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Sumitomo Drive Technologies



Motion Control Drives FINE CYCLO® High Precision Gearboxes UA series

Specifications, dimensions, and other items are subject to change without prior notice.

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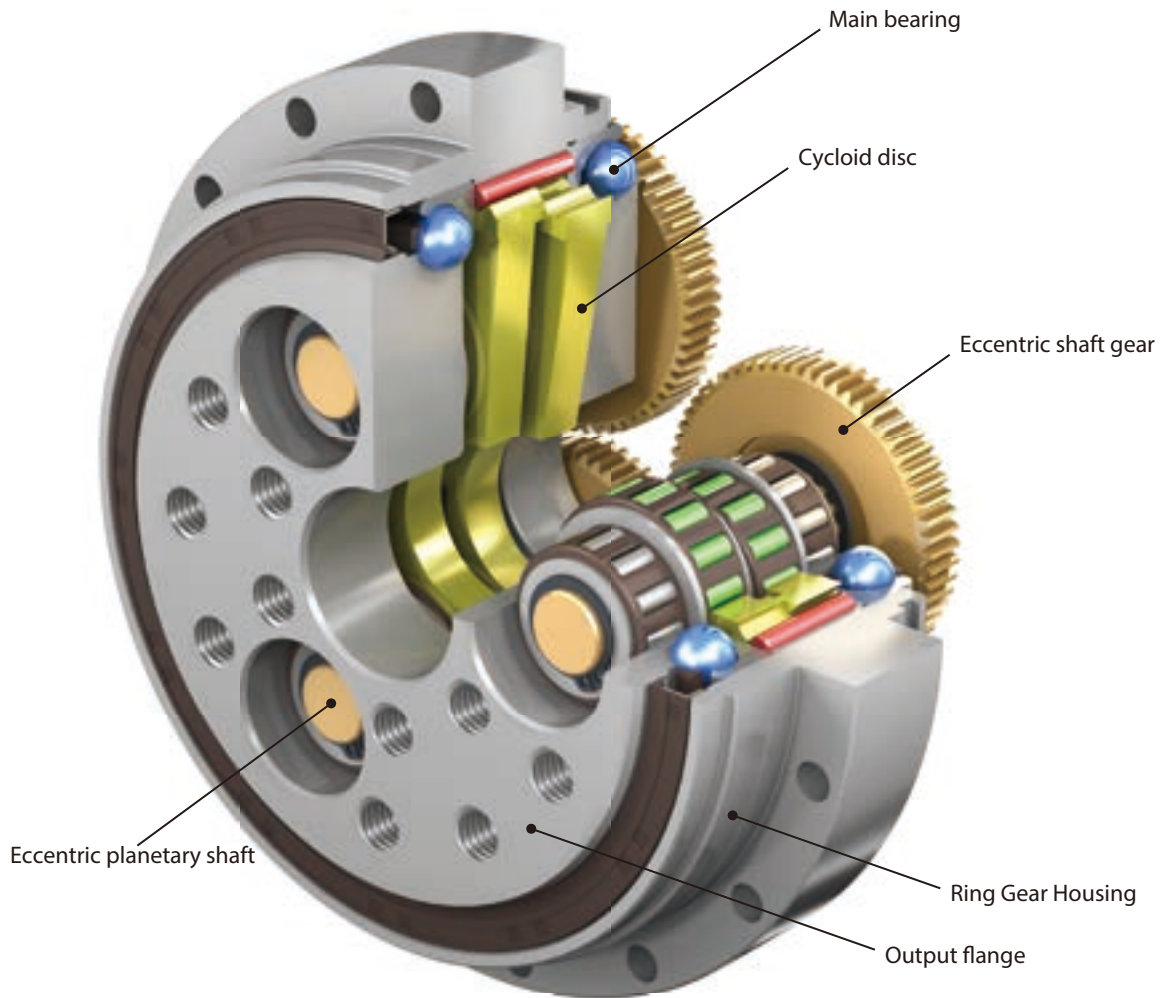
 Sumitomo Heavy Industries, Ltd.

No.F2005E-3

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UA series



Features

- High stiffness
- High efficiency (especially slow speed rotation)
- Compact
- Low vibration
- Low backlash
- Long lifetime
- External load support (total cost reduction and improvement in the reliability)

The UA series of FINE CYCLO® High Precision Gearboxes is excellent especially in the stiffness, vibration level, efficiency at low speed rotation, etc. thanks to our unique new two-teeth form.

