Technical Documentation

HIGH PRECISION REDUCERS FOR SERVO MOTORS

Servo Motor Assembly Procedure

APG Type

Step 1. Turn the input shaft and align the clamping bolt head to the wrench hole for clamping bolt.

Step 2. Wipe with rust-preventive agent, oil, etc. off the internal surface of the input shaft and the output shaft of the servo motor.

Step 3. Insert the servo motor shaft.

When a bushing is provided, align the position of the slit of the bushing with that of the input tightening portion as shown in [Figure-1].

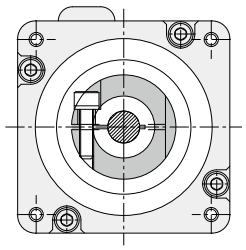
Additionally, when a key groove is provided, align the position of the slit of the bushing with the key groove as shown in [Figure-2].

* When using an IP65 reducer, insert a sheet gasket between the input flange and the servo motor before inserting the servo motor into the reducer body.

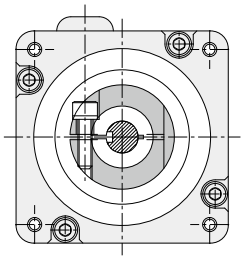
Step 4. Tighten the servo motor and the flange portion of the reducer using the flange clamping bolts.

Step 5. Tighten the clamping bolt of the input shaft to the specified torque.

Step 6. Mount the rubber cap (accessory) to the wrench hole.



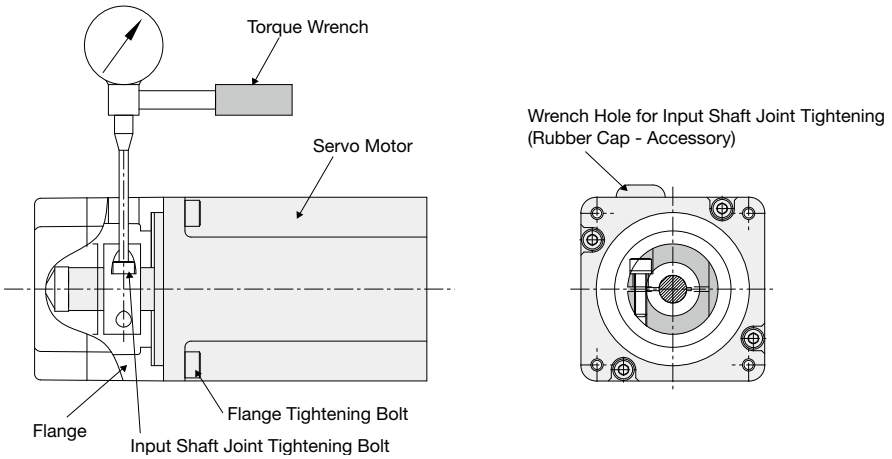
[Figure-1] Without a key groove



[Figure-2] With a key groove

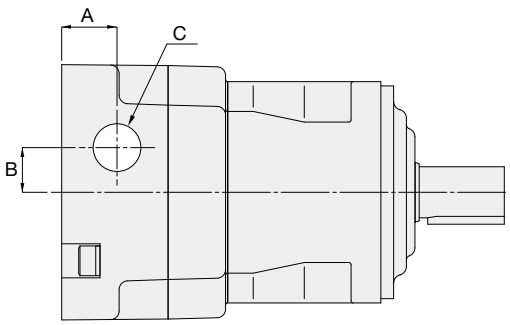
■ Tightening Torques for Input Shaft Joint Tightening Bolts

Power Class	100 W	200 W	400 W	750 W	1000 W	1500 W	2000 W	3000 W
Tightening Torque (N·m)	5.1	5.1	5.1	9	35	35	35	35
Tightening Bolt Size	M4	M4	M4	M5	M8	M8	M8	M8



Note 1: Do not tighten the tightening bolt with no shaft applicable to the flange type inserted in the input shaft joint.

■ Detailed Diagram of Wrench Hole for Input Shaft Joint Tightening

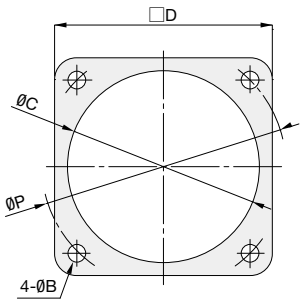


Power Class		Dimension A	Dimension B	Dimension C
100 W		13	9	Ø10
200 W		13	10.5	Ø10
400 W		13	10.5	Ø10
750 W		14.5	15	Ø10
1000 W		20	20	Ø11.5
1500 W	Flange Type Code K1*, K2*	20	20	Ø11.5
	Flange Type Code K3*	25	20	Ø11.5
2000 W	Flange Type Code K1*, K2*	20	20	Ø11.5
	Flange Type Code K3*	25	20	Ø11.5
3000 W	Flange Type Code K1*, K2*	20	20	Ø11.5
	Flange Type Code K3*	25	20	Ø11.5

Note 1: For flange type codes, please refer to the Motor Matching / Motor Power Design Lists on pages 674 to 677.

■ IP65 Specification Servo Motor Assembly Procedure

When using an IP65 reducer, insert a sheet gasket between the input flange and the servo motor before inserting the servo motor into the reducer body.



●Dimensions of Sheet gasket for Input Flange Area

Sheet Gasket	ØDimension B	ØDimension C	□ Dimension D	ØDimension P
□40	Ø4.5	Ø30.5	□40	Ø46
□60	Ø5.5	Ø50.5	□60	Ø70
□80	Ø6.5	Ø70.5	□80	Ø90
□100	Ø9	Ø95.5	□100	Ø115
□130	Ø9	Ø110.5	□130	Ø145

AFC Type

Step 1. Turn the input shaft and align the clamping bolt head to the wrench hole for clamping bolt.

Step 2. Wipe with rust-preventive agent, oil, etc. off the internal surface of the input shaft and the output shaft of the servo motor.

Step 3. Insert the servo motor shaft.

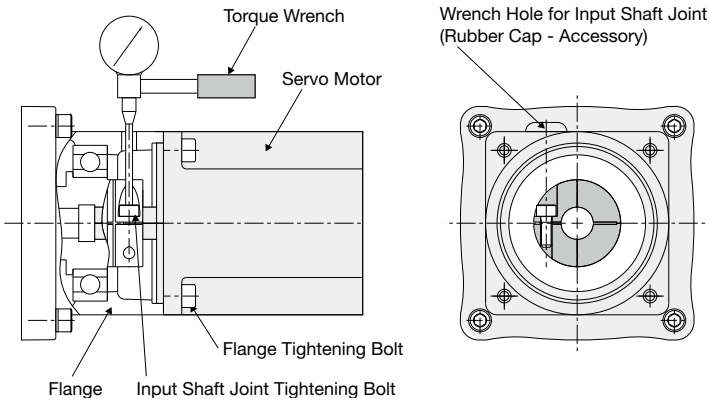
Step 4. Tighten the servo motor and the flange portion of the reducer using the flange clamping bolts.

Step 5. Tighten the clamping bolt of the input shaft to the specified torque.

Step 6. Mount the rubber cap (accessory) to the wrench hole.

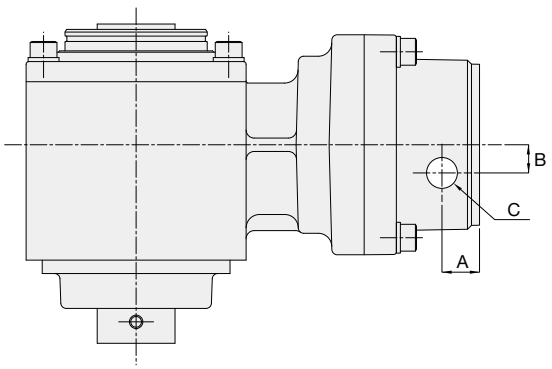
■ Tightening Torques for Input Shaft Joint Tightening Bolts

Power Class	100 W	200 W	400 W	750 W	1000 W	2000 W	3000 W
Tightening Torque (N·m)	5.1	5.1	5.1	9	35	35	35
Tightening Bolt Size	M4	M4	M4	M5	M8	M8	M8



Note 1: Do not tighten the tightening bolt with no shaft applicable to the flange type inserted in the input shaft joint.

■ Detailed Diagram of Wrench Hole for Input Shaft Joint Tightening



Power Class		Dimension A	Dimension B	Dimension C
100 W		12	8	Ø11.5
200 W		14	10.5	Ø11.5
400 W		14	10.5	Ø11.5
750 W		14	15	Ø11.5
1000 W		18.5	20	Ø11.5
2000 W	Flange Type Code Other than K75	18.5	20	Ø11.5
	Flange Type Code K75	18.5	24.5	Ø11.5
3000 W	Flange Type Code Other than K75	18.5	20	Ø11.5
	Flange Type Code K75	18.5	24.5	Ø11.5

* For the position of the wrench hole for input shaft joint tightening, refer to page 840.

Note 1: For flange type codes, please refer to the Motor Matching / Motor Power Design Lists on pages 678 to 681.

AG3/AH2/AF3 Types

Step 1. Turn the input shaft and align the clamping bolt head to the wrench hole for clamping bolt.

Step 2. Wipe with rust-preventive agent, oil, etc. off the internal surface of the input shaft and the output shaft of the servo motor.

Step 3. Insert the servo motor shaft.

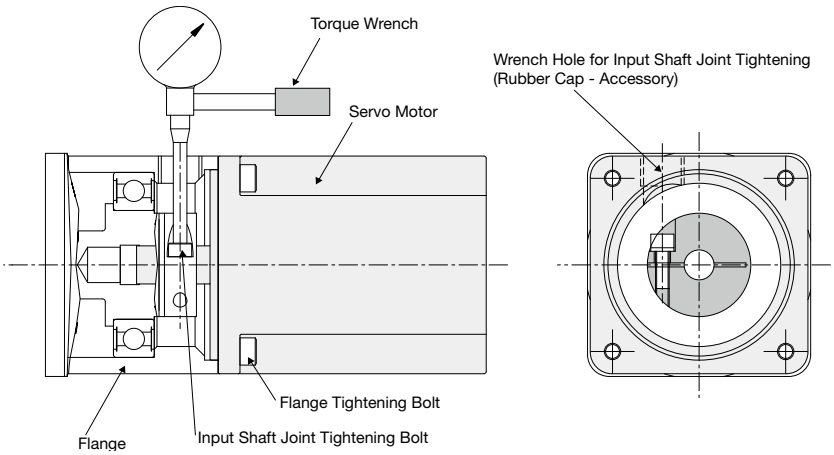
Step 4. Tighten the servo motor and the flange portion of the reducer using the flange clamping bolts.

Step 5. Tighten the clamping bolt of the input shaft to the specified torque.

Step 6. Mount the cap screw (accessory) to the wrench hole.

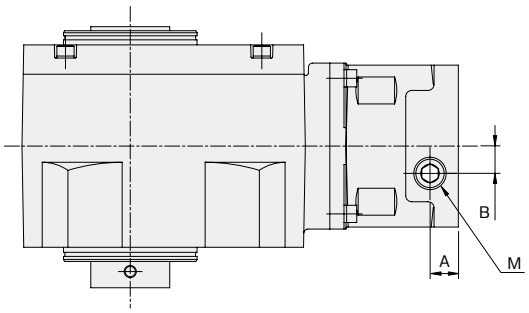
■ Tightening Torques for Input Shaft Joint Tightening Bolts

Power Class	100 W	200 W	400 W	750 W	1000 W	2000 W
Tightening Torque (N·m)	8.33	8.33	8.33	12.74	29.40	29.40
Tightening Bolt Size	M5	M5	M5	M6	M8	M8



Note 1: Do not tighten the tightening bolt with no shaft applicable to the flange type inserted in the input shaft joint.

■ Detailed Diagram of Wrench Hole for Input Shaft Joint Tightening



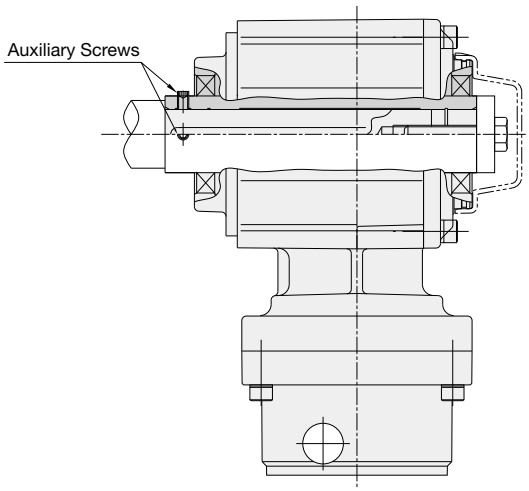
* For the position of the wrench hole for input shaft joint tightening, refer to page 840.

Power Class		Dimension A		Dimension B	Dimension M	
		AF3	AH2/ AG3		AF3	AH2/ AG3
100 W (Only precision 1 arc min and 3 arc min specifications)		14	14	10	M8	M8
100 W (Only low backlash specifications)		14	14.5	10	M16	M8
200 W		14	14.5	13.5	M16	M8
400 W		14	14.5	13.5	M16	M8
750 W		15	15	16	M16	M10
1000 W		19	19	20	M16	M12
2000 W	Flange Type Code K21/K22/K23 K31/K32/K33	18.5	17	20	M16	M12
2000 W	Flange Type Code F31/F33	28.5	27	20	M16	M12

Note 1: For flange type codes, please refer to the Motor Matching / Motor Power Design Lists on pages 682 to 685.

