Sumitomo Drive Technologies

Always on the Move

Motion Control Drives

FINE CYCLO®

F2C-C series

Catalogue 991137 -F2003E-1

Table of Contents

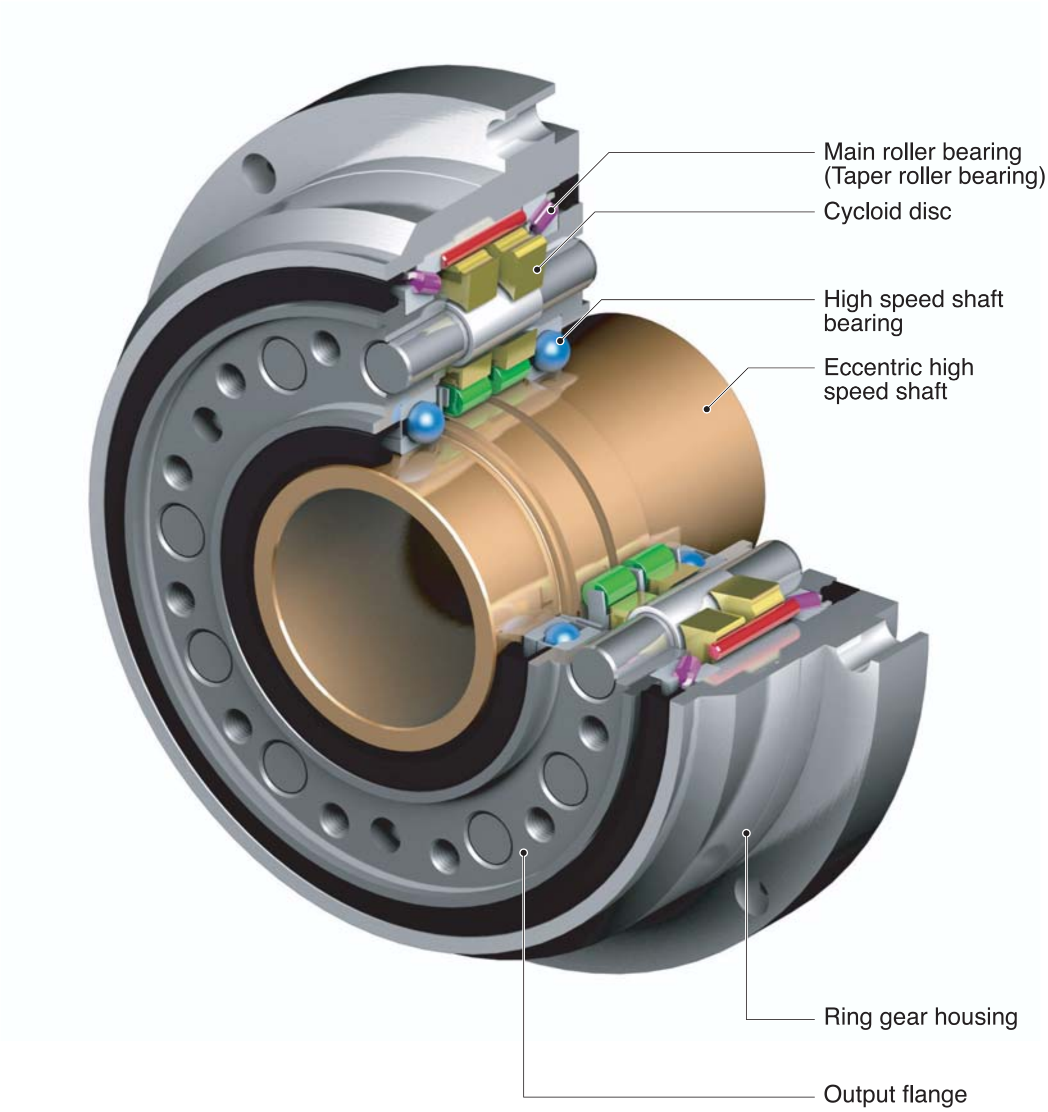
ISO9001 PTC NAGOYA PLANT

ISO14001 PTC NAGOYA PLANT

Motion Control Drives
FINE CYCLO®

F2C-C series

NEW



Large Hollow Bore

Enlarged hollow diameter enables effective use of space for cable or shaft.

Reduces Man-Hour for Assembly

High-speed shafy supported by the reducer simplifies coupling with motor.

Complete Sealed Design

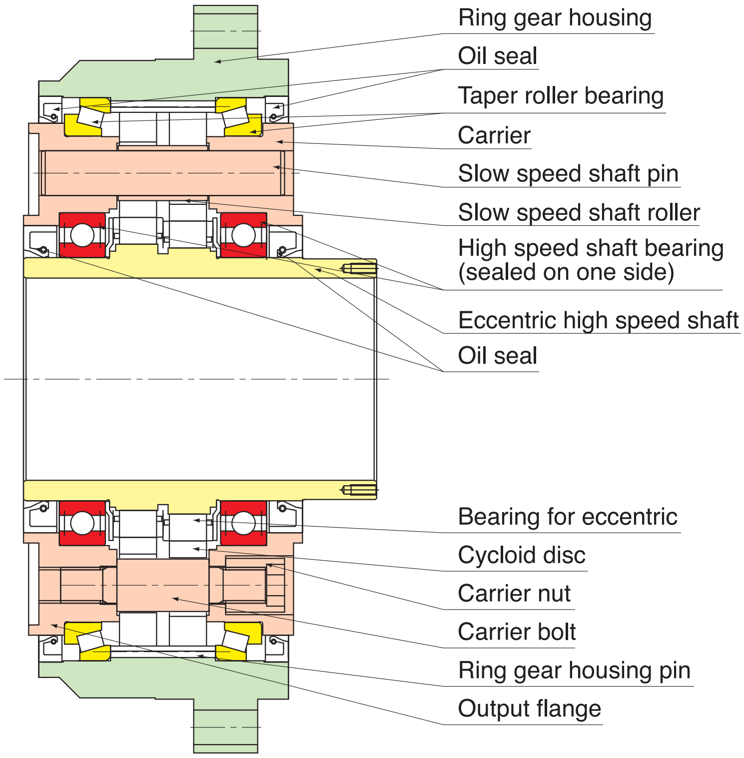
Grease is sealed inside the reducer.
Customers are released from the sealing work.

Compact Design

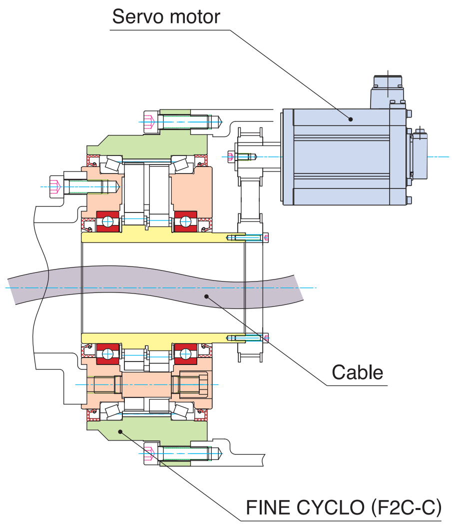
Simple construction with less number of parts than single stage reducer mechanism.

