TECHNICAL INFORMATION

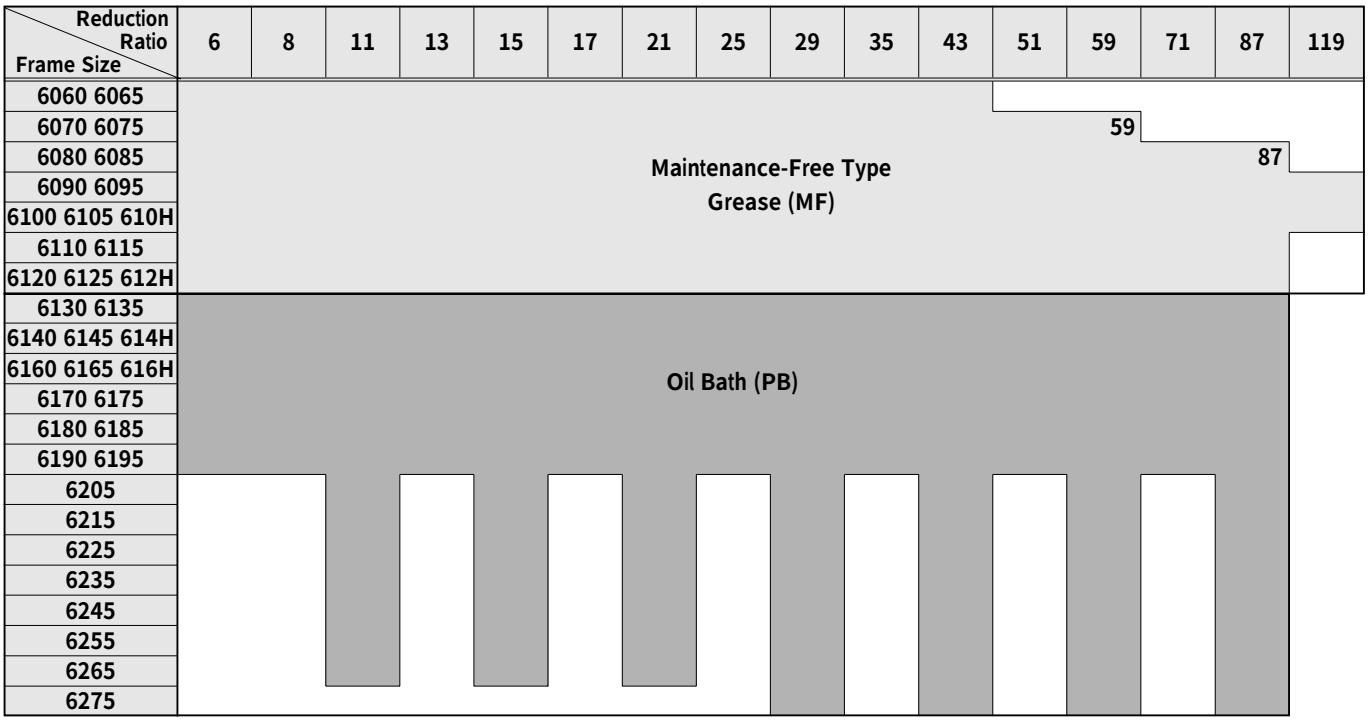
REDUCER

Lubrication

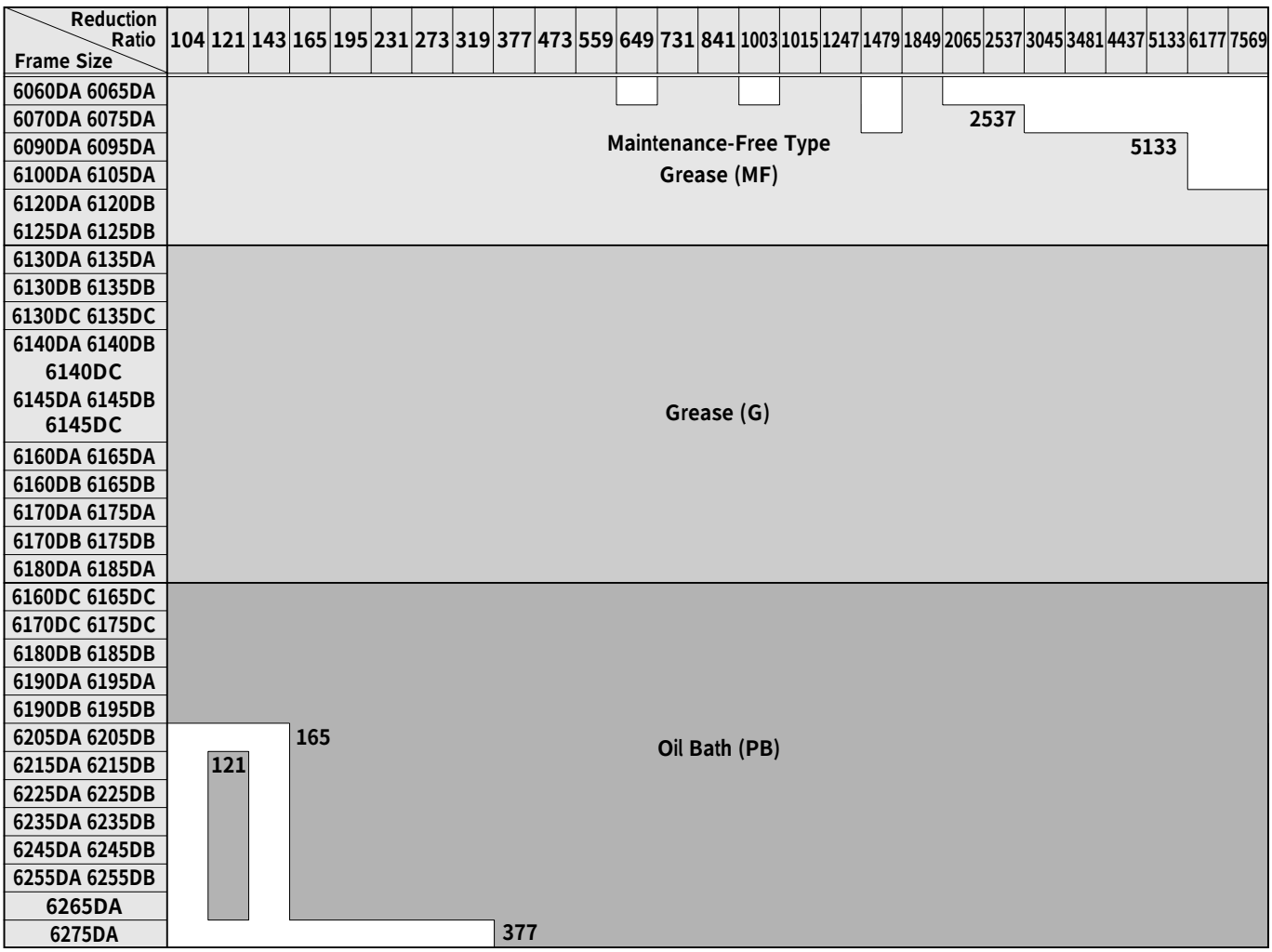
1. Standard Type

Table E-1 Horizontal (Slow Speed Shaft Not Inclined)

a) Single Reduction



b) Double Reduction



Note : This table shows the standard lubrication method when the Cyclo Drive is driven at the standard input speed.

Table E-2 Vertical Type (Consult us in advance when the slow speed shaft direction is upward) (Downward Slow Speed Shaft Direction)

a) Single Reduction

Frame Size \ Reduction Ratio	6	8	11	13	15	17	21	25	29	35	43	51	59	71	87	119
6060 6065	Maintenance-Free Type Grease (MF)															
6070 6075													59			
6080 6085															87	
6090 6095																
6100 6105																
6110 6115																
6120 6125																
6130 6135	Oil Bath (PB)															
6140 6145																
6160 6165	Forced Oil Lubrication (P)															
6170 6175																
6180 6185																
6190 6195																
6205																
6215																
6225																
6235																
6245																
6255																
6265																
6275									TP		TP		TP		TP	

TP : Postive Displacement Pump Lubrication (See Table E-3)

b) Double Reduction

Frame Size \ Reduction Ratio	104	121	143	165	195	231	273	319	377	473	559	649	731	841	1003	1015	1247	1479	1849	2065	2537	3045	3481	4437	5133	6177	7569
6060DA 6065DA	Maintenance-Free Type Grease (MF)																										
6070DA 6075DA																					2537						
6090DA 6095DA																									5133		
6100DA 6105DA																											
6120DA 6120DB 6125DA 6125DB																											
6130DA 6135DA	Grease (G)																										
6130DB 6135DB																											
6130DC 6135DC																											
6140DA 6140DB 6140DC 6145DA 6145DB 6145DC																											
6160DA 6165DA																											
6160DB 6165DB																											
6170DA 6175DA																											
6170DB 6175DB																											
6180DA 6185DA																											
6160DC 6165DC										473																	
6170DC 6175DC														841													
6180DB 6185DB																1015											
6190DA 6195DA																				2065							
6190DB 6195DB																											
6205DA 6205DB				165						Forced Oil Lubrication (P)								1849								
6215DA 6215DB		121																			2537						
6225DA 6225DB																											
6235DA 6235DB		(P)																									
6245DA 6245DB																											
6255DA 6255DB																											
6265DA																											
6275DA										TP : Positive Displacement Pump Lubrication (See Table E-3)																	

Note : This table shows the standard lubrication method when the Cyclo Drive is driven at the standard input speed.

Table E-3 Trochoid Pump Type

Cyclo Drive			Trochoid Pump					
Type	Frame Size	Reduction Ratio	Pump Type	Pump Motor	50 Hz Zone		60 Hz Zone	
					Discharge ℓ/min	Max. Pressure kg/cm²	Discharge ℓ/min	Max. Pressure kg/cm²
Vertical shaft	6275	29,43,59,87	TOP216HA-VB3	0.75 kW 4P	24.0	8	28.8	5.0
	6275DA	All reduction ratios	TOP204HA-VB3	0.4 kW 4P	6.0	16	7.2	11.5

Note : 1. Trochoid pump manufactured by Nippon Oil Pump Mfg. Ltd. used as the standard pump.
2. A relief valve (Pressure set at 3 kgf/cm²) is a standard attachment in the trochoid pump.

LUBRICANTS

1. Grease Lubricated Models

The grease lubricated models shown in Table E-4 are packed with grease prior to shipment; they may be used without replenishment.

(i) Maintenance-Free Series.
The models in the shaded □ column of Tables E-1 and E-2 are sealed with long-life grease(Alvania Grease RA), replenishment is practically unnecessary, but replacement approximately every 20,000 hours of operation or 4～5 years, will provide longer service life.

(ii) Grease lublicated models, other than as specified in (i) above.
Please replenish or replace, as specified in the Instruction Manual.

Table E-4 Standard Grease

Ambient Temperature °C	Cyclo Drive			Sumitomo Manufactured Motor		
	(i)Maintenance-Free Series	(ii) Other than (i) models		Sealed Bearings	Open Bearings	
					E,B Type insulation	F Type insulation
	Shell Oil	Shell Oil	Cosmo Oil	Kyodo Yushi	Shell Oil	Shell Oil
-10 ≀ 50	SHELL ALVANIA GREASE RA	SHELL ALVANIA GREASE 2	COSMO GREASE DYNAMAX SH No.2	MULTEMP SRL	SHELL ALVANIA GREASE 2	DARINA GREASE 2

Note): 1. Avoid the use of grease other than shown in Table E-4
2. Drives shown in column (ii) of Table 32 are packed with COSMO GREASE DYNAMAX SH No.2, at the time of shipment.
3. The mixture of the two types of grease shown in column (ii) is permissible.
4. For consistent use in ambient temperatures other than 0°C～40°C, please consult us.

2. Oil Lubricated Models

The oil lubricated models are not filled with oil prior to shipping. Before operating, please be sure to fill the unit with oil up to the red line on the oil guage.

Table E-5 Mild EP Oil Brand Recommended (Equivalent to SP Type Industrial High-Pressure Gear Oil or JIS K2219 No.2 Industrial Gear Oil)

Ambient temp.	Gulf Oil	Esso Oil	Mobil Oil	Shell Oil	Caltex Oil	BP Oil
-10°C to 5°C	EP Lubricant HD 68	Spartan EP 68	Mobil gear 626 (ISO VG 68)	Omala Oil 68		Energol GR-XP 68
0°C to 35°C	EP Lubricant HD 100 HD 150	Spartan EP 100 EP 150	Mobil gear 627 629 (ISO VG 100, 150)	Omala Oil 100 150	Meropa 100 150	Energol GR-XP 100 GR-XP 150
30°C to 50°C	EP Lubricant HD 220 HD 320 HD 460	Spartan EP 220 EP 320 EP 460	Mobil gear 630 632 633 634 (ISO VG 220～460)	Omala Oil 220 320 460	Meropa 220 320 460	Energol GR-XP 220 GR-XP 320 GR-XP 460

Notes : 1. For use in winter or relatively low ambient temperature, use the lower viscosity oil specified for each ambient temperature range.
2. For consistent use in ambient temperatures other than 0°C～40°C, please consult us.

VOLUME OF OIL FILLING

Table E-6 Volume of Oil Filling, litres (Approximate)

Single Reduction	Frame Size	6130 6135	6140 6145 614H	6160 6165 616H	6170 6175	6180 6185	6190 6195	6205	6215	6225	6235	6245	6255	6265	6275
	Horizontal	0.7	0.7	1,4	1.9	2.5	4.0	5.5	8.5	10	15	16	21	29	56
	Vertical	1.1	1.1	1.0	1.9	2.0	2.7	5.7	7.5	10	12	15	42	51	(60)

Double Reduction	Frame Size	6160 DC 6165 DC	6170 DC 6175 DC	6180 DB 6185 DB	6190 DA 6195 DA	6190 DB 6195 DB	6205 DA	6205 DB	6215 DA	6215 DB	6225 DA	6225 DB	6235 DA	6235 DB	6245 DA	6245 DB	6255 DA	6255 DB	6265 DA	6275 DA
	Horizontal	1.5	2.4	3.5	5.8	6.0	6.0	6.0	10	10	11	11	17	17	18	18	23	23	32	60
	Vertical	1.0	1.9	2.0	2.7	2.7	11	11	14	14	18	18	23	23	29	29	42	42	51	(60)

( ) with trochoid pump.

How to refer to the rating plate

There are two types of rating plates , Type I and Type II. Examples of typical plates are shown below, refer to the proper one.