Examples of Tightening Driven Shafts

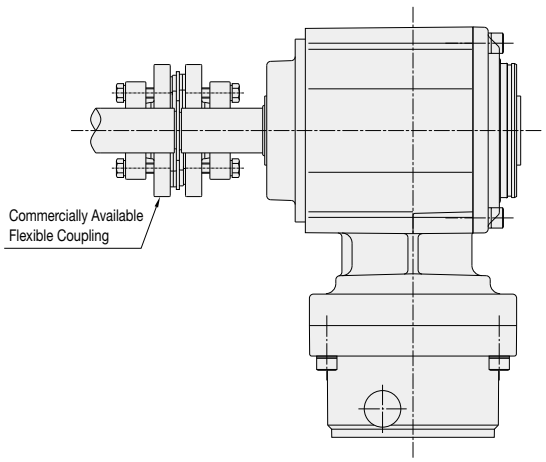
In the case of a right angle hollow bore type



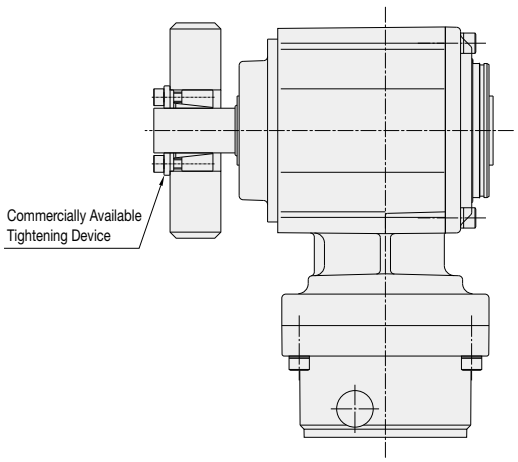
Note 1: This method prevents backlash by inserting a stepped driven shaft with a key into the right angle hollow bore and fixing the shaft on the end face with a screw etc. and then with the two auxiliary screws.

In the case of parallel shaft and right angle shaft types without a key

■ Item to be installed on a shaft
(Tightening with a ball screw etc.)



■ Item to be installed in a hole
(Tightening with a pulley etc.)



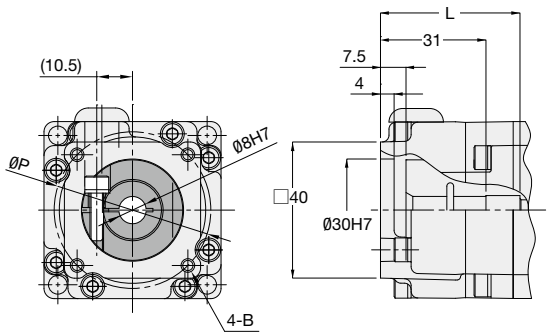
* The figure shows the AFC Type. These tightening methods also apply to the AF3 Type.

MEMO

Detailed Diagrams of Input Shaft and Flange Shapes

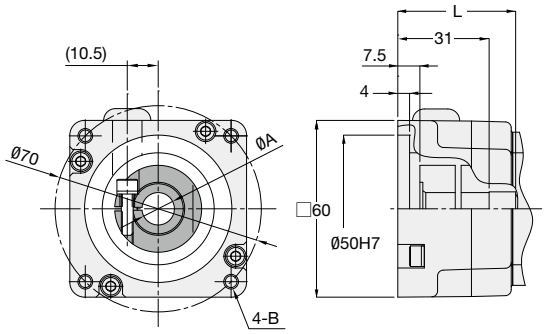
APG Type

■ 100 W Class S1/S3



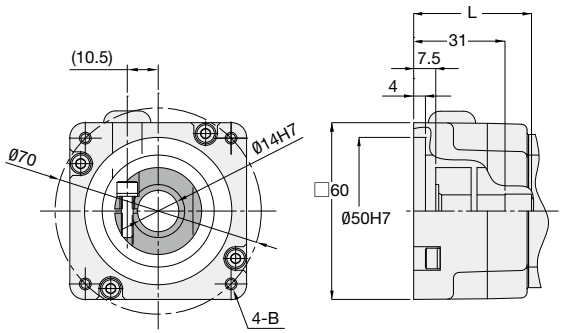
Type	Reduction Ratio	Dimension L	Dimension P	Dimension B	Bushing
S1	Up to 1/10	39	Ø46	M4, Depth 10	Yes
	From 1/15	34.5			
S3	Up to 1/10	39	Ø45	M3, Depth 10	Yes
	From 1/15	34.5			

■ 200 W Class S1/S2/S3



Type	Reduction Ratio	Dimension L	Dimension A	Dimension B	Bushing
S1	Up to 1/10	39	Ø11H7	M5, Depth 13.5 (Through)	Yes
	From 1/15	34.5			
S2	Up to 1/10	39	Ø14H7	M5, Depth 13.5 (Through)	No
	From 1/15	34.5			
S3	Up to 1/10	39	Ø11H7	M4, Depth 13.5 (Through)	Yes
	From 1/15	34.5			

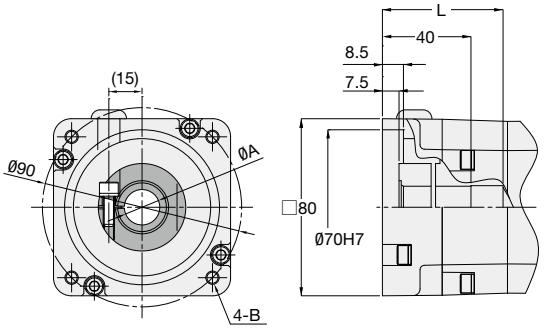
■ 400 W Class S1/S3



Type	Reduction Ratio	Dimension L	Dimension B	Bushing
S1	Up to 1/5	39	M5, Depth 13.5 (Through)	No
	1/10		M5, Depth 10	
	From 1/15	34.5	M5, Depth 13.5 (Through)	
S3	Up to 1/5	39	M4, Depth 13.5 (Through)	No
	1/10		M4, Depth 9	
	From 1/15	34.5	M4, Depth 13.5 (Through)	

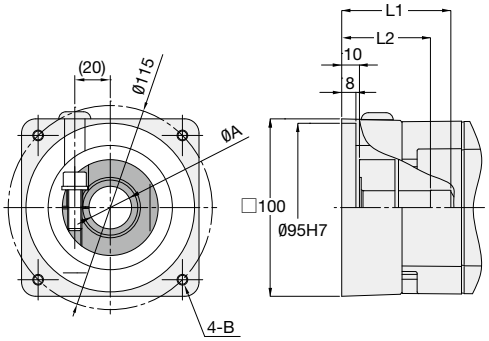
Detailed Diagrams of Input Shaft and Flange Shapes

■ 750 W Class S1/S2/S3/S4



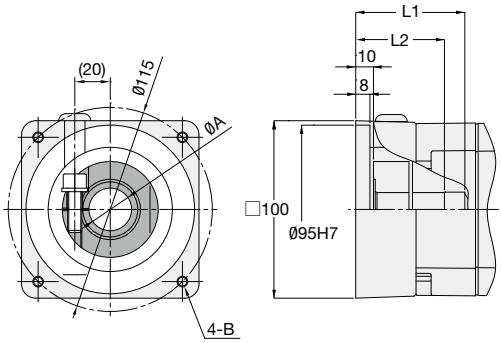
Type	Reduction Ratio	Dimension L	Dimension A	Dimension B	Bushing
S1	Up to 1/10	54.5	Ø16H7	M6, Depth 17 (Through)	Yes
	From 1/15	44.5			
S2	Up to 1/10	54.5	Ø19H7	M6, Depth 17 (Through)	No
	From 1/15	44.5			
S3	Up to 1/10	54.5	Ø19H7	M5, Depth 17 (Through)	No
	From 1/15	44.5			
S4	Up to 1/10	54.5	Ø16H7	M5, Depth 17 (Through)	Yes
	From 1/15	44.5			

■ 1000 W Class K13/K21/K22/K23



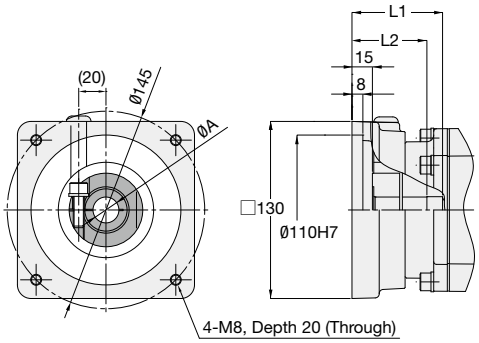
Type	Reduction Ratio	Dimension L1	Dimension L2	Dimension A	Dimension B	Bushing
K13	Up to 1/10	61	50	Ø24H7	M6, Depth 15	Yes
	From 1/15	59	41			
K21	Up to 1/10	61	50	Ø19H7	M8, Depth 16	Yes
	From 1/15	59	41			
K22	Up to 1/10	61	50	Ø22H7	M8, Depth 16	Yes
	From 1/15	59	41			
K23	Up to 1/10	61	50	Ø24H7	M8, Depth 16	Yes
	From 1/15	59	41			

■ 1500 W Class K13/K21/K22/K23



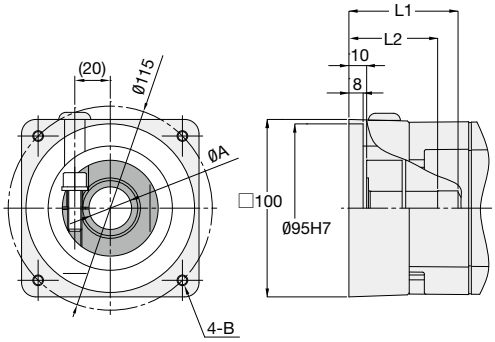
Type	Reduction Ratio	Dimension L1	Dimension L2	Dimension A	Dimension B	Bushing
K13	Up to 1/10	61	50	Ø24H7	M6, Depth 15	Yes
	From 1/15	59	41			
K21	Up to 1/10	61	50	Ø19H7	M8, Depth 16	Yes
	From 1/15	59	41			
K22	Up to 1/10	61	50	Ø22H7	M8, Depth 16	Yes
	From 1/15	59	41			
K23	Up to 1/10	61	50	Ø24H7	M8, Depth 16	Yes
	From 1/15	59	41			

■ 1500 W Class K31/K32/K33



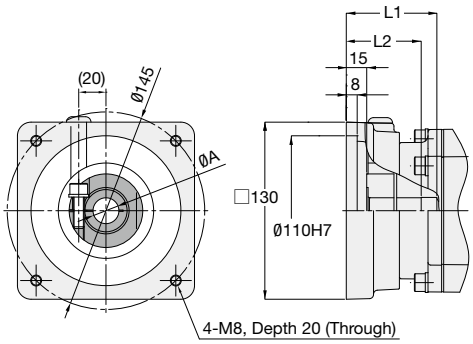
Type	Reduction Ratio	Dimension L1	Dimension L2	Dimension A	Bushing
K31	Up to 1/10	66	55	Ø19H7	Yes
	From 1/15	64	46		
K32	Up to 1/10	66	55	Ø22H7	Yes
	From 1/15	64	46		
K33	Up to 1/10	66	55	Ø24H7	Yes
	From 1/15	64	46		

■ 2000 W Class K13/K21/K22/K23



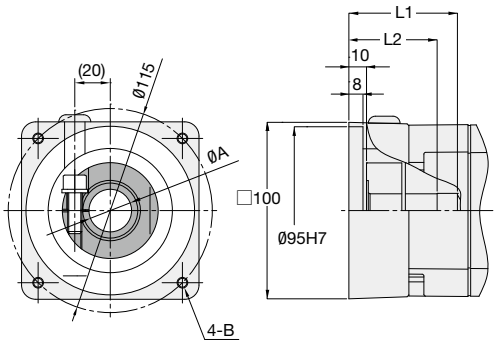
Type	Reduction Ratio	Dimension L1	Dimension L2	Dimension A	Dimension B	Bushing
K13	Up to 1/10	61	50	Ø24H7	M6, Depth 15	Yes
	From 1/15	59	41			
K21	Up to 1/10	61	50	Ø19H7	M8, Depth 16	Yes
	From 1/15	59	41			
K22	Up to 1/10	61	50	Ø22H7	M8, Depth 16	Yes
	From 1/15	59	41			
K23	Up to 1/10	61	50	Ø24H7	M8, Depth 16	Yes
	From 1/15	59	41			

■ 2000 W Class K31/K32/K33



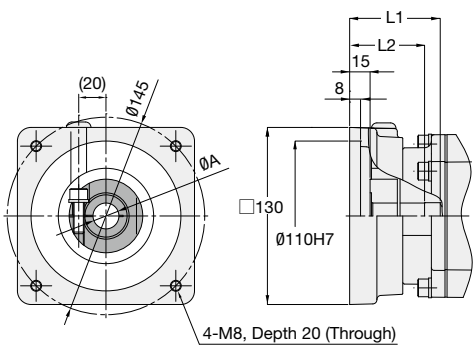
Type	Reduction Ratio	Dimension L1	Dimension L2	Dimension A	Bushing
K31	Up to 1/10	66	55	Ø19H7	Yes
	From 1/15	64	46		
K32	Up to 1/10	66	55	Ø22H7	Yes
	From 1/15	64	46		
K33	Up to 1/10	66	55	Ø24H7	Yes
	From 1/15	64	46		

■ 3000 W Class K13/K21/K22/K23



Type	Reduction Ratio	Dimension L1	Dimension L2	Dimension A	Dimension B	Bushing
K13	Up to 1/10	61	50	Ø24H7	M6, Depth 15	Yes
K21	Up to 1/10	61	50	Ø19H7	M8, Depth 16	Yes
K22	Up to 1/10	61	50	Ø22H7	M8, Depth 16	Yes
K23	Up to 1/10	61	50	Ø24H7	M8, Depth 16	Yes

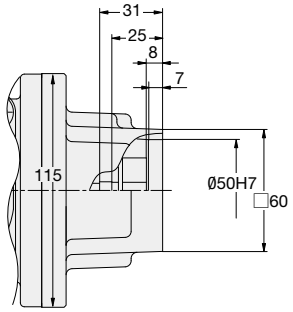
■ 3000 W Class K31/K32/K33/K34

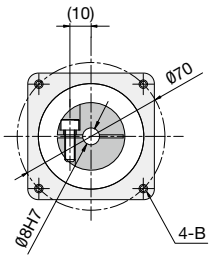


Type	Reduction Ratio	Dimension L1	Dimension L2	Dimension A	Bushing
K31	Up to 1/10	66	55	Ø19H7	Yes
K32	Up to 1/10	66	55	Ø22H7	Yes
K33	Up to 1/10	66	55	Ø24H7	Yes
K34	Up to 1/10	66	55	Ø28H7	No

