How to Read Gearhead Specifications

Gearheads are shown for both AC standard motors and Speed Control Systems.

● Gearmotor – Torque Table (Example)

◆ Single-Phase115/230 VAC, 60 Hz

Unit = Upper values: lb-in/Lower values: N·m

Model		Speed r/min	600	500	360	300	240	200	144	120	100	72	60	50	36	30	24	20	18	15	12	10
		Gear Ratio	**3**	**3.6**	**5**	**6**	**7.5**	**9**	**12.5**	**15**	**18**	**25**	**30**	**36**	**50**	**60**	**75**	**90**	**100**	**120**	**150**	**180**
5RK90GU-AWU **5RK90GU-AWTU**	**5GU□KA**		12.3 1.4	15 1.7	21 2.4	24 2.8	31 3.6	38 4.3	46 5.3	56 6.4	68 7.7	85 9.7	102 11.6	123 13.9	170 19.3	177 20	177 20	177 20	177 20	177 20	177 20	177 20

① Permissible Torque: It refers to the value of load torque driven by the gearhead's output shaft.
Each value is shown for the corresponding gear ratio.

Permissible torque when a gearhead is connected can be calculated with the equation below.
Permissible torque for some products are omitted. In that case, use the equation below to calculate the permissible torque.

Permissible Torque $T_G = T_M \times i \times \eta$

T_G : Permissible Torque of Gearhead
T_M : Motor Torque
i : Gear Ratio of Gearhead
η : Gearhead Efficiency

● Gearhead Efficiency

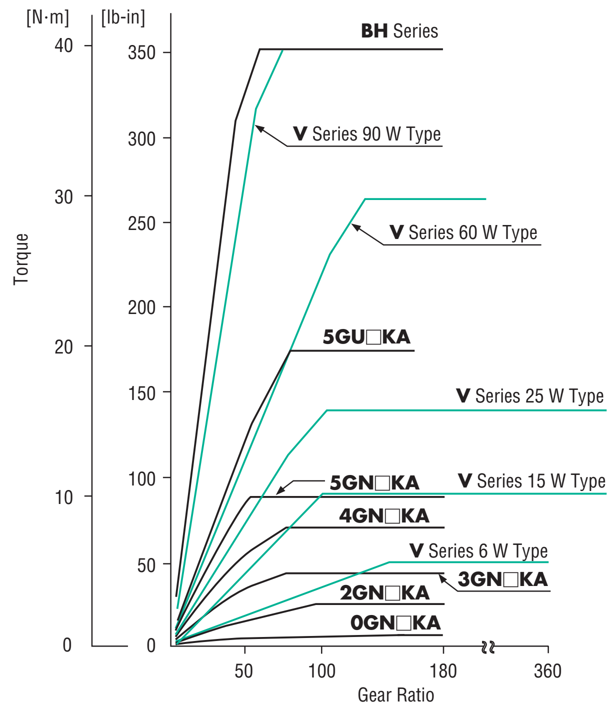
Model \ Gear Ratio	**3**	**3.6**	**5**	**6**	**7.5**	**9**	**12.5**	**15**	**18**	**25**	**30**	**36**	**50**	**60**	**75**	**90**	**100**	**120**	**150**	**180**	**250**	**300**	**360**
V Series 6 W, 15 W, 25 W Type			90 %								86 %								81 %				
V Series 40 W, 60 W Type			90 %							86 %								81 %					
V Series 90 W Type			90 %						86 %						81 %								
2GN□KA, 3GN□KA, **4GN□KA, 5GN□KA,**	81 %									73 %			66 %										
0GN□KA, 5GU□KA,	81 %						73 %			66 %					59 %								
5GU□KHA													66 %		59 %								
BH Series		90 %		90 %		90 %		86 %			86 %			81 %		81 %		81 %		81 %			
BHF Series	90 %		90 %			90 %		86 %			86 %		81 %				81 %			81 %			

