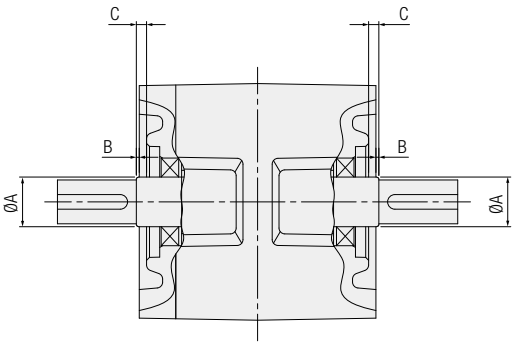
Dimension / Frame Size	A	B
18	20	1
22	24	1
28	30	1
32	35	1
40	42	1

■ VF3F (frame size 22/28/32) Type



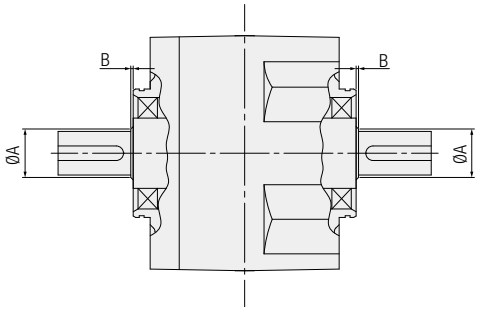
Dimension / Frame Size	A	B
22	24	1
28	30	1
32	35	1

■ VF3F (frame size 18) Type



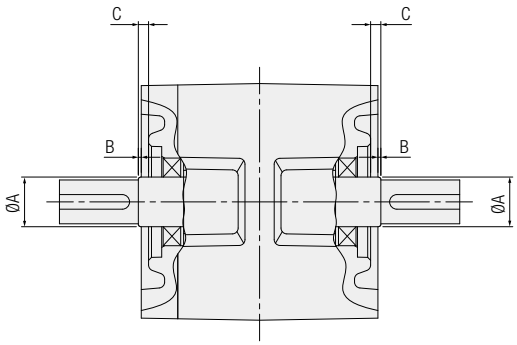
Dimension / Frame Size	A	tolerances	B	C
18	20	-0.024 -0.037	1	2

■ AF3F (frame size 22/28/32/40) Type



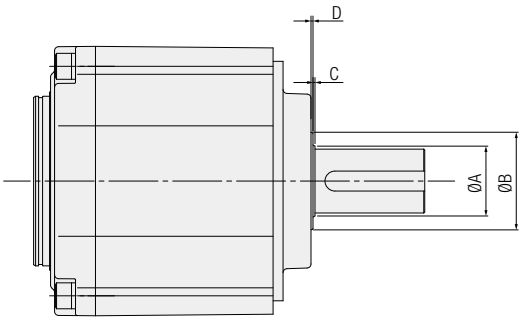
Dimension / Frame Size	A	B
22	24	1
28	30	1
32	35	1
40	42	1

■ AF3F (frame size 18) Type



Dimension / Frame Size	A	tolerances	B	C
18	20	No	1	2

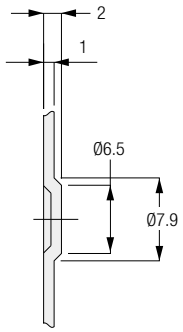
■ AFC Type



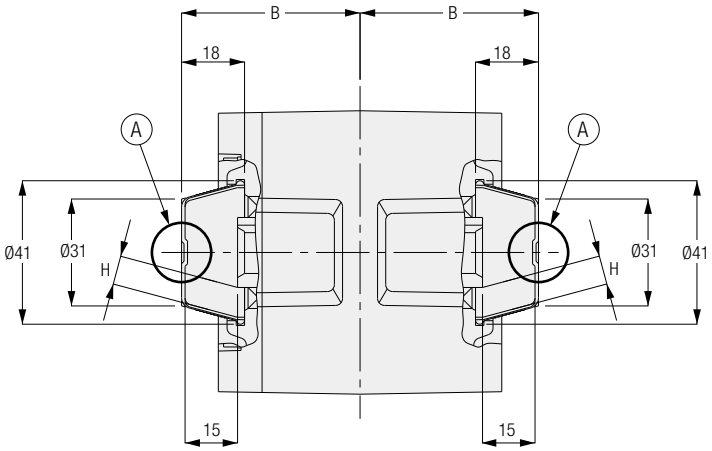
Dimension / Frame Size	ØA	ØB	tolerances	C	D
12	14	19	-0.02 -0.04	(1)	1
15	17	24	-0.02 -0.04	(1)	1
18	20	29	-0.02 -0.04	(1)	1
22	24	34	-0.02 -0.04	(1)	1
28	30	44	-0.02 -0.04	(1)	1
32	35	49	-0.02 -0.04	(1)	1