AG3·AH2 Type

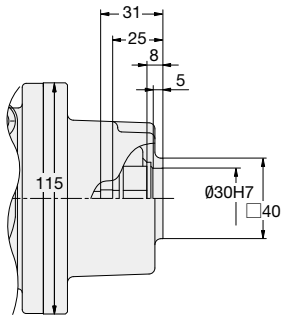
■ 100 W Class (only low backlash specifications) F1/F3

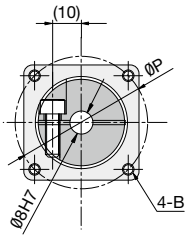




Type	Dimension B
F1	M5, Depth 10
F3	M4, Depth 10

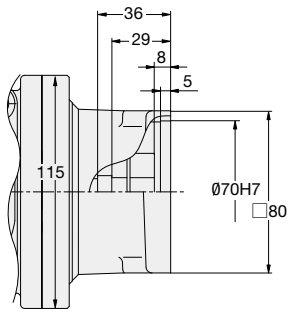
■ 100 W Class (only low backlash specifications) S1/S3

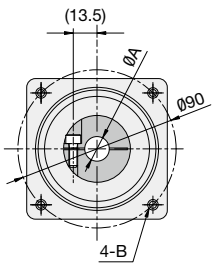




Type	Dimension B	Dimension P
S1	M4, Depth 10	Ø46
S3	M3, Depth 10	Ø45

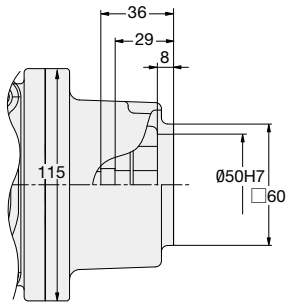
■ 200 W Class F1/F2/F3

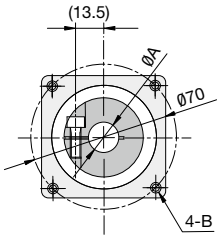




Type	Dimension A	Dimension B
F1	Ø11H7	M6, Depth 12 (Through)
F2	Ø14H7	M6, Depth 12 (Through)
F3	Ø11H7	M5, Depth 12 (Through)

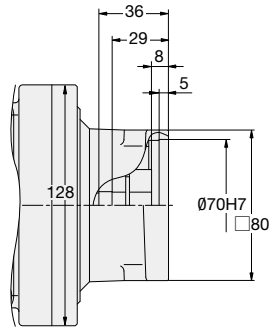
■ 200 W Class S1/S2/S3

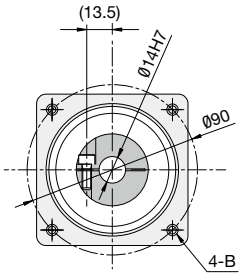




Type	Dimension A	Dimension B
S1	Ø11H7	M5, Depth 10
S2	Ø14H7	M5, Depth 10
S3	Ø11H7	M4, Depth 10

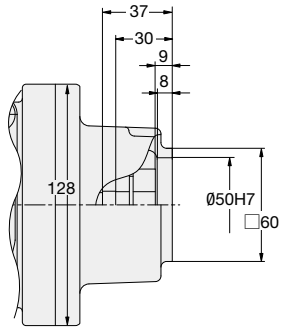
■ 400 W Class F1/F3

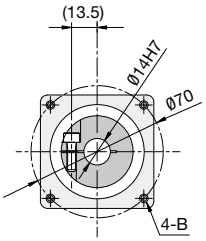




Type	Dimension B
F1	M6, Depth 12 (Through)
F3	M5, Depth 12 (Through)

■ 400 W Class S1/S3

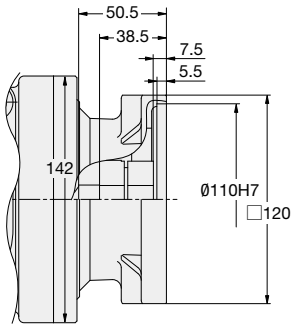


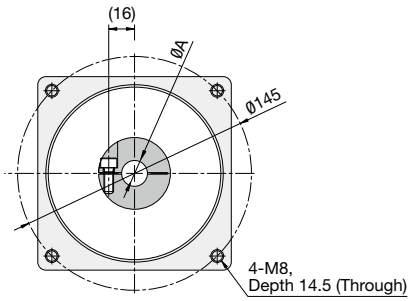


Type	Dimension B
S1	M5, Depth 10
S3	M4, Depth 10

Detailed Diagrams of Input Shaft and Flange Shapes

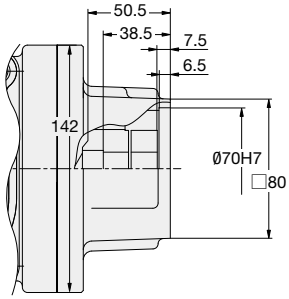
■ 750 W Class F1/F2

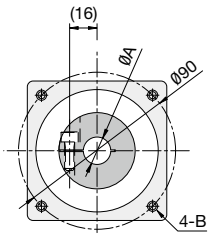




Type	Dimension A
F1	Ø16H7
F2	Ø19H7

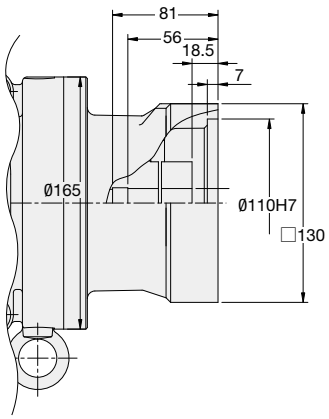
■ 750 W Class S1/S2/S3/S4

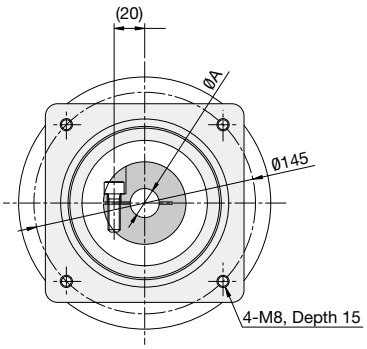




Type	Dimension A	Dimension B
S1	Ø16H7	M6, Depth 12
S2	Ø19H7	M6, Depth 12
S3	Ø19H7	M5, Depth 10
S4	Ø16H7	M5, Depth 10

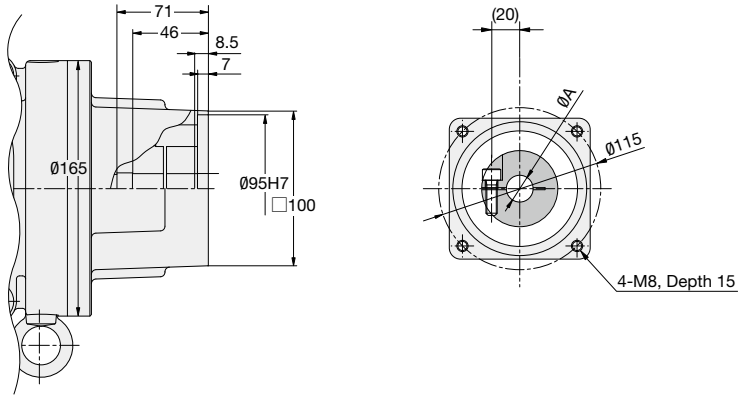
■ 2000 W Class F31/F33





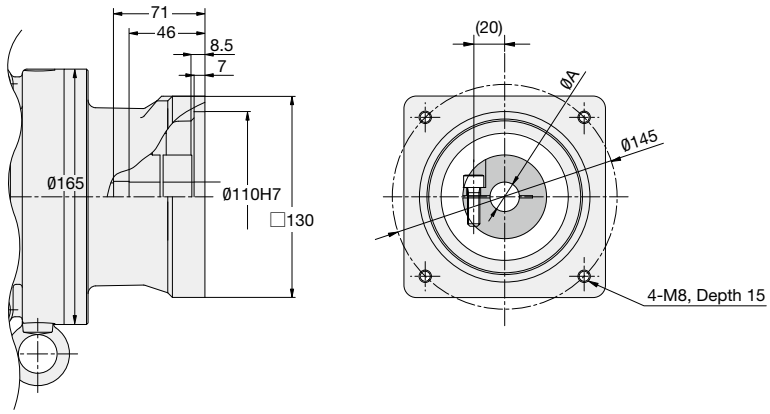
Type	Dimension A
F31	Ø19H7
F33	Ø24H7

■ 2000 W Class K21/K22/K23



Type	Dimension A
K21	Ø19H7
K22	Ø22H7
K23	Ø24H7

■ 2000 W Class K31/K32/K33

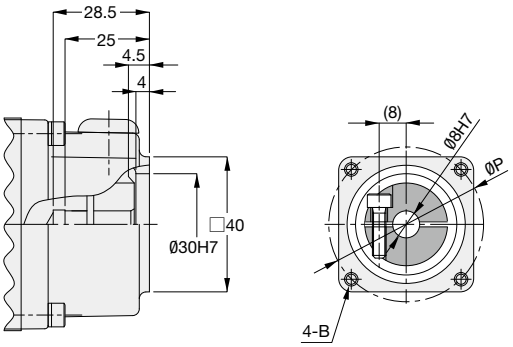


Type	Dimension A
K31	Ø19H7
K32	Ø22H7
K33	Ø24H7

Detailed Diagrams of Input Shaft and Flange Shapes

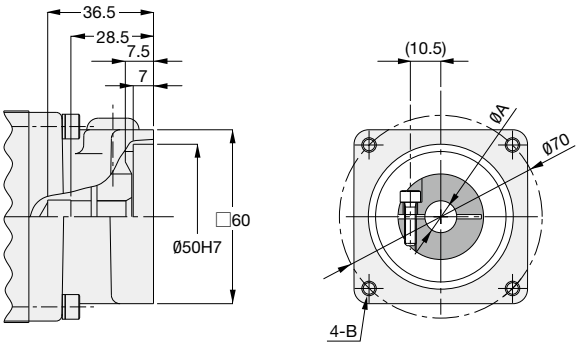
AFC Type (Right Angle Hollow Bore/Right Angle Shaft) Backlash 3 arc min/30 arc min Specifications

■ 100 W Class S1/S3



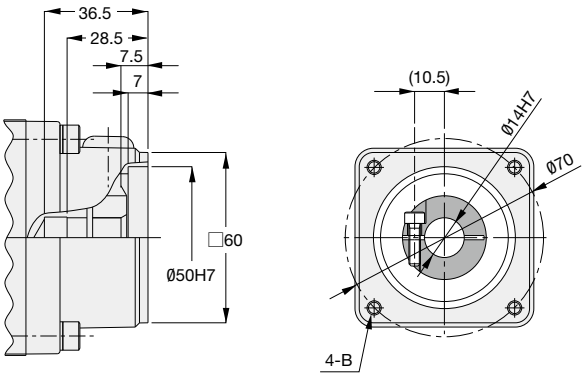
Type	Dimension B	Dimension P
S1	M4, Depth 10	Ø46
S3	M3, Depth 10	Ø45

■ 200 W Class S1/S2/S3



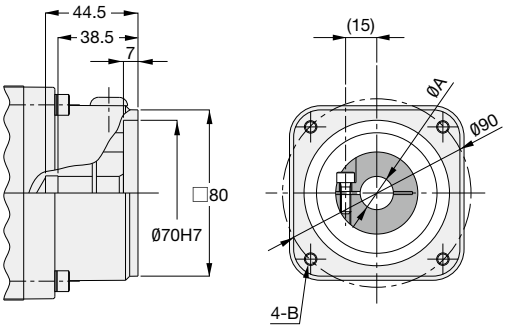
Type	Frame Size	Dimension A	Dimension B
S1	12/18	Ø11H7	M5, Depth 10 (Through)
	15/22	Ø11H7	M5, Depth 15 (Through)
S2	12/18	Ø14H7	M5, Depth 10 (Through)
	15/22	Ø14H7	M5, Depth 15 (Through)
S3	12/18	Ø11H7	M4, Depth 10 (Through)
	15/22	Ø11H7	M4, Depth 15 (Through)

■ 400 W Class S1/S3



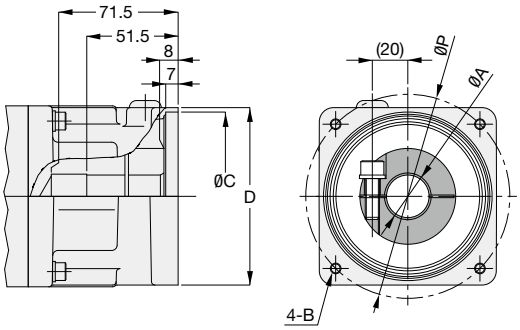
Type	Frame Size	Dimension B
S1	15/22	M5, Depth 15 (Through)
	18/28	M5, Depth 10
S3	15/22	M4, Depth 15 (Through)
	18/28	M4, Depth 10

■ 750 W Class S1/S2/S3/S4



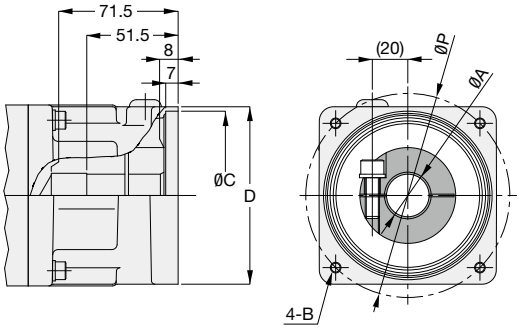
Type	Frame Size	Dimension A	Dimension B
S1	18/28	Ø16H7	M6, Depth 10 (Through)
	22/32	Ø16H7	M6, Depth 12
S2	18/28	Ø19H7	M6, Depth 10 (Through)
	22/32	Ø19H7	M6, Depth 12
S3	18/28	Ø19H7	M5, Depth 10 (Through)
	22/32	Ø19H7	M5, Depth 12
S4	18/28	Ø16H7	M5, Depth 10 (Through)
	22/32	Ø16H7	M5, Depth 12