Model \ Gear Ratio	**5**	**10**	**15**	**20**	**30**	**50**	**100**	**200**
BX Series 30~120 W Type **FBL Ⅱ** Series **AXH** Series 30~100 W Type	90 %				86%			81%
BX Series 200 W, 400 W Type	81 %			73%			66%	

- The efficiency of the BH6G2-□RH and BH6G2-□RA is 73% for all gear ratios, both during rated operation and at start.
- Gearhead efficiency of all the decimal gearheads is 81%.
- For the efficiency of Right-Angle Gearheads, see the page for Right-Angle Gearheads. The efficiency of Right-Angle Gearheads → Page A-191

Maximum Permissible Torque

The gearhead output torque increases proportionally as the gear ratio increases. However, factors affecting the gearhead mechanical strength such as gear construction and materials etc., limit the size of the load which can be applied to the gearhead. This torque is called the maximum permissible torque.
The maximum permissible torques of typical gearheads are shown in the figure to the right.



(Maximum Permissible Torque of Gearhead)

Speed and Direction of Rotation
Gearmotor – Torque Table (Example)

◆ Single-Phase 115 VAC/230 VAC, 60 Hz

Unit = Upper values: lb-in/Lower values: N·m

Model	Speed ① r/min	600	500	360	300	240	200	144	120	100	72	60	50	36	30	24	20	18	15	12	10
	Gear Ratio	**3**	**3.6**	**5**	**6**	**7.5**	**9**	**12.5**	**15**	**18**	**25**	**30**	**36**	**50**	**60**	**75**	**90**	**100**	**120**	**150**	**180**
5RK90GU-AWU **5RK90GU-AWTU**	**5GU□KA**	12.3 1.4	15 1.7	21 2.4	24 2.8	31 3.6	38 4.3	46 5.3	56 6.4	68 7.7	85 9.7	102 11.6	123 13.9	170 19.3	177 20	177 20	177 20	177 20	177 20	177 20	177 20

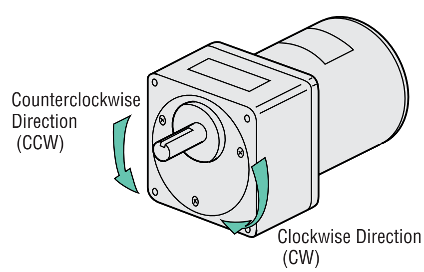
① Speed: This refers to the speed of rotation in the gearhead output shaft. The speeds, depending on gear ratio, are shown in the permissible torque table when the gearhead is attached. The speed is calculated by dividing the motor's synchronous speed by the gear ratio. The actual speed, according to the load condition, is 2~20% less than the displayed value.

The speed is calculated with the following equation.

$$\text{Speed } N_G = \frac{N_M}{i}$$

N_G : Speed of Gearhead [r/min]
N_M : Speed of Motor [r/min]
i : Gear Ratio of Gearhead

② Direction of rotation: This refers to the direction of rotation viewed from the output shaft. The shaded areas indicate rotation in the same direction as the motor shaft, while the others rotate in the opposite direction. The direction of gearhead shaft rotation may differ from motor shaft rotation depending on the gear ratio of the gearhead. The gear ratio and rotation direction of each gearhead is shown in the table below.



◆ Gear Ratio and Rotation Direction of Gearhead (Example)

For details see the page where each product is listed.

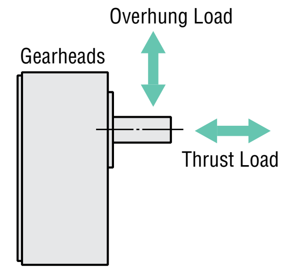
□ ······ Same direction as the motor shaft
□ ······ Opposite direction as the motor shaft

Model \ Gear Ratio	3	3.6	5	6	7.5	9	12.5	15	18	25	30	36	50	60	75	90	100	120	150	180
2GN□KA, 3GN□KA, 4GN□KA, 5GN□KA, 5GC□KA																				
0GN□KA, 5GU□KA, 5GCH□KA																				
5GU□KHA																				

✻ Connection of a decimal gearhead reduces the speed by 10:1, but does not affect the direction of rotation.