1. Gearmotor

(1)Rating plate type Ⅰ: Gearmotor

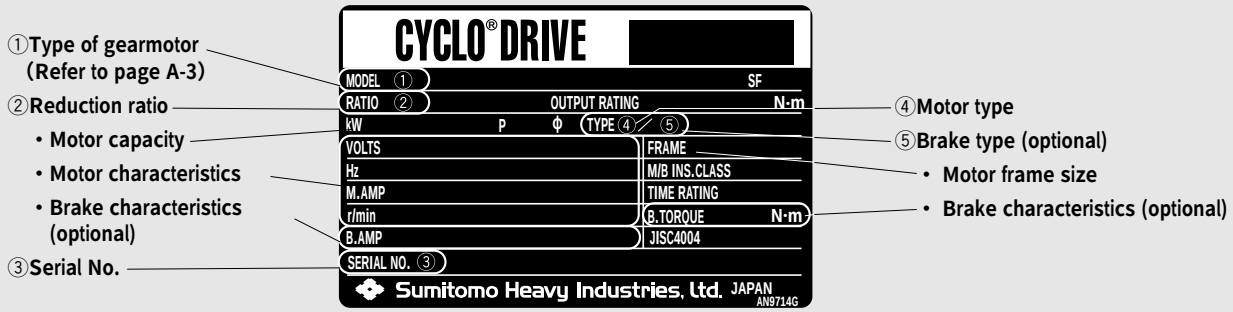
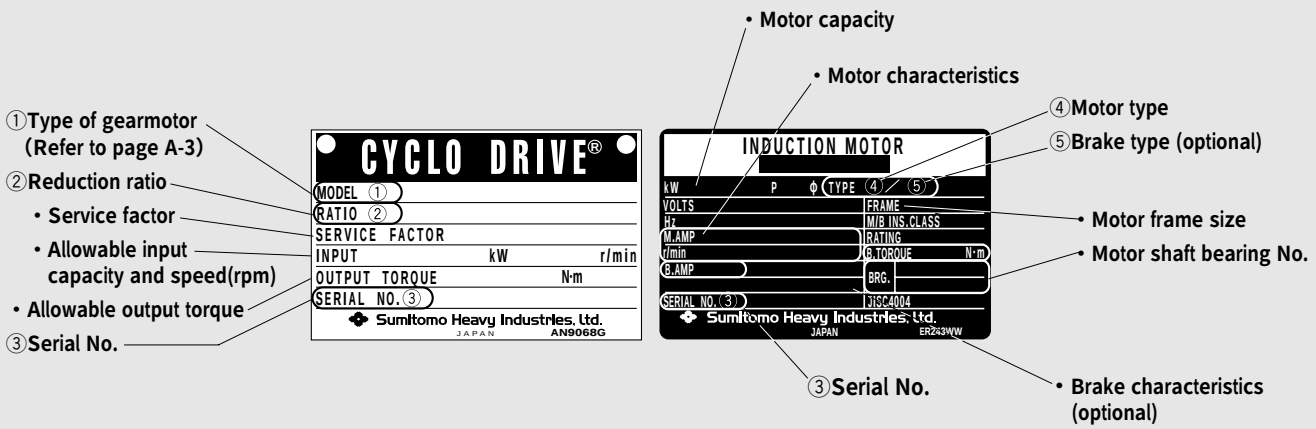


Fig.E-1 Rating plate of gearmotor (Type Ⅰ)

(2)Rating plate type Ⅱ: Reducer with motor



Rating plate of gear Rating plate of motor

Fig.E-2 Rating plates of reducer with motor (Type Ⅱ)

2. Reducer

(1)Rating plate type Ⅰ

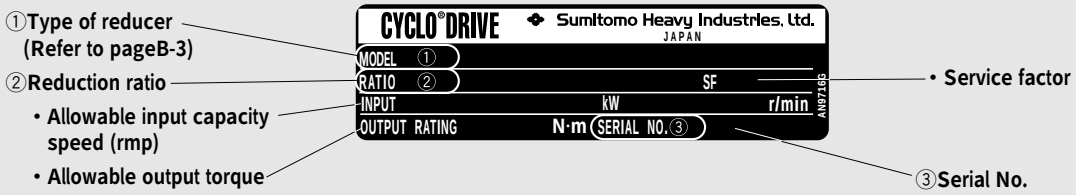


Fig.E-3 Rating plate of reducer(Type Ⅰ)

(2)Rating plate type Ⅱ

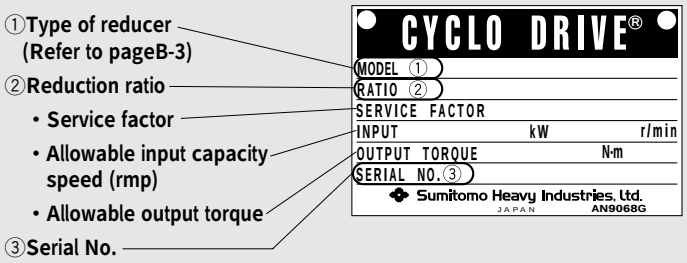


Fig.E-4 Rating plate of reducer (Type Ⅱ)

ALLOWABLE RADIAL AND AXIAL LOAD

When a gear or pulley are coupled with Cyclo reducer, please use within the range of the allowable radial and axial load.

1. Radial·Axial Load on Slow Speed Shaft

Please confirm the radial·axial load on the slow speed shaft using the following formula :

① Radial load Pr

$$Pr = \frac{T\ell}{R} \leqq \frac{Pro}{Lf \cdot Cf \cdot Fs} \text{ (N, kgf)}$$

② Axial load Pa

$$Pa \leqq \frac{Pao}{Cf \cdot Fs} \text{ (N, kgf)}$$

③ When radial·axial load co-exist.

$$\left(\frac{Pr \cdot Lf}{Pro} + \frac{Pa}{Pao} \right) \cdot Cf \cdot Fs \leqq 1$$

Pr : Actual radial load (N, kgf)
T ℓ : Actual transmitted torque (N·m, kgf·m) on slow speed shaft of the reducer.
R : Pitch circle radius (m) of sprocket, gear, pulley, etc.
Pro : Allowable radial load (N, kgf) (Refer to selection table)
Pa : Actual axial load (N, kgf)
Pao : Allowable axial load (N, kgf) (Table E-10, 11)
Lf : Load location factor (Table E-9)
Cf : Coupling factor (Table E-7)
Fs : Shock factor (Table E-8)

- When the radial load exceeds the allowable values, a larger frame size may be selected, but depending upon the extent of the load, this may be avoided by using the heavy radial load type; please refer to Page E-12.
- In case of particularly extreme frequency of starting, please consult us.

Table E-7 Coupling Factor Cf

Coupling Method	Cf
Chain	1
Gears	1.25
V-Belt	1.5

Table E-8 Shock Factor Fs

Degree of Shock	Fs
When practically no shock	1
When there is light shock	1～1.2
When there is severe shock	1.4～1.6

Further detailed intermediate values in Tables E-9～E-11 should be calculated according to the interpolation method.

Example of calculation according to interpolation method.

Load Location Factor

Frame size 6075 Load Location Factor for L=18mm calculated below.

$$1.00 + \frac{1.29-1.00}{20-15} \times (18-15) = 1.17$$

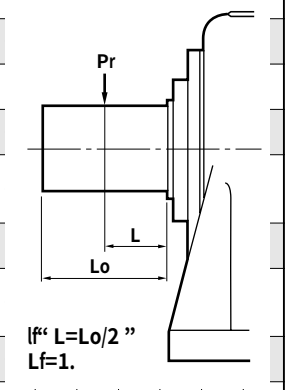
Thrust Load Capacity

Frame size 6180 Thrust Load Capacity for output speed 130r/min calculated bellow.

$$12500 + \frac{13100-12500}{150-125} \times (150-130) = 12980 \text{ (N)}$$

Table E-9 Load Location Factor (Slow Speed Shaft) Lf

Frame size / Single Reduction	Double Reduction	Lmm ~5	10	15	20	25	30	35	40	45	50	60	70	80	90	100	120	140	160	180	200	225	250	275	300
6060 6065	6060DA 6065DA	0.83	0.94	1.19	1.56	—	—	—	—	—	—	—	—	—	—	—	—	—							
6070 6075	6070DA 6075DA	0.82	0.91	1.00	1.29	1.59	1.88	—	—	—	—	—	—	—	—	—	—	—							
6080 6085	—	0.81	0.87	0.94	1.03	1.28	1.54	1.80	—	—	—	—	—	—	—	—	—	—							
6090 6095	6090DA 6095DA	0.86	0.92	0.97	1.13	1.38	1.64	1.90	—	—	—	—	—	—	—	—	—	—							
6100 6105 610H	6100DA 6105DA	0.86	0.92	0.97	1.13	1.38	1.64	1.90	—	—	—	—	—	—	—	—	—	—							
6110 6115	—	0.78	0.84	0.90	0.96	1.02	1.08	1.19	1.36	1.53	—	—	—	—	—	—	—	—							
6120 6125 612H	6120DA 6120DB 6125DA 6125DB	—	0.82	0.87	0.92	0.97	1.08	1.25	1.42	1.59	1.76	—	—	—	—	—	—	—							
6130 6135	6130DA 6130DB 6130DC 6135DA 6135DB 6135DC	—	—	0.83	0.87	0.92	0.96	1.00	1.13	1.25	1.38	1.63	1.88	—	—	—	—	—							
6140 6145 614H	6140DA 6140DB 6140DC 6145DA 6145DB 6145DC	—	—	—	0.66	0.73	0.80	0.87	0.93	1.00	1.10	1.30	1.50	1.70	1.90	—	—	—	—	—	—	—	—	—	—
6160 6165 616H	6160DA 6160DB 6160DC 6165DA 6165DB 6165DC	—	—	—	0.83	0.87	0.90	0.93	0.97	1.00	1.11	1.32	1.53	1.75	1.96	—	—	—	—	—	—	—	—	—	—
6170 6175	6170DA 6170DB 6170DC 6175DA 6175DB 6175DC	—	—	—	0.86	0.89	0.92	0.94	0.97	1.00	1.11	1.32	1.53	1.75	1.96	—	—	—	—	—	—	—	—	—	—
6180 6185	6180DA 6180DB 6185DA 6185DB	—	—	—	—	0.85	0.87	0.90	0.93	0.95	0.98	1.09	1.26	1.43	1.60	1.78	—	—	—	—	—	—	—	—	—
6190 6195	6190DA 6190DB 6195DA 6195DB	—	—	—	—	—	0.85	0.87	0.89	0.91	0.93	0.97	1.04	1.18	1.32	1.46	1.75	—	—	—	—	—	—	—	—
6205	6205DA 6205DB	—	—	—	—	—	—	—	0.70	0.74	0.77	0.84	0.91	0.98	1.05	1.12	1.26	1.40	1.54	—	—	—	—	—	—
6215	6215DA 6215DB	—	—	—	—	—	—	—	0.70	0.73	0.77	0.84	0.91	0.98	1.05	1.13	1.27	1.41	1.56	—	—	—	—	—	—
6225	6225DA 6225DB	—	—	—	—	—	—	—	0.86	0.88	0.90	0.93	0.96	0.99	1.02	1.06	1.12	1.19	1.25	—	—	—	—	—	—
6235	6235DA 6235DB	—	—	—	—	—	—	—	0.82	0.84	0.85	0.88	0.91	0.94	0.97	1.00	1.06	1.12	1.18	1.24	1.30	—	—	—	—
6245	6245DA 6245DB	—	—	—	—	—	—	—	0.83	0.84	0.86	0.89	0.92	0.94	0.97	1.00	1.06	1.11	1.17	1.23	1.29	—	—	—	—
6255	6255DA 6255DB	—	—	—	—	—	—	—	—	—	0.83	0.85	0.88	0.90	0.93	0.95	1.00	1.05	1.10	1.22	1.36	1.52	1.69	—	—
6265	6265DA	—	—	—	—	—	—	—	—	—	—	—	0.83	0.85	0.88	0.90	0.94	0.98	1.04	1.17	1.29	1.45	1.61	1.77	1.93
6275	6275DA	—	—	—	—	—	—	—	—	—	—	—	—	0.67	0.71	0.75	0.82	0.90	0.98	1.09	1.21	1.35	1.50	1.65	1.79



If" L=Lo/2 "
Lf=1.

Table E-10 Axial Load Capacity (Slow Speed Shaft) Pao (N)

(Cf, Lf, Fs=1)

Frame size / Single Reduction	Double Reduction	Output Speed r/min ~10	15	20	25	30	35	40	50	60	80	100	125	150	200	250	300
6060 6065	6060DA 6065DA	294	294	294	294	294	294	294	294	294	294	294	294	294	294	—	—
6070 6075	6070DA 6075DA	785	785	785	785	785	785	785	785	785	785	785	785	785	785	785	785
6080 6085	—	981	981	981	981	981	981	981	981	981	981	981	981	981	981	981	981
6090 6095	6090DA 6095DA	981	981	981	981	981	981	981	981	981	981	981	981	981	981	981	981
6100 6105 610H	6100DA 6105DA	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470
6110 6115	—	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470
6120 6125 612H	6120DA 6120DB 6125DA 6125DB	2940	2940	2940	2940	2940	2940	2940	2940	2940	2940	2940	2940	2940	2770	2500	2390
6130 6135	6130DA 6130DB 6130DC 6135DA 6135DB 6135DC	3920	3920	3920	3920	3920	3920	3920	3920	3920	3920	3920	3920	3920	3920	3920	3920
6140 6145 614H	6140DA 6140DB 6140DC 6145DA 6145DB 6145DC	5400	5400	5400	5400	5400	5400	5400	5400	5400	5230	4860	4560	4370	3850	3670	3450
6160 6165 616H	6160DA 6160DB 6160DC 6165DA 6165DB 6165DC	6870	6870	6870	6870	6870	6870	6870	6870	6870	6870	6870	6870	6870	6300	5700	—
6170 6175	6170DA 6170DB 6170DC 6175DA 6175DB 6175DC	9810	9810	9810	9810	9810	9810	9810	9810	9810	9810	9810	9680	9020	8090	7330	6880
6180 6185	6180DA 6180DB 6185DA 6185DB	13700	13700	13700	13700	13700	13700	13700	13700	13700	13700	13700	13100	12500	11000	—	—
6190 6195	6190DA 6190DB 6195DA 6195DB	19600	19600	19600	19600	19600	19600	19600	19600	19600	19600	19600	18500	17500	15400	—	—
6205	6205DA 6205DB	26500	23500	21100	19600	18600	18100	17700	16700	15700	14200	13200	12800	12300	11300	—	—
6215	6215DA 6215DB	27500	24500	22100	20600	19600	18600	18100	17200	16200	14700	13700	13200	12800	11800	—	—
6225	6225DA 6225DB	29400	25600	23200	21700	20600	19600	18700	17600	16700	15300	14400	13600	13100	12100	—	—
6235	6235DA 6235DB	35300	31400	28400	26500	25000	23500	22600	21100	20100	18600	17700	16700	—	—	—	—
6245	6245DA 6245DB	37300	33800	30900	28800	27300	26100	25100	23500	22300	21000	19900	19100	—	—	—	—
6255	6255DA 6255DB	48100	43100	39400	36900	35100	33600	32300	30400	28500	26800	25500	24200	—	—	—	—
6265	6265DA	52000	52000	51000	47500	44800	42800	41600	38900	37300	34800	33000	31100	—	—	—	—
6275	6275DA	58900	58900	58900	58900	58900	58900	58900	58900	—	—	—	—	—	—	—	—