Concentric Right Angle Hollow Bore Safety Cap Detailed Dimensions

F2S Type



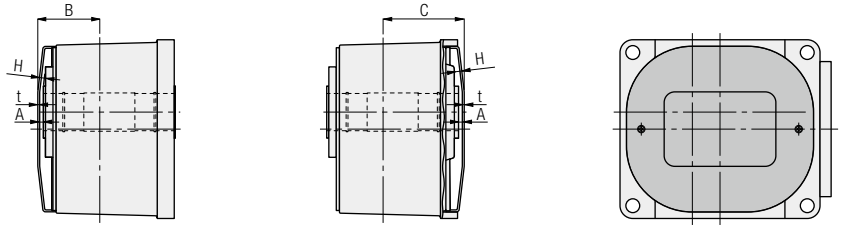
Ⓐ Detailed Diagram



Frame Size	B	H
12	51	8.2
15	60	6.3

Right Angle Hollow Bore Safety Cover Detailed Dimensions

■ FS Type

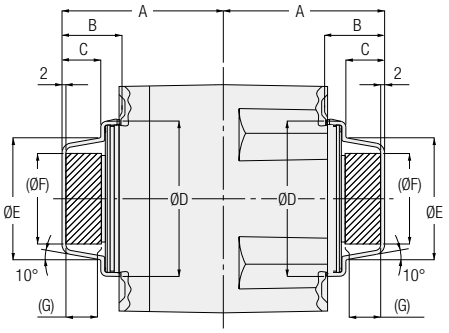


When attached to the R face

When attached to the L face

Frame Size	A Gap between shaft and cover	B When attached to the R face	C When attached to the L face	H	t
25	1.2	51	63	0.61	1.8
30	1.2	54	69	0.74	1.8
35	1.2	56	74	0.54	1.8
45	1.2	62	84	0.39	1.8
55	3.0	87	104	2.07	2.0

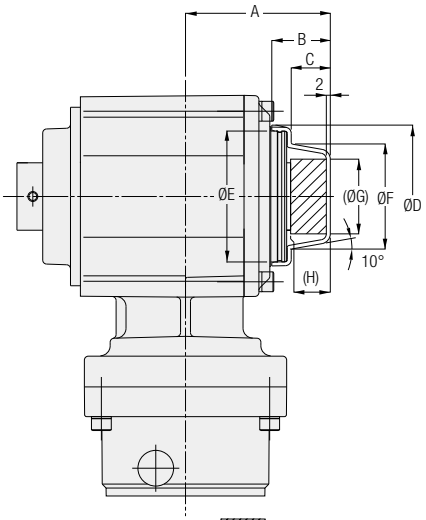
■ F3S Type/VF3S Type



The areas in shading are empty spaces.

Frame Size	A	B	C	D	E	F	G
20	64	25.5	15.7	57	40	26	14
25	79	29.5	19.7	70	53	37.5	18
30	82	29.5	19.7	79	62	46.5	18
35	95	33.5	23.7	89	72	55	22
45	108	33.5	23.7	104	87	70	22

■ AFC Type



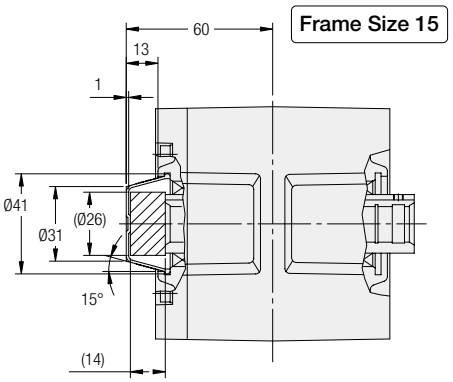
The areas in shading are empty spaces.