■ 1000 W Class K13/K22/K23/K61



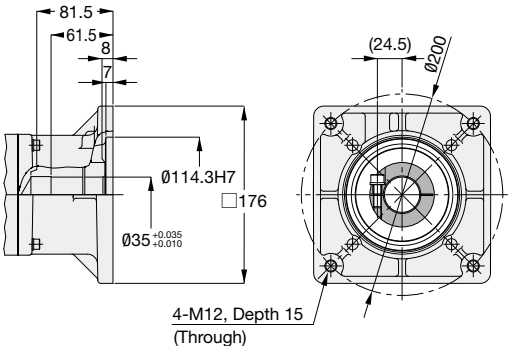
Type	Dimension A	Dimension B	Dimension C	Dimension D	Dimension P
K13	Ø24H7	M6, Depth 15 (Through)	Ø95H7	□100	Ø115
K22	Ø22H7	M8, Depth 15 (Through)	Ø95H7	□100	Ø115
K23	Ø24H7	M8, Depth 15 (Through)	Ø95H7	□100	Ø115
K61	Ø19H7	M6, Depth 12	Ø80H7	□90	Ø100

■ 2000 W Class K13/K21/K22/K23/K31/K32/K33/K41



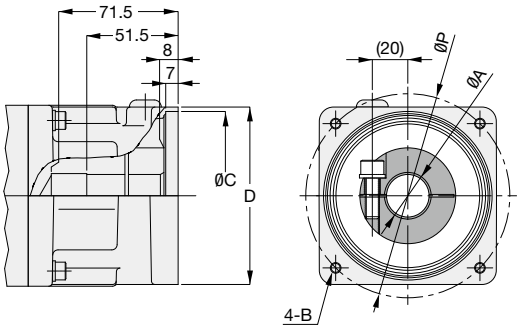
Type	Dimension A	Dimension B	Dimension C	Dimension D	Dimension P
K13	Ø24H7	M6, Depth 15 (Through)	Ø95H7	□100	Ø115
K21	Ø19H7	M8, Depth 15 (Through)	Ø95H7	□100	Ø115
K22	Ø22H7	M8, Depth 15 (Through)	Ø95H7	□100	Ø115
K23	Ø24H7	M8, Depth 15 (Through)	Ø95H7	□100	Ø115
K31	Ø19H7	M8, Depth 15 (Through)	Ø110H7	□130	Ø145
K32	Ø22H7	M8, Depth 15 (Through)	Ø110H7	□130	Ø145
K33	Ø24H7	M8, Depth 15 (Through)	Ø110H7	□130	Ø145
K41	Ø19H7	M8, Depth 15 (Through)	Ø110H7	□120	Ø145

■ 2000 W Class and 3000 W Class K75



Detailed Diagrams of Input Shaft and Flange Shapes

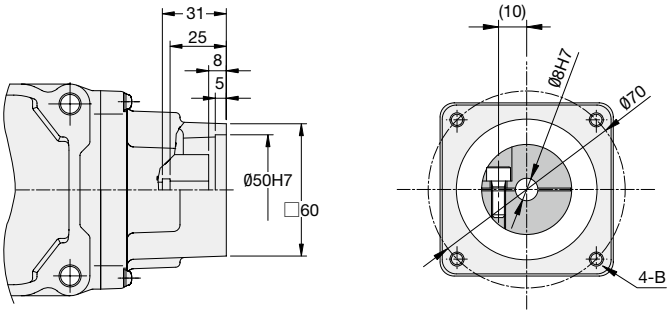
■ 3000 W Class K13/K21/K22/K23/K32/K33/K34/K52



Type	Dimension A	Dimension B	Dimension C	Dimension D	Dimension P
K13	Ø24H7	M6, Depth 15 (Through)	Ø95H7	□100	Ø115
K21	Ø19H7	M8, Depth 15 (Through)	Ø95H7	□100	Ø115
K22	Ø22H7	M8, Depth 15 (Through)	Ø95H7	□100	Ø115
K23	Ø24H7	M8, Depth 15 (Through)	Ø95H7	□100	Ø115
K32	Ø22H7	M8, Depth 15 (Through)	Ø110H7	□130	Ø145
K33	Ø24H7	M8, Depth 15 (Through)	Ø110H7	□130	Ø145
K34	Ø28H7	M8, Depth 15 (Through)	Ø110H7	□130	Ø145
K52	Ø22H7	M8, Depth 15 (Through)	Ø110H7	□120	Ø130

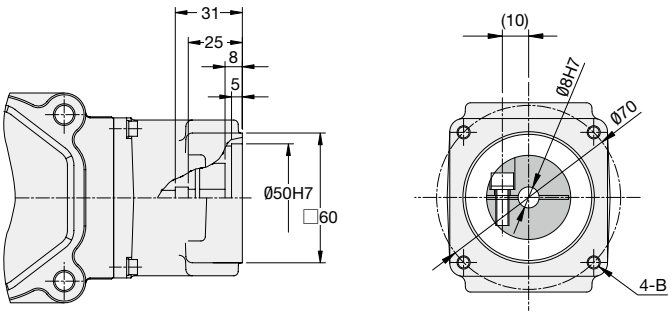
AF3 Type

■ 100 W Class (only backlash 1 arc min/3 arc min specifications) F1/F3



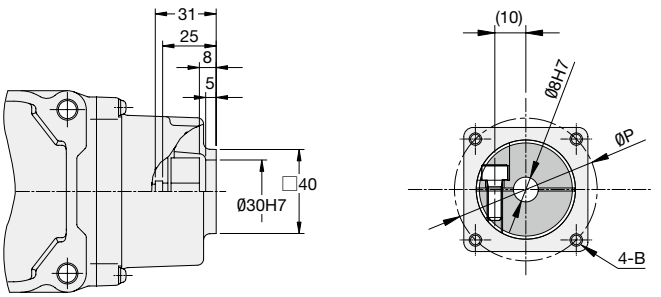
Type	Dimension B
F1	M5, Depth 10
F3	M4, Depth 10

■ 100 W Class (only low backlash specifications) F1/F3



Type	Dimension B
F1	M5, Depth 12
F3	M4, Depth 12

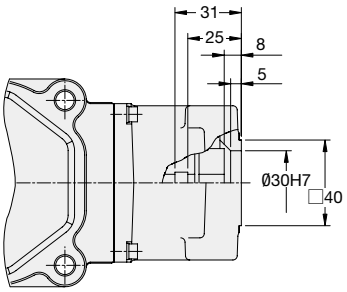
■ 100 W Class (only backlash 1 arc min/3 arc min specifications) F1/F3

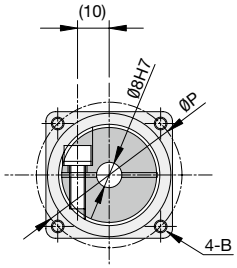


Type	Dimension B	Dimension P
S1	M4, Depth 10	Ø46
S3	M3, Depth 10	Ø45

Detailed Diagrams of Input Shaft and Flange Shapes

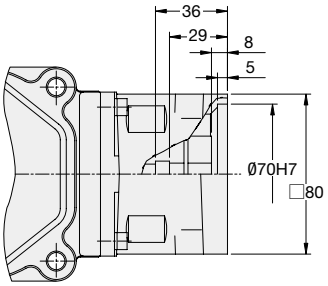
■ 100 W Class (only low backlash specifications) S1/S3

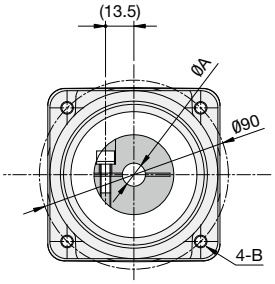




Type	Dimension B	Dimension P
S1	M4, Depth 10	Ø46
S3	M3, Depth 10	Ø45

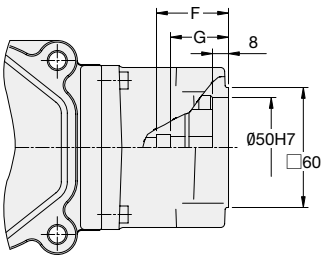
■ 200 W Class F1/F2/F3

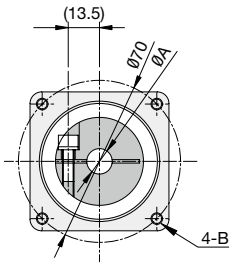




Type	Dimension A	Dimension B
F1	Ø11H7	M6, Depth 12 (Through)
F2	Ø14H7	M6, Depth 12 (Through)
F3	Ø11H7	M5, Depth 12 (Through)

■ 200 W Class S1/S2/S3/S5

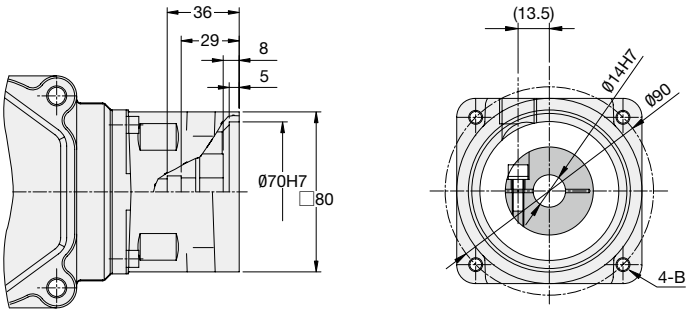




Type	Dimension A	Dimension B	Dimension F	Dimension G
S1	Ø11H7	M5, Depth 12	36	29
S2	Ø14H7	M5, Depth 12	36	29
S3	Ø11H7	M4, Depth 12	36	29
S5	Ø9H7	M5, Depth 12	32	25

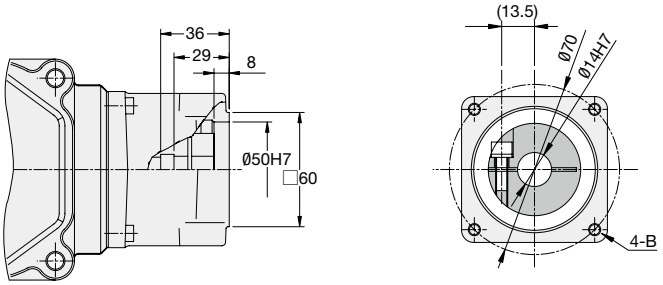
* S5 is available only for backlash 1 arc min and 3 arc min specifications.

■ 400 W Class F1/F3



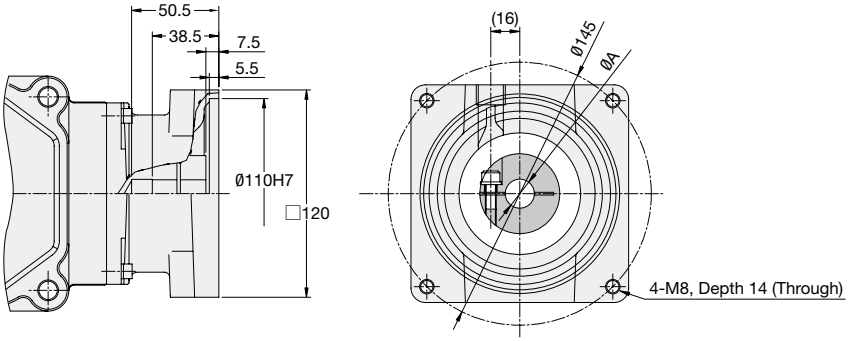
Type	Dimension B
F1	M6, Depth 12 (Through)
F3	M5, Depth 12 (Through)

■ 400 W Class S1/S3



Type	Dimension B
S1	M5, Depth 12
S3	M4, Depth 12

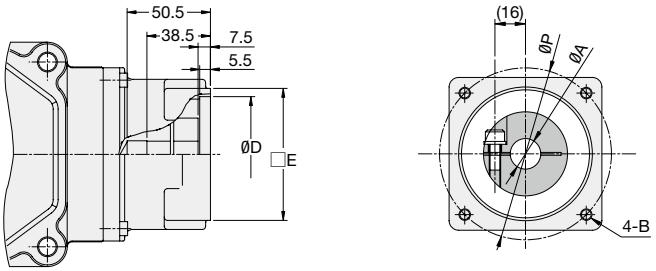
■ 750 W Class F1/F2



Type	Dimension A
F1	Ø16H7
F2	Ø19H7

Detailed Diagrams of Input Shaft and Flange Shapes

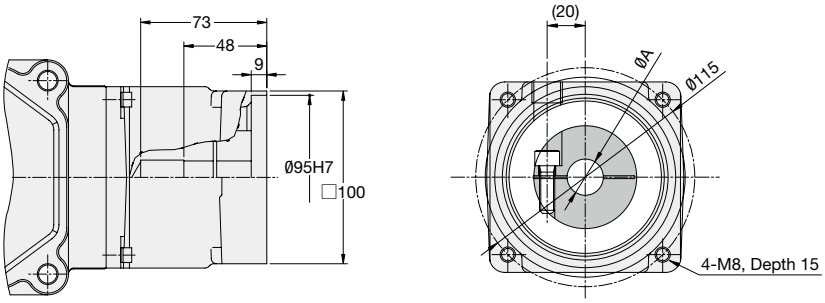
■ 750 W Class S1/S2/S3/S4/S6



Type	Dimension A	Dimension B	Dimension D	Dimension E	Dimension P
S1	Ø16H7	M6, Depth 12	Ø70H7	□80	Ø90
S2	Ø19H7	M6, Depth 12	Ø70H7	□80	Ø90
S3	Ø19H7	M5, Depth 10	Ø70H7	□80	Ø90
S4	Ø16H7	M5, Depth 10	Ø70H7	□80	Ø90
S6	$Ø14^{+0.030}_{+0.012}$	M6, Depth 12	Ø80H7	□90	Ø100

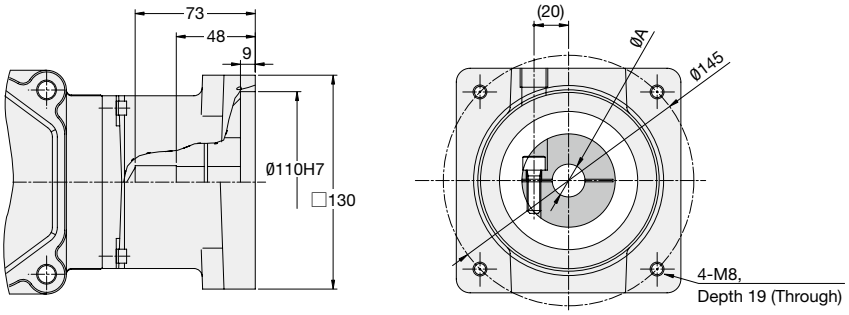
* S6 is available only for backlash 1 arc min and 3 arc min specifications.