1. Construction

Fig. C-1

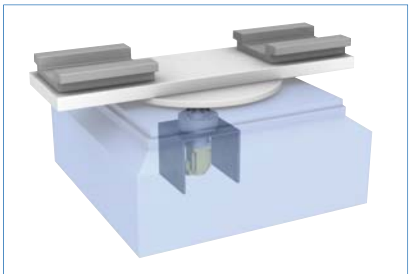


Main Example of Use



2. Application Examples


Industral Robot
Axis Driving, Robot Slider


Machine Tool
Automatic Pallet Changer Drive

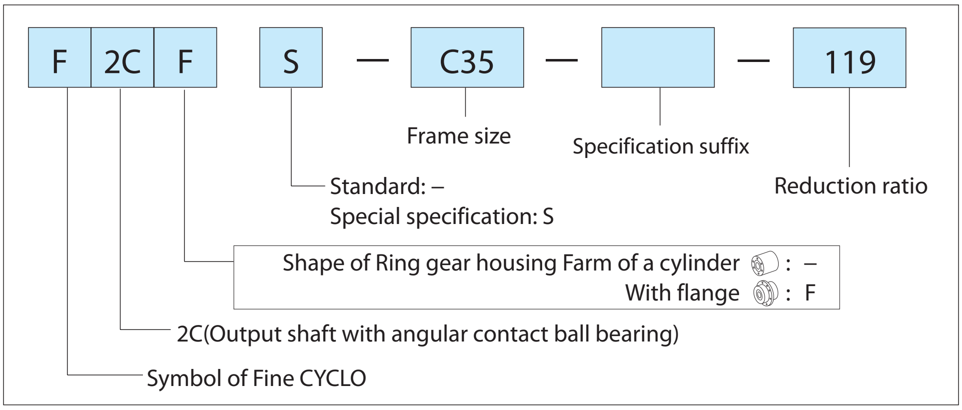

Welding Positioner


Machine Tool
Automatic Pallet Pool Drive


Liquid Crystal Transfer Robot
Axis Driving, Robot Slider


Liquid Crystal Transfer Robot

3. Nomenclature



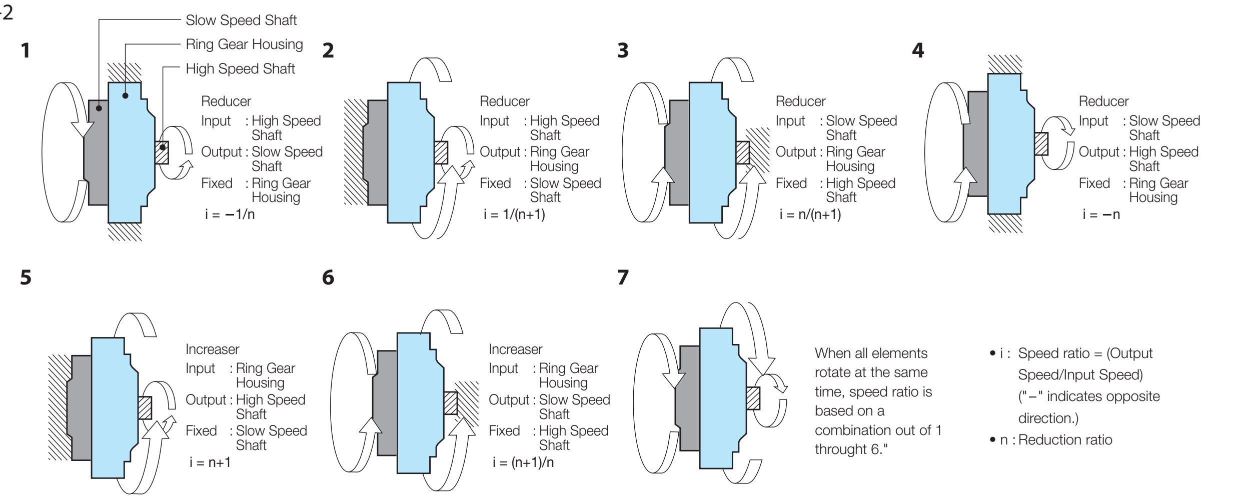
4. Products

Mark • : Model Lineup

Frame size	Reduction ratio		
	59	89	119
C25	•	•	•
C35	•	•	•
C45	•	•	•
C55	•	•	•
C65	•	•	•

5. Speed Ratio & Rotation Direction

Fig. C-2



6. Operating Principles

The reducer portion of the FINE CYCLO® 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 FINE CYCLO®, 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.

Fig. C-3 Principle of internal Planetary Gearing

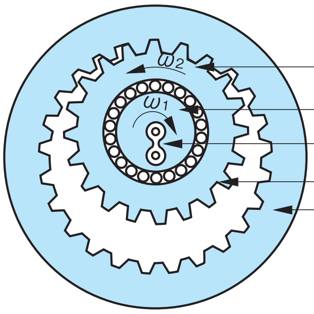


Fig. C-4 Epitrochoid Planet Gear-Circular(PIN) Tooth Sun Gear Combination

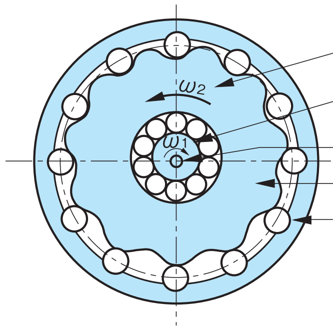


Fig. C-5 Constant Speed Internal Gearing

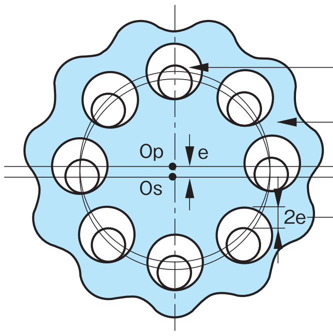
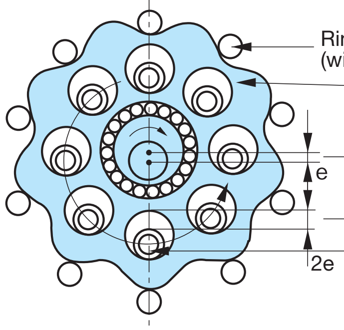


Fig. C-6 Combination of Planet-Sun Gears and Constant Speed Internal Gear



See Fig. C-3

In equation 1, below, P identifies the number of the planet gear teeth, S that of the sun gear, w2 the angular velocity of the planet gear around its own axis. The velocity ratio of w2 to w1 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 w1 around the axis of the sun gear, the planet gear rotates at the angular velocity:

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

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 FINE CYCLO®, illustrated in Fig. C-4, 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. C-5.

In this mechanism shown in Fig. C-6, 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.

7. Rating

Table C-1 Rating Table (Input rotation base)

Input speed n_1(r/min)			2500			2000			1750			1500		
Model	Frame size	Reduction ratio	Rated output torque (Upper/N·m) (Lower/kgf·m)	Output speed (r/min)	Allowable input power (kW)	Rated output torque (Upper/N·m) (Lower/kgf·m)	Output speed (r/min)	Allowable input power (kW)	Rated output torque (Upper/N·m) (Lower/kgf·m)	Output speed (r/min)	Allowable input power (kW)	Rated output torque (Upper/N·m) (Lower/kgf·m)	Output speed (r/min)	Allowable input power (kW)
F2C	C25	59	370 37.7	42.4	2.19	396 40.4	33.9	1.87	412 42	29.7	1.70	432 44.0	25.4	1.53
		89	370 37.7	28.1	1.45	396 40.4	22.5	1.24	412 42	19.7	1.13	432 44.0	16.9	1.01
		119	370 37.7	21.0	1.08	396 40.4	16.8	0.93	412 42	14.7	0.84	432 44.0	12.6	0.76
F2CF	C35	59				754 76.9	33.9	3.56	785 80	29.7	3.24	822 83.8	25.4	2.91
		89				754 76.9	22.5	2.36	785 80	19.7	2.15	822 83.8	16.9	1.93
		119				754 76.9	16.8	1.77	785 80	14.7	1.61	822 83.8	12.6	1.44
F2CF	C45	59							1275 130	29.7	5.27	1336 136	25.4	4.73
		89							1275 130	19.7	3.50	1336 136	16.9	3.14
		119							1275 130	14.7	2.61	1336 136	12.6	2.35
F2CF	C55	59										2055 209	25.4	7.28
		89										2055 209	16.9	4.83
		119										2055 209	12.6	3.61
F2CF	C65	59												
		89												
		119												

Table C-2 Maximum acceleration or deceleration torque

Frame size	Maximum acceleration or deceleration torque		Peak torque for emergency stop	
	(N·m)	(kgf·m)	(N·m)	(kgf·m)
C25	1030	105	2060	210
C35	1962	200	3924	400
C45	3188	325	6377	650
C55	4316	440	8633	880
C65	6278	640	12577	1280

1000			750			600			Allowable maximum input speed (r/min)	Allowable maximum input speed(r/min)		Equivalent On input shaft Upper/Moment of inertia ($\times10^{-4}kg\cdot m^2$) Lower/GD^2 ($\times10^{-4}kgf\cdot m^2$)	Mass (kg)
Rated output torque (Upper/N·m) (Lower/kgf·m)	Output speed (r/min)	Allowable input power (kW)	Rated output torque (Upper/N·m) (Lower/kgf·m)	Output speed (r/min)	Allowable input power (kW)	Rated output torque (Upper/N·m) (Lower/kgf·m)	Output speed (r/min)	Allowable input power (kW)		50% ED	100% ED		
487 49.7	16.9	1.15	531 54.2	12.7	0.94	568 57.9	10.2	0.81	3500	2900	1450	6.95 27.8	12.5
487 49.7	11.2	0.76	531 54.2	8.4	0.62	568 57.9	6.7	0.53	3500	2900	1450	6.90 27.6	
487 49.7	8.4	0.57	531 54.2	6.3	0.47	568 57.9	5.0	0.40	3500	2900	1450	6.90 27.6	
928 94.6	16.9	2.19	1012 103	12.7	1.79	1082 110	10.2	1.53	2500	2100	1050	28.5 114	21
928 94.6	11.2	1.45	1012 103	8.4	1.19	1082 110	6.7	1.02	2500	2100	1050	28.5 114	
928 94.6	8.4	1.09	1012 103	6.3	0.89	1082 110	5.0	0.76	2500	2100	1050	28.5 114	
1508 154	16.9	3.56	1644 168	12.7	2.91	1758 179	10.2	2.49	2100	1800	900	61.3 245	32
1508 154	11.2	2.36	1644 168	8.4	1.93	1758 179	6.7	1.65	2100	1800	900	61.0 244	
1508 154	8.4	1.77	1644 168	6.3	1.44	1758 179	5.0	1.24	2100	1800	900	61.0 244	
2321 237	16.9	5.48	2530 258	12.7	4.48	2705 276	10.2	3.83	1800	1500	750	114 456	45
2321 237	11.2	3.63	2530 258	8.4	2.97	2705 276	6.7	2.54	1800	1500	750	114 454	
2321 237	8.4	2.72	2530 258	6.3	2.22	2705 276	5.0	1.90	1800	1500	750	114 454	
3713 378	16.9	8.77	4048 413	12.7	7.17	4328 441	10.2	6.14	1700	1400	700	200 799	62
3713 378	11.2	5.82	4048 413	8.4	4.75	4328 441	6.7	4.07	1700	1400	700	199 796	
3713 378	8.4	4.35	4048 413	6.3	3.56	4328 441	5.0	3.04	1700	1400	700	199 796	