Table E-11 Axial Load Capacity (Slow Speed Shaft) Pao (kgf)

(Cf, Lf, Fs=1)

Frame size / Output Speed r/min		~10	15	20	25	30	35	40	50	60	80	100	125	150	200	250	300
Single Reduction	Double Reduction																
6060 6065	6060DA 6065DA	30	30	30	30	30	30	30	30	30	30	30	30	30	30	–	–
6070 6075	6070DA 6075DA	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
6080 6085	–	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6090 6095	6090DA 6095DA	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
6100 6105 610H	6100DA 6105DA	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
6110 6115	–	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
6120 6125 612H	6120DA 6120DB 6125DA 6125DB	300	300	300	300	300	300	300	300	300	300	300	300	300	282	255	244
6130 6135	6130DA 6130DB 6130DC 6135DA 6135DB 6135DC	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400
6140 6145 614H	6140DA 6140DB 6140DC 6145DA 6145DB 6145DC	550	550	550	550	550	550	550	550	550	533	495	465	445	392	374	352
6160 6165 616H	6160DA 6160DB 6160DC 6165DA 6165DB 6165DC	700	700	700	700	700	700	700	700	700	700	700	700	700	642	581	–
6170 6175	6170DA 6170DB 6170DC 6175DA 6175DB 6175DC	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	987	919	825	747	701
6180 6185	6180DA 6180DB 6185DA 6185DB	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1340	1270	1120	–	–
6190 6195	6190DA 6190DB 6195DA 6195DB	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1890	1780	1570	–	–
6205	6205DA 6205DB	2700	2400	2150	2000	1900	1850	1800	1700	1600	1450	1350	1300	1250	1150	–	–
6215	6215DA 6215DB	2800	2500	2250	2100	2000	1900	1850	1750	1650	1500	1400	1350	1300	1200	–	–
6225	6225DA 6225DB	3000	2610	2360	2210	2100	2000	1910	1790	1700	1560	1470	1390	1340	1230	–	–
6235	6235DA 6235DB	3600	3200	2900	2700	2550	2400	2300	2150	2050	1900	1800	1700	–	–	–	–
6245	6245DA 6245DB	3800	3450	3150	2940	2780	2660	2560	2400	2270	2140	2030	1950	–	–	–	–
6255	6255DA 6255DB	4900	4390	4020	3760	3580	3430	3290	3100	2910	2730	2600	2470	–	–	–	–
6265	6265DA	5300	5300	5200	4840	4570	4360	4240	3970	3800	3550	3360	3170	–	–	–	–
6275	6275DA	6000	6000	6000	6000	6000	6000	6000	6000	–	–	–	–	–	–	–	–

2. Heavy Radial Load Type (Complementary Options)

When the radial load of the slow speed shaft exceeds the allowable value of the standard Cyclo reducer, a larger frame size may be selected, but depending upon the degree of the load, this may be avoided by using the heavy radial load type. Please refer to Table E-12～15, for the allowable radial load on the slow speed shaft of the heavy radial load type.

Table E-12 Allowable Radial Load Pro (N) (Max) on the Slow Speed Shaft of the Light Heavy Radial Load Type.

(Cf, Lf, Fs=1)

Frame size / Output Speed r/min		～1	2	3	4	5	6	8	10	15	20	25	30
Single Reduction	Double Reduction												
6130 6135	6130DA 6130DB 6130DC 6135DA 6135DB 6135DC	14700	14700	14700	14700	14700	14700	14700	14700	14700	14700	14700	14700
6160 6165 616H	6160DA 6160DB 6160DC 6165DA 6165DB 6165DC	22100	22100	22100	22100	22100	22100	22100	22100	22100	22100	22100	22100
6170 6175	6170DA 6170DB 6170DC 6175DA 6175DB 6175DC	29500	29500	29500	29500	29500	29500	29500	29500	29500	29500	29500	29500
6180 6185	6180DA 6180DB 6185DA 6185DB	41700	41700	41700	41700	41700	41700	41700	41700	41700	41700	41700	41700
6190 6195	6190DA 6190DB 6195DA 6195DB	59000	59000	59000	59000	59000	59000	59000	59000	59000	59000	59000	59000

Frame size / Output Speed r/min		35	40	50	60	80	100	125	150	200	250	300
Single Reduction	Double Reduction											
6130 6135	6130DA 6130DB 6130DC 6135DA 6135DB 6135DC	14700	14700	14700	14700	14100	13500	12600	11900	10900	10200	9660
6160 6165 616H	6160DA 6160DB 6160DC 6165DA 6165DB 6165DC	22100	22100	22100	22100	22100	21600	20100	19000	17500	16300	15400
6170 6175	6170DA 6170DB 6170DC 6175DA 6175DB 6175DC	29500	29500	29500	29500	29500	29300	27400	25900	23800	22200	21100
6180 6185	6180DA 6180DB 6185DA 6185DB	41700	41700	41700	41700	41300	38600	36200	34200	31400	–	–
6190 6195	6190DA 6190DB 6195DA 6195DB	59000	59000	55200	53000	47200	44000	41000	38300	34700	–	–

Table E-13 Allowable Radial Load Pro (kgf) (Max) on the Slow Speed Shaft of the Light Heavy Radial Load Type.

(Cf, Lf, Fs=1)

Frame size / Output Speed r/min		～1	2	3	4	5	6	8	10	15	20	25	30
Single Reduction	Double Reduction												
6130 6135	6130DA 6130DB 6130DC 6135DA 6135DB 6135DC	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
6160 6165 616H	6160DA 6160DB 6160DC 6165DA 6165DB 6165DC	2250	2250	2250	2250	2250	2250	2250	2250	2250	2250	2250	2250
6170 6175	6170DA 6170DB 6170DC 6175DA 6175DB 6175DC	3010	3010	3010	3010	3010	3010	3010	3010	3010	3010	3010	3010
6180 6185	6180DA 6180DB 6185DA 6185DB	4250	4250	4250	4250	4250	4250	4250	4250	4250	4250	4250	4250
6190 6195	6190DA 6190DB 6195DA 6195DB	6010	6010	6010	6010	6010	6010	6010	6010	6010	6010	6010	6010

Frame size / Output Speed r/min		35	40	50	60	80	100	125	150	200	250	300
Single Reduction	Double Reduction											
6130 6135	6130DA 6130DB 6130DC 6135DA 6135DB 6135DC	1500	1500	1500	1500	1440	1380	1280	1210	1110	1040	985
6160 6165 616H	6160DA 6160DB 6160DC 6165DA 6165DB 6165DC	2250	2250	2250	2250	2250	2200	2050	1940	1780	1660	1570
6170 6175	6170DA 6170DB 6170DC 6175DA 6175DB 6175DC	3010	3010	3010	3010	3010	2990	2790	2640	2430	2260	2150
6180 6185	6180DA 6180DB 6185DA 6185DB	4250	4250	4250	4250	4210	3930	3690	3490	3200	–	–
6190 6195	6190DA 6190DB 6195DA 6195DB	6010	6010	5630	5400	4810	4490	4180	3900	3540	–	–

Table E-14 Allowable Radial Load Pro〔N〕(Max) on the Slow Speed Shaft of the Heavy Radial Load Type.

(Cf, Lf, Fs=1)

Frame size / Output Speed r/min	Double Reduction	～1	2	3	4	5	6	8	10	15	20	25	30
6130 6135	6130DA 6130DB 6130DC 6135DA 6135DB 6135DC	24000	24000	24000	24000	24000	24000	24000	24000	23800	21800	20400	19300
6160 6165 616H	6160DA 6160DB 6160DC 6165DA 6165DB 6165DC	33600	33600	33600	33600	33600	33600	33600	33600	33600	33600	33300	31500
6170 6175	6170DA 6170DB 6170DC 6175DA 6175DB 6175DC	45900	45900	45900	45900	45900	45900	45900	45900	45900	45900	45300	42900
6180 6185	6180DA 6180DB 6185DA 6185DB	55700	55700	55700	55700	55700	55700	55700	55700	55700	55700	55700	55700
6190 6195	6190DA 6190DB 6195DA 6195DB	71800	71800	71800	71800	71800	71800	71800	71800	71800	71800	71800	69300
6205	6205DA 6205DB	97800	97800	97800	97800	97800	97800	97800	97800	89100	81800	76500	72400
6215	6215DA 6215DB	132000	132000	132000	132000	126000	119000	109000	102000	90500	83000	77600	73500
6225	6225DA 6225DB	161000	161000	161000	161000	156000	148000	135000	126000	112000	103000	96300	91100
6235	6235DA 6235DB	183000	183000	183000	183000	183000	183000	170000	159000	141000	129000	121000	114000
6245	6245DA 6245DB	223000	223000	223000	223000	209000	198000	181000	169000	150000	138000	129000	122000
6255	6255DA 6255DB	274000	274000	274000	274000	258000	244000	224000	210000	185000	170000	159000	151000
6265	6265DA	283000	283000	283000	283000	283000	283000	270000	253000	224000	205000	191000	181000
6275	6275DA	272000	272000	272000	272000	272000	272000	272000	272000	272000	272000	272000	272000

Frame size / Output Speed r/min	Double Reduction	35	40	50	60	80	100	125	150	200	250	300
6130 6135	6130DA 6130DB 6130DC 6135DA 6135DB 6135DC	18400	17800	16500	15600	14400	13500	12600	11900	10900	10200	9660
6160 6165 616H	6160DA 6160DB 6160DC 6165DA 6165DB 6165DC	30100	28900	27000	25600	23500	22000	20500	19400	17900	16600	15400
6170 6175	6170DA 6170DB 6170DC 6175DA 6175DB 6175DC	40900	39300	36800	34800	31900	29900	27900	26400	24300	22200	21100
6180 6185	6180DA 6180DB 6185DA 6185DB	54000	51900	48500	45900	42100	39400	36900	34900	32000	–	–
6190 6195	6190DA 6190DB 6195DA 6195DB	66100	63500	59400	56300	51600	48300	45100	42800	39300	–	–
6205	6205DA 6205DB	69100	66400	62100	58800	54000	50500	47100	44600	41000	–	–
6215	6215DA 6215DB	70100	67400	63000	59600	54800	51300	47900	45400	41600	–	–
6225	6225DA 6225DB	87000	83500	78100	74000	67900	63500	59400	56300	51500	–	–
6235	6235DA 6235DB	109000	105000	98100	92900	85300	79800	74500	–	–	–	–
6245	6245DA 6245DB	116000	112000	105000	98900	90800	84900	79400	–	–	–	–
6255	6255DA 6255DB	144000	139000	129000	123000	112000	105000	98300	–	–	–	–
6265	6265DA	174000	166000	156000	148000	135000	126000	118000	–	–	–	–
6275	6275DA	–	–	–	–	–	–	–	–	–	–	–

Notes : 1. Please use JIS B1051 erection bolts, with strength in excess of 8.8.

2. The heavy radial load type is distinguished with the R2, suffix following the frame size.
   Example : CHHM5-6135-R2

3. Please consult us, as the following conditions require special review :
   - When the shaft direction is vertical (Vertical type) .
   - When a thrust load is simultaneously imposed on the slow speed shaft.

Table E-15 Allowable Radial Load Pro〔kgf〕(Max) on the Slow Speed Shaft of the Heavy Radial Load Type.

(Cf, Lf, Fs=1)

Frame size / Output Speed r/min		～1	2	3	4	5	6	8	10	15	20	25	30
Single Reduction	Double Reduction												
6130 6135	6130DA 6130DB 6130DC 6135DA 6135DB 6135DC	2450	2450	2450	2450	2450	2450	2450	2450	2430	2220	2080	1970
6160 6165 616H	6160DA 6160DB 6160DC 6165DA 6165DB 6165DC	3430	3430	3430	3430	3430	3430	3430	3430	3430	3430	3390	3210
6170 6175	6170DA 6170DB 6170DC 6175DA 6175DB 6175DC	4680	4680	4680	4680	4680	4680	4680	4680	4680	4680	4620	4370
6180 6185	6180DA 6180DB 6185DA 6185DB	5680	5680	5680	5680	5680	5680	5680	5680	5680	5680	5680	5680
6190 6195	6190DA 6190DB 6195DA 6195DB	7320	7320	7320	7320	7320	7320	7320	7320	7320	7320	7320	7060
6205	6205DA 6205DB	9970	9970	9970	9970	9970	9970	9970	9970	9080	8340	7800	7380
6215	6215DA 6215DB	13500	13500	13500	13500	12800	12100	11100	10400	9230	8460	7910	7490
6225	6225DA 6225DB	16400	16400	16400	16400	15900	15100	13800	12800	11400	10500	9820	9290
6235	6235DA 6235DB	18700	18700	18700	18700	18700	18700	17300	16200	14400	13100	12300	11600
6245	6245DA 6245DB	22700	22700	22700	22700	21300	20200	18500	17200	15300	14100	13100	12400
6255	6255DA 6255DB	27900	27900	27900	27900	26300	24900	22800	21400	18900	17300	16200	15400
6265	6265DA	28800	28800	28800	28800	28800	28800	27500	25800	22800	20900	19500	18500
6275	6275DA	27700	27700	27700	27700	27700	27700	27700	27700	27700	27700	27700	27700

Frame size / Output Speed r/min		35	40	50	60	80	100	125	150	200	250	300
Single Reduction	Double Reduction											
6130 6135	6130DA 6130DB 6130DC 6135DA 6135DB 6135DC	1880	1810	1680	1590	1470	1380	1280	1210	1110	1040	985
6160 6165 616H	6160DA 6160DB 6160DC 6165DA 6165DB 6165DC	3070	2950	2750	2610	2400	2240	2090	1980	1820	1690	1570
6170 6175	6170DA 6170DB 6170DC 6175DA 6175DB 6175DC	4170	4010	3750	3550	3250	3050	2840	2690	2480	2260	2150
6180 6185	6180DA 6180DB 6185DA 6185DB	5500	5290	4940	4680	4290	4020	3760	3560	3260	–	–
6190 6195	6190DA 6190DB 6195DA 6195DB	6740	6470	6060	5740	5260	4920	4600	4360	4010	–	–
6205	6205DA 6205DB	7040	6770	6330	5990	5500	5150	4800	4550	4180	–	–
6215	6215DA 6215DB	7150	6870	6420	6080	5590	5230	4880	4630	4240	–	–
6225	6225DA 6225DB	8870	8510	7960	7540	6920	6470	6060	5740	5250	–	–
6235	6235DA 6235DB	11100	10700	10000	9470	8700	8130	7590	–	–	–	–
6245	6245DA 6245DB	11800	11400	10700	10100	9260	8650	8090	–	–	–	–
6255	6255DA 6255DB	14700	14200	13100	12500	11400	10700	10000	–	–	–	–
6265	6265DA	17700	16900	15900	15100	13800	12800	12000	–	–	–	–
6275	6275DA	–	–	–	–	–	–	–	–	–	–	–

Notes : 1. Please use JIS B1051 erection bolts, with strength in excess of 8.8.