Specifications Table for Permissible Overhung Load and Permissible Thrust Load (Example)

Gearhead Mode	Gear Ratio	Maximum Permissible Torque lb-in (N·m)	Permissible Overhung Load lb.(N) ① 0.39 inch (10 mm) from shaft end	Permissible Overhung Load lb.(N) ① 0.79 inch (20 mm) from shaft end	Permissible Thrust Load lb.(N) ②
4GN□KA	**3~18**	70 (8.0)	22 (100)	33 (150)	11 (50)
	25~180		45 (200)	67 (300)	



① Permissible Overhung Load: The value ① shown in the table above is the one for the permissible overhung load. As shown in the figure above, permissible overhung load is the permissible value of the load applied in a direction perpendicular to the gearhead output shaft.

② Permissible Thrust Load: The value ② shown in the table above is the one for permissible thrust load specifications. As shown in the figure above, this term refers to the permissible value of load applied in the axial direction to the gearhead output shaft.

When a chain, gear, belt, etc. is used as the transmission mechanism, an overhung load is always applied the output shaft.
The overhung load is calculated with the following equation.

$$\text{Overhung Load } W = \frac{K \times T \times f}{\gamma}$$

W: Overhung Load [lb. (N)]
K: Load Coefficient for Driving Method (See the right table)
T: Torque at Gearhead Output Shaft [lb-in (N·m)]
f: Service Factor
γ: Effective Radius of Gear or Pulleys [in. (m)]

◇Load Coefficient for Driving Method (K)

Drive System	K
Chain or Synchronous belt	1
Gear	1.25
V-belt	1.5
Flat belt	2.5

◇Service Factor (f)

Load Type	Example	Factor f
Uniform Load	· Unidirectional continuous operation · For driving belt conveyors and film rollers that are subject to minimal load fluctuation	1.0
Light Impact	· Frequent starting and stopping · Cam drive and inertial body positioning via stepping motor	1.5
Medium Impact	· Frequent instantaneous bidirectional operation, starting and stopping of reversible motors · Frequent instantaneous stopping via brake pack of AC motors · Frequent instantaneous starting and stopping of brushless motors, servo motors	2.0

Permissible Load Inertia for Gearheads

This refers to the permissible value for load inertia (J) at the gearhead output shaft. Based on the permissible value at the motor output shaft, calculate J with the following equation and convert it into the permissible value for the gearhead output shaft.

Permissible Load Inertia

Gear ratio 3:1~50:1 $J_G = J_M \times i^2$
Gear ratio 60:1 or higher $J_G = J_M \times 2500$

J_G: Permissible Load Inertia at the gearhead output shaft J [oz-in^2 (kg·m^2)]
J_M: Permissible Load Inertia at the motor shaft J [oz-in^2 (kg·m^2)]
i : Gear ratio (Example: i = 3 means the gear ratio of 3:1)

◆ Permissible Load Inertia at the Gearhead Output Shaft (Example)

No. of Phase	Frame Size	Output Power	Permissible Load Inertia at Motor Shaft J [oz-in^2 ($\times 10^{-4}$ kg·m^2)]
Single-Phase	3.15 inch (80 mm)	25 W (1/30 HP)	1.7 (0.31)

For some products that are combination types, the permissible load inertia at the gearhead output shaft is directly shown as the specifications values, divided with each gear ratio.