: 50%ED range : 100%ED range

Notes:

1. Rated output torque
   Rated output torque implies allowable mean load torque at each output speed. Rated output torque for below 600r/min input is the same as 600r/min.
   Allowable input power is the value converted from rated output torque, when it is 100%. This value takes efficiency of FINE CYCLO® in consideration.
2. Allowable maximum input speed and allowable mean input speed
   Reducer may be used within maximum input speed indicated in the Table, however, allowable mean input speed is limited by operation (%ED).
3. Allowable acceleration or deceleration peak torque
   Allowable peak torque at normal start and stop.
4. Allowable momentary maximum torque
   Allowable momentary maximum torque at emergency stop or heavy shock, when loading 1000 times in overall lifetime.
5. Moment of inertia, GD^2
   Value at input shaft. Divide them by g (Moment of inertia: $9.8m/sec^2$) or 4g (GD^2: $4 \times 9.8m/sec^2$) to convert from them to inertia.
6. Calculate the rated torque using the following formula when the speed is not shown in the table above.

$$T_{2N} = T_{2N,600}\left(\frac{600}{n_1}\right)^{0.3}$$

T_{2N}: Rated torque at input speed n_1

$T_{2n,600}$: Rated torque at input speed n_1 is 600r/min

8. Engineering Data

8-1. Stiffness and lost motion

•Hysteresis curve — Relationship between load and displacement of output flange (rotational angle) when load is removed slowly from allowable torque to zero torque, with fixed input shaft.

•Lost Motion — Torsional deflected angle at ±3% allowable output torque.

•Stiffness — Slope of the straight line connecting two points, when allowable torque is 50% and 100% on the hysteresis curve.

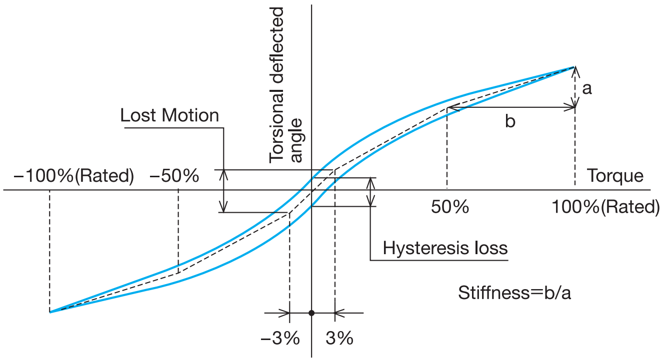


Fig. C-7 Hysteresis curve

Table C-3 Engineering data

Frame size	Rated output torque at input speed 1750 r/min	Lost Motion		Stiffness
		Measured torque	Lost Motion	
	Nm	Nm	arc min	N·m/arc min
C25	412	12.4	1.0	128
C35	785	23.5		294
C45	1275	38.3		491
C55	1962	58.9		687
C65	3139	94.2		1030

Note) arc min means "minute" of the angle.Stiffness is the average value (typical data).

(Example calculation of torsional deflected angle)

Calculation of torsion angle when torque is applied in one direction using C35 as example.

1) When load torque is 15N·m

(When load torque is in the range of lost motion)

$$\theta = \frac{15}{23.5} \times \frac{1}{2} = 0.32 \text{ arcmin}$$

2) When load torque is 600N·m

$$\theta = \frac{1}{2} \times \frac{600-23.5}{294} = 2.5 \text{ arcmin}$$

8-2. No Load Running Torque

No load running torque indicates torque on input shaft for rotating reducer under no-load condition.

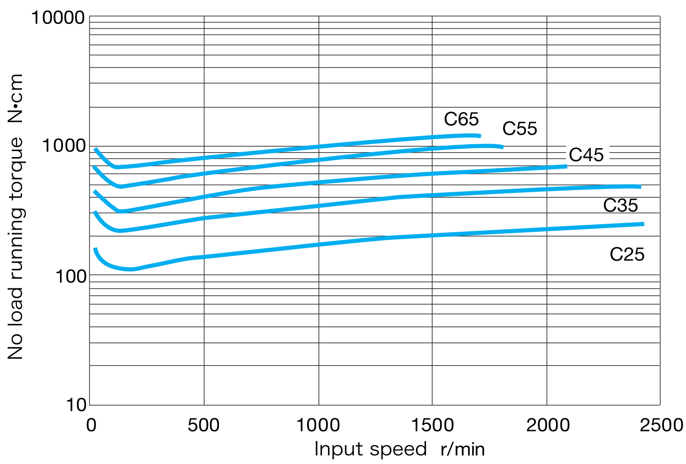


Fig. C-8

Notes) 1. Fig. C-8 shows average data after reducers have been run.
2. Measurement Conditions

Ring gear housing temperature	Approx. 30°C
Accuracy in assembled dimensions	Refer to 11.1
Lubrication	Standard grease

8-3. No-Load Friction Torque on Output Shaft

Indicates torque necessary to start rotation from output side of reducer from stop without load.

Table C-4 Value of no-load friction torque on output shaft

Frame size	No-load friction torque on output shaft	
	N·m	kgf·m
C25	59	6
C35	118	12
C45	147	15
C55	245	25
C65	343	35

Notes: 1. Table C-4 shows average data after reducers have been run.
2. Measurement Conditions

Accuracy in assembled dimensions	Refer Item 11-1
Lubrication	Standard grease

8-4. Efficiency

Fig. C-9 Efficiency Curve (Frame size C25-C45)

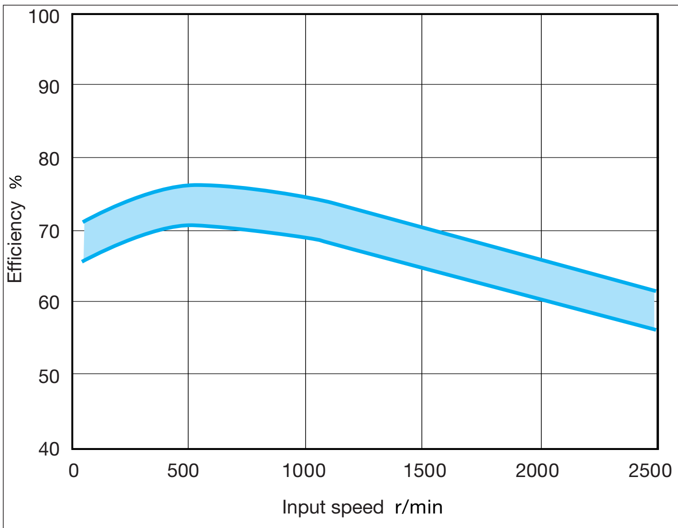
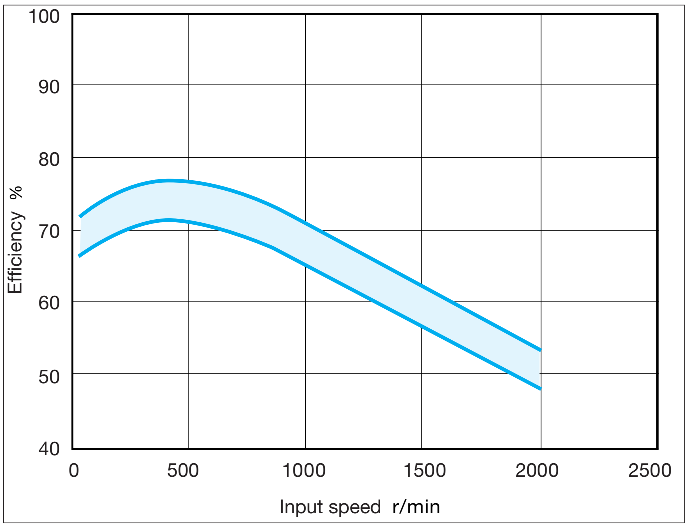
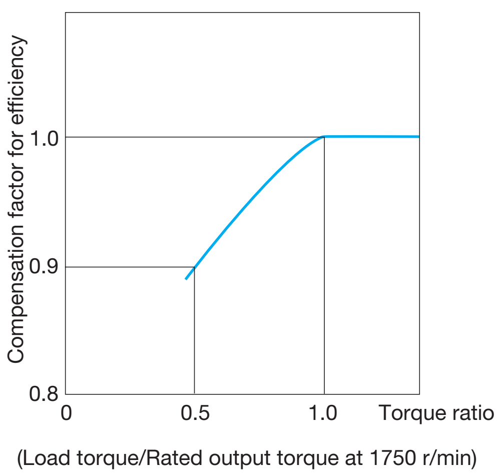


Fig. C-10 (Frame size C55-C65)



Efficiency varies by input speed, load torque, grease temperature, reduction ratio, etc.
Fig. C-9 and C-10 indicates efficiency vs. input speed at allowable output torque with stable grease temperature.
Efficiency curve is indicated with flexible coverage for variations in models and reduction ratio.