Thanks to it, the series is effective especially for purposes which require track accuracy for industrial robots, machine tools, and FA equipment.

1. Construction

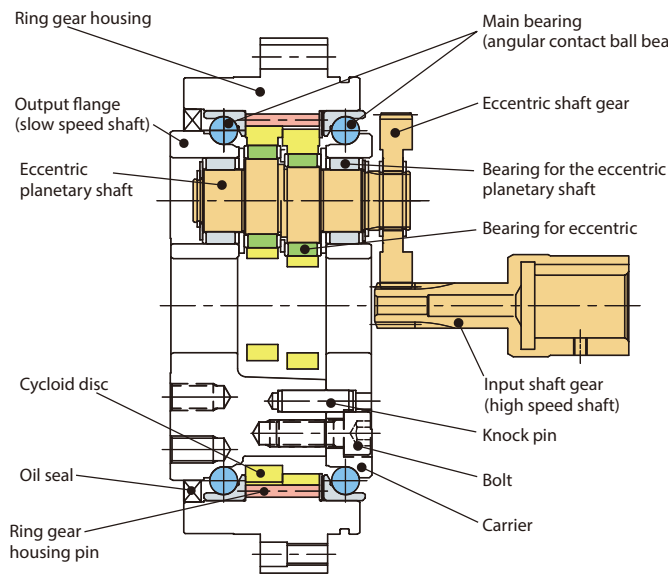


Figure 1. UA15, UA25, UA35, UA45, UA55

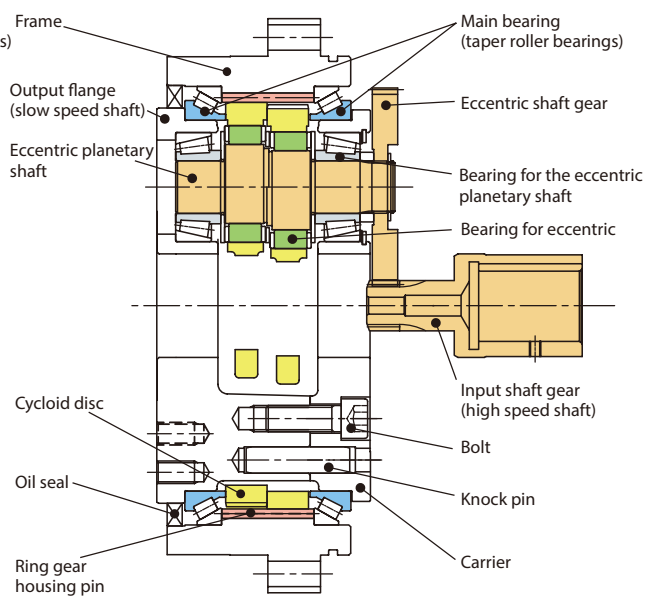
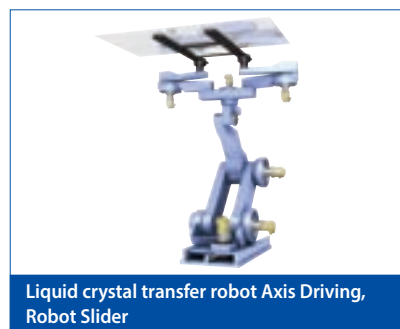
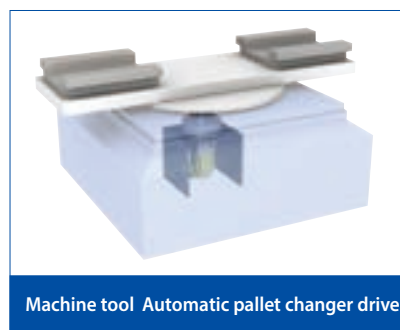
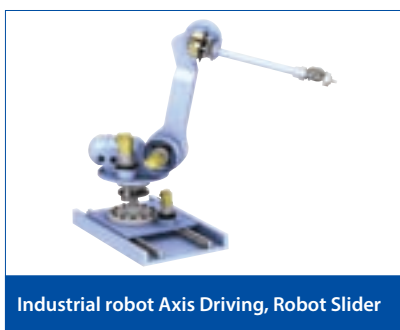