Common Specifications

Permissible Overhung Load and Permissible Thrust Load of Round Shaft Motors

Permissible Overhung Load

Motor			Permissible Overhung Load lb. N			
Motor Frame Size in. (mm)	Motor Shaft Size in. (mm)	Series	0.39 in. (10 mm) from shaft end		0.79 in. (20 mm) from shaft end	
□1.64 (□42)	ϕ0.1969 (ϕ5)	**K**	9	40	—	—
□2.36 (□60)	ϕ0.2500 (ϕ6.35)	World **K**	11.2	50	24	110
□2.76 (□70)	ϕ0.2500 (ϕ6.35)	World **K**	9	40	13.5	60
□3.15 (□80)	ϕ0.3125 (ϕ7.937) ϕ0.3150 (ϕ8)	World **K** **K**	20	90	31	140
□3.54 (□90)	ϕ0.3750 (ϕ9.525) ϕ0.3937 (ϕ10)	World **K** **K**	31	140	45	200
	ϕ0.4724 (ϕ12)	World **K** **K**	54	240	60	270
□4.09 (□104)	ϕ0.5512 (ϕ14)	**BH**	72	320	78	350

Permissible Thrust Load

Avoid thrust as much as possible. If thrust load is unavoidable, keep it to no more than half the motor weight.

Permissible Overhung Load and Permissible Thrust Load of Gearheads

Model	Gear Ratio	Maximum Permissible Torque		Permissible Overhung Load lb. N				Permissible Thrust Load	
				0.39 in. (10 mm) from shaft end		0.79 in. (20 mm) from shaft end			
		lb-in	N·m					lb.	N
0GN□KA	**3~180**	8.8	1.0	4.5	20	—	—	3.3	15
2GN□KA	**3~18**	26	3.0	11.2	50	18	80	6.7	30
	25~180			27	120	40	180		
3GN□KA	**3~18**	44	5.0	18	80	27	120	9	40
	25~180			33	150	56	250		
4GN□KA	**3~18**	70	8.0	22	100	33	150	11.2	50
	25~180			45	200	67	300		
5GN□KA, 5GC□KA	**3~18**	88	10	56	250	78	350	22	100
	25~180			67	300	101	450		
5GU□KA, 5GCH□KA	**3~9**	177	20	90	400	112	500	33	150
	12.5~18			101	450	135	600		
	25~180			112	500	157	700		
5GU□KHA	**50~180**	260	30	90	400	135	600	33	150
VHI206, VHR206 Type	**5~9**	53	6	22	100	33	150	9	40
	12.5~25			33	150	45	200		
	30~360			45	200	67	300		
VHI315, VHR315 Type	**5~9**	88	10	33	150	45	200	18	80
	12.5~25			45	200	67	300		
	30~360			67	300	90	400		
VHI425, VHR425 Type	**5~9**	141	16	45	200	56	250	22	100
	12.5~25			67	300	78	350		
	30~360			101	450	123	550		
VHI540, VHR540 Type **VHI560, VHR560** Type	**5~9**	260	30	90	400	112	500	33	150
	12.5~18			101	450	135	600		
	25~300			112	500	157	700		
VHI590, VHR590 Type	**5~9**	350	40	90	400	112	500	33	150
	12.5~18			101	450	135	600		
	25~180			112	500	157	700		
BHI62, BHF62 Parallel Shaft Type	**3~36**	350	40	123	550	180	800	45	200
	50~180			146	650	220	1000		
BHI62RH Right-Angle Hollow Shaft Type **BHF62RH** Right-Angle Hollow Shaft Type	**5~36**	530	60	270*	1200*	240*	1100*	67	300
	50~180			490*	2200*	450*	2000*		
BHI62RA Right-Angle Solid Shaft Type **BHF62RA** Right-Angle Solid Shaft Type	**5~36**	530	60	200	900	220	1000	67	300
	50~180			380	1700	410	1850		
FPW425 Type	**3~18**	70	8.0	22	100	33	150	11.2	50
	25~180			45	200	67	300		
FPW540 Type	**3~18**	88	10	56	250	78	350	22	100
	25~180			67	300	101	450		
FPW560 Type	**3~9**	132	15	90	400	112	500	33	150
	12.5~18			101	450	135	600		
	25~180			112	500	157	700		
FPW690 Type	**3~9**	260	30	123	550	180	800	45	200
	12.5~180			146	650	220	1000		

- For permissible overhung load and permissible thrust load of **4GN□RH**, **5GN□RH**, **5GU□RH** (Right-Angle Gearheads Hollow Shaft Type), see the page where the products are listed. →Page A-189

* For **BH** and **BHF** Series Right-Angle Hollow Shaft Combination Types, the permissible overhung load values are distances from the flange mounting surface. The permissible overhung loads at each distance is calculated with the equation on the following page.