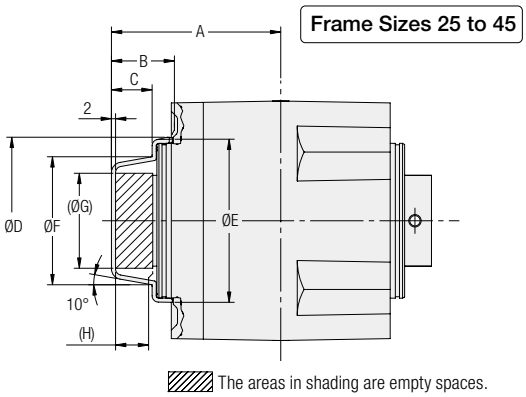
Dimension / Frame Size	Reduction Ratio	Power Class	A	B	C	D	E	F	G	H
12	1/3 to 1/10	100 W, 200 W	54	25.5	15.7	52	50	37	23	14
15	1/3 to 1/10	200 W, 400 W	56	25.5	15.7	52	50	37	23	14
	1/10 to 1/30	100 W	60							
18	1/3 to 1/10	400 W, 750 W	61	25.5	15.7	59	57	40	26	14
	1/10 to 1/60	100 W, 200 W	65							
22	1/3 to 1/5	1000 W	73	29.5	19.7	72	70	53	37.5	18
	1/7.5 to 1/10	750 W								
	1/10 to 1/60	200 W, 400 W	76							
28	1/3 to 1/5	2000 W	82	29.5	19.7	81	79	62	46.5	18
	1/7.5 to 1/10	1000 W								
	1/10 to 1/60	400 W, 750 W	80.5							
	1/15 to 1/30	0.75 kW *								
32	1/3 to 1/5	3000 W	86	33.5	23.7	91	89	72	55	22
	1/7.5 to 1/10	2000 W								
	1/10 to 1/30	1000 W	93							
	1/40 to 1/60	750 W								
		0.75 kW *								

Note: The values marked with * are the values of a battery powered gearmotor.

■ AF3S Type

● 1 arc min and 3 arc min Specifications

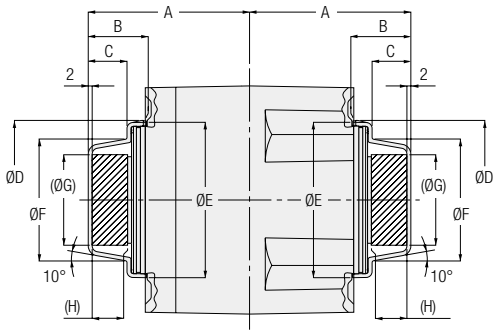




The areas in shading are empty spaces.

Frame Size	A	B	C	D	E	F	G	H
25	79	29.5	19.7	72	70	53	37.5	18
30	82	19.5	19.7	81	79	62	46.5	18
35	95	33.5	23.7	91	89	72	55	22
45	108	33.5	23.7	106	104	87	70	22

● Low Backlash Specification



The areas in shading are empty spaces.

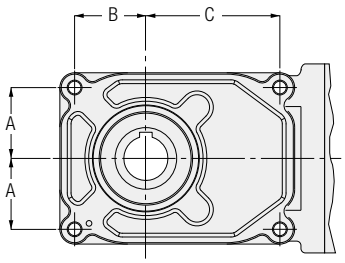
Frame Size	A	B	C	D	E	F	G	H
20	64	25.5	15.7	59	57	40	26	14
25	79	29.5	19.7	72	70	53	37.5	18
30	82	19.5	19.7	81	79	62	46.5	18
35	95	33.5	23.7	91	89	72	55	22
45	108	33.5	23.7	106	104	87	70	22

Frame Sizes for Concentric Right Angle Hollow Bore/Concentric Right Angle Shaft

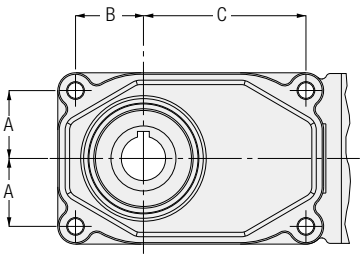
Concentric right angle hollow bore types and concentric right angle shaft types are available in two shapes with the same frame size. Please note that the shape differs depending on the reduction ratio even if the frame size is the same. In addition, concentric right angle hollow bore types and concentric right angle shaft types are provided with tapped mounting holes (standard specification) for flange mount on both sides and face mount.