2. The heavy radial load type is distinguished with the R2, suffix following the frame size.
   Example : CHHM5-6135-R2

3. Please consult us, as the following conditions require special review :
   - When the shaft direction is vertical (Vertical type) .
   - When a thrust load is simultaneously imposed on the slow speed shaft.

3. Radial Load on High Speed Shaft for Reducer

Please confirm the radial load on the high speed shaft, in accordance with the following formula :

$$Pr \leqq \frac{Pro}{Lf \cdot Cf \cdot Fs} \quad (N, kgf)$$

Pr : Actual radial load (N, kgf)
Pro : Allowable radial load (N, kgf) (Table E-17, 18)
Lf : Load location factor (Table E-16)
Cf : Coupling factor (Table E-7)
Fs : Shock factor (Table E-8)

Table E-16 Radial Load Location Factor (High Speed Shaft) Lf

Frame size		Lmm																			
Single Reduction	Double Reduction	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100	120	140	160	180	200
6060 6065	6060DA 6065DA 6070DA 6075DA	0.73	0.91	1.20	1.60	2.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
6070 6075	6090DA 6095DA 6100DA 6105DA 6120DA 6125DA 6130DA 6135DA 6140DA 6145DA	0.73	0.91	1.20	1.60	2.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
6080 6085	–	0.73	0.91	1.20	1.60	2.00	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
6090 6095	6120DB 6125DB 6130DB 6135DB 6140DB 6145DB 6160DA 6165DA 6170DA 6175DA	0.88	0.96	1.20	1.59	2.00	2.38	–	–	–	–	–	–	–	–	–	–	–	–	–	–
6100 6105 610H	6130DC 6135DC 6140DC 6145DC 6160DB 6165DB 6170DB 6175DB 6180DA 6185DA	0.91	0.97	1.20	1.59	2.00	2.38	–	–	–	–	–	–	–	–	–	–	–	–	–	–
6110 6115	–	0.91	0.97	1.20	1.59	2.00	2.38	–	–	–	–	–	–	–	–	–	–	–	–	–	–
6120 6125 612H	6160DC 6165DC 6170DC 6175DC 6190DA 6195DA 6205DA	–	0.81	0.93	1.14	1.41	1.67	1.96	2.22	–	–	–	–	–	–	–	–	–	–	–	–
6130 6135	6180DB 6185DB 6190DB 6195DB 6205DB 6215DA 6225DA	–	0.78	0.89	1.00	1.23	1.45	1.69	1.92	2.13	–	–	–	–	–	–	–	–	–	–	–
6140 6145 614H	–	–	0.78	0.89	1.00	1.23	1.45	1.69	1.92	2.13	–	–	–	–	–	–	–	–	–	–	–
6160 6165 616H	6215DB 6235DA 6245DA	–	0.92	0.95	0.98	1.05	1.18	1.28	1.41	1.52	1.64	1.85	–	–	–	–	–	–	–	–	–
6170 6175	6255DB 6255DA	–	–	0.93	0.96	0.99	1.05	1.16	1.28	1.39	1.49	1.72	1.92	2.17	–	–	–	–	–	–	–
6180 6185	6235DB 6245DB	–	–	–	0.93	0.96	0.99	1.05	1.15	1.25	1.35	1.56	1.75	1.96	2.17	–	–	–	–	–	–
6190 6195	6255DB 6265DA 6275DA	–	–	–	0.93	0.95	0.98	1.00	1.09	1.16	1.25	1.41	1.59	1.75	1.92	2.08	–	–	–	–	–
6205	–	–	–	–	–	0.93	0.95	0.97	1.00	1.04	1.10	1.22	1.33	1.45	1.56	1.68	1.91	–	–	–	–
6215	–	–	–	–	–	0.93	0.95	0.98	1.00	1.03	1.08	1.19	1.29	1.40	1.51	1.61	1.82	–	–	–	–
6225	–	–	–	–	–	0.94	0.96	0.98	1.00	1.02	1.04	1.08	1.14	1.24	1.33	1.42	1.60	–	–	–	–
6235	–	–	–	–	–	0.84	0.86	0.87	0.89	0.93	0.98	1.07	1.16	1.25	1.34	1.44	1.62	–	–	–	–
6245	–	–	–	–	–	0.91	0.92	0.94	0.96	0.98	0.99	1.07	1.15	1.24	1.33	1.42	1.59	–	–	–	–
6255	–	–	–	–	–	–	–	0.92	0.93	0.94	0.96	0.99	1.03	1.09	1.16	1.22	1.34	1.47	1.60	1.72	–
6265	–	–	–	–	–	–	–	0.92	0.93	0.94	0.96	0.99	1.03	1.09	1.16	1.22	1.34	1.47	1.60	1.72	–
6275	–	–	–	–	–	–	–	–	–	0.93	0.94	0.97	0.99	1.04	1.14	1.22	1.39	1.56	1.72	1.92	2.08

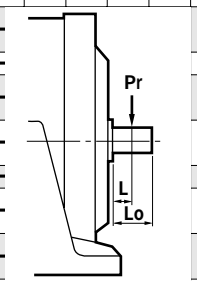


Table E-17 Radial Load Capacity (High Speed Shaft) Pro (N)

(Cf, Lf, Fs=1)

Frame size / Single Reduction	Double Reduction	Ratio	Input Speed r/min 1750	1450	1165	980	870	720	580
6060 6065	6060DA 6065DA 6070DA 6075DA	6~17,25~35	196	147	147	196	196	196	196
		21,43	78.5	29.4	49.1	49.1	49.1	49.1	49.1
6070 6075	6090DA 6095DA 6100DA 6105DA 6120DA 6125DA 6130DA 6135DA 6140DA 6145DA	6~17,25~35,51,59	196	147	147	196	196	196	196
		21,43	49.1	49.1	49.1	49.1	49.1	147	196
6080 6085	—	6~15,21~29,43~59,87	196	147	147	196	196	196	196
		17,35,71	49.1	49.1	49.1	49.1	49.1	147	196
6090 6095	6120DB 6125DB 6130DB 6135DB 6140DB 6145DB 6160DA 6165DA 6170DA 6175DA	6~17,25~71,119	294	294	294	294	294	294	294
		21,87	196	196	196	196	245	245	294
6100 6105 610H	6130DC 6135DC 6140DC 6145DC 6160DB 6165DB 6170DB 6175DB 6180DA 6185DA	6~11,17~119	441	441	491	540	589	589	589
		13,15	441	343	441	491	491	540	589
6110 6115	—	6,8,21~87	441	343	441	491	491	540	589
		11~17	196	196	196	196	245	245	294
6120 6125 612H	6160DC 6165DC 6170DC 6175DC 6190DA 6195DA 6205DA	6~17	590	690	740	780	880	880	880
		21~87	540	440	490	540	590	880	880
6130 6135	6180DB 6185DB 6190DB 6195DB 6205DB 6215DA 6225DA	6~17,21	1370	1370	1370	1520	1620	1720	1860
		25~87	1280	1280	1280	1370	1470	1570	1770
6140 6145 614H	—	6,8	1370	1370	1370	1520	1620	1720	1860
		11~21	1230	980	1080	1180	1230	1320	1470
		25	1080	1130	1180	1280	1320	1370	1470
		29~87	540	590	590	690	690	690	1080
6160 6165 616H	6215DB 6235DA 6245DA	8~25,51,59	1770	1770	1960	2060	2160	2160	2160
		29~43,71,87	1080	1180	1280	1370	1370	1570	1770
6170 6175	6255DB 6255DA	11~87	2060	2060	2260	2260	2350	2450	2650
6180 6185	6235DB 6245DB	11~87	2750	2550	2750	2940	3040	3340	3430
6190 6195	6255DB 6265DA 6275DA	11~25	3040	3040	3240	3530	3630	3920	3920
		29~87	2650	2550	2840	2940	3140	3340	3630
6205	—	11~87	5400	4910	5400	5890	6080	6230	6180
6215	—	11~87	5740	5100	5440	6130	6330	6820	7260
6225	—	11~87	6620	5790	5980	6130	6620	6970	7500
6235	—	11~87	—	—	10000	9520	9170	8980	8730
6245	—	11~87	—	—	11100	10100	10100	10600	11200
6255	—	11~87	—	—	11800	10800	11300	12300	13100
6265	—	11~87	—	—	11800	10800	11300	12300	13100
6275	—	29~87	—	—	14700	14700	14700	14700	14700

Table E-18 Radial Load Capacity (High Speed Shaft) Pro (kgf)

(Cf, Lf, Fs=1)

Frame size / Single Reduction	Double Reduction	Ratio	Input Speed r/min 1750	1450	1165	980	870	720	580
6060 6065	6060DA 6065DA 6070DA 6075DA	6~17,25~35	20	15	15	20	20	20	20
		21,43	8	3	5	5	5	5	5
6070 6075	6090DA 6095DA 6100DA 6105DA 6120DA 6125DA 6130DA 6135DA 6140DA 6145DA	6~17,25~35,51,59	20	15	15	20	20	20	20
		21,43	5	5	5	5	5	15	20
6080 6085	—	6~15,21~29,43~59,87	20	15	15	20	20	20	20
		17,35,71	5	5	5	5	5	15	20
6090 6095	6120DB 6125DB 6130DB 6135DB 6140DB 6145DB 6160DA 6165DA 6170DA 6175DA	6~17,25~71,119	30	30	30	30	30	30	30
		21,87	20	20	20	20	25	25	30
6100 6105 610H	6130DC 6135DC 6140DC 6145DC 6160DB 6165DB 6170DB 6175DB 6180DA 6185DA	6~11,17~119	45	45	50	55	60	60	60
		13,15	45	35	45	50	50	55	60
6110 6115	—	6,8,21~87	45	35	45	50	50	55	60
		11~17	20	20	20	20	25	25	30
6120 6125 612H	6160DC 6165DC 6170DC 6175DC 6190DA 6195DA 6205DA	6~17	60	70	75	80	90	90	90
		21~87	55	45	50	55	60	90	90
6130 6135	6180DB 6185DB 6190DB 6195DB 6205DB 6215DA 6225DA	6~17,21	140	140	140	155	165	175	190
		25~87	130	130	130	140	150	160	180
6140 6145 614H	—	6,8	140	140	140	155	165	175	190
		11~21	125	100	110	120	125	135	150
		25	110	115	120	130	135	140	150
		29~87	55	60	60	70	70	70	110
6160 6165 616H	6215DB 6235DA 6245DA	8~25,51,59	180	180	200	210	220	220	220
		29~43,71,87	110	120	130	140	140	160	180
6170 6175	6255DB 6255DA	11~87	210	210	230	230	240	250	270
6180 6185	6235DB 6245DB	11~87	280	260	280	300	310	340	350
6190 6195	6255DB 6265DA 6275DA	11~25	310	310	330	360	370	400	400
		29~87	270	260	290	300	320	340	370
6205	—	11~87	550	501	550	600	620	635	630
6215	—	11~87	585	520	555	625	645	695	740
6225	—	11~87	675	590	610	625	675	710	765
6235	—	11~87	—	—	1020	970	935	915	890
6245	—	11~87	—	—	1130	1030	1030	1080	1140
6255	—	11~87	—	—	1200	1100	1150	1250	1340
6265	—	11~87	—	—	1200	1100	1150	1250	1340
6275	—	29~87	—	—	1500	1500	1500	1500	1500

INTRODUCTION TO MOMENT OF INERTIA

1. Starting Time Moment of inertia

For successful starting of a driven machine, the starting torque must be adequately larger than the load torque and even after starting commences, the motor torque must consistently be greater than the load torque, until reaching full load speed.
The difference between the motor torque and the load torque during the starting period is referred to as the accelerating torque. If the average accelerating torque is taken as $\bar{T}a$ (N·m), the starting time ts (s) up to the rotating speed n (r/min), is calculated according to the following formula :

$$ts = \frac{(J_M + J_C + J_L) \cdot n}{9.55 \cdot \bar{T}a} \quad (S)$$

J_M : Motor moment of inertia (Inclusive of brake drum)
J_C : Cyclo reducer moment of Inertia
J_L : Driven machine moment of Inertia (Inclusive of coupling, pulley) when converted to the motor shaft.