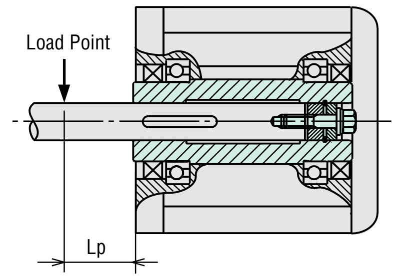
◆ Calculating the Permissible Overhung Load for BH6G2-□RH

As shown in the figure below, when the end of the shaft being driven is supported, calculate the permissible overhung load using the following equation. (This mechanism is the most demanding in terms of overhung load.)

● Gear Ratio 5:1～36:1

$$\text{Permissible Overhung Load W [lb. (N)]} = \frac{3.44\text{ in. (87.5 mm)}}{3.44\text{ in. (87.5 mm)} + L_p} \times 300\text{ lb. (1350 N)}$$

300 lb. (1350 N): Permissible Overhung Load at the flange mounting surface



● Gear Ratio 50:1～180:1

$$\text{Permissible Overhung Load W [lb. (N)]} = \frac{3.44\text{ in. (87.5 mm)}}{3.44\text{ in. (87.5 mm)} + L_p} \times 550\text{ lb. (2450 N)}$$

550 lb. (2450 N): Permissible Overhung Load at the flange mounting surface

■ Permissible Load Inertia of Gearhead

When a high load inertia (J) is connected to a gearhead, high torques are exerted instantaneously on the gearhead when starting up in frequent, discontinuous operations (or when stopped by an electromagnetic brake, or when stopped instantaneously by a speed control motor). Excessive impact loads can be the cause of gearhead or motor damage.
The table below gives values for permissible load inertia on the motor shaft. Use the motor and gearhead within these parameters. The permissible inertial load value shown for three-phase motors is the value when reversing after a stop.
The permissible load inertia (J) on the gearhead output shaft is calculated with the following equation.
The life of the gearhead when operating at the permissible inertial load with instantaneous stops of the motors with electromagnetic brakes or speed control motors is at least 2 million cycles.

● Permissible Load Inertia at Gearhead Output Shaft

Gear ratio 3:1～50:1 $J_G = J_M \times i^2$
Gear ratio 60:1 or higher $J_G = J_M \times 2500$

J_G: Permissible Load Inertia at the gearhead output shaft J [oz-in^2 (kg·m^2)]
J_M: Permissible Load Inertia at the motor shaft J [oz-in^2 (kg·m^2)]
i : Gear ratio (Example: i = 3 means the gear ratio of 3:1)

● Permissible Load Inertia at the Motor Shaft
AC Motor

No. of Phase	Frame Size inch (mm)	Output Power W (HP)	Permissible Load Inertia at Motor Shaft J: oz-in^2 ($\times 10^{-4}$ kg·m^2)
Single-Phase	1.64 (42) sq.	1 (1/750)	0.088 (0.016)
	2.36 (60) sq.	6 (1/125)	0.34 (0.062)
	2.76 (70) sq.	15 (1/50)	0.77 (0.14)
	3.15 (80) sq.	25 (1/30)	1.7 (0.31)
	3.54 (90) sq.	40 (1/19)	4.1 (0.75)
		60 (1/12)	6.0 (1.1)
		90 (1/8)	6.0 (1.1)
	40.9 (104) sq.	200 (1/4)	11 (2.0)
Three-Phase	3.15 (80) sq.	25 (1/30)	1.7 (0.31)
	3.54 (90) sq.	40 (1/19)	4.1 (0.75)
		60 (1/12)	6.0 (1.1)
		90 (1/8)	6.0 (1.1)
	40.9 (104) sq.	200 (1/4)	11 (2.0)