■ Shape

<Figure 1>



<Figure 2>



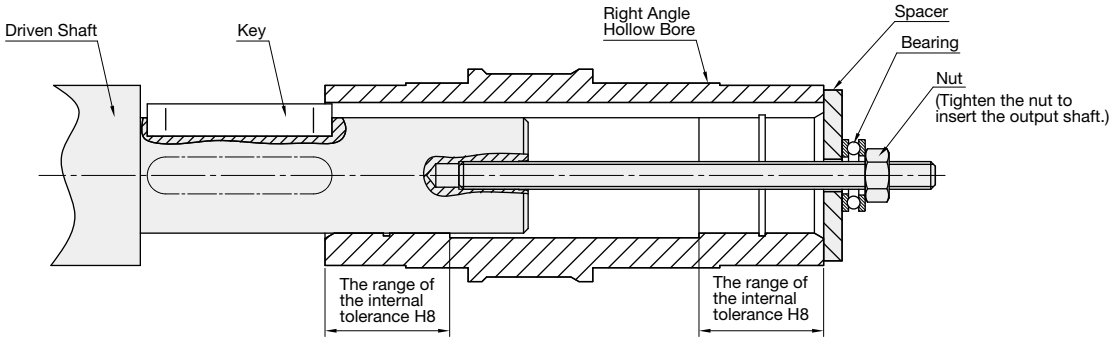
Frame Size	Reduction Ratio	Power	Shape	A	B	C
20(18)	1/5 to 1/60	0.1 kW	1	38.5	38.5	68.5
25(22)	1/5 to 1/60	0.2 kW	1	43.5	43.5	76.5
	1/80 to 1/240	0.1 kW	2	43.5	43.5	95.5
30(28)	1/5 to 1/60	0.4 kW	1	48	48	91
	1/80 to 1/240	0.2 kW	2	46	46	110
35(32)	1/5 to 1/60	0.75 kW	1	56	56	105
	1/80 to 1/240	0.4 kW	2	54	54	140
45(40)	1/5 to 1/60	1.5 kW	1	73	73	134
	1/5 to 1/30	2.2 kW				
	1/80 to 1/240	0.75 kW	2	69	69	167

Note 1: The values in parenthesis in Frame Size are for concentric right angle shaft types.

FS/F2S/F3S Types/AF3S Type/VF3S Type/AFC Type

Installing the Right Angle Hollow Bore of the Reducer to the Driven Shaft

- Apply an anti-seize agent (molybdenum disulfide etc.) suitable for the environment of use to the surface of the driven shaft and the internal diameter of the right angle hollow bore, and insert the reducer into the driven shaft.
- When no shock is imposed under a uniform load, the recommended tolerance for the driven shaft is h7. In addition, if a shock load is imposed or a radial load is high, tighten the fit. The internal diameter of the right angle hollow bore is designed to have a tolerance of H8.
- If the fit is tight, insert the right angle hollow bore output shaft by tapping its end face with a plastic hammer. In this case, be sure not to hit the casing. In addition, if you make a jig as shown in the diagram below, you can insert the shaft more smoothly.

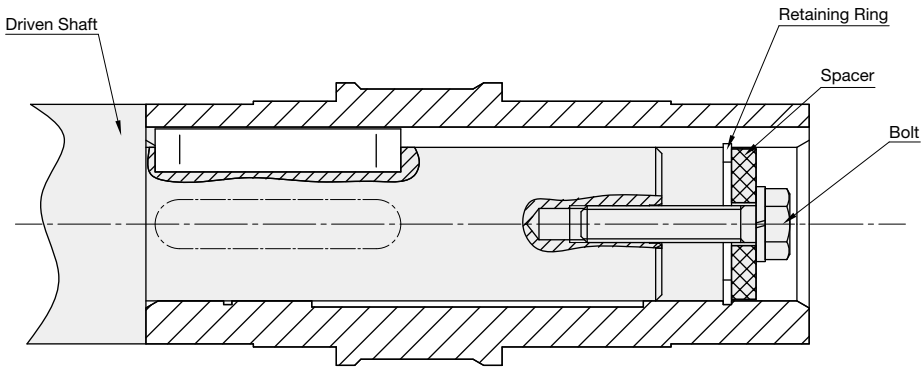


(Please prepare a spacer, a nut, a bolt, a key material, and a bearing yourself.)

- It is recommended to arrange the length of the driven shaft and the detent key to reach the range of the internal diameter tolerance H_8 on the fixing side.
  (The dimension of the range of the internal tolerance H8 corresponds to L_1 in “Output Shaft Detailed Dimensions” on pages 870 to 873.)
- It is recommended to adjust the axial runout of the driven shaft to 0.05 mm or less at the end of the shaft. If the axial runout increases during operation, it may adversely affect the reducer.