Average accelerating torque $\bar{T}a$

Here, the average accelerating torque, refers to the average value of the difference between the motor torque and the load torque or the actual torque for accelerating the load, as shown in the graph at the right. For determining the starting time, the motor torque curve and load torque curve are necessary. However, since it is extremely difficult to determine the average accelerating torque by this method, the average accelerating torque at the actual load time is calculated according to the following formula:
When starting at full voltage, the average accelerating torque Ta〔N・m〕may roughly be calculated by the following formula :

$$\bar{T}a \quad 0.8 \left(\frac{Ts+Tm}{2}\right) - \bar{T}_L \ (N \cdot m)$$

Furthermore, if the average load torque $\bar{T}_L$ (N・m) during the starting period is equivalent the full load torque $\bar{T}_L$ (N・m) of the motor may roughly be equal to the following :

In case of constant torque load ・・・・・・$\bar{T}_L$ T_L (N・m)
In case of square of reduced torque load ・・$\bar{T}_L$ $0.34T_L$ (N・m)

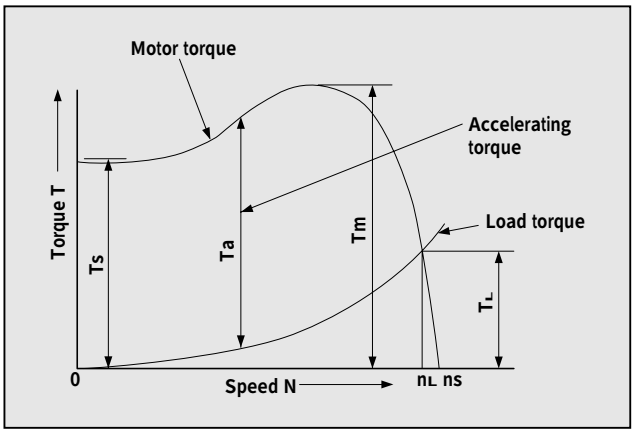
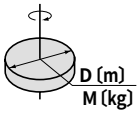
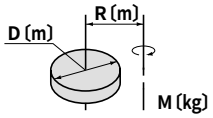
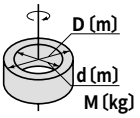
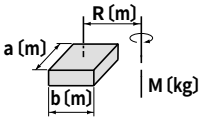
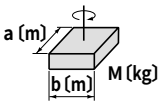
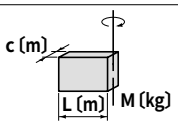


Fig E-5 Torque Curve

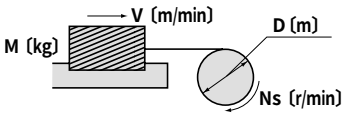
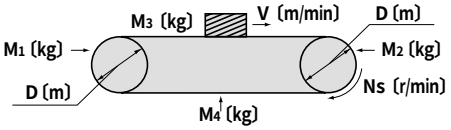
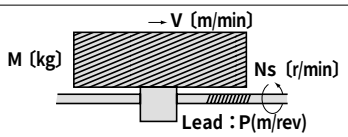
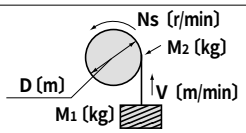
Ts : Starting torque
Tm: Maximum torque (Stalling torque)
Ta : Accelerating torque
T_L : Full load torque
ns : Synchronous rotating speed
n_L : Full load rotating speed

2. Calculation of Moment of Inertia

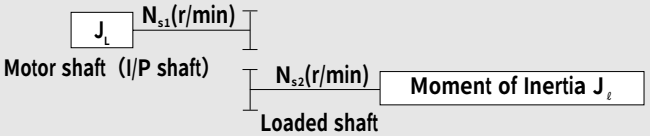
(1)Moment of Inertia of rotating motion

Rotating motion on the center of gravity		Rotating motion off the center of gravity	
	$J=\frac{1}{8}MD^2$ (kg•m²)		$J=\frac{M}{4}\left(\frac{1}{2}D^2+4R^2\right)$ (kg•m²)
	$J=\frac{1}{8}M(D^2+d^2)$ (kg•m²)		$J=\frac{M}{4}\left(\frac{a^2+b^2}{3}+4R^2\right)$ (kg•m²)
	$J=\frac{1}{12}M(a^2+b^2)$ (kg•m²)		$J=\frac{1}{12}M(4L^2+C^2)$ (kg•m²)

(2)Moment of Inertia of rectilinear motion (Loaded shaft side)

General application		$J=\frac{M}{4}\left(\frac{V}{\pi \cdot Ns}\right)^2=\frac{M}{4}D^2$	(kg•m²)
Horizontal motion by conveyor		$J=\frac{1}{4}\left(\frac{M_1+M_2}{2}+M_3+M_4\right)\times D^2$	(kg•m²)
Horizontal motion by lead screw		$J=\frac{M}{4}\left(\frac{V}{\pi \cdot Ns}\right)^2=\frac{M}{4}\left(\frac{P}{\pi}\right)^2$	(kg•m²)
Vertical motion by hoist		$J=\frac{M_1D^2}{4}+\frac{1}{8}M_2D^2$	(kg•m²)

(3)Calculation of moment of inertia at different rotating speeds



$$J_L=\left(\frac{N_{s2}}{N_{s1}}\right)^2 J_\ell=\left(\frac{1}{Z}\right)^2 J_\ell$$

Z : Total ratio

INTRODUCTION TO GD²

1. Starting Time GD²

For successful starting of a driven machine, the starting torque must be adequately larger than the load torque and even after starting commences, the motor torque must consistently be greater than the load torque, until reaching full load speed.
The difference between the motor torque and the load torque during the starting period is referred to as the accelerating torque: If the average accelerating torque is taken as $\overline{T}a$ (kgf·m), the starting time ts (s) up to the rotating speed n (r/min), is calculated according to the following formula :

$$ts = \frac{(GD_M^2 + GD_C^2 + GD_L^2) \cdot n}{375 \cdot \overline{T}a} (S)$$

However GD_M^2: GD^2 (kgf • m²) of motor (Inclusive of brake drum)
GD_C^2: GD^2 (kgf • m²) of Cyclo reducer
GD_L^2: GD^2 (kgf • m²) of driven machine (Inclusive of coupling, pulley) when converted to the motor shaft.

Average accelerating torque $\overline{T}a$

Here, the average accelerating torque, refers to the average value of the difference between the motor torque and the load torque or the actual torque for accelerating the load, as shown in the graph at the right. For determining the starting time, the motor torque curve and load torque curve are necessary. However, since it is extremely difficult to determine the average accelerating torque by this method, the average accelerating torque at the actual load time is calculated according to the following formula.
When starting at full voltage, the average accelerating torque Ta (kgf • m) may roughly be calculated by the following formula :

$$\overline{T}a \quad 0.8 \left(\frac{Ts+Tm}{2}\right) - \overline{T}_L \ (kgf \cdot m)$$

Furthermore, if the average load torque $\overline{T}_L$ (kgf • m) during the starting period is equivalent, the full load torque $\overline{T}_L$ (kgf • m) of the motor may roughly be equal to the following :

In case of constant torque load • • • • • • $\overline{T}_L$ T_L (kgf • m)
In case of square of reduced torque load • • $\overline{T}_L$ $0.34T_L$ (kgf • m)

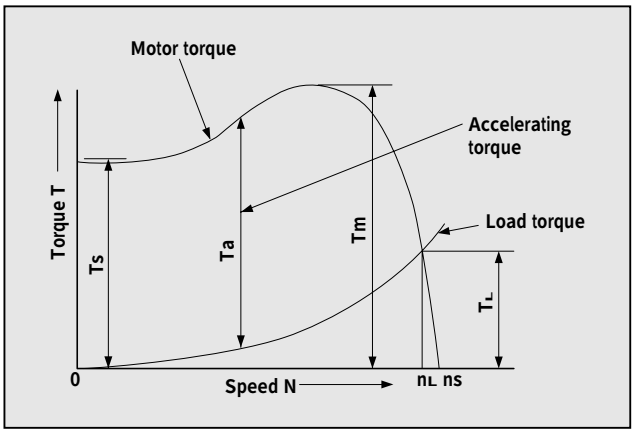
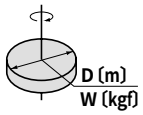
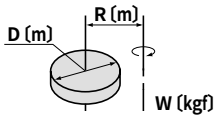
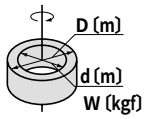
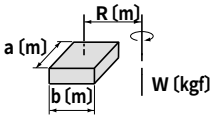
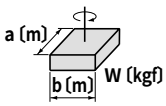
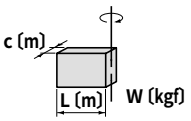


Fig E-6 Torque Curve

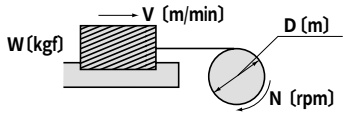
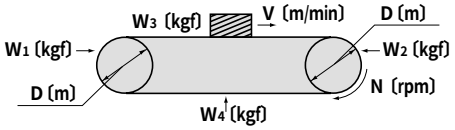
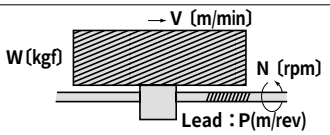
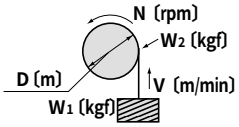
Ts : Starting torque
Tm: Maximum torque (Stalling torque)
Ta : Accelerating torque
T_L : Full load torque
ns : Synchronous rotating speed
n_L : Full load rotating speed

2. Calculation of GD^2

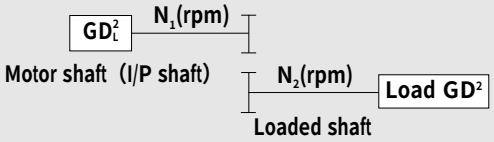
(1) GD^2 of rotating motion

Rotating motion on the center of gravity		Rotating motion off the center of gravity	
	$GD^2=\frac{1}{2}WD^2$ (kgf・m²)		$GD^2=W\left(\frac{1}{2}D^2+4R^2\right)$ (kgf・m²)
	$GD^2=\frac{1}{2}W(D^2+d^2)$ (kgf・m²)		$GD^2=W\left(\frac{a^2+b^2}{3}+4R^2\right)$ (kgf・m²)
	$GD^2=\frac{1}{3}W(a^2+b^2)$ (kgf・m²)		$GD^2=\frac{1}{3}W(4L^2+C^2)$ (kgf・m²)

(2) GD^2 of rectilinear motion (Loaded shaft side GD^2)

General application		$GD^2=W\left(\frac{V}{\pi \cdot N}\right)^2=WD^2$ (kgf・m²)
Horizontal motion by conveyor		$GD^2=\left(\frac{W_1+W_2}{2}+W_3+W_4\right)\times D^2$ (kgf・m²)
Horizontal motion by lead screw		$GD^2=W\left(\frac{V}{\pi \cdot N}\right)^2=W\left(\frac{P}{\pi}\right)^2$ (kgf・m²)
Vertical motion by hoist		$GD^2=W_1D^2+\frac{1}{2}W_2D^2$ (kgf・m²)

(3) Calculation of GD^2 at different rotating speeds



$$GD_L^2=\left(\frac{N_2}{N_1}\right)^2GD^2=\left(\frac{1}{Z}\right)^2GD^2$$

Z : Total ratio

Moment of Inertia • GD^2

Table E-19 Moment of Inertia • GD^2 on Motor Shaft of Cyclo Gearmotor (Single Stage Reduction, Only Cyclo part)

Unit : GD_c^2 ($\times 10^{-4}$kgf•m^2) • J_c (Moment of inertia) ($\times 10^{-4}$kg•m^2)

Frame Size	Reduction Ratio															
	6		8		11		13		15		17		21		25	
	GD_c^2	J_c	GD_c^2	J_c	GD_c^2	J_c	GD_c^2	J_c	GD_c^2	J_c	GD_c^2	J_c	GD_c^2	J_c	GD_c^2	J_c
6060 6065	0.666	0.167	0.532	0.133	0.449	0.112	0.423	0.106	0.407	0.102	0.396	0.099	0.378	0.095	0.366	0.092
6070 6075	0.682	0.171	0.541	0.135	0.454	0.114	0.426	0.107	0.409	0.102	0.398	0.100	0.379	0.095	0.367	0.092
6080 6085	1.61	0.403	1.32	0.330	1.12	0.280	1.07	0.268	1.02	0.255	0.997	0.249	0.688	0.172	0.665	0.166
6090 6095	3.82	0.955	2.96	0.740	2.37	0.593	2.49	0.623	2.42	0.605	2.12	0.530	1.61	0.403	1.56	0.390
6100 6105	3.07	0.768	2.22	0.555	1.36	0.340	1.40	0.350	1.28	0.320	0.897	0.224	1.03	0.258	0.942	0.236
6110 6115	5.99	1.50	4.44	1.11	3.38	0.845	3.07	0.768	2.88	0.720	2.75	0.688	2.44	0.610	2.38	0.595
6120 6125	12.4	3.10	10.1	2.53	6.24	1.56	6.82	1.71	6.46	1.62	4.82	1.21	5.56	1.39	5.17	1.29
6130 6135	34.3	8.58	23.5	5.88	17.3	4.33	14.7	3.68	13.2	3.30	12.1	3.03	10.0	2.51	9.39	2.35
6140 6145	37.7	9.43	25.6	6.40	18.2	4.55	14.7	3.68	13.3	3.33	11.8	2.95	10.1	2.52	9.41	2.35
6160 6165	98.7	24.7	68.9	17.2	45.4	12.4	41.5	11.0	37.7	9.90	32.2	8.35	29.9	7.65	28.2	71.5
6170 6175	264	66.0	197	49.3	153	37.5	140	35.3	124	31.3	119	30.0	111	28.0	107	27.0
6180 6185	—	—	—	—	231	58.5	209	52.8	186	46.8	177	44.5	167	42.3	156	39.3
6190 6195	—	—	—	—	545	136	503	126	478	120	460	115	428	107	415	104
6205	—	—	—	—	646	162	—	—	565	141	—	—	517	129	—	—
6215	—	—	—	—	990	248	—	—	864	216	—	—	789	197	—	—
6225	—	—	—	—	1220	305	—	—	1030	258	—	—	927	232	—	—
6235	—	—	—	—	1990	498	—	—	1710	428	—	—	1530	383	—	—
6245	—	—	—	—	3610	903	—	—	3170	793	—	—	2890	723	—	—
6255	—	—	—	—	5870	1470	—	—	5120	1280	—	—	4630	1160	—	—
6265	—	—	—	—	8590	2150	—	—	7460	1870	—	—	6800	1700	—	—
6275	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Frame Size	Reduction Ratio															
	29		35		43		51		59		71		87		119	
	GD_c^2	J_c	GD_c^2	J_c	GD_c^2	J_c	GD_c^2	J_c	GD_c^2	J_c	GD_c^2	J_c	GD_c^2	J_c	GD_c^2	J_c
6060 6065	0.361	0.090	0.356	0.089	0.351	0.088	—	—	—	—	—	—	—	—	—	—
6070 6075	0.362	0.091	0.356	0.089	0.351	0.088	0.348	0.087	0.346	0.087	—	—	—	—	—	—
6080 6085	0.650	0.163	0.633	0.158	0.380	0.095	0.373	0.093	0.370	0.093	0.365	0.091	0.363	0.091	—	—
6090 6095	1.30	0.325	1.01	0.253	0.993	0.248	0.968	0.242	0.723	0.181	0.954	0.239	0.712	0.178	0.944	0.236
6100 6105	0.651	0.163	0.607	0.152	0.573	0.143	0.790	0.198	0.528	0.132	0.767	0.192	0.511	0.128	0.750	0.188
6110 6115	2.32	0.580	2.23	0.558	2.19	0.548	2.13	0.533	2.12	0.530	2.10	0.525	2.09	0.523	—	—
6120 6125	3.63	0.908	3.46	0.865	3.30	0.825	4.58	1.15	3.15	0.788	4.48	1.12	3.04	0.760	—	—
6130 6135	8.63	2.16	8.33	2.08	7.84	1.96	7.71	1.93	7.64	1.91	7.45	1.86	7.40	1.85	—	—
6140 6145	8.63	2.16	8.34	2.09	7.84	1.96	7.65	1.91	7.64	1.91	7.45	1.86	7.40	1.85	—	—
6160 6165	25.2	6.35	24.3	6.10	23.3	5.85	23.0	5.75	23.1	5.78	22.1	5.53	21.8	5.45	—	—
6170 6175	102	25.5	100	25.3	97.7	24.5	96.7	24.2	95.6	23.9	95.2	23.8	94.7	23.7	—	—
6180 6185	149	37.5	147	37.0	144	36.0	140	35.0	139	34.8	138	34.5	137	34.3	—	—
6190 6195	402	101	393	98.3	387	96.8	383	95.8	380	95.0	378	94.5	376	94.0	—	—
6205	482	121	—	—	460	115	—	—	451	113	—	—	446	117	—	—
6215	735	184	—	—	700	175	—	—	686	172	—	—	678	170	—	—
6225	840	210	—	—	788	197	—	—	766	192	—	—	753	188	—	—
6235	1410	353	—	—	1340	335	—	—	1300	325	—	—	1290	323	—	—
6245	2720	680	—	—	2600	650	—	—	2550	638	—	—	2530	633	—	—
6255	4320	1080	—	—	4140	1040	—	—	4060	1020	—	—	4010	1000	—	—
6265	6330	1580	—	—	6030	1510	—	—	5900	1480	—	—	5820	1460	—	—
6275	19600	4900	—	—	18900	4730	—	—	18600	4650	—	—	18400	4600	—	—

Notes : 1. Table E-19 does not include J·GD^2 of motor.