■ 1000 W Class (only backlash 1 arc min/3 arc min specifications) K21/K22/K23



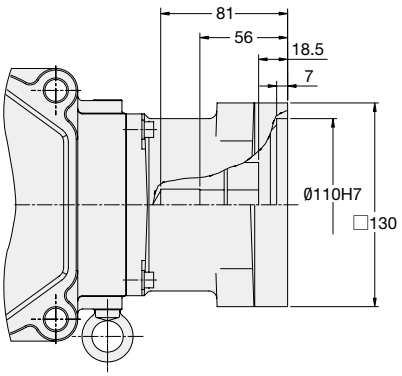
Type	Dimension A
K21	Ø19H7
K22	Ø22H7
K23	Ø24H7

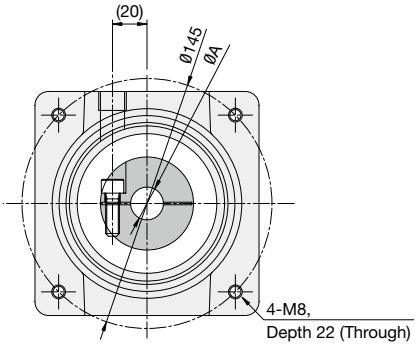
■ 1000 W Class (only backlash 1 arc min/3 arc min specifications) K31/K32/K33



Type	Dimension A
K31	Ø19H7
K32	Ø22H7
K33	Ø24H7

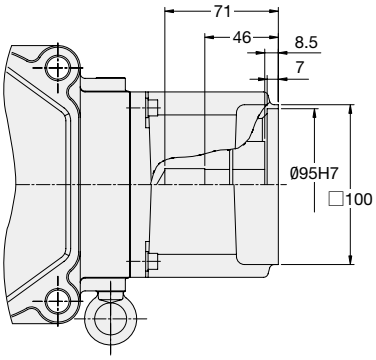
■ 2000 W Class F31/F33

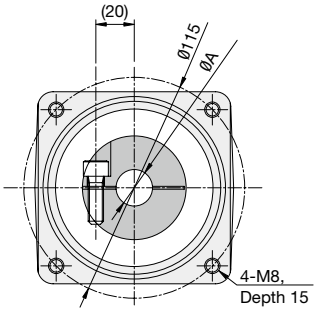




Type	Dimension A
F31	Ø19H7
F33	Ø24H7

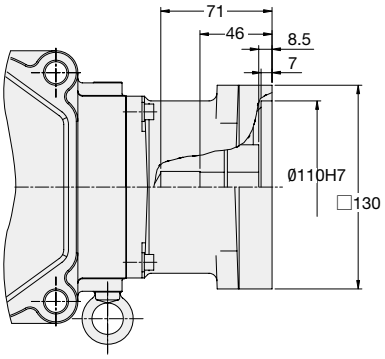
■ 2000 W Class K21/K22/K23

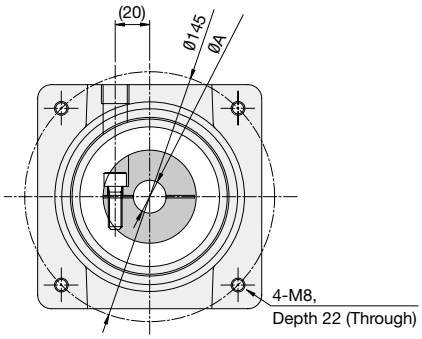




Type	Dimension A
K21	Ø19H7
K22	Ø22H7
K23	Ø24H7

■ 2000 W Class K31/K32/K33





Type	Dimension A
K31	Ø19H7
K32	Ø22H7
K33	Ø24H7

MEMO

Performance Tables [for Calculation and Selection]

APG Type Backlash 3 arc min/15 arc min Specifications

[Notes]
- This performance table is based on pairing with a servo motor running at the rated input speed of 3000 r/min.
- The motor rated output torque is based on values after a warm-up operation of the unit.
- The transmission efficiency percentage is only a reference value.
- The transmission efficiency varies greatly depending on the input speed and the load on the product. Please be cautious.

Reduction Ratio	Output Shaft Diameter	Motor Power Class	Motor Rated Output Torque (3000 r/min)	Transmission Efficiency
		W	N·m	%
1/3	12	100	0.57	55
	12	200	1.5	75
	12	400	3.4	85
	18	750	6.4	85
	22	1000	7.2	70
	22	1500	11.5	75
	22	2000	17.2	85
	28	3000	25.8	85
1/5	12	100	1.0	55
	12	200	2.5	75
	12	400	5.7	85
	18	750	10.7	85
	22	1000	12.7	75
	22	1500	21.5	85
	22	2000	28.6	85
	28	3000	43.0	85
1/10	12	100	2.1	60
	12	200	5.1	75
	18	400	10.8	80
	18	750	21.5	85
	22	1000	26.4	75
	22	1500	43.0	85
	22	2000	57.3	85
	28	3000	85.9	85
1/15	12	100	3.3	65
	12	200	7.6	75
	18	400	16.2	80
	22	750	30.4	80
	28	1000	40.6	80
	28	1500	60.9	80
	28	2000	81.2	80

Performance Tables [for Calculation and Selection]

Reduction Ratio	Output Shaft Diameter	Motor Power Class	Motor Rated Output Torque (3000 r/min)	Transmission Efficiency
		W	N·m	%
1/20	12	100	4.5	65
	12	200	10.2	75
	18	400	21.6	80
	22	750	40.6	80
	28	1000	54.1	80
	28	1500	81.2	80
	28	2000	108.2	80
1/30	12	100	6.7	65
	18	200	15.3	75
	18	400	32.5	80
	22	750	60.9	80
	28	1000	81.2	80
	28	1500	121.8	80
1/40	18	100	8.3	60
	18	200	19.1	70
	22	400	40.7	75
	28	750	81.2	80
	28	1000	108.2	80
1/50	18	100	10.3	60
	18	200	25.5	75
	22	400	50.9	75
	28	750	95.5	75
	28	1000	135.3	80
1/60	18	100	12.4	60
	18	200	28.6	70
	22	400	61.1	75
	28	750	121.8	80
1/100	18	100	20.7	60
	22	200	44.6	65
	28	400	95.5	70

AG3 Type Low Backlash Specification

[Notes]

- This performance table is based on pairing with a servo motor running at the rated input speed of 3000 r/min.
- The motor rated output torque is based on values after a warm-up operation of the unit.
- The transmission efficiency percentage is only a reference value.
- The transmission efficiency varies greatly depending on the input speed and the load on the product. Please be cautious.
- The "*" mark indicates a limited torque type. Please make sure to check the motor rated output torque.

Reduction Ratio	Output Shaft Diameter	Motor Power Class	Motor Rated Output Torque (3000 r/min)	Transmission Efficiency
		W	N·m	%
1/5	18	100	0.9	55
	18	200	1.9	60
	22	400	4.0	65
	28	750	9.6	80
	32	2000	25	80
1/10	18	100	1.9	60
	18	200	3.9	60
	22	400	8.0	65
	28	750	19	80
	32	2000	51	80
1/15	18	100	2.9	60
	18	200	5.8	60
	22	400	13	65
	28	750	29	80
	32	2000	76	80
1/20	18	100	3.8	60
	18	200	7.7	60
	22	400	16	65
	28	750	39	80
	32	2000	102	80
1/25	18	100	4.8	60
	18	200	10	60
	22	400	20	65
	28	750	46	80
	32	2000	130	80
1/30	18	100	5.8	60
	22	200	12	60
	28	400	25	65
	32	750	59	80
	40	2000	153	80
1/40	18	100	7.7	60
	22	200	16	65
	28	400	35	70
	32	750	71	75
	40	2000	211	80
1/50	18	100	10	60
	22	200	20	65
	28	400	43	70
	32	750	88	75
	40	2000	261	80

Performance Tables [for Calculation and Selection]

Reduction Ratio	Output Shaft Diameter	Motor Power Class	Motor Rated Output Torque (3000 r/min)	Transmission Efficiency
		W	N·m	%
1/60	22	100	13	65
	22	200	26	65
	28	400	52	70
	32	750	107	75
	40	2000	302	80
1/80	22	100	16	65
	22	200	33	65
	28	400	71	70
	32	750	142	75
	40	2000	423	80
1/100	22	100	20	65
	28	200	43	65
	32	400	88	70
	40	750	177	75
	50	2000	533	80
1/120	22	100	25	65
	28	200	50	65
	32	400	108	70
	40	750	218	75
	50	2000	594	80
1/160	22	100	32	65
	28	200	68	65
	32	400	141	70
	40	750	278	75
	50	2000	844	80
1/200	22	100	40	65
	28	200	81	65
	32	400	180	70
	40	750	348	75
	50	2000	* 862	80

AH2 Type Low Backlash Specification

[Notes]

- This performance table is based on pairing with a servo motor running at the rated input speed of 3000 r/min.
- The motor rated output torque is based on values after a warm-up operation of the unit.
- The transmission efficiency percentage is only a reference value.
- The transmission efficiency varies greatly depending on the input speed and the load on the product. Please be cautious.
- The "*" mark indicates a limited torque type. Please make sure to check the motor rated output torque.

Reduction Ratio	Output Shaft Diameter	Motor Power Class	Motor Rated Output Torque (3000 r/min)	Transmission Efficiency
		W	N·m	%
1/5	22	100	0.9	55
	22	200	2.0	60
	28	400	3.9	60
	32	750	7.8	65
	40	2000	24	70
1/10	22	100	2.2	65
	22	200	4.3	65
	28	400	8.4	65
	32	750	16	65
	40	2000	47	70
1/15	22	100	3.4	70
	22	200	7.1	70
	28	400	14	70
	32	750	26	70
	40	2000	73	75
1/20	22	100	4.6	70
	22	200	9.4	70
	28	400	19	70
	32	750	35	70
	40	2000	98	75
1/25	22	100	5.6	70
	22	200	12	70
	28	400	25	75
	32	750	45	75
	40	2000	122	75
1/30	22	100	6.9	70
	22	200	15	75
	28	400	29	75
	32	750	56	75
	40	2000	145	75
1/40	22	100	9.2	70
	22	200	20	75
	28	400	39	75
	32	750	74	75
	40	2000	196	75
1/50	22	100	11	70
	22	200	25	75
	28	400	49	75
	32	750	94	75
	40	2000	243	75

Performance Tables [for Calculation and Selection]

Reduction Ratio	Output Shaft Diameter	Motor Power Class	Motor Rated Output Torque (3000 r/min)	Transmission Efficiency
		W	N·m	%
1/60	22	100	14	70
	22	200	27	70
	28	400	55	70
	32	750	110	75
	40	2000	292	75
1/80	22	100	19	70
	22	200	34	65
	28	400	71	65
	32	750	141	70
	40	2000	380	70
1/100	22	100	24	70
	28	200	43	65
	32	400	88	65
	40	750	172	70
	50	2000	476	70
1/120	22	100	30	75
	28	200	57	70
	32	400	110	70
	40	750	212	70
	50	2000	584	75
1/160	22	100	40	75
	28	200	75	70
	32	400	149	70
	40	750	282	70
	50	2000	775	75
1/200	22	100	50	75
	28	200	94	70
	32	400	188	70
	40	750	353	70
	50	2000	* 862	70
1/240	22	100	60	75
	28	200	110	70
	32	400	221	70
	40	750	423	70
	50	2000	* 862	70

AFC Type (Right Angle Hollow Bore) Backlash 3 arc min/30 arc min Specifications

[Notes]

- This performance table is based on pairing with a servo motor running at the rated input speed of 3000 r/min.
- The motor rated output torque is based on values after a warm-up operation of the unit.
- The transmission efficiency percentage is only a reference value.
- The transmission efficiency varies greatly depending on the input speed and the load on the product. Please be cautious.

Reduction Ratio	Output Shaft Diameter	Motor Power Class	Motor Rated Output Torque (3000 r/min)	Transmission Efficiency
		W	N·m	%
1/3	15	400	2.9	70
	18	750	5.7	75
	22	1000	7.7	75
	28	2000	16.2	80
	32	3000	24.4	80
1/5	12	200	2.1	60
	15	400	4.8	70
	18	750	9.5	75
	22	1000	12.9	75
	28	2000	27.1	80
	32	3000	40.6	80
1/7.5	12	100	1.4	55
	15	200	3.3	60
	18	400	7.2	70
	22	750	14.3	75
	28	1000	20.1	75
	32	2000	40.6	80
1/10	12	100	1.9	55
	15	200	4.5	65
	18	400	9.5	70
	22	750	19.1	75
	28	1000	26.7	75
	32	2000	54.1	80

Performance Tables [for Calculation and Selection]

Reduction Ratio	Output Shaft Diameter	Motor Power Class	Motor Rated Output Torque (3000 r/min)	Transmission Efficiency
		W	N·m	%
1/10	15	100	1.9	55
	18	200	4.1	60
	22	400	9.5	70
	28	750	19.1	75
	32	1000	26.7	75
1/12	15	100	2.4	55
	18	200	5.2	60
	22	400	11.9	70
	28	750	23.9	75
	32	1000	32.6	75
1/15	15	100	2.9	55
	18	200	6.2	60
	22	400	14.3	70
	28	750	28.6	75
	32	1000	39.2	75
1/20	15	100	3.8	55
	18	200	8.9	65
	22	400	19.1	70
	28	750	38.2	75
	32	1000	52.2	75
1/25	15	100	4.8	55
	18	200	11.1	65
	22	400	23.9	70
	28	750	47.7	75
	32	1000	65.3	75
1/30	15	100	5.7	55
	18	200	13.4	65
	22	400	28.6	70
	28	750	57.3	75
	32	1000	78.3	75
1/40	18	100	8.3	60
	22	200	19.1	70
	28	400	40.7	75
	32	750	79.3	80
1/50	18	100	10.3	60
	22	200	23.9	70
	28	400	50.9	75
	32	750	99.1	80
1/60	18	100	12.4	60
	22	200	28.6	70
	28	400	61.1	75
	32	750	118.9	80

AFC Type (Right Angle Shaft) Backlash 3 arc min/30 arc min Specifications

[Notes]

- This performance table is based on pairing with a servo motor running at the rated input speed of 3000 r/min.
- The motor rated output torque is based on values after a warm-up operation of the unit.
- The transmission efficiency percentage is only a reference value.
- The transmission efficiency varies greatly depending on the input speed and the load on the product. Please be cautious.