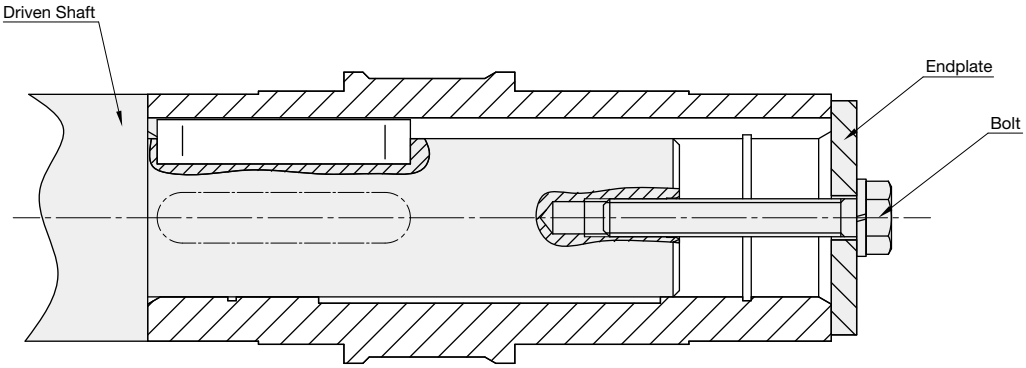
Connecting the Reducer to the Driven Shaft

● When the driven shaft is provided with a step



Fixation Using a Spacer and a Retaining Ring
(Please prepare a spacer, a bolt, and a retaining ring yourself.)

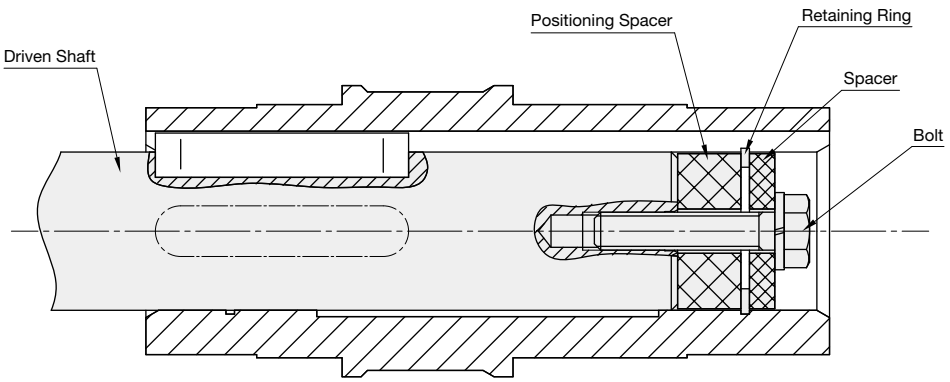
Note 1: Please note that the retaining ring may deform if the bolt is tightened excessively.



Fixation Using an Endplate
(Please prepare endplates and bolts yourself.)

Note 1: Please note that the resin cover attached to the F Type as an accessory cannot be mounted.
You are also requested to mount a protective cover to protect personnel from getting caught/entangled to the output shaft.

● When the driven shaft is not provided with a step

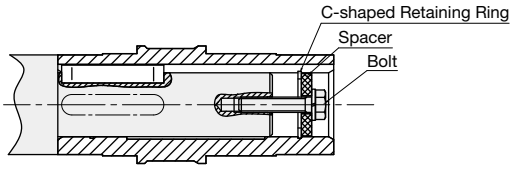


Fixation Using a Spacer and a Retaining Ring
(Please prepare a spacer, a positioning spacer, a bolt, and a retaining ring yourself.)

Note 1: Be sure to allow a gap between the outer diameter of the spacer and the internal diameter of the right angle hollow bore. If the fit is tight or the outer diameter of the spacer is inaccurate, the axial runout of the driven shaft and right angle hollow bore may increase.
Use a positioning spacer to position the reducer. It is not required if the length of the driven shaft is secured in advance. In addition, attaching a positioning spacer enables you to smoothly remove the shaft from the right angle hollow bore. (For removal from the right angle hollow bore, refer to [Figure-1] on page 887.)

Recommended Sizes for the Fixing Elements of the Driven Shaft

Design the tightening of right angle hollow bore types for general purposes by referring to the dimensions shown in the right table to ensure strength.