Obtain the J·GD^2 of the single stage reduction gearmotor by adding the J·GD^2 of the motor Tables E-21, 22.

2. Calculate the J·GD^2 of the 2-Stage reduction model from the following formula :

J·GD^2 of the 2-stage reduction model =

$$\text{J·GD}^2\text{ of 1st stage} + \frac{\text{J·GD}^2\text{ (2nd stage)}}{(\text{Reduction ratio of 1st stage})^2}$$

Calculate the J·GD^2 of the 1st stage (Input side) in the same manner as calculating the J·GD^2 of single stage reduction model.

For the J·GD^2 of the 2nd stage (output side) , the values shown in Table E-19 may be used.

* The values in Table E-19 are subject to change without notice.

Table E-20 Moment of Inertia • GD^2 on High Speed Shaft of Cyclo Reducer (Single Stage Reducer)

Unit : GD_c^2 ($\times 10^{-4}$kgf•m²) • J_c (Moment of Inertia) ($\times 10^{-4}$kg•m²)

Frame Size	Reduction Ratio															
	6		8		11		13		15		17		21		25	
	GD_c^2	J_c	GD_c^2	J_c	GD_c^2	J_c	GD_c^2	J_c	GD_c^2	J_c	GD_c^2	J_c	GD_c^2	J_c	GD_c^2	J_c
6060 6065	0.764	0.191	0.630	0.158	0.547	0.137	0.521	0.130	0.505	0.126	0.494	0.124	0.476	0.119	0.464	0.116
6070 6075	0.780	0.195	0.639	0.160	0.552	0.138	0.524	0.131	0.507	0.127	0.496	0.124	0.477	0.119	0.465	0.116
6080 6085	1.70	0.425	1.41	0.353	1.22	0.305	1.16	0.290	1.11	0.278	1.09	0.273	0.782	0.196	0.759	0.190
6090 6095	4.06	1.015	2.73	0.683	2.60	0.650	2.25	0.563	2.18	0.545	2.36	0.590	1.380	0.345	1.330	0.333
6100 6105	3.32	0.830	1.98	0.495	1.60	0.400	1.15	0.288	1.03	0.259	1.18	0.295	0.783	0.196	0.695	0.174
6110 6115	6.23	1.56	4.68	1.17	3.62	0.905	3.31	0.828	3.12	0.780	2.99	0.748	2.68	0.670	2.62	0.655
6120 6125	13.8	3.45	8.68	2.17	7.64	1.91	5.42	1.36	5.06	1.27	6.22	1.56	4.17	1.04	3.77	0.943
6130 6135	36.8	9.20	26.0	6.50	19.8	4.95	17.2	4.30	15.8	3.95	14.6	3.65	12.6	3.15	18.9	4.73
6140 6145	41.7	10.4	28.9	7.23	21.2	5.30	17.3	4.33	15.8	3.95	14.5	3.63	12.6	3.15	12.0	3.00
6160 6165	146	36.5	116	29.0	92.6	23.2	88.7	22.2	84.9	21.2	79.4	19.9	77.1	19.3	75.4	18.9
6170 6175	315	78.8	248	62.0	204	51.0	191	47.8	175	43.8	170	42.5	161	40.3	158	39.5
6180 6185	—	—	—	—	292	73.0	271	67.8	247	61.8	239	59.8	228	57.0	217	54.3
6190 6195	—	—	—	—	678	169	636	159	611	152	594	148	561	140	548	137
6205	—	—	—	—	946	237	—	—	864	216	—	—	817	204	—	—
6215	—	—	—	—	1490	373	—	—	1360	340	—	—	1290	323	—	—
6225	—	—	—	—	1930	483	—	—	1750	438	—	—	1640	410	—	—
6235	—	—	—	—	3240	810	—	—	2960	740	—	—	2780	695	—	—
6245	—	—	—	—	4940	1240	—	—	4500	1130	—	—	4220	1060	—	—
6255	—	—	—	—	8910	2230	—	—	8160	2040	—	—	7670	1920	—	—
6265	—	—	—	—	11700	2930	—	—	10600	2650	—	—	9960	2490	—	—
6275	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Frame Size	Reduction Ratio																GD² of fan Moment of Inertia	
	29		35		43		51		59		71		87		119			
	GD_c^2	J_c	GD_c^2	J_c	GD_c^2	J_c	GD_c^2	J_c	GD_c^2	J_c	GD_c^2	J_c	GD_c^2	J_c	GD_c^2	J_c	GD_c^2	J_c
6060 6065	0.460	0.115	0.454	0.114	0.449	0.112	—	—	—	—	—	—	—	—	—	—	—	—
6070 6075	0.460	0.115	0.454	0.114	0.450	0.113	0.446	0.112	0.445	0.111	—	—	—	—	—	—	—	—
6080 6085	0.744	0.186	0.727	0.182	0.474	0.119	0.467	0.117	0.463	0.116	0.459	0.115	0.456	0.114	—	—		
6090 6095	1.54	0.385	1.25	0.313	1.23	0.308	0.731	0.183	0.960	0.240	0.717	0.179	0.949	0.237	0.707	0.177	—	—
6100 6105	0.899	0.225	0.854	0.214	0.820	0.205	0.543	0.136	0.776	0.194	0.520	0.130	0.758	0.190	0.503	0.126	—	—
6110 6115	2.56	0.64	2.47	0.618	2.43	0.608	2.37	0.593	2.36	0.590	2.34	0.585	2.33	0.583	—	—	—	—
6120 6125	5.03	1.26	4.86	1.22	4.70	1.18	3.19	0.798	4.55	1.14	3.08	0.770	4.44	1.11	—	—	—	—
6130 6135	11.2	2.80	10.9	2.73	10.3	2.58	10.2	2.55	10.2	2.55	9.97	2.49	9.93	2.48	—	—	—	—
6140 6145	11.2	2.80	10.9	2.73	10.3	2.58	10.2	2.55	10.2	2.55	9.99	2.50	9.93	2.48	—	—	—	—
6160 6165	72.4	18.1	71.5	17.9	70.5	17.6	70.2	17.6	70.3	17.6	69.3	17.3	69.0	17.3	—	—	35.4	8.85
6170 6175	153	38.3	151	37.8	148	37.0	147	36.8	146	36.5	146	36.5	145	36.3	—	—	33.3	8.33
6180 6185	211	52.8	209	52.3	206	51.5	202	50.5	200	50.0	199	49.8	198	49.5	—	—	32.7	8.18
6190 6195	535	133	527	131	520	130	516	129	513	128	511	127	509	127	—	—	83.6	20.9
6205	782	196	—	—	760	190	—	—	750	188	—	—	745	186	—	—	248	62.0
6215	1240	310	—	—	1200	300	—	—	1190	298	—	—	1180	295	—	—	419	105
6225	1550	388	—	—	1500	375	—	—	1480	370	—	—	1470	368	—	—	599	150
6235	2660	665	—	—	2580	645	—	—	2550	638	—	—	2530	633	—	—	1040	260
6245	4040	1010	—	—	3930	983	—	—	3880	970	—	—	3850	963	—	—	1040	260
6255	7360	1840	—	—	7180	1800	—	—	7100	1780	—	—	7060	1770	—	—	2370	593
6265	9480	2370	—	—	9180	2300	—	—	9050	2260	—	—	8980	2250	—	—	2370	593
6275	—	—	—	—	29900	7480	—	—	29600	7400	—	—	29400	7350	—	—	9540	2390

Notes : 1. The value of the fan has been to the J·GD^2 of the Frame sizes of 6160～6275.

2. The J·GD^2 of the 2-stage reduction model is calculated by the following formula :

J·GD^2 of 2-stage reduction model =

$$\text{J·GD}^2 \text{ of 1st stage} + \frac{\text{J·GD}^2 \text{ of 2nd stage}}{(\text{Reduction ratio of 1st stage})^2}$$

Use value in Table E-20 for J·GD^2 of 1st stage.

For the J·GD^2 of the 2nd stage, deduct the J·GD^2 of the fan from the value in Table E-20.

* Values Table E-20 are subject to change without notice.

Table E-21 Moment of Inertia・GD² of Three Phase Motor

Unit：GD_M^2 kgf・m²・J_M (Moment of Inertia) kg・m²

kW,P	0.1kW×4P		0.2kW×4P		0.25kW×4P		0.4kW×4P		0.55kW×4P		0.75kW×4P	
	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M
Standard	0.0013	0.000325	0.0020	0.000500	0.0020	0.000500	0.0026	0.000650	0.00405	0.00101	0.00480	0.00120
With Brake	0.0014	0.000350	0.0022	0.000550	0.0022	0.000550	0.0027	0.000675	0.00445	0.00111	0.00520	0.00130

kW,P	1.1kW×4P		1.5kW×4P		2.2kW×4P		3.0kW×4P		3.7kW×4P		5.5kW×4P	
	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M
Standard	0.0074	0.00185	0.0085	0.00213	0.0133	0.00333	0.0281	0.00700	0.0339	0.00848	0.0457	0.0114
With Brake	0.0083	0.00208	0.0094	0.00235	0.0149	0.00373	0.0325	0.00810	0.0383	0.00958	0.0501	0.0125

kW,P	7.5kW×4P		11kW×4P		15kW×4P		18.5、22kW×4P		30kW×4P		37kW×4P	
	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M
Standard	0.107	0.0268	0.150	0.0375	0.359	0.0898	0.9	0.225	1.0	0.250	1.23	0.308
With Brake	0.121	0.0303	0.164	0.0410	0.428	0.107	0.972	0.243	1.05	0.262	1.28	0.321

kW,P	45kW×4P		55kW×4P	
	GD_M^2	J_M	GD_M^2	J_M
Standard	1.37	0.343	2.70	0.675

kW,P	15kW×6P		22kW×6P		30kW×6P		37kW×6P		45kW×6P		55kW×6P	
	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M
Standard	1.27	0.318	1.45	0.363	1.9	0.475	2.4	0.600	4.0	1.00	4.7	1.18

Table E-22 Moment of inertia・GD² of Motor for Inverter

Unit：GD_M^2 kgf・m²・J_M (Moment of Inertia) kg・m²

kW,P	0.1kW×4P		0.2kW×4P		0.4kW×4P		0.75kW×4P		1.5kW×4P		2.2kW×4P	
	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M
Standard	0.0020	0.000500	0.0026	0.000650	0.00480	0.00120	0.0085	0.00213	0.0133	0.00333	0.0339	0.00848
With Brake	0.0022	0.000550	0.0027	0.000675	0.00520	0.00130	0.0094	0.00235	0.0149	0.00373	0.0383	0.00958

kW,P	3.7kW×4P		5.5kW×4P		7.5kW×4P		11kW×4P		15kW×4P	
	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M
Standard	0.0457	0.0114	0.107	0.0268	0.150	0.0375	0.359	0.0898	0.9	0.225
With Brake	0.0501	0.0125	0.121	0.0303	0.164	0.0410	0.428	0.107	0.972	0.243

kW,P	18.5kW×4P		22kW×4P		30kW×4P		37kW×4P	
	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M	GD_M^2	J_M
Standard	1.0	0.250	1.0	0.250	1.23	0.308	1.37	0.343
With Brake	1.05	0.262	1.05	0.262	1.28	0.321	—	—

〔Example 1〕 CNHM2-6115-29

(1) J_M=0.00213kg・m²
(Standard 1.5kW×4-Pole motor in Table E-21)

(2) Frame size 6115 of Cyclo reducer.
J_C : Reduction ratio of 29＝0.580×10^{-4}kg・m²
(From the Table E-19)

(3) ΣJ of CNHM2-6115-29
ΣJ＝Motor J_M＋Cyclo reducer J_C
＝0.00213＋0.000058
＝0.002188kg・m²

〔Example 2〕 CVVM20-6215DA-165 (15×11)

(1) J_M=0.0898kg・m² (Standard 15kW×4-Pole motor in Table E-21)

(2) Combination of Cyclo reducer, Frame size 6215 with ratio 15 ＋ Frame size 6135 with ratio 11. (Refer Page 9)

(3) 1st stage of 6135 Ratio 11, $J_C=4.33\times10^{-4}$kg・m²

(4) 2nd stage of 6215 Ratio 15, $J_C=216\times10^{-4}$kg・m²
(Both (3) & (4) from Table E-19)

(5) Cyclo reducer $J_C=4.33\times10^{-4}+\frac{216\times10^{-4}}{11^2}=0.0006$kg・m²

(6) ΣJ of CVVM20-6215DA-165
ΣJ＝Motor J_M＋Cyclo reducer J_C
＝0.0898＋0.0006
＝0.0904kg・m²

OPERATING PRINCIPLES

The reducer portion of the CYCLO gearmotor is fundamentaly different in principle and mechanism from the involute gearing mechanism of competitive gearmotors. The unique speed reducer portion is an ingenious combination of the following two mechanisms:

- A combination of a planet gear and a fixed internal sun gear. In the CYCLO gearmotor, the planet gear has cycloidal-shaped teeth and the sun gear has circular pin teeth.
  The number of teeth in the planet gear is one or two less than the sun gear.
- A constant speed internal gearing mechanism.