Fig. C-11 Compensation Curve of Efficiency



Compensation efficiency=Efficiency(Fig.C-9, Fig. C-10) x Compensation factor for efficiency(Fig.C-11)

Note) 1. Efficiency varies when load torque differs with allowable torque. Check the compensation factor in the left diagram.
2. When torque ratio is over 1.0, compensation factor for efficiency is 1.0.

8-5. ALLOWABLE RADIAL LOAD & AXIAL LOAD OF HIGH SPEED SHAFT

When a gear or sheave is mounted on the high speed shaft, radial load and axial load should be equal to or less than allowable value. Check radial & axial load by following the next formula (1)-(3).

(1) Radial load Pr

$$Pr = \frac{T\ell}{R} \leq \frac{Pro}{Lf \cdot Cf \cdot F_{S1}} \text{ [N, kgf]} \qquad \text{(Formula C-1)}$$

(2) Axial load Pa

$$Pa \leq \frac{Pao}{Cf \cdot F_{S1}} \text{ [N, kgf]} \qquad \text{(FormulaC-2)}$$

(3) When radial and axial load co-exist

$$\left(\frac{Pr \cdot Lf}{Pro} + \frac{Pa}{Pao} \right) \cdot Cf \cdot F_{S1} \leq 1 \qquad \text{(FormulaC-3)}$$

Pr : Actual radial load [N, kgf]
$T\ell$: Equivalent torque on input shaft [N·m, kgf·m]
R : Pitch circle radius of sprocket, gear, or sheave [m]
Pro : Allowable radial load [N, kgf] (Table C-5)
Pa : Actual axial load [N, kgf]
Pao : Allowable axial load [N, kgf] (Table C-6)
Lf : Load location factor (Table C-7)
Cf : Coupling factor (Table C-8)
F_{S1} : Shock factor (Table C-9)

Table C-5 Actual radial load Pro(Up: N/Down: kgf)

Frame size	Input speed r/min						
	2500	2000	1750	1500	1000	750	600
C25		563 57	589 60	620 63	709 72	781 80	841 86
C35			687 70	723 74	828 84	911 93	981 100
C45			785 80	826 84	946 96	1041 106	1121 114
C55				981 100	1123 114	1236 126	1332 136
C65					1419 145	1561 159	1682 171

Table C-6 Actual axial load Pao(Up: N/Down: kgf)

Frame size	Input speed r/min						
	2500	2000	1750	1500	1000	750	600
C25	540 55	589 60	628 64	677 69	824 84	942 96	1040 106
C35		746 76	795 81	863 88	1040 106	1197 122	1334 136
C45			912 93	981 100	1197 122	1373 140	1530 156
C55				1481 151	1785 182	2050 209	2276 232
C65					2570 262	2953 301	3286 335

Table C-7 Load Location Factor Lf

L (mm)	Frame size				
	C25	C35	C45	C55	C65
5	0.80	0.76	0.75	0.73	0.73
10	0.86	0.81	0.79	0.77	0.77
15	0.92	0.86	0.83	0.80	0.80
20	0.98	0.90	0.87	0.84	0.84
25	1.14	0.95	0.91	0.88	0.87
30	1.36	1.00	0.95	0.91	0.90
35	1.59	1.17	0.99	0.95	0.94
40	1.82	1.33	1.11	0.99	0.97
45	2.05	1.50	1.25	1.07	1.02
50		1.67	1.39	1.19	1.14
60		2.00	1.67	1.43	1.36
70			1.94	1.67	1.59
80				1.90	1.82
Lf=When 1 of L(mm)	22	30	36	42	44

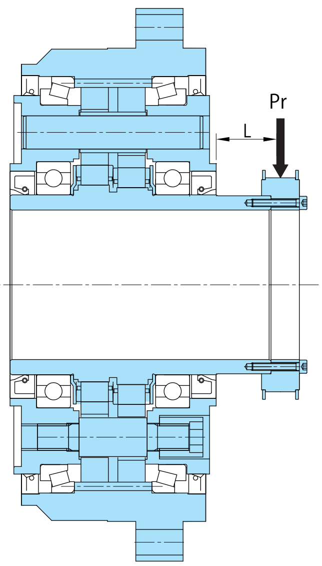


Fig. C-12 Load location on input shaft

Table C-8 Coupling Factor Cf

Coupling method	Cf
Chain	1
Machine gear or pinion	1.25
Timing belt	1.25
V-Belt	1.5

Table C-9 Shock Factor F_{S1}

Degree of shock	F_{S1}
Practically no shock	1
Light shock	1-1.2
Severe shock	1.4-1.6

9. Main Bearings

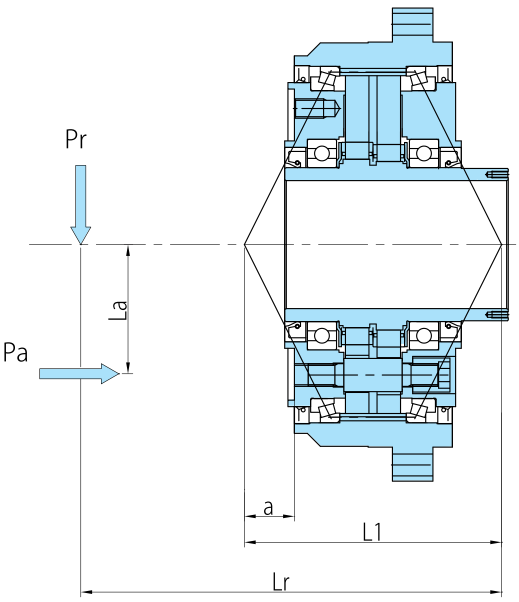


Fig. C-13 Span between each loading point

Note) Consult us if: Lr > 4 x L1

Pr: Actual radial load(N, kgf)
Pa: Actual axial load(N, kgf)

Table C-10 Span of Loading Points(mm)

Frame size	Span of Loading Points	
	L1(mm)	a(mm)
C25	102	13.5
C35	135.2	24.6
C45	158.8	30.9
C55	191.8	41.9
C65	211.8	46.4

Table C-11 Moment Stiffness

Frame size	Moment Stiffness (N·m/arcmin)
C25	883
C35	1668
C45	2649
C55	3924
C65	5690

1. Moment Stiffness
   Indicates stiffness on inclination of output shaft with external moment.

   External moment (M)
   $M = Pr \cdot Lr + Pa \cdot La$ ....(Formula C-4)

2. Allowable Moment & Allowable Axial Load
   Check external moment and external axial load with Formula C-5, Formula C-6, and Fig.C-13.

   Equivalent moment (Me)
   $Me = Cf \cdot F_{S1} \cdot Pr \cdot Lr + Cf \cdot F_{S1} \cdot Pa \cdot La$ ....(Formula C-5)

   Equivalent axial load (Pae)
   $Pae = Cf \cdot F_{S1} \cdot Pa$ ....(Formula C-6)
   Cf : Coupling factor [Table C-13]
   F_{S1}: Shock factor [Table C-14]

Table C-12 Allowable Moment & Allowable Axial Load

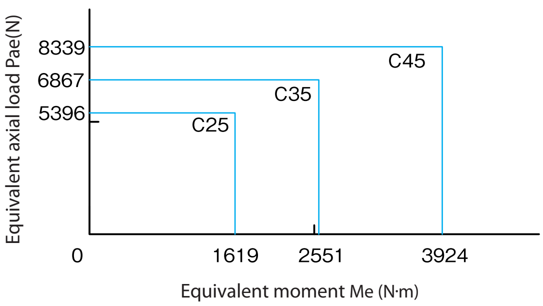
Frame size	Allowable Moment (N·m)	Allowable Axial Load (N)
C25	1619	5396
C35	2551	6867
C45	3924	8339
C55	6082	10791
C65	8829	13734

Table C-13 Coupling Factor Cf

Load connection factor	Cf
General purpose chain	1
Machine gear or pinion	1.25
Timing belt	1.25
V-Belt	1.5