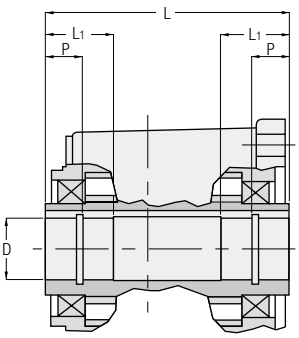


● Recommended Sizes for the Fixing Elements of the Driven Shaft

Category / Frame Size	Bolt Size	Spacer Dimensions			C-shaped Retaining Ring for Hole
		Outer Diameter	Internal Diameter	Width	
F2S-12 AFCZ12S	M5	Ø11.5	Ø6	3	12
F2S-15 AFCZ15S	M6	Ø14.5	Ø7	3	15
AFCZ18S	M6	Ø17.5	Ø7	3	18
F3S-20 AF3S20	M6	Ø19.5	Ø7	3	20
AFCZ22S	M6	Ø21.5	Ø7	4	22
FS-25 F3S-25 AF3S25	M6	Ø24.5	Ø7	4	25
AFCZ28S	M8	Ø27.5	Ø9	5	28
FS-30 F3S-30 AF3S30	M8	Ø29.5	Ø9	5	30
AFCZ32S	M10	Ø31.5	Ø11	5	32
FS-35 F3S-35 AF3S35	M10	Ø34.5	Ø11	5	35
FS-45 F3S-45 AF3S45	M10	Ø44.5	Ø11	5	45
FS-55	M12	Ø54.5	Ø13	6	55

Driven Shaft Length

Arrange the driven shaft to reach both ends of the L_1 area. (Refer to the figure on the right)
However, allow for some margin for the spacer dimensions required for the following (removal from the right angle hollow bore)

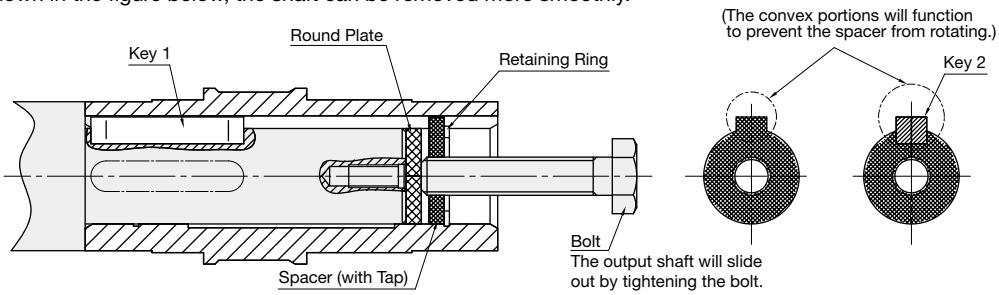


Regarding the Driven Shaft Key Length

Set the length of the key at least 1.5 times the hole diameter of the right angle hollow bore.
In addition, adjust the key insertion position so that at least 1/2 of the overall length of the key is engaged with L_1. It is not necessary to apply on both sides of the two L_1 places. (Refer to the figure on the right)

Shaft Removal from the Right Angle Hollow Bore

Take care not to impose unnecessary force between the casing and the right angle hollow bore. If you make and use a jig as shown in the figure below, the shaft can be removed more smoothly.



[Figure-1] (Please prepare a spacer, a round plate, a bolt, a retaining ring, and a key yourself.)

How to Mount a Reducer

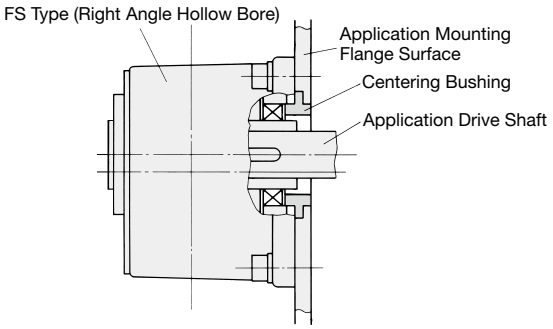
Advantages and disadvantages of flange mount and torque arm mount

	Advantage	Disadvantage
Flange Mount	- The reducer can be installed directly on the machine. - The reducer requires less space.	- Centering with the application is required. - Four tapped holes for mounting are required for the application (F Type).
Torque Arm Mount	- Centering with the application is easy. - Only one detent is required for fixation with the application.	- A torque arm is required. - Space for mounting a torque arm is required.

Flange Mount

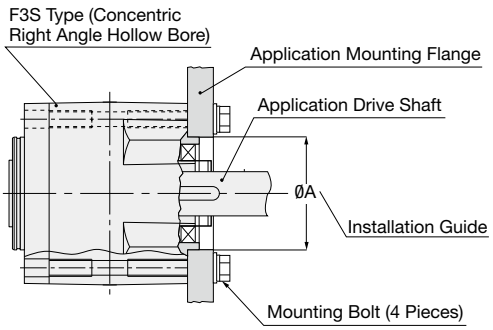
■ FS Type

When the reducer is mounted directly on the flange surface of the mating machine, motor burn-out, bearing damage, etc. may occur if the reducer is misaligned. To prevent such problems, be sure to perform centering. Using a centering bushing as shown in the figure on the right enables you to easily perform centering. (Please prepare a centering bushing yourself.)