Reduction Ratio	Output Shaft Diameter	Motor Power Class	Motor Rated Output Torque (3000 r/min)	Transmission Efficiency
		W	N·m	%
1/3	15	400	2.9	70
	18	750	5.7	75
	22	1000	7.7	75
	28	2000	16.2	80
	32	3000	24.4	80
1/5	12	200	2.1	60
	15	400	4.8	70
	18	750	9.5	75
	22	1000	12.9	75
	28	2000	27.1	80
	32	3000	40.6	80
1/7.5	12	100	1.4	55
	15	200	3.3	60
	18	400	7.2	70
	22	750	14.3	75
	28	1000	20.1	75
	32	2000	40.6	80
1/10	12	100	1.9	55
	15	200	4.5	65
	18	400	9.5	70
	22	750	19.1	75
	28	1000	26.7	75
	32	2000	54.1	80

Performance Tables [for Calculation and Selection]

Reduction Ratio	Output Shaft Diameter	Motor Power Class	Motor Rated Output Torque (3000 r/min)	Transmission Efficiency
		W	N·m	%
1/10	15	100	1.9	55
	18	200	4.1	60
	22	400	9.5	70
	28	750	19.1	75
	32	1000	26.7	75
1/12	15	100	2.4	55
	18	200	5.2	60
	22	400	11.9	70
	28	750	23.9	75
	32	1000	32.6	75
1/15	15	100	2.9	55
	18	200	6.2	60
	22	400	14.3	70
	28	750	28.6	75
	32	1000	39.2	75
1/20	15	100	3.8	55
	18	200	8.9	65
	22	400	19.1	70
	28	750	38.2	75
	32	1000	52.2	75
1/25	15	100	4.8	55
	18	200	11.1	65
	22	400	23.9	70
	28	750	47.7	75
	32	1000	65.3	75
1/30	15	100	5.7	55
	18	200	13.4	65
	22	400	28.6	70
	28	750	57.3	75
	32	1000	78.3	75
1/40	18	100	8.3	60
	22	200	19.1	70
	28	400	40.7	75
	32	750	79.3	80
1/50	18	100	10.3	60
	22	200	23.9	70
	28	400	50.9	75
	32	750	99.1	80
1/60	18	100	12.4	60
	22	200	28.6	70
	28	400	61.1	75
	32	750	118.9	80

AF3S Type (Concentric Right Angle Hollow Bore) Backlash 1 arc min/3 arc min Specifications

[Notes]

- This performance table is based on pairing with a servo motor running at the rated input speed of 3000 r/min.
- The motor rated output torque is based on values after a warm-up operation of the unit.
- The transmission efficiency percentage is only a reference value.
- The transmission efficiency varies greatly depending on the input speed and the load on the product. Please be cautious.
- The "*" mark indicates a limited torque type. Please make sure to check the motor rated output torque.

Reduction Ratio	Output Shaft Diameter	Motor Power Class	Motor Rated Output Torque (3000 r/min)	Transmission Efficiency
		W	N·m	%
1/10	15	100	2.2	60
	25	200	3.8	60
	30	400	7.8	60
	35	750	16	60
	35	1000	22	70
	45	2000	44	70
1/15	15	100	3.5	65
	25	200	6.4	65
	30	400	13	65
	35	750	26	65
1/20	15	100	5.0	70
	25	200	8.9	65
	30	400	18	65
	35	750	36	70
	35	1000	45	70
	45	2000	90	70
1/25	15	100	6.4	70
	25	200	12	65
	30	400	23	70
	35	750	46	70
1/30	15	100	7.6	75
	25	200	14	65
	30	400	27	70
	35	750	55	70
	35	1000	67	70
	45	2000	144	75
1/40	15	100	10	75
	25	200	19	65
	30	400	36	70
	35	750	76	75
	35	1000	96	75
	45	2000	191	75

Performance Tables [for Calculation and Selection]

Reduction Ratio	Output Shaft Diameter	Motor Power Class	Motor Rated Output Torque (3000 r/min)	Transmission Efficiency
		W	N·m	%
1/50	15	100	13	75
	25	200	24	65
	30	400	45	70
	35	750	95	75
	35	1000	120	75
	45	2000	239	75
1/60	15	100	15	75
	25	200	29	65
	30	400	54	70
	35	750	115	75
	35	1000	143	75
	45	2000	287	75
1/75	15	100	18	70
	30	200	31	60
	35	400	63	65
	45	750	135	70
1/90	15	100	22	70
	30	200	37	60
	35	400	75	65
	45	750	162	70
1/120	15	100	29	70
	30	200	50	60
	35	400	100	65
	45	750	217	70
1/150	30	200	57	60
	35	400	124	65
	45	750	251	70
1/180	30	200	* 57	60
	35	400	* 124	65
	45	750	* 251	70

AF3F Type (Concentric Right Angle Shaft) Backlash 1 arc min/3 arc min Specifications

[Notes]

- This performance table is based on pairing with a servo motor running at the rated input speed of 3000 r/min.
- The motor rated output torque is based on values after a warm-up operation of the unit.
- The transmission efficiency percentage is only a reference value.
- The transmission efficiency varies greatly depending on the input speed and the load on the product. Please be cautious.
- The "*" mark indicates a limited torque type. Please make sure to check the motor rated output torque.

Reduction Ratio	Output Shaft Diameter	Motor Power Class	Motor Rated Output Torque (3000 r/min)	Transmission Efficiency
		W	N·m	%
1/10	18	100	2.2	60
	22	200	3.8	60
	28	400	7.8	60
	32	750	16	60
	32	1000	22	70
	40	2000	44	70
1/15	18	100	3.5	65
	22	200	6.4	65
	28	400	13	65
	32	750	26	65
1/20	18	100	5.0	70
	22	200	8.9	65
	28	400	18	65
	32	750	36	70
	32	1000	45	70
	40	2000	90	70
1/25	18	100	6.4	70
	22	200	12	65
	28	400	23	70
	32	750	46	70
1/30	18	100	7.6	75
	22	200	14	65
	28	400	27	70
	32	750	55	70
	32	1000	67	70
	40	2000	144	75
1/40	18	100	10	75
	22	200	19	65
	28	400	36	70
	32	750	76	75
	32	1000	96	75
	40	2000	191	75

Performance Tables [for Calculation and Selection]

Reduction Ratio	Output Shaft Diameter	Motor Power Class	Motor Rated Output Torque (3000 r/min)	Transmission Efficiency
		W	N·m	%
1/50	18	100	13	75
	22	200	24	65
	28	400	45	70
	32	750	95	75
	32	1000	120	75
	40	2000	239	75
1/60	18	100	15	75
	22	200	29	65
	28	400	54	70
	32	750	115	75
	32	1000	143	75
	40	2000	287	75
1/75	18	100	18	70
	28	200	31	60
	32	400	63	65
	40	750	135	70
1/90	18	100	22	70
	28	200	37	60
	32	400	75	65
	40	750	162	70
1/120	18	100	29	70
	28	200	50	60
	32	400	100	65
	40	750	217	70
1/150	28	200	57	60
	32	400	124	65
	40	750	251	70
1/180	28	200	* 57	60
	32	400	* 124	65
	40	750	* 251	70

AF3S Type (Concentric Right Angle Hollow Bore) Low Backlash Specification

[Notes]

- This performance table is based on pairing with a servo motor running at the rated input speed of 3000 r/min.
- The motor rated output torque is based on values after a warm-up operation of the unit.
- The transmission efficiency percentage is only a reference value.
- The transmission efficiency varies greatly depending on the input speed and the load on the product. Please be cautious.

Reduction Ratio	Output Shaft Diameter	Motor Power Class	Motor Rated Output Torque (3000 r/min)	Transmission Efficiency
		W	N·m	%
1/5	30	400	3.8	60
	35	750	7.4	60
	45	2000	24	70
1/7.5	30	400	5.9	60
	35	750	11	60
	45	2000	35	70
1/10	20	100	2.0	60
	25	200	3.8	60
	30	400	7.8	60
	35	750	15	60
	45	2000	47	70
1/12	30	400	11	65
	35	750	20	65
	45	2000	57	70
1/15	20	100	3.1	65
	25	200	6.4	65
	30	400	13	65
	35	750	25	65
	45	2000	69	70
1/20	20	100	4.7	70
	25	200	8.8	65
	30	400	17	65
	35	750	34	70
	45	2000	92	70
1/25	20	100	5.9	70
	25	200	12	70
	30	400	23	70
	35	750	44	70
	45	2000	120	75
1/30	20	100	7.1	70
	25	200	14	70
	30	400	27	70
	35	750	53	70
	45	2000	144	75
1/40	20	100	9.4	70
	25	200	19	70
	30	400	36	70
	35	750	74	75
	45	2000	191	75
1/50	20	100	12	70
	25	200	24	70
	30	400	45	70
	35	750	94	75
	45	2000	239	75

Reduction Ratio	Output Shaft Diameter	Motor Power Class	Motor Rated Output Torque (3000 r/min)	Transmission Efficiency
		W	N·m	%
1/60	20	100	14	70
	25	200	27	70
	30	400	55	70
	35	750	113	75
	45	2000	287	75
1/80	25	100	17	65
	30	200	34	65
	35	400	71	65
	45	750	141	70
1/100	25	100	22	65
	30	200	44	65
	35	400	86	65
	45	750	172	70
1/120	25	100	28	70
	30	200	55	70
	35	400	102	65
	45	750	212	70
1/160	25	100	37	70
	30	200	74	70
	35	400	141	65
	45	750	282	70
1/200	25	100	47	70
	30	200	94	70
	35	400	181	70
	45	750	353	70
1/240	25	100	57	70
	30	200	110	70
	35	400	221	70
	45	750	423	70

AF3F Type (Concentric Right Angle Shaft) Low Backlash Specification

[Notes]
- This performance table is based on pairing with a servo motor running at the rated input speed of 3000 r/min.
- The motor rated output torque is based on values after a warm-up operation of the unit.
- The transmission efficiency percentage is only a reference value.
- The transmission efficiency varies greatly depending on the input speed and the load on the product. Please be cautious.

Reduction Ratio	Output Shaft Diameter	Motor Power Class	Motor Rated Output Torque (3000 r/min)	Transmission Efficiency
		W	N·m	%
1/5	28	400	3.8	60
	32	750	7.4	60
	40	2000	24	70
1/7.5	28	400	5.9	60
	32	750	11	60
	40	2000	35	70
1/10	18	100	2.0	60
	22	200	3.8	60
	28	400	7.8	60
	32	750	15	60
	40	2000	47	70
1/12	28	400	11	65
	32	750	20	65
	40	2000	57	70
1/15	18	100	3.1	65
	22	200	6.4	65
	28	400	13	65
	32	750	25	65
	40	2000	69	70
1/20	18	100	4.7	70
	22	200	8.8	65
	28	400	17	65
	32	750	34	70
	40	2000	92	70
1/25	18	100	5.9	70
	22	200	12	70
	28	400	23	70
	32	750	44	70
	40	2000	120	75
1/30	18	100	7.1	70
	22	200	14	70
	28	400	27	70
	32	750	53	70
	40	2000	144	75
1/40	18	100	9.4	70
	22	200	19	70
	28	400	36	70
	32	750	74	75
	40	2000	191	75
1/50	18	100	12	70
	22	200	24	70
	28	400	45	70
	32	750	94	75
	40	2000	239	75

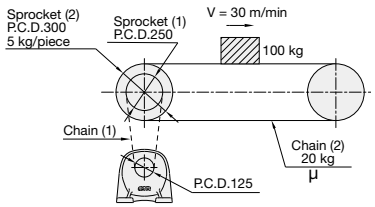
Performance Tables [for Calculation and Selection]

Reduction Ratio	Output Shaft Diameter	Motor Power Class	Motor Rated Output Torque (3000 r/min)	Transmission Efficiency
		W	N·m	%
1/60	18	100	14	70
	22	200	27	70
	28	400	55	70
	32	750	113	75
	40	2000	287	75
1/80	22	100	17	65
	28	200	34	65
	32	400	71	65
	40	750	141	70
1/100	22	100	22	65
	28	200	44	65
	32	400	86	65
	40	750	172	70
1/120	22	100	28	70
	28	200	55	70
	32	400	102	65
	40	750	212	70
1/160	22	100	37	70
	28	200	74	70
	32	400	141	65
	40	750	282	70
1/200	22	100	47	70
	28	200	94	70
	32	400	181	70
	40	750	353	70
1/240	22	100	57	70
	28	200	110	70
	32	400	221	70
	40	750	423	70

Selection Process Steps and Examples

Selection Examples High Precision Reducers for Servo Motors

Application .....Conveyor (light shock load)
Connection method .....Chain (located in the center of the shaft)
Conveyance velocity V .....30 m/min
Workpiece weight.....100 kg
Operation time .....12 hours/day
Number of startups and stops ...720 times/day
Friction coefficient of chain and guide μ...0.2
Servo motor rated speed .....3000 r/min

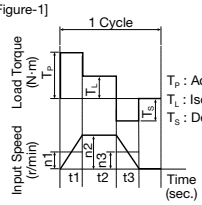


The chain (1), the sprocket (1), and other conditions shall not be included in this calculation.

Please utilize the calculation and selection tool on our website. (https://sentei.nissei-gtr.co.jp/english/servo_calculation)
You may calculate the necessary power by inputting the usage conditions and the series on our website.