Table C-14 Shock factor F_{S1}

Load Classification	F_{S1}
Uniform load (no shock)	1
Moderate shocks	1-1.2
Heavy shocks	1.4-1.6



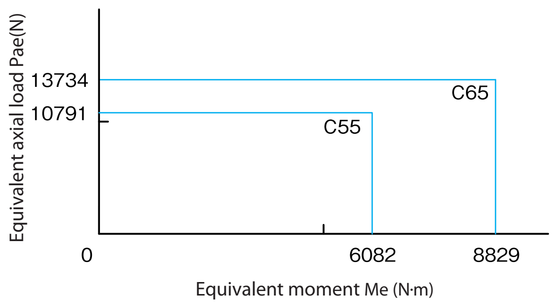
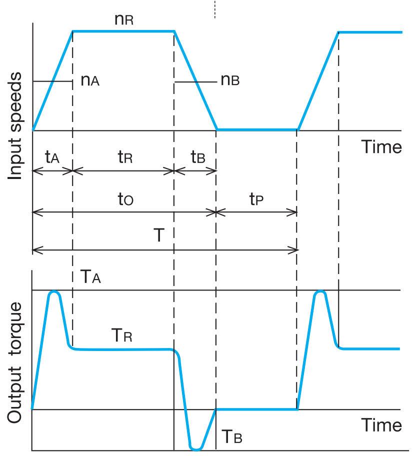


Fig. C-14 Diagram of Allowable Moment & Axial Load

10. Selection

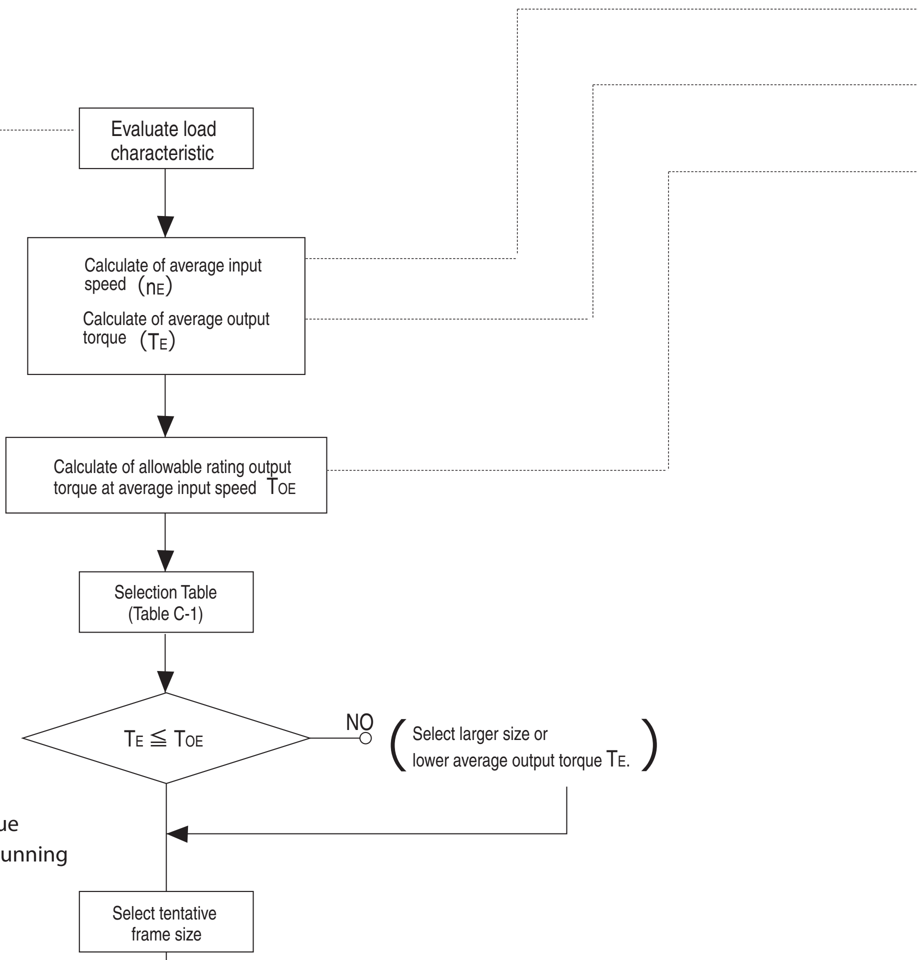
10-1. Flow Cart and Formula of Selection

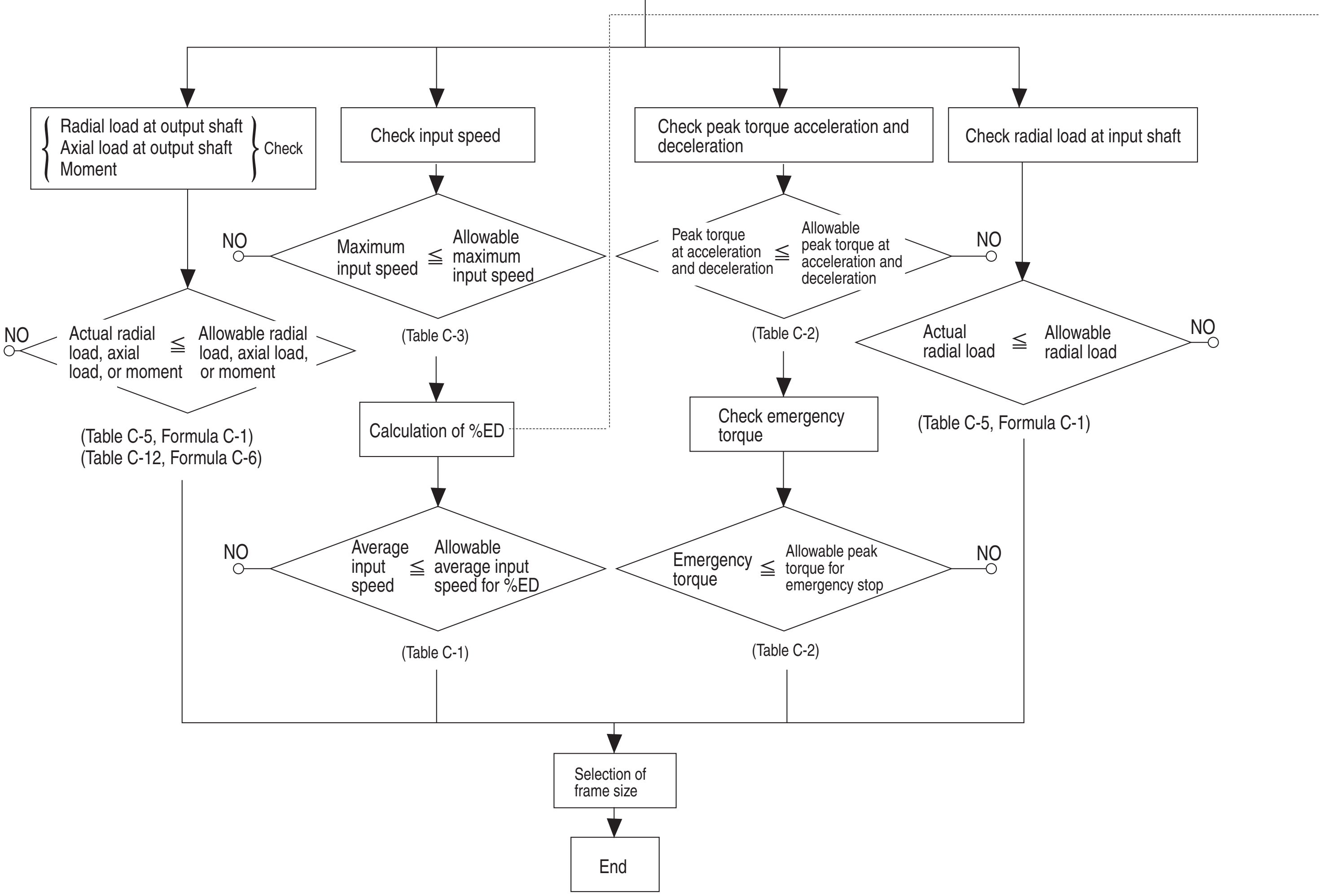
FIG. C-15 Load cycle



- n_A : Average input speed during acceleration under condition defined in Fig. C-15 $\quad n_A = \frac{n_R}{2}$
- n_R : Input speed with normal running
- n_B : Average input speed during deceleration in Fig. C-15 $\quad n_B = \frac{n_R}{2}$

- t_A : Acceleration time
- t_R : Normal running time
- t_B : Deceleration time
- t_O : Total running time
- t_P : Standstill time
- T : Time/Cycle
- T_A : Acceleration peak torque
- T_R : Torque during normal running
- T_B : Peak torque at braking





Calculation in Load Condition of Fig. C-15

◯ Average input speed $n_E = \left(\dfrac{t_A n_A + t_R n_R + t_B n_B}{t_O} \right)$ .... (Formula C-8)

◯ Average output torque $T_E = \left(\dfrac{t_A n_A T_A^{10/3} + t_R n_R T_R^{10/3} + t_B n_B T_B^{10/3}}{t_O} \right)^{0.3} \times F_{S2}$ .... (Formula C-9)

◯ Allowable rating output torque at average input speed $T_{OE} = \left(\dfrac{600}{n_E} \right)^{0.3} \times T_O$ .... (Formula C-10)

To: Rated output torque at input speed 600r/min (Table C-2)
When $n_E < 600$, T_{OE} equals to T_O at input speed 600r/min.