■F3S Type/VF3S Type/AF3S Type

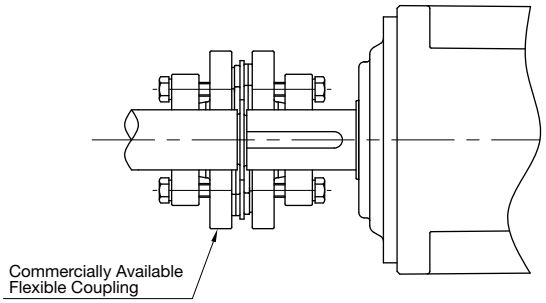
When the reducer is mounted directly on the flange surface of the mating machine, motor burn-out, bearing damage, etc. may occur if the reducer is misaligned. To prevent such problems, be sure to perform centering. An installation guide as shown in the figure on the right is provided.
The dimension tolerance for ØA for the installation guide is h7.
Fasten mounting bolts as shown in the figure on the right. Use four bolts.



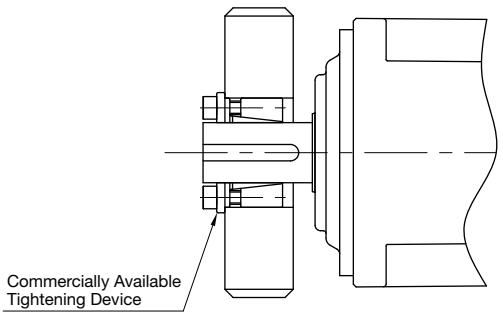
APG Type

Tightening Example

● Items to be attached to shafts
(tightening with a ball screw etc.)

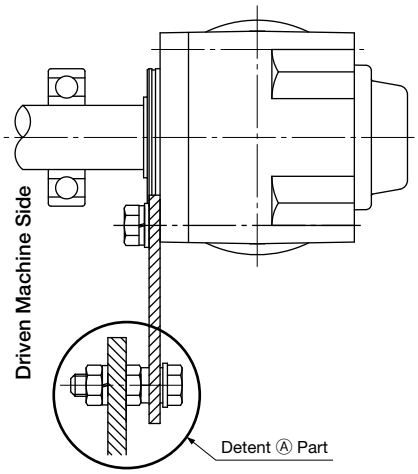


● Items to be attached into holes
(tightening with a pulley etc.)



Torque Arm

Fixing the Reducer and the Torque Arm



- Install the torque arm detent on the driven machine side.
- Since the torque arm sustains reactive force from rotation, use a thick plate or bolt having sufficient strength with particular consideration given to shock loads during startup and braking.
  You can also order an optional torque arms from us.
  Refer to page 894.
- To install the torque arm and the reducer, fix them using mounting bolts with a spring washer and a flat washer.
  For tightening torques, refer to the table shown below.

● Bolt sizes and tightening torques

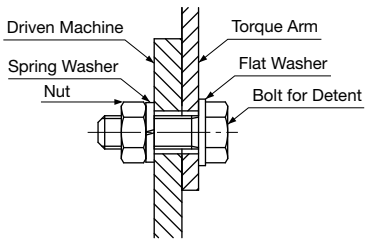
(reference values)

Bolt Size	Tightening Torque N·m
M5	2.9
M6	4.9
M8	13
M10	25
M12	44
M14	69
M16	108
M20	294

■ Installation Example of Detent Ⓐ

● For CW/CCW rotation operation and unidirectional operation (intermittent)

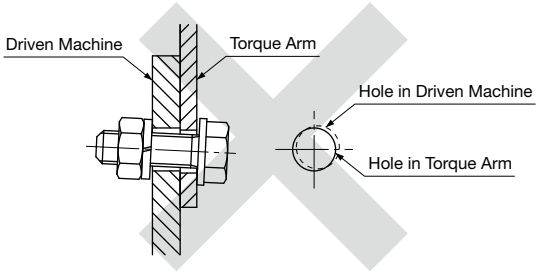
Securely fix the torque arm so that it does not become loose. In this step, confirm that no radial load (suspension load) is imposed on the driven shaft and the entire right angle hollow bore of the reducer due to misalignment between the hole of the detent and the driven machine. [Figure-1]