See Fig.E-7

In equation 1, below, P identifies the number of the planet gear teeth, S that of the sun gear, ω2 the angular velocity of the planet gear around its own axis. The velocity ratio of ω2 to ω1 is shown as follows:

$$\frac{\omega 2}{\omega 1} = 1 - \frac{S}{P} = -\frac{S-P}{P} \quad \cdots \text{Equation 1}$$

With S greater by one or two than P in this equation, the highest velocity ratio is obtainable.
That is, if S-P=1 is applied to Equation 1, the velocity ratio may be calculated from the following equation:

$$\frac{\omega 2}{\omega 1} = \frac{1}{P} \quad \cdots \text{Equation 2}$$

Or if S-P=2 is applied to Equation 1, the velocity ratio may be calculated from the following equation:

$$\frac{\omega 2}{\omega 1} = \frac{2}{P} \quad \cdots \text{Equation 3}$$

As the crankshaft rotates at the angular velocity ω1 around the axis of the sun gear, the planet gear rotates at the angular

velocity $-\frac{1\omega 1}{P}$ or $-\frac{2\omega 1}{P}$

when P indicates the number of the teeth of the planet gear and the symbol '–' indicates that the rotation of the planet gear is in a reverse direction to that of the crankshaft.
In the CYCLO gearmotor, illustrated in Fig.E-8, circular teeth(pins) are adapted for the sun gear and epitrochoid curved teeth for the planet gear, thereby avoiding tooth top interference. The rotation of the planet gear around its own axis is taken out through a constant speed internal gearing mechanism as shown in Fig.E-9.
In this mechanism shown in Fig.E-10, the pins of the slow speed shaft are evenly spaced on a circle that is concentric to the axis of the sun gear. The pins transmit the rotation of the planet gear by rolling internally on the circumference of the bores of each planet gear or cycloid disc. The diameter of the bores minus the diameter of the slow speed shaft pins is equal to twice the eccentricity value of the crank shaft (eccentric). This mechanism smoothly transmits only the rotation of the planet gear around its own axis to the slow speed shaft.

Fig.E-7 Principle of internal Planetary Gearing

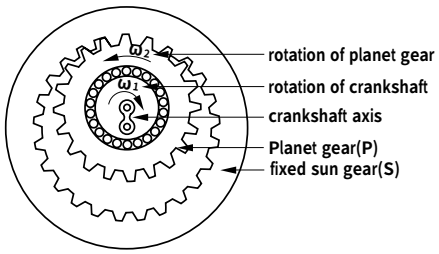


Fig.E-8 Epitrochoid Planet Gear-Circular(PIN) Tooth Sun Gear Combination

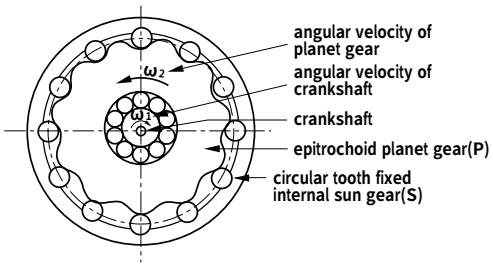


Fig.E-9 Constant Speed Internal Gearing

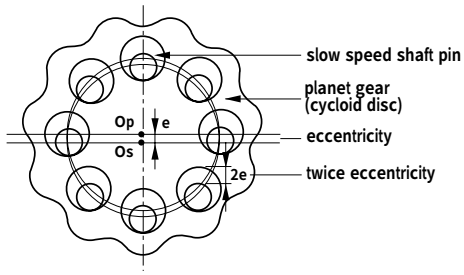
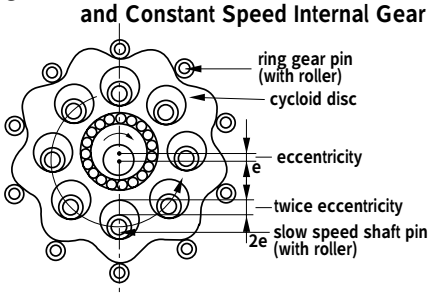


Fig.E-10 Combination of Planet-Sun Gears and Constant Speed Internal Gear



Construction Drawing

Construction of gearmotor and reducer

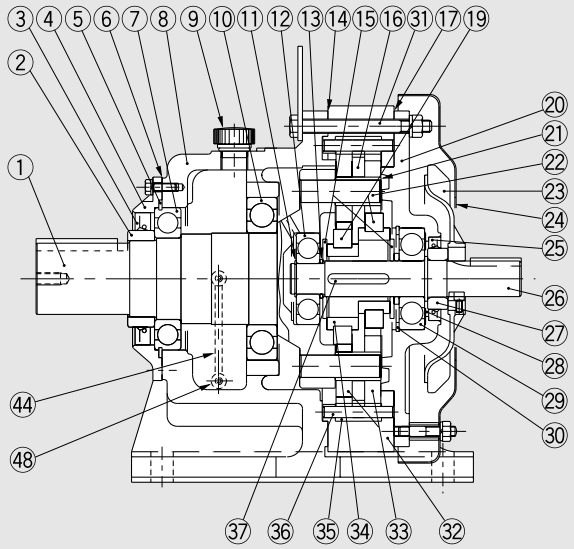


Fig.E-11 Type CHH (Horizontal•Reducer)
Single reduction (Example: Frame size 6175)

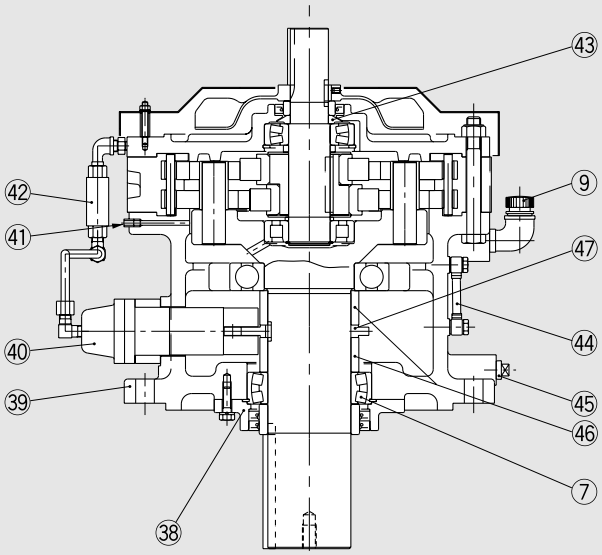


Fig.E-12 Type CVV (Vertical•Reducer)
Single reduction (Example: Frame size 6225)

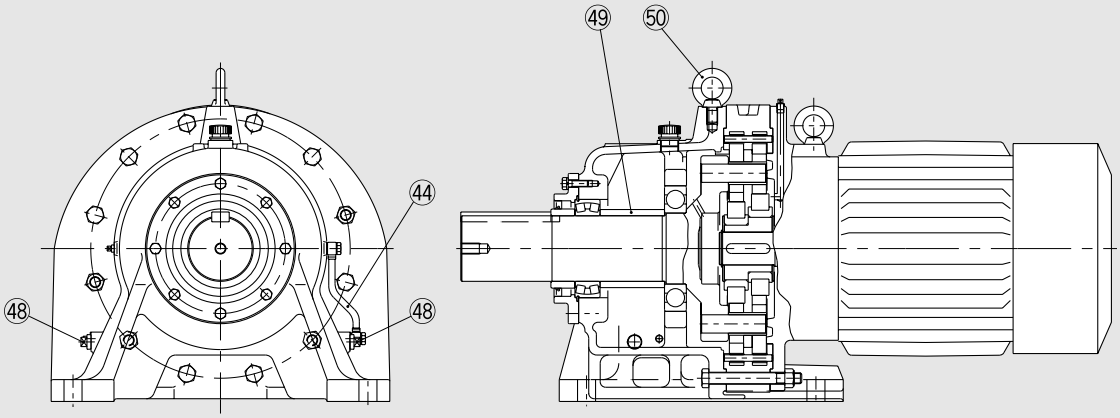


Fig.E-13 Type CHHM (Horizontal•Gearmotor)
Single reduction (Example: Frame size 6225)

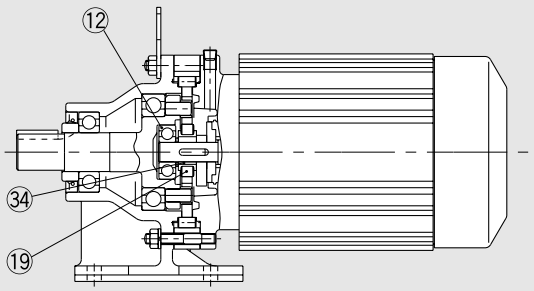


Fig.E-14 Type CNHM (Horizontal•Gearmotor)
Single reduction (Example: Frame size 6085)

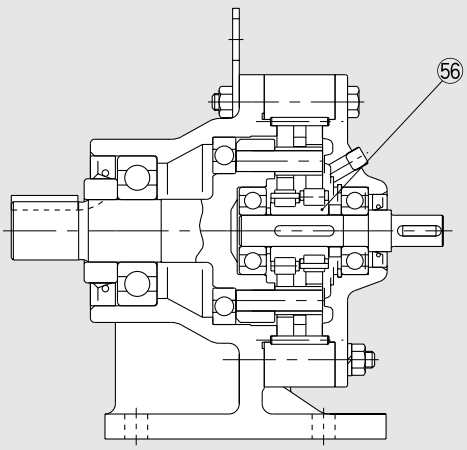


Fig.E-15 Type CNH (Horizontal•Reducer)
Single reduction (Example: Frame size 6105)

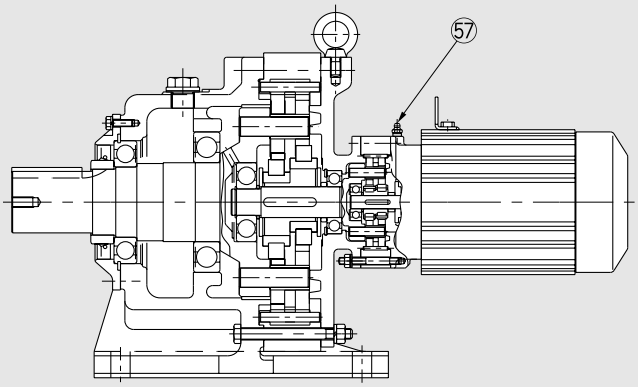


Fig.E-16 Type CHHM (Horizontal•Gearmotor)
Double reduction (Example: Frame size grease lubricated 6185DB)

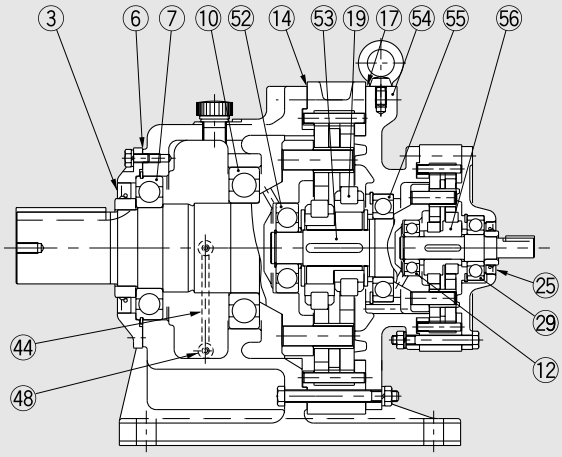


Fig.E-17 Type CHH (Horizontal•Reducer)
Double reduction (Example: Frame size 6185DB)

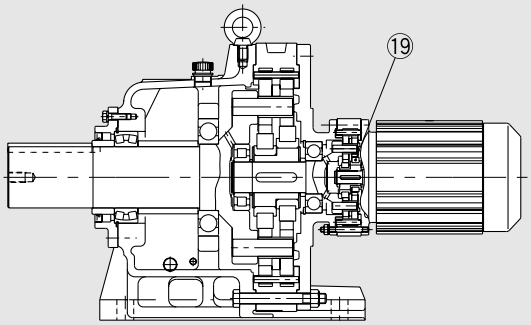


Fig.E-18 Type CHHM (Horizontal•Gearmotor)
Double reduction (Example: Frame size 6225DB)

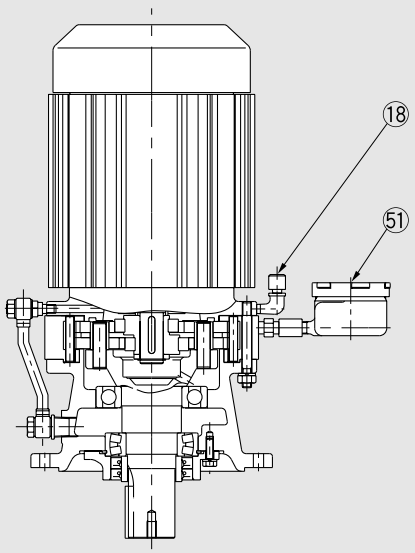


Fig.E-19 Type CVVM (Vertical•Gearmotor)
Single reduction (Example: Frame size 6145)

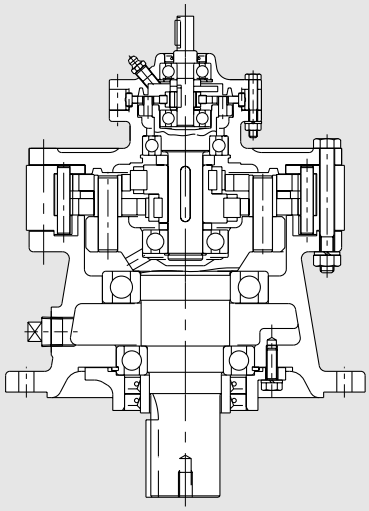


Fig.E-20 Type CVV (Vertical•Reducer)
Double reduction (Example: Frame size 6135DA)