◯ %ED $\%ED = \dfrac{t_O}{T} \times 100$ .... (Formula C-11)

Maximum of single cycle time is 10 minutes when calculating %ED. When single cycle time is over 10 minutes, calculate %ED as T =10 (minutes).

Table C-15 F_{S2} Load factor

Loading condition	F_{S2}
Uniform load	1
Moderate shock	11.2
Heavy shock	1.41.6

10-2. Example of Selection

0

Evaluate F2C-C25-119 for following specification.

(Specification)
T_A : Acceleration peak torque 600N·m
T_R : Normal running torque 250N·m
T_B : Peak torque at breaking 400N·m
Emergency torque : 1700N·m (1000 times during overall life time)
n_A : Average input speed during acceleration 1250r/min
n_R : Input speed with normal running 2500r/min
n_B : Average input speed during deceleration 1250r/min

t_A : Acceleration time 0.3sec
t_R : Normal running time 3.0sec
t_B : Deceleration time 0.3sec
t_P : Total running time 3.6sec
t_O : Standstill time 3.6sec
T : Single cycle time 7.2sec
Radial load at input shaft : Operated by timing belt with moderate shock 196N at point 25mm from end of shaft
Radial load at output shaft : Connection with gear, moderate shock 4116N at 60mm point from side of flange

It considered that reducer is used to operate wrist of robot with moderate shock.

(Calculate) Average input speed $n_E = \dfrac{0.3 \times 1250 + 3.0 \times 2500 + 0.3 \times 1250}{3.6} = 2292(r/min)$

Average output torque $T_E = \left(\dfrac{0.3 \times 1250 \times 600^{10/3} + 3.0 \times 2500 \times 250^{10/3} + 0.3 \times 1250 \times 400^{10/3}}{3.6 \times 2292} \right)^{0.3} \times 1 = 306(N{\cdot}m)$

◯ Allowable output torque at average input speed $T_{OE} = \left(\dfrac{600}{2292} \right)^{0.3} \times 568 = 380(N{\cdot}m) \geq 306(N{\cdot}m)$->F2C-C25-119

◯ Calculate of %ED $\%ED = \dfrac{3.6}{7.2} \times 100 = 50\%$

◯ Evaluate of maximum input speed 2500(r/min) < 3500(r/min) (Table C-1)

◯ Evaluate of average input speed 2292(r/min) at50%ED < 2900(r/min) at50%ED (Table C-1)

◯ Evaluate of peak torque at acceleration and deceleration 600(N·m) < 1030(N·m) (Table C-2)

◯ Evaluate of emergency torque 1700(N·m) < 2060(N·m) (Table C-2)

◯ Allowable radial load at input shaft with coefficient in consideration

$Pro = 538N = 841 \times (600/2292)^{1/3}$, Lf =1.14, Cf =1.25, F_{S1}=1.2

$\dfrac{Pro}{Lf \times Cf \times F_{S1}} = \dfrac{538}{1.14 \times 1.25 \times 1.2} = 315(N) > 196(N)$ (Table C-5, Fomula C-1)

◯ Evaluate of allowable moment

Lr = 55+L1−a = 55+102−13.5 = 143.5mm

External Moment Calculated with the Coefficient

Cf = 1.25, F_{S1} = 1.2, $M = Cf \times F_{S1} \times Pr \times Lr = 1.25 \times 1.2 \times 4116 \times 143.5 \times 10^{-3} = 886(N{\cdot}m) < 1619(N{\cdot}m)$

F2C-C25-119 is selected by evaluation above.

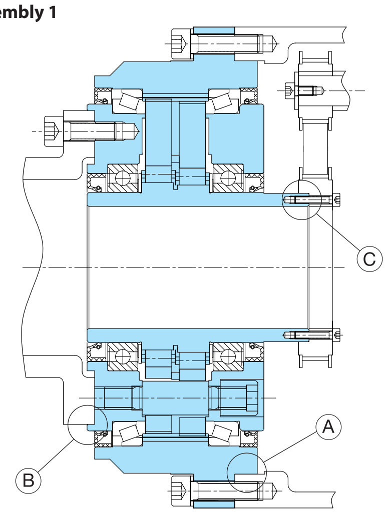
11. Notice for Designing

11-1 Precision in Assembly Dimensions

Fig. C-16 Method of Assembly

- Pilot for mounting input parts(Pully, Gear etc.) are as Ⓒ in following figure.
- Use Ⓑ for output shaft assembly and Ⓐ for casing assembly as pilot for mounting.

Example for Assembly 1



11-2. Tightening Torque and Allowable Transmitted Torque for Bolts

1 Allowable transmitted torque for bolts
Quantity, size, and tightening torque of bolt for the output flange and ring gear housing are shown in Table C-16. Allowable peak torque for emergency stop that can be transmitted is shown in Table C-16.

Table C-16

Frame size	Output Flange Bolts					Ring gear housing bolts				
	Number of bolts-size	Tightening torque		Allowable transmitted torque by bolts		Number of bolts-size	Tightening torque		Allowable transmitted torque by bolts	
		N·m	kgf·cm	N·m	kgf·m		N·m	kgf·cm	N·m	kgf·m
F2C-C25	12-M8	33.4	340	2080	212	12-M8	33.4	340	3178	324
F2CF-C35	12-M10	65.7	670	4267	435	8-M10	65.7	670	4670	476
F2CF-C45	12-M12	114	1160	7191	733	8-M12	114	1160	7760	791
F2CF-C55	12-M14	181	1850	10919	1113	12-M12	114	1160	1308	1326
F2CF-C65	12-M16	284	2890	16893	1722	16-M16	114	1160	19404	1978

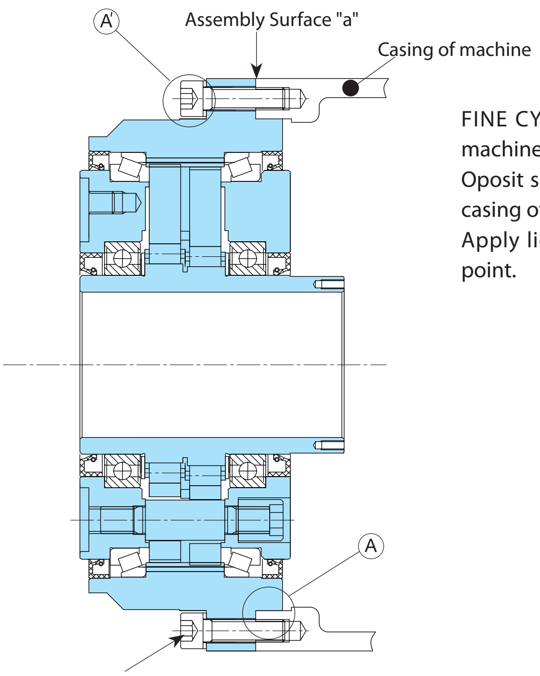
Frame size	Eccentric High Speed Shaft				
	Number of bolts-size	Tightening torque		Allowable transmitted torque by bolts	
		N·m	kgf·cm	N·m	kgf·m
F2C-C25	6-M3	1.67	17	69	7.0
F2CF-C35	6-M4	3.92	40	157	16
F2CF-C45	6-M4	3.92	40	196	20
F2CF-C55	8-M5	8.04	82	481	49
F2CF-C65	12-M5	8.04	82	785	80

- Bolt: Use metric hexagon socket head cap screw based on JIS B1176, strength grade 10.9"
- Countermeasure for bolts loosening: Use adhesives (Loctite262, etc.) or spring washer (based on JIS B1251, class 2).
- Use conical spring washer (Based on JIS B1251, class 2) on flange side when coupling the reducer to prevent damaging the bolt bearing surface.
- Friction Coefficient: 0.15

11-3. Assembly Procedure

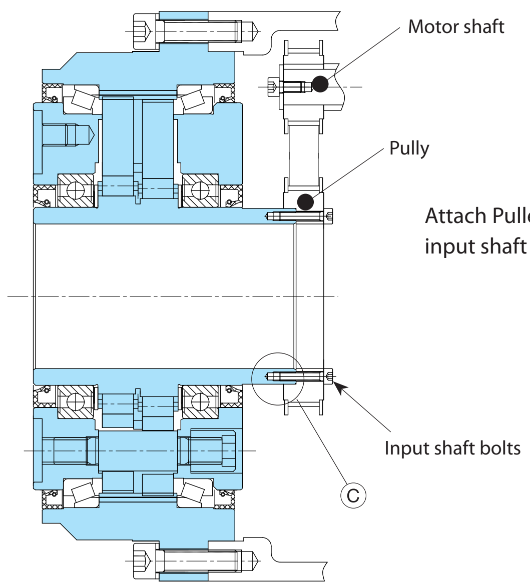
Example for Assembly 1

(1)