Selection Process Steps		Selection Examples
Determining Series and Backlash	**Determining a right angle hollow bore, parallel shaft, or right angle shaft** - Compact Parallel Shaft/Planetary Type APG - Compact Right Angle Hollow Bore Type AFC - Compact Right Angle Shaft Type AFC - Right Angle Hollow Bore Type AF3 - Right Angle Shaft Type AF3 - Parallel Shaft Type AG3 - Right Angle Shaft Type AH2 *Backlash differs depending on the series.	Based on the mounting space, decide on the compact parallel or planetary type APG. Since repeated stop precision is not required, determine 15 arc min for backlash.
Determining the reduction ratio	**Determining the reduction ratio (i)** $i = \frac{\text{Required Speed of Output Shaft}}{\text{Input Shaft Speed}}$	Required speed of output shaft $= \frac{30\times1000}{300\times\pi} \times \frac{250}{125} \approx 63.66$ r/min $i = \frac{63.66}{3000} \approx \frac{1}{47.12}$ Select 1/40 for the reduction ratio since the speed will exceed the servo motor rated speed of 3000 r/min if 1/50 is selected for the reduction ratio. Selected reduction ratio $i = \frac{1}{40}$
Examining the load torque	**Calculating the actual load torque (T_{LE})** Service factor (Sf) in [Table-1] on page 832	Based on the load condition (light shock load) the service factor (Sf) is 1.25. $T_{LE} = 9.8 \times (100 + 5 \times 2 + 20) \times 0.2 \times \frac{300}{2\times1000} \times \frac{125}{250} \times 1.25 = 23.89$ N·m
Examining the inertia	**Calculating the load's moment of inertia of reducer input shaft equivalent (J_i)** Correction coefficient (C) in [Table-1] on page 833	Based on operation conditions, the correction coefficient (C) is 3. $J_i = \left(100 + \frac{1}{2} \times 5 \times 2 + 20\right) \times \left(\frac{300}{2\times1000}\right)^2 \times \left(\frac{125}{250}\right)^2 \times \left(\frac{1}{40}\right)^2 \times 3 = 0.00131836$ kg·m²
Examining the O.H.L.	**Calculating the O.H.L. based on the actual load torque (T_{LE})** $\text{O.H.L.} = \frac{T_{LE} \times fb \times fw}{R}$ R : Pitch Circle Radius (m) of sprocket, pulley, gear, etc. attached to reducer shaft fb: Coefficient for the connection method in [Table-1] on page 835 fw: Coefficient for the load level in [Table-2] on page 835 **Correcting the tolerance based on the O.H.L. position** [Table-1] on page 836	Based on the operation conditions, the coefficient for the connection method (fb) is 1.3, and the coefficient for the load level (fw) is 1.3. $\text{O.H.L.} = \frac{23.89 \times 1.3 \times 1.3}{\frac{125}{2\times1000}} = 645.99$ N The tolerance does not need to be corrected because the load position of the O.H.L. is at the middle of the shaft. * Please add values as needed if there are other factors that may affect the O.H.L. of the product, such as belt tension.
Tentative selection of a model	**Based on the torque, the inertia, and the O.H.L., select a model that meets all conditions.**	$T_{LE} \le$ Motor rated output torque (N·m) in the Performance Table [for Calculation and Selection] on page 812 O.H.L. ≤ Allowable output shaft O.H.L. (N) <Performance Table> Select a model that meets these conditions. * When a tolerance for the load's moment of inertia is set for the servo motor itself, check it as well.
		Tentatively selected model **APGZ22K-40Q400△N** * A flange type code for servo motor mounting will be shown in △.

Selection Process Steps and Examples

Selection Process Steps		Selection Examples
Examining the acceleration and deceleration torques	**Check whether the torques required for accelerating and decelerating the load within the specified time are equal to or lower than the allowable peak torque of startup/stop of the tentatively selected model.** [Figure-1]  T_P : Acceleration Torque T_L : Isokinetic Torque T_S : Deceleration Torque Acceleration Torque: $T_P = \left[\frac{2\pi \times (J_r + \frac{J_t}{C}) \times n2}{60 \times t1} + T_t \right] \times \frac{1}{i_Z} \times \frac{1}{\frac{\eta}{100}}$ Isokinetic Torque: $T_L = \frac{T_{LE}}{Sf}$ Deceleration torque: $T_S = \left[\frac{2\pi \times (J_r + \frac{J_t}{C}) \times n2}{60 \times t3} - T_t \right] \times \frac{1}{i_Z} \times \frac{\eta}{100}$ Load Torque of Input Shaft Equivalent: $(T_t) = T_{LE} \times i_Z$ Jr: Internal Moment of Inertia of Input Shaft Equivalent ($kg \cdot m^2$) <Performance Table> i_z: Actual Reduction Ratio <Performance Table> η: Transmission Efficiency (%) in Performance Table [for Calculation and Selection] on page 812	Since the selected reduction ratio is 1/40, the servo motor speed at V = 30 m/min is 2547 r/min. [Operation conditions] Acceleration time t1: 0.2 sec. Input speed during acceleration n1: 1273.5 r/min Isokinetic time t2: 1.0 sec. Input speed during isokinetic operation n2: 2547 r/min Deceleration t3: 0.4 sec. Input speed during deceleration n3: 1273.5 r/min * The input speed during acceleration n1 and the input speed during deceleration n3 shall be the average value (n2/2) of the input speed during isokinetic operation n2. Performance values of the tentatively selected model APGZ22K-40Q400△N J_r: Internal Moment of Inertia of Input Shaft Equivalent ($kg \cdot m^2$) … 0.0000143 i_z: Actual reduction ratio … 1/40 η: Transmission Efficiency (%) … 75 Calculate the load torque of input shaft equivalent (T_t). $T_t = 23.89 \times \frac{1}{40} = 0.6$ N·m Acceleration Torque $T_P = \left[\frac{2\pi \times (0.0000686 + \frac{0.00131836}{3}) \times 2547}{60 \times 0.2} + 0.6 \right] \times \frac{1}{\frac{1}{40}} \times \frac{1}{\frac{75}{100}}$ = 64.3 N·m ≤ 122 N·m Allowable peak torque of startup/stop of the tentatively selected model APGZ22K-40Q400△N <Performance Table> Verdict: Acceptable Isokinetic Torque $T_L = \frac{23.89}{1.25} = 19.1$ N·m Deceleration Torque $T_S = \left[\frac{2\pi \times (0.0000686 + \frac{0.00131836}{3}) \times 2547}{60 \times 0.4} - 0.6 \right] \times \frac{1}{\frac{1}{40}} \times \frac{1}{\frac{75}{100}}$ = 15.9 N·m ≤ 122 N·m Allowable peak torque of startup/stop of the tentatively selected model APGZ22K-40Q400△N <Performance Table> Verdict: Acceptable
Examining the average load torque	**Check whether the average load torque is equal to or lower than the allowable average torque of the tentatively selected model.** Average Load Torque $T_M = \sqrt[3]{\frac{n_1 \times t_1 \times \lvert T_P \rvert^3 + n_2 \times t_2 \times \lvert T_L \rvert^3 + n_3 \times t_3 \times \lvert T_S \rvert^3}{n_1 \times t_1 + n_2 \times t_2 + n_3 \times t_3}}$	Average Load Torque $T_M = \sqrt[3]{\frac{1273.5 \times 0.2 \times \lvert 64.3 \rvert^3 + 2547 \times 1 \times \lvert 19.1 \rvert^3 + 1273.5 \times 0.4 \times \lvert 15.9 \rvert^3}{1273.5 \times 0.2 + 2547 \times 1 + 1273.5 \times 0.4}}$ = 29.8 N·m ≤ 40.7 N·m Allowable average torque of the tentatively selected model APGZ22K-40Q400△N <Performance Table> Verdict: Acceptable
Result of model selection	**Decide on the tentatively selected model based on the judgment results of the acceleration, deceleration, and average load torques.**	Since the judgment results of all of the acceleration, deceleration, and average load torqued are acceptable, select the model **APGZ22K-40Q400△N**. * A flange type code for servo motor mounting will be shown in △. If even one of the verdicts is unacceptable, reexamine a model with the next higher level of power, or reexamine the tentatively selected model by reducing the load torque and other conditions.

Service Factor/Allowable Moment of Inertia

Service Factor (Sf)

A reducer is designed under the condition of operating for ten hours/day under a light shock load.
When you use a reducer under a condition of a longer operation time under a heavier shock load, correct the load torque based on the service factor shown in the table below.

[Table-1]

Load Condition	Service Factor (Sf)			Application Example
	Operating for less than three hours/day	Operating for three to ten hours/day	Operating for more than ten hours/day	
Uniform load	1	1	1	Conveyors (uniform load), screens, agitators (low viscosity), water treatment machines (light load), machine tools (feed shafts), elevators, extruders, distillers
Light shock load	1	1	1.25	Conveyors (nonuniform or heavy load), agitators (high viscosity), machines for vehicles, water treatment machines (moderate load), hoists (light load), paper mills, feeders, food machines, pumps, sugar making machines, textile machines
Heavy shock load	1	1.25	1.5	Hoists (heavy load), hammer mills, metal working machines, crushers, tumblers

Allowable Moment of Inertia J

If a reducer with a high inertia load is operated intermittently, high torque may be instantaneously produced when it starts to run (or when it stops if it is provided with a brake), resulting in an unexpected accident. Keep the level of the inertia of the application within the allowable value shown in the table below in accordance with the connection method and the frequency of startup.

APG/AFC Types

[Table-2]

Motor Power Class (W)	Allowable Moment of Inertia (Input Shaft Equivalent) ($\times 10^{-4}$kg·m^2)
100	1.1
200	3.2
400	4.2
750	13.8
1000	16.3
1500	21.0
2000	26.0
3000	35.0

Note: The power indicates the power designation of the model and type codes of the reducer.

AG3/AH2/AF3 Types

■ Backlash 1 arc min/3 arc min Specifications

Motor Power Class (W)	Frame Size	Reduction Ratio	Allowable Moment of Inertia (Input Shaft Equivalent) ($\times 10^{-4}$kg·m^2)
100	15 (18)	1/10 to 1/120	2.5
200	25 (22)	1/10 to 1/60	5.0
	30 (28)	1/75 to 1/120	3.5
		1/150	2.2
		1/180	1.5
400	30 (28)	1/10 to 1/60	10.0
	35 (32)	1/75 to 1/120	7.0
		1/150	4.5
		1/180	3.1
750	35 (32)	1/10 to 1/60	16.3
	45 (40)	1/75 to 1/120	11.4
		1/150	7.3
		1/180	5.0
1000	35 (32)	1/10 to 1/60	16.3
2000	45 (40)	1/10 to 1/60	32.6

Note: The power indicates the power designation of the model and type codes of the reducer.

■ Low Backlash

Motor Power Class (W)	Allowable Moment of Inertia (Input Shaft Equivalent) ($\times 10^{-4}$kg·m^2)
100	2.5
200	5
400	10
750	16.3
2000	32.6

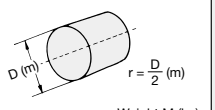
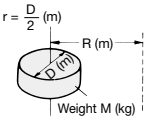
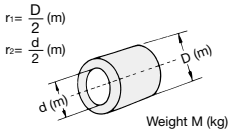
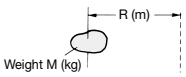
Correction coefficient of moment of inertia J according to operating conditions

[Table-1]

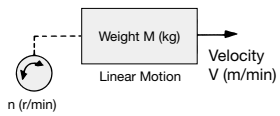
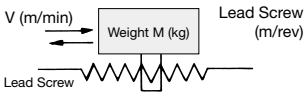
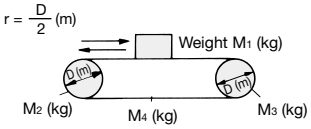
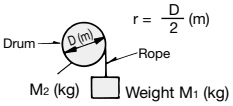
Connection Method	Frequency of Startup	Correction Coefficient
When no looseness occurs because of direct coupling etc.	70 times/day max	1
	More than 70 times/day	1.5
When looseness occurs due to chain fastening etc.	70 times/day max	2
	More than 70 times/day	3

Method for Calculating the Moment of Inertia

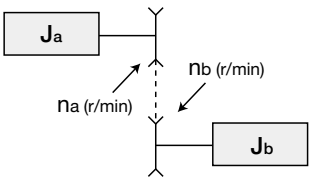
■ Rotor's moment of inertia J

If the center of rotation is aligned with the center of gravity		If the center of rotation is not aligned with the center of gravity	
	SI Units		SI Units
	$J = \frac{1}{2} Mr^2$ (kg·m²)		$J = \frac{1}{2} Mr^2 + MR^2$ (kg·m²)
	$J = \frac{1}{2} M(r_1^2 + r_2^2)$ (kg·m²)		(If the size is negligible) $J = MR^2$ (kg·m²)

■ Moment of inertia J in linear motion

		SI Units
General case		$J = \frac{1}{4} M \cdot \left(\frac{V}{\pi \cdot n}\right)^2$ (kg·m²)
In the case of horizontal linear motion (When moving an object with a lead screw)		$J = \frac{1}{4} M \cdot \left(\frac{P}{\pi}\right)^2 = \frac{1}{4} M \cdot \left(\frac{V}{\pi \cdot n}\right)^2$ (kg·m²)
In the case of horizontal linear motion (Conveyor etc.)		$J = M_1r^2 + \frac{1}{2} M_2r^2 + \frac{1}{2} M_3r^2 + M_4r^2$ (kg·m²)
In the case of vertical linear motion (Crane, winch, etc.)		$J = M_1r^2 + \frac{1}{2} M_2r^2$ (kg·m²)

■ Conversion of the moment of inertia J when the speed ratio is available



Convert the load's moment of inertia J_b into the equivalent value on the n_a shaft.

$$J = J_a + \left(\frac{n_b}{n_a}\right)^2 \times J_b$$

Overhung Load (O.H.L.)

Overhung Load (O.H.L.)

An overhung load (O.H.L.) is a suspending load imposed on a shaft. When a chain, belt, gear, etc. are used to couple the reducer shaft with the machine working with it, this O.H.L. must be taken into consideration.

APG/AFC Types

$$\text{O.H.L.} = \frac{T_{LE}}{R} \times fb \times fw \text{ (N)}$$

- T_{LE} : Equivalent output torque acting on the reducer shaft (N·m)
- R : Pitch circle radius (m) of the sprocket, pulley, gear, etc. attached to reducer shaft
- fb : Refer to the coefficient for the connection method [Table-1].
- fw : Refer to the coefficient for the load level [Table-2].