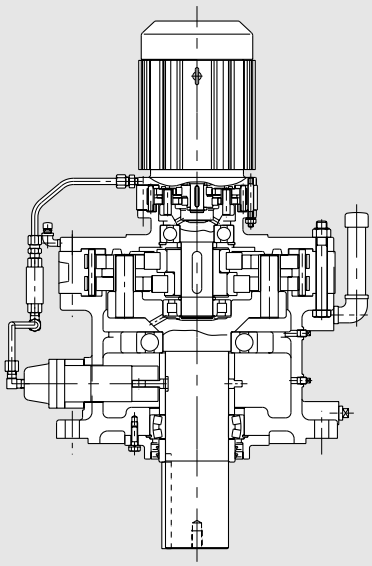
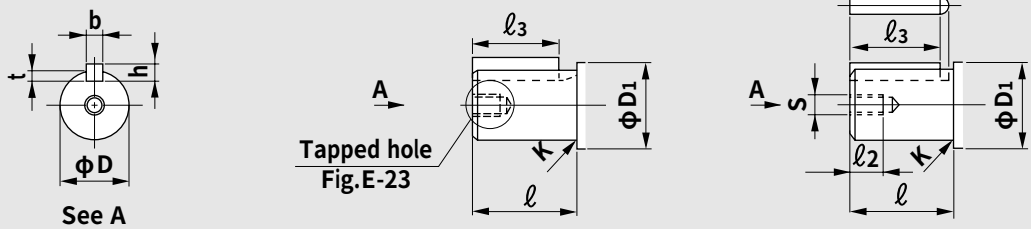


Fig.E-21 Type CVVM (Vertical•Gearmotor)
Double reduction (Example: Frame size 6225DA)

Principal parts

No.	Part Name	No.	Part Name	No.	Part Name	No.	Part Name	No.	Part Name
1	Slow speed shaft	13	Spacer	25	Oil seal	37	Key	49	Spacer
2	Collar(Slow speed shaft)	14	Gasket B	26	High speed shaft	38	Gland	50	Eye bolt
3	Oil seal	15	End plate	27	Collar (High Speed Shaft)	39	Flanged casing	51	Oil filler
4	Slow speed end cap	16	Spacer ring	28	Spacer	40	Plunger pump	52	Intermediate shaft, bearing A
5	Retaining ring	17	Gasket C	29	High speed shaft, bearing B	41	Air vent plug	53	Intermediate shaft
6	Gasket A	18	Air vent plug	30	Retaining ring	42	Oil signal	54	Intermediate cover
7	Slow speed shaft, bearing A	19	Bearing for eccentric (High speed shaft section)	31	Bolt for ring gear housing	43	Oil slinger	55	Intermediate shaft, bearing B
8	Horizontal casing	20	High speed end shield	32	Ring gear housing	44	Oil level gauge	56	Eccentric bearing (Double)
9	Oil filler plug	21	Slow speed shaft roller	33	Cycloid disc	45	Plug (Oil drain)	57	Grease nipple
10	Slow speed shaft, bearing B	22	Slow speed shaft pin	34	Eccentric	46	Spacer		
11	Retaining ring	23	Cooling fan	35	Ring gear roller	47	Cam		
12	High speed shaft, bearing A	24	Fan cover	36	Ring gear pin	48	Plug (Oil drain)		

DETAILED DIMENSION OF SLOW SPEED SHAFT



〔Fig.E-22a〕 〔Fig.E-22b〕

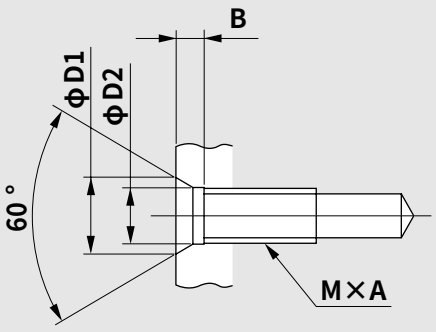
●Dimension of high speed shaft end ; Dimension tolerance in accordance with JIS B 0401-1976 "h6".
●Dimension of shaft end key ; Parallel key in accordance with JIS B 1301-1976.

Table E-23 Dimension of Slow Speed Shaft

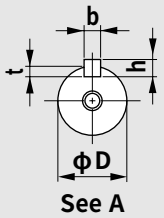
Frame size		Slow Speed Shaft													
		Fig.	D (h6)	Tolerance	D1	ℓ	K (Roundness)	t	Tolerance	b (Key) (h9)	Tolerance	h (Key)	Tolerance	ℓ3 (Key)	ℓ4
Single Reduction	Double Reduction														
6060	6060DA	E-22b	14	0 -0.011	30	25	—	3	+0.1 0	5	0 -0.030	5	0 -0.030	20	22.5
6065	6065DA														
6070	6070DA	E-22b	18		30	30	—	3.5		6		6		25	—
6075	6075DA														
6080	—	E-22b	22	0 -0.013	45	35	—	3.5		6		6		30	33
6085	—														
6090	6090DA	E-22a	28		45	35	—	4	+0.2 0	8	0 -0.036	7	0 -0.090	32	—
6095	6095DA														
6100	6100DA	E-22a	28		50	35	—	4		8		7		32	—
6105	6105DA														
610H	—														
6110	—	E-22b	32	0 -0.016	55	45	—	5		10		8		37	42
6115	—														
6120	6120DA 6120DB	E-22a	38		65	55	—	5		10		8		50	—
6125	6125DA 6125DB														
612H	—														

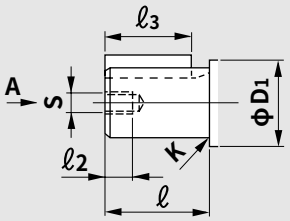
Table E-24 Dimension of Tapped hole

Frame size		Tap	Depth	Center hole		
Single Reduction	Double Reduction	M	A	ϕD1	ϕD2	B
6060	6060DA	M5	16	7	5.2	2.6
6065	6065DA	M5	16	7	5.2	2.6
6070	6070DA	M6	16	9	6.2	3.4
6075	6075DA	M6	16	9	6.2	3.4
6080	—	M6	16	9	6.2	3.4
6085	—	M6	16	9	6.2	3.4
6090	6090DA	M8	20	11	8.2	3.6
6095	6095DA	M8	20	11	8.2	3.6
6100	6100DA	M8	20	11	8.2	3.6
6105	6105DA	M8	20	11	8.2	3.6
610H	—	M8	20	11	8.2	3.6
6110	—	M8	20	11	8.2	3.6
6115	—	M8	20	11	8.2	3.6
6120	6120DA 6120DB	M8	20	11	8.2	3.6
6125	6125DA 6125DB	M8	20	11	8.2	3.6
612H	—	M8	20	11	8.2	3.6

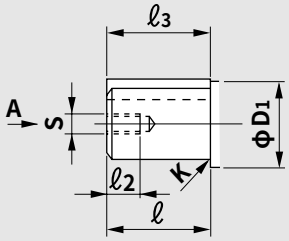


〔Fig.E-23〕

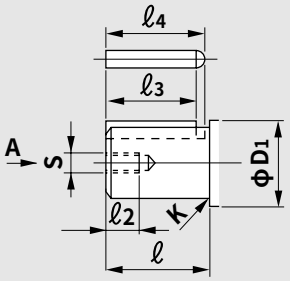




〔Fig.E-24〕



〔Fig.E-25〕



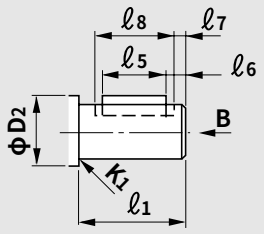
〔Fig.E-26〕

Table E-25 Dimension of Slow Speed Shaft

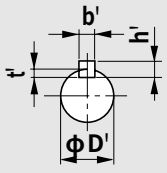
Frame size		Slow Speed Shaft															
			D				K			t		b (Key)		h (Key)		ℓ3	ℓ4
Single Reduction	Double Reduction	Fig.	(h6)	Tolerance	D1	ℓ	(Roundness)	s	ℓ2		Tolerance	(h9)	v		Tolerance	(Key)	
6130	6130DA 6130DB 6130DC	E-24	50	0 -0.016	65	70 (61)	—	M10	18	5.5	+0.2 0	14	0 -0.043	9	0 -0.090	56	—
6135	6135DA 6135DB 6135DC	E-24															
6140	6140DA 6140DB 6140DC	E-24	50		65	90 (81)	—	M10	18	5.5		14		9		80	
6145	6145DA 6145DB 6145DC	E-24															
614H	—	E-24															
6160	6160DA 6160DB 6160DC	E-24	60	0 -0.019	85	90 (80)	—	M10	18	7		18		11	0 -0.110	80	—
6165	6165DA 6165DB 6165DC	E-24															
616H	—	E-24															
6170	6170DA 6170DB 6170DC	E-24	70		95	90 (84)	—	M12	24	7.5		20		12		80	—
6175	6175DA 6175DB 6175DC	E-24															
6180	6180DA 6180DB	E-24	80		110	110 (100)	—	M12	24	9		22	0 -0.052	14		100	—
6185	6185DA 6185DB	E-24															
6190	6190DA 6190DB	E-26	95	0 -0.022	120	135 (125)	—	M20	34	9		25		14		125	137.5
6195	6195DA 6195DB	E-26															
6205	6205DA 6205DB	E-25	100		120	165	—	M20	34	10		28		16		165	—
6215	6215DA 6215DB	E-25	110		130	165	—	M20	34	10		28		16		165	—
6225	6225DA 6225DB	E-25	120		145	165	—	M20	34	11		32		18		165	—
6235	6235DA 6235DB	E-25	130	0 -0.025	160	200	—	M24	41	11	+0.3 0	32	0 -0.063	18	0 -0.130	200	—
6245	6245DA 6245DB	E-25	140		170	200	—	M24	41	12		36		20		200	—
6255	6255DA 6255DB	E-25	160		190	240	—	M30	49	13		40		22		240	—
6265	6265DA	E-25	170		200	300	—	M30	49	13		40		22		300	—
6275	6275DA	E-25	180		230	330 (320)	—	M30	52	15		45		25		330 (320)	—

Note : " ℓ , ℓ3 "dimensions in parentheses are for models with vertical output shaft.

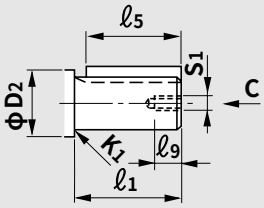
DETAILED DIMENSION OF HIGH SPEED SHAFT



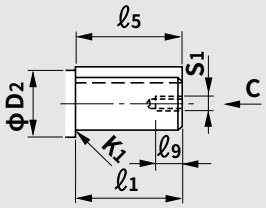
〔Fig.E-27〕



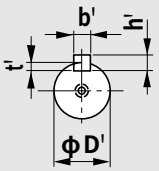
See B



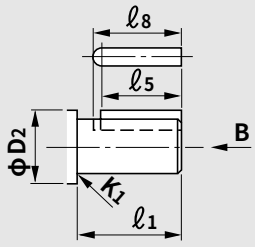
〔Fig.E-28〕



〔Fig.E-29〕



See C



〔Fig.E-30〕

●Dimension of high speed shaft end ; Dimension tolerance in accordance with JIS B 0401-1976"h6"
●Dimension of shaft end key ; Parallel key in accordance with JIS B 1301-1976
●※S1 & 9 Dimension Tap Hole is only for vertical (Type CVV,CVF) Single stage only

Table E-26 Dimension of High Speed Shaft

Frame size		High Speed Shaft																
Single Reduction	Double Reduction	Fig.	D' (h6)	Tolerance	D2	ℓ1	K1 (Roundness)	t'	Tolerance	b' (Key) (h9)	Tolerance	h' (Key)	Tolerance	ℓ5 (Key)	ℓ6	ℓ7	ℓ8	※S1	※ℓ9
6060	6060DA	E-27	12	0 -0.011	17	25	0.5	2.5	+0.1 0	4	0 -0.030	4	0 -0.030	18	3	1	22	—	—
6065	6065DA	E-27																	
6070	6070DA	E-27	12		17	25	0.5	2.5		4		4		18				—	—
6075	6075DA	E-27																	
6080	—	E-27	12		17	25	0.5	2.5		4		4		18				—	—
6085	—	E-27																	
6090	6090DA	E-27	15		20	25	1	3		5		5		16	3.5		21	—	—
6095	6095DA	E-27																	
6100	6100DA	E-27	15		20	25	1	3		5		5		16				—	—
6105	6105DA	E-27																	
610H	—	E-27																	
6110	—	E-27	15		20	25	1	3		5		5		16	3.5	1		—	—
6115	—	E-27																	
6120	6120DA 6120DB	E-30	18		32	35	—	3.5		6		6		25	—	—	28	—	—
6125	6125DA 6125DB	E-30																	
612H	—	E-30																	
6130	6130DA 6130DB 6130DC	E-30	22	0 -0.013	38	40	—	3.5		6		6		32	—	—	35	—	—
6135	6135DA 6135DB 6135DC	E-30																	
6140	6140DA 6140DB 6140DC	E-30	22		38	40	—	3.5		6		6		32				—	—
6145	6145DA 6145DB 6145DC	E-30																	
614H	—	E-30																	
6160	6160DA 6160DB 6160DC	E-29	30		70	45	—	4		8	0 -0.036	7	0 -0.090	45	—	—	—	M10	20
6165	6165DA 6165DB 6165DC	E-29																	
616H	—	E-29																	
6170	6170DA 6170DB 6170DC	E-28	35	0 -0.016	70	55	—	5	+0.2 0	10	0 -0.043	8		50	—	—	—	M12	25
6175	6175DA 6175DB 6175DC	E-28																	
6180	6180DA 6180DB	E-28	40		70	65	—	5		12		8		63	—	—	—	M16	30
6185	6185DA 6185DB	E-28																	
6190	6190DA 6190DB	E-29	45		82	70	—	5.5		14		9		70	—	—	—	M16	30
6195	6195DA 6195DB	E-29																	
6205	6205DA 6205DB	E-29	45		82	82	—	5.5		14		9		82	—	—	—	—	—
6215	6215DA 6215DB	E-29	50		82	82	—	5.5		14		9		82	—	—	—	—	—
6225	6225DA 6225DB	E-29	55	0 -0.019	90	82	—	6		16		10	0 -0.110	82	—	—	—	—	—
6235	6235DA 6235DB	E-29	60		110	105	—	7		18		11		105	—	—	—	—	—
6245	6245DA 6245DB	E-29	65		110	105	—	7		18		11		105	—	—	—	—	—
6255	6255DA 6255DB	E-29	80		130	130	—	9		22	0 -0.052	14		130	—	—	—	—	—
6265	6265DA	E-29	80		130	130	—	9		22		14		130	—	—	—	—	—
6275	6275DA	E-30	90	$^{0}_{-0.022}$	140	150	—	9		25		14		140	—	—	—	—	—