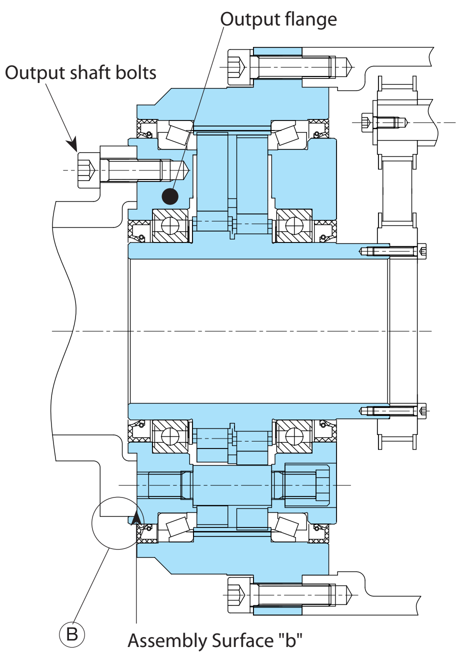
FINE CYCLO® F-Series is attached to the casing of machine with bolts.(Pilot Ⓐ)
Oposit side (Pilot Ⓐ') can be used for attaching to the casing of machine.
Apply liquid gasket to the assembly side "a" at this point.

(2)



Attach Pulley or equivalent parts to input shaft with bolts.

(3)



Attach Output flange of FINE CYCLO to output shaft of machine by bolts.(Pilot Ⓑ)
Apply liquid gasket to the assembly side "b" at this point.

Notes1) Make sure to apply specified tightening torque(refer to Table C-16) to bolts when attaching reducer.
Notes2) Choose bolts shorter then the depth of tap indicated in output side flange and input shaft in Outline Drawing.
Recommended liquid gasket: Liquid gasket Three Bond 1215 of Three Bond Co., Ltd.

11-4. Lubrication

• Grease supply at the time of assembly is not necessary. FINE CYCLO® is filled with grease (Multemp FZ No. 00) before shipment to customer.
• Overhaul recommended when reducer runs for total 20000 hours or 3-5 years after purchase.
• Overhaul requires experience and technique. F-CYCLO must be sent to SHI-factory.
• Condition of use: Ambient temperture -10 - +40 Ceisius Degree.