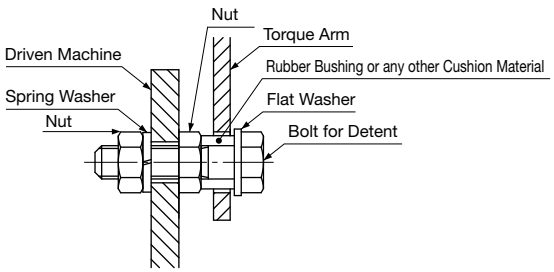
[Figure-1]

Note 1: If the detent is loose, a shock may be applied to the torque arm upon each startup and cause a failure such as bolt looseness.
If it is impossible to install the detent without looseness for some unavoidable reason, use a rubber bushing or another cushion material between the torque arm and the detent bolt to protect the bolt.
In addition, use a bolt that has sufficient strength. [Figure-2]

<Bad Example>



Excessive force will be applied to the driven shaft and the right angle hollow bore and result in defects.



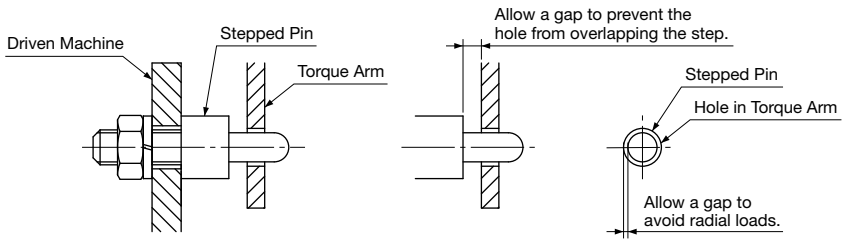
[Figure-2]

● Unidirectional Operation (Continuous)

In unidirectional operation (continuous) that does not frequently impose startup torque, the torque arm can be used with the detent in a free state.

However, the driven shaft and the right angle hollow bore need to be fixed. Refer to pages 885 and 886.

In this case, it is necessary to secure sufficient clearance for looseness in both radial and thrust directions for alignment between the driven machine and the torque arm detent. [Figure-1]



[Figure-1]
Installation Example Using a Stepped Pin

Torque Arm Design

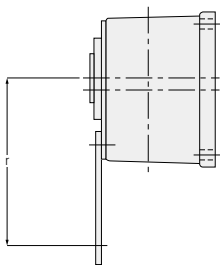
You can order optional torque arms from us, but if you manufacture a torque arm yourself, keep in mind the points described below. For optional torque arms, refer to page 894.

● When using a torque arm as shown in [Figure-2]

Set the distance r from the center of the output shaft to the detent to

SI Units

$$r\ (mm) \geq \frac{\text{Actual load torque (N·m)} \times 1000}{\text{Allowable O.H.L. (N)} - 9.8 \times \text{Gearmotors (kg)}}$$



[Figure-2]

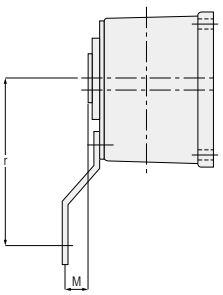
Note 2: For the plate thickness of the torque arm, refer to page 894.

● When using a torque arm as shown in [Figure-3]

Set the distance r from the center of the output shaft to the detent to

SI Units

$$r\ (mm) \geq \frac{\text{Actual load torque (N·m)} \times (A + M) \times 1000}{\{\text{Allowable O.H.L. (N)} - 9.8 \times \text{Gearmotors (kg)}\} \times (A + 20)}$$



[Figure-3]

■ Constant A

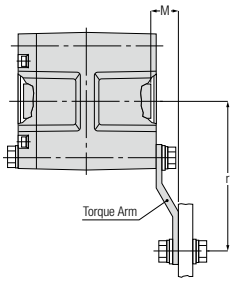
Frame Size	A (mm)
20	68.5
25	84.5
30	91
35	98
45	113
55	150

● In case of using the torque arm as shown in [Figure-4]

the distance r from the center of the output shaft to the detent can be calculated with the following formulas:

SI Units

$$r\ (mm) \geq \frac{\text{Actual load torque (N·m)} \times (A + M) \times 1000}{\{\text{Allowable O.H.L. (N)} - 9.8 \times \text{Gearmotors Weight (kg)}\} \times (A + 10)}$$



[Figure-4]

■ Constant A

Frame Size	A (mm)
12	43
15	55

MEMO