Be sure to make the O.H.L. value calculated from the equation shown above smaller than the corrected O.H.L. Fx (page 836).

■ Connection Coefficient fb [Table-1]

Connection Method	fb
Timing belt	1.2
Gear, chain	1.3
V belt	2
Flat belt (with tension pulley)	3
Flat belt	4

■ Load Factor fw [Table-2]

Load Level	fw
Smooth operation without shock	1.2
Ordinary operation	1.3
Operation with vibration or shock load	2

AG3/AH2/AF3 Types

$$\text{O.H.L.} = \frac{T_{LE} \times K_1 \times K_2}{R} \text{ (N)}$$

- T_{LE} : Equivalent output torque acting on the reducer shaft (N·m)
- R : Pitch circle radius (m) of the sprocket, pulley, gear, etc. attached to reducer shaft
- K_1 : Refer to the coefficient for the connection method [Table-3].
- K_2 : Refer to the coefficient for the load point [Table-4].

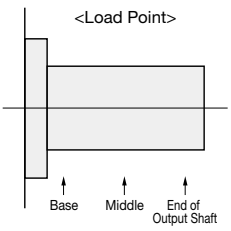
Be sure to make the O.H.L. value calculated from the equation shown above smaller than the allowable O.H.L. value listed in the performance table.

■ Coefficient K_1 [Table-3]

Connection Method	K_1
Chain, timing belt	1.00
Gear	1.25
V belt	1.50

■ Coefficient K_2 [Table-4]

Load Point	K_2
Base of the shaft	0.75
Middle of the shaft	1.00
End of Output Shaft	1.50



Correcting the tolerance based on the O.H.L. position

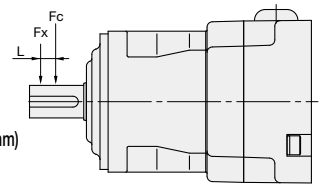
APG Type

(1) Point of O.H.L.
Allowable output shaft O.H.L. of the APG Type is calculated at the middle of the shaft.

(2) Correcting the allowable output shaft O.H.L.
Correct the allowable output shaft O.H.L. with the equation shown below in accordance with the conditions under which the motor will be used.

$$Fx = Fc \times \frac{A}{A+L}$$

- Fx : Corrected O.H.L. (N)
- Fc : Allowable Output Shaft O.H.L. (N)
- A : Parameter (mm)
- L : O.H.L. load point (amount of displacement from the middle of the shaft) (mm)



■ Constant A

[Table-1]

Frame Size	A (mm)
12	23.5
18	32
22	38.5
28	43.5

AFC Type

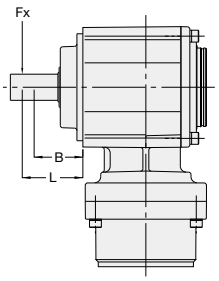
(1) Load point of O.H.L.
Allowable output shaft O.H.L. is calculated at Bmm from the flange surface.

(2) Correcting the load of the allowable output shaft O.H.L.
Correct the allowable output shaft O.H.L. with the equation shown below in accordance with the conditions under which the motor will be used.

a. When one end of the output shaft is not borne by a pillow

$$Fx = Fc \times \frac{C+B}{C+L}$$

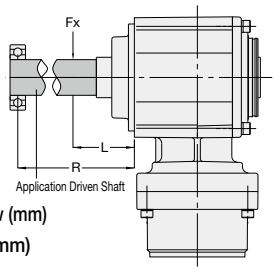
- Fx : Corrected O.H.L. (N)
- Fc : Allowable Output Shaft O.H.L. (N)
- B : Parameter (mm)
- C : Parameter (mm)
- L : O.H.L. load point (distance from the flange surface) (mm)



b. When one end of the output shaft is borne by a pillow

$$Fx = Fc \times \frac{R}{R-L}$$

- Fx : Corrected O.H.L. (N)
- Fc : Allowable Output Shaft O.H.L. (N)
- R : Distance from the flange surface to the center of the pillow (mm)
- L : O.H.L. load point (distance from the flange surface) (mm)



■ Constant B

(Load point of the allowable output shaft O.H.L.)

Frame Size	B (mm)
12	22
15	35
18	35
22	41
28	43.5
32	48.5

■ Constant C

Frame Size	C (mm)
12	50
15	52
18	58
22	68
28	78.5
32	91.5

AF3S Type <Backlash 1 arc min/3 arc min Specifications>

(1) Load point of O.H.L.
The load point of the allowable O.H.L. is calculated at 20 mm from the flange surface.

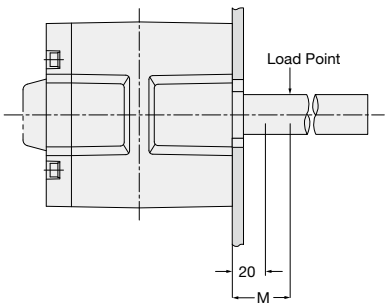
(2) Correcting the load of the allowable output shaft O.H.L.
Correct the allowable output shaft O.H.L. with the equation shown below in accordance with the conditions under which the motor will be used.

a. When one end of the output shaft is not borne by a pillow

If the load point M of the O.H.L. is more than 20 mm, adjust via:

Please correct using the following formula:

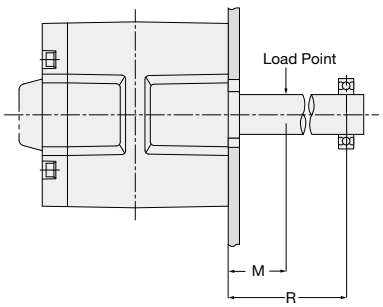
$$\text{Corrected O.H.L. (N)} = \frac{B+20}{B+M} \times \text{Allowable O.H.L. (N)}$$



b. When one end of the output shaft is borne by a pillow

Please correct using the following formula:

$$\text{Corrected O.H.L. (N)} = \frac{R}{R-M} \times \text{Allowable O.H.L. (N)}$$



■ Constant B

Frame Size	B (mm)
15	55
25	56
30	61
35	70
45	85

AF3S Type <Low Backlash Specification>

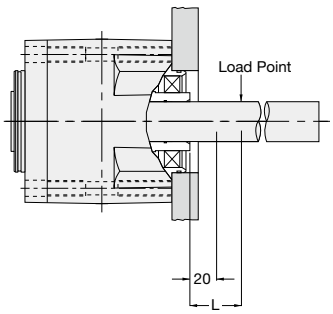
(1) Load point of O.H.L.
The load point of the allowable O.H.L. is calculated to be 20 mm from the end of the output shaft.

(2) Correcting the load of the allowable output shaft O.H.L.
Correct the allowable output shaft O.H.L. with the equation shown below in accordance with the conditions under which the motor will be used.

a. When one end of the output shaft is not borne by a pillow

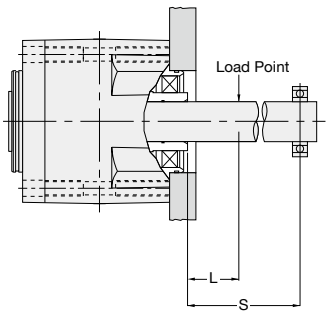
If the load point L of the O.H.L. is more than 20 mm,

$$\text{Corrected O.H.L. (N)} = \frac{A+20}{A+L} \times \text{Allowable O.H.L. (N)}$$



b. When one end of the output shaft is borne by a pillow

$$\text{Corrected O.H.L. (N)} = \frac{S}{S-L} \times \text{Allowable O.H.L. (N)}$$



■ Constant A

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

Thrust Load

Use the motor under a condition that meets the equation shown below.

Thrust load (N) × fw ≤ Allowable output shaft thrust load (N) [fw: coefficient based on the load level]

■ Load factor fw

Load Level	fw
Smooth operation without shock	1.2
Ordinary operation	1.3
Operation with vibration or shock load	2

If an excessive thrust load is applied under the usage conditions, contact your nearest Sales Office or the CS Center.

Continuous Rated Input Torque of Reducers

If the rated speed of the servo motor is below 3000 r/min, be careful with the continuous rated torque of the servo motor. Select a reducer whose continuous rated input torque (table below) is higher than the continuous rated torque of the servo motor.

Reducer Power	Continuous Rated Input Torque (N·m)
100 W Class	0.32
200 W Class	0.64
400 W Class	1.3
750 W Class	2.4
1000 W Class	3.2
1500 W Class	4.8
2000 W Class	6.4
3000 W Class	9.6

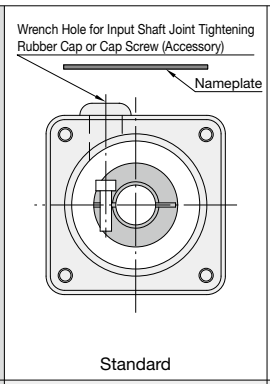
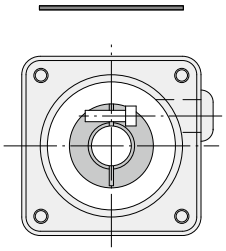
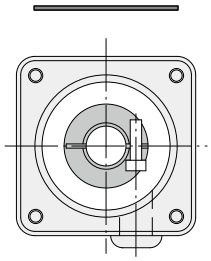
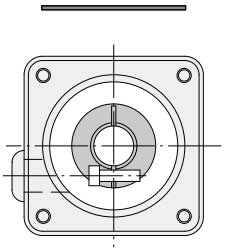
Backlash Value

Backlash value is defined as the amount of return(converted to angle unit) to point zero upon applying a small torque (±5 % of the rated torque) on the output shaft whilst having the input shaft locked in, then releasing the output shaft.

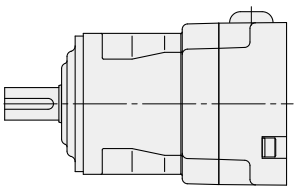
Change of Position of Wrench Hole for Input Shaft Joint Tightening

Order Method

If you intend to use the wrench hole for input shaft joint tightening in a position other than the standard position, order it with the appropriate option code shown below.

Design	Standard	Wrench Hole (Right)	Wrench Hole (Lower)	Wrench Hole (Left)
				
Option Code	Standard	B3	B6	B9

Note 1: All diagrams are views from the input side of the motor.
Note 2: Instructions not necessary if ordered standard.
Note 3: The side in which the nameplate is attached for a standard product shall be the standard position of the wrench hole for input shaft joint tightening.
Note 4: ═ indicates the attachment position of the nameplate.



List of Applicable Models (AFC/AG3/AH2/AF3)

The APG Type can be installed by turning 90 ° because its four mounting holes are provided on the four corners of the square.
The AFC type is available for all models.
For the AG3, AH2, and AF3 Types, refer to the table shown below.

■ Backlash 1 arc min/3 arc min Specifications

Power (W)	Frame Size	AF3 Type
100	18 (15)	△
200	22 (25)	○
	28 (30)	○
400	28 (30)	○
	32 (35)	○
750	32 (35)	○
	40 (45)	○
1000	32 (35)	○
2000	40 (45)	○

Note 1: The figures in the parentheses indicate the frame sizes of right angle hollow bore types.
Note 2: The model marked with "△" in the table is available only for a low wrench hole for input shaft joint tightening.
Note 3: For the models marked with *, please contact your nearest Sales Office or the CS Center.

■ Backlash 30 arc min Specification

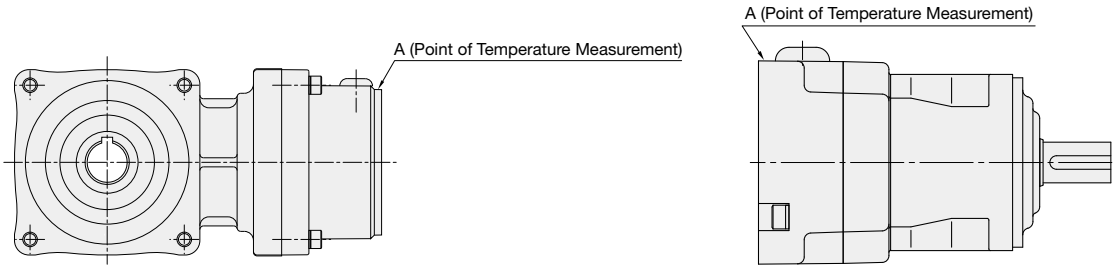
Power (W)	Frame Size	AG3 Type	AH2 Type	AF3 Type
100	18 (20)	*	*	○
	22 (25)	*	*	○
200	18	*	*	*
	22 (25)	*	*	○
	28 (30)	*	*	○
400	22	○	*	*
	28 (30)	○	○	○
	32 (35)	○	○	○
750	28	○	*	*
	32 (35)	○	○	○
	40 (45)	○	○	○
2000	32	○	*	*
	40 (45)	○	○	○
	50	○	○	*

Precautions for Installation

Installation Environment

Ambient Temperature	0 °C to 40 °C
Ambient Humidity	85 % or less
Altitude	1,000 m or lower
Installation Environment	A place free from corrosive gas, explosive gas, and/or vapor. Well ventilated place with no dust.
Installation Place	Indoors

Take care to keep the surface temperature (area A) below 90 °C.
If the surface temperature exceeds 90 °C, cool it with an external fan or heat sink to keep it below 90 °C.



Installation Procedure

Secure the reducer with four bolts on a vibration-free and flat machine-processed surface.
If the foundation is bad or the mounting surface is not flat enough, vibration may occur during operation and the service life of the reducer may be shortened.
Make sure the flatness of the mounting surface is 0.1 mm or less.

Installation Orientation

All models adopt a grease lubrication method and can therefore be installed in any orientation.

Connection with application

1. H7 fit is recommended for a coupling, sprocket, pulley, gear, etc. to be attached to the reducer shaft.
2. In direct coupling, accurately align the center of the reducer shaft and that of the mating shaft.
3. In chain or gear engagement, keep the reducer shaft and the mating shaft parallel accurately to each other, and install the device so that the line connecting the centers of both shafts is perpendicular to the shafts.
4. When attaching a coupling or application to the output shaft, do not apply strong impacts via hammer or similar tool. The bearing may get damaged and cause an abnormal sound, vibrations, or damage.