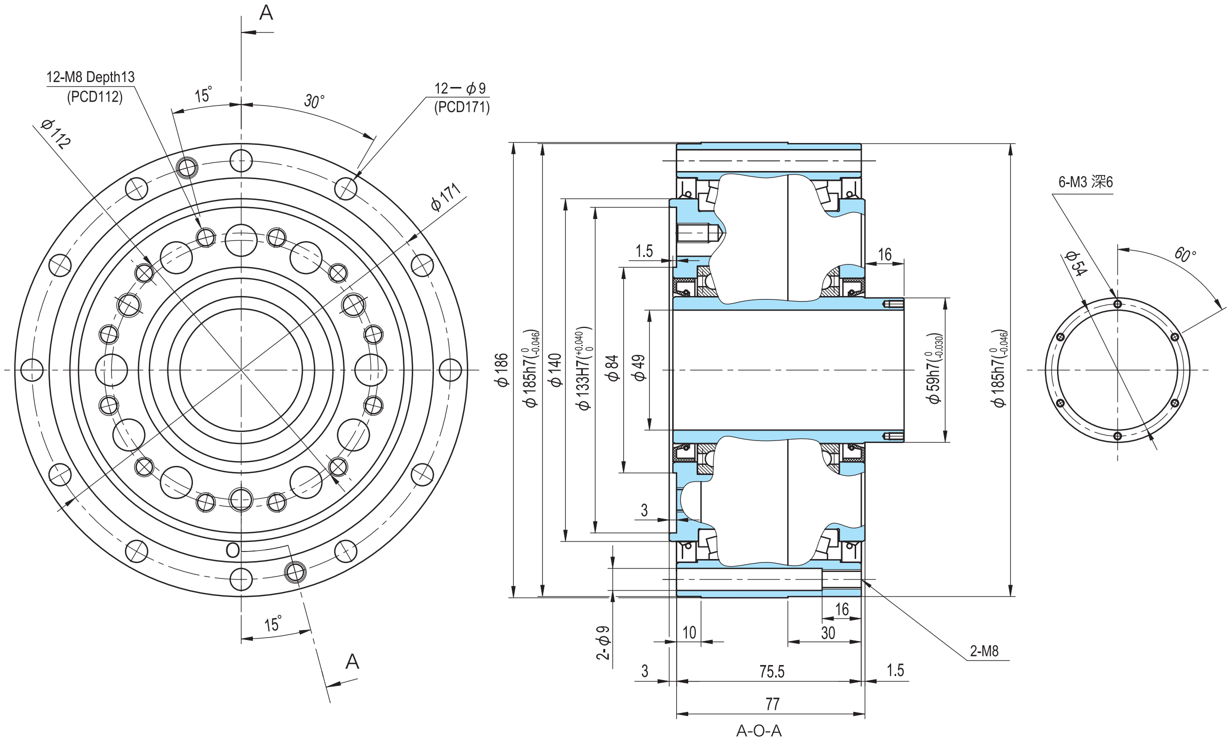
Table C-18

Unit: g

Frame size	C25	C35	C45	C55	C65
Grease(g)	75	110	140	200	300

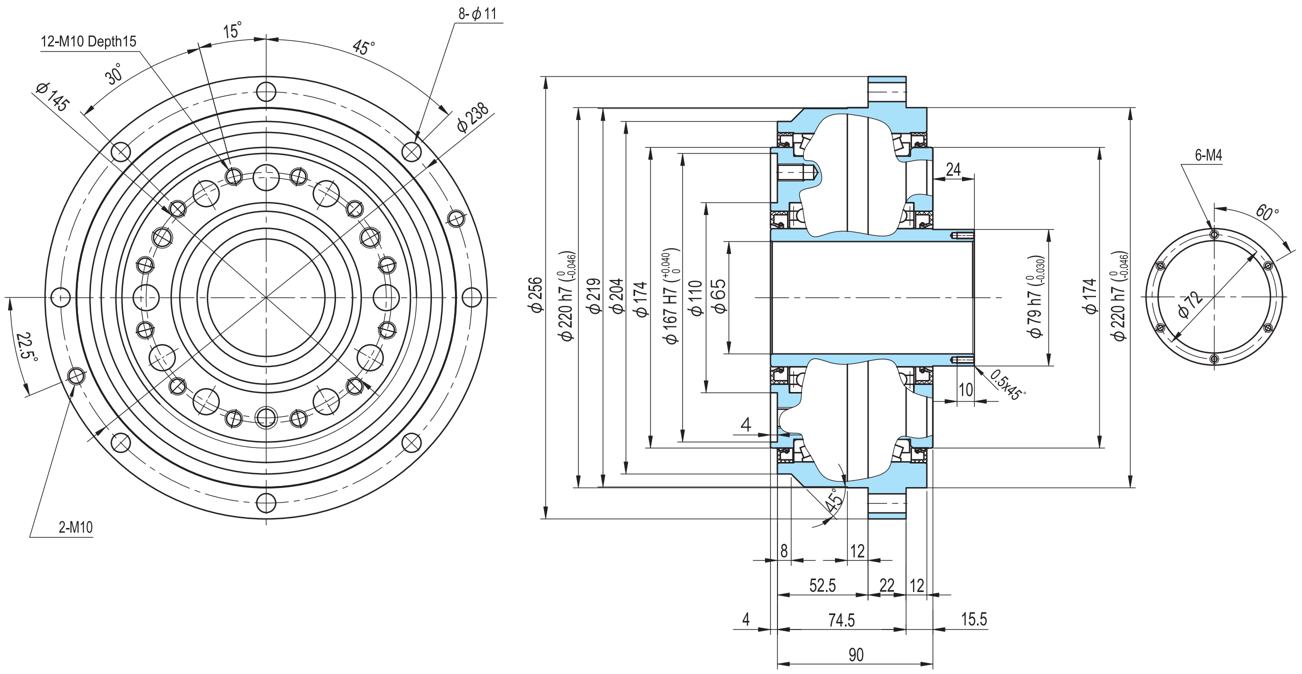
12. Outline Drawing

F2C-C25



Mass 12.5kg

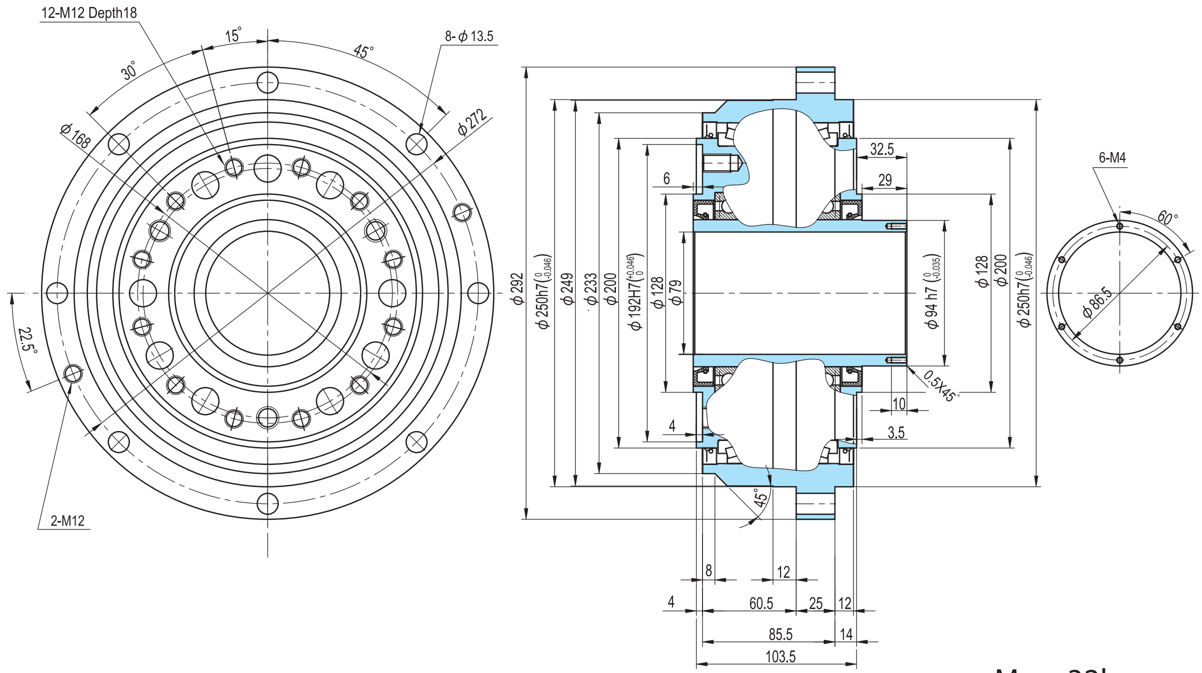
F2CF-C35



Mass 21kg

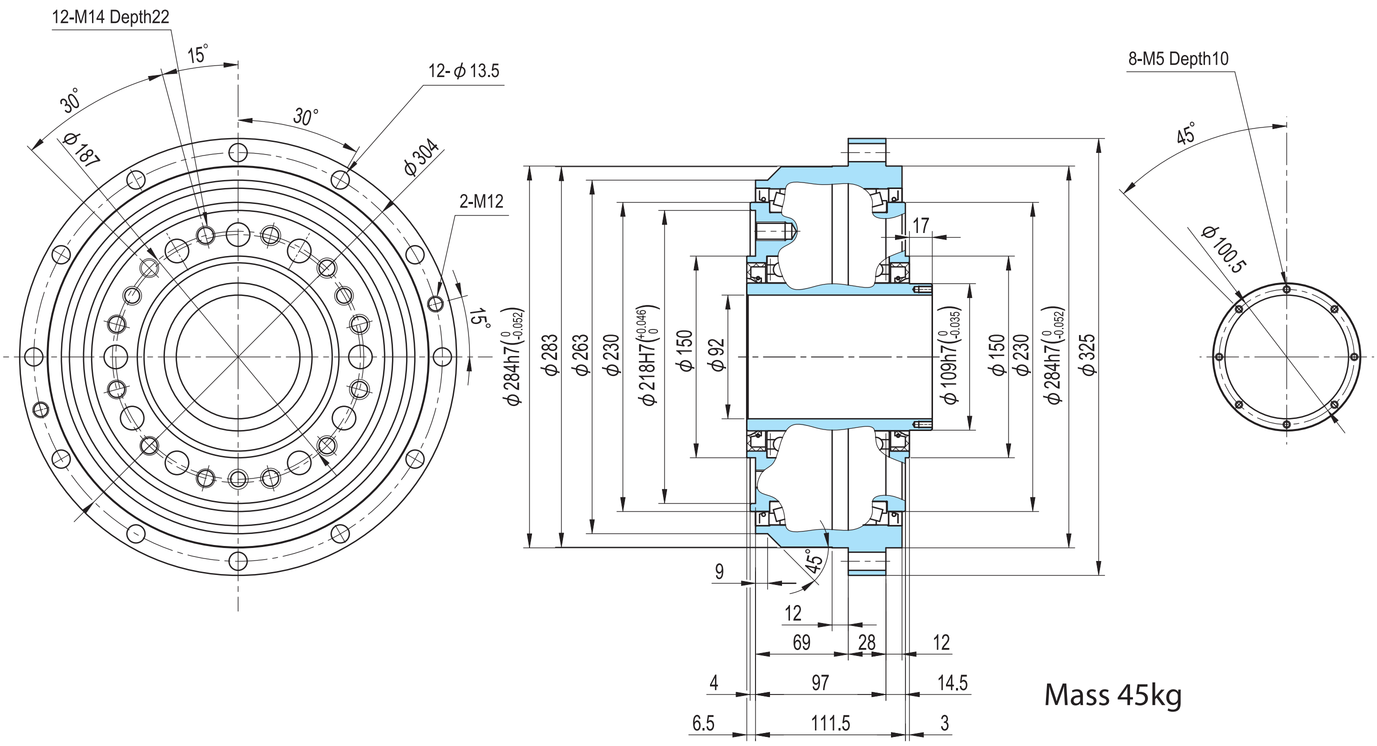
Outline Drawing

F2CF-C45



Mass 32kg

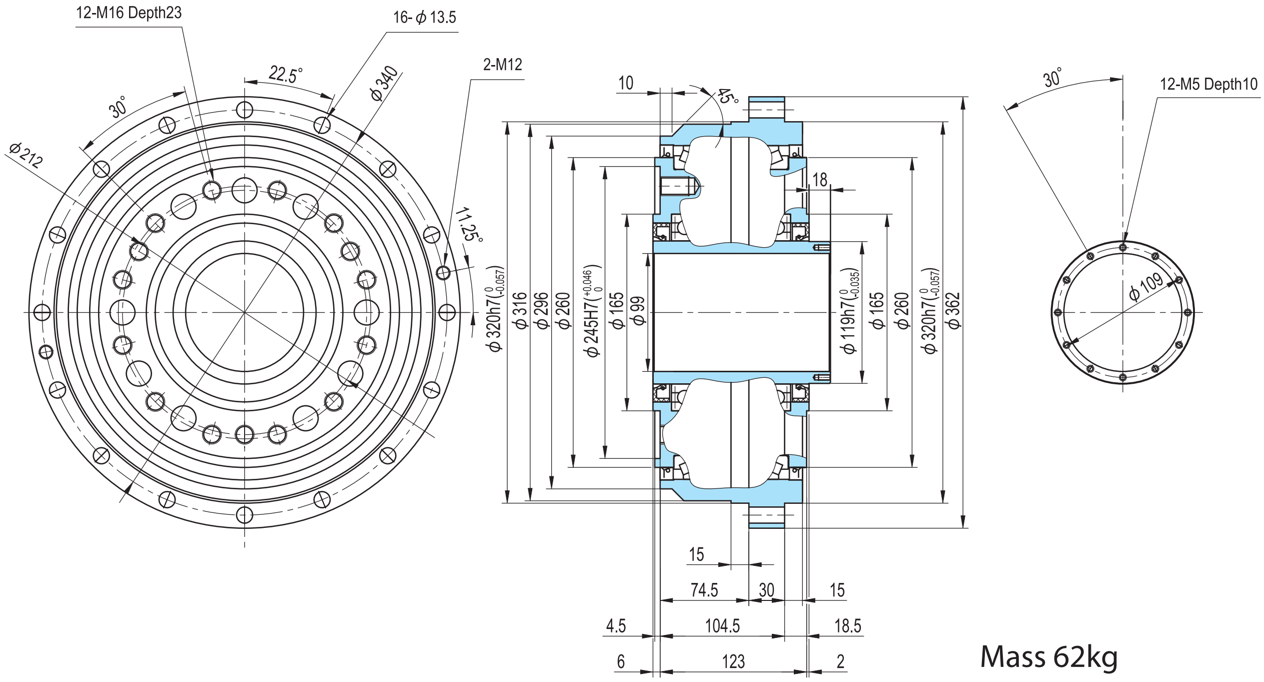
F2CF-C55



Mass 45kg

Outline Drawing

F2CF-C65



Mass 62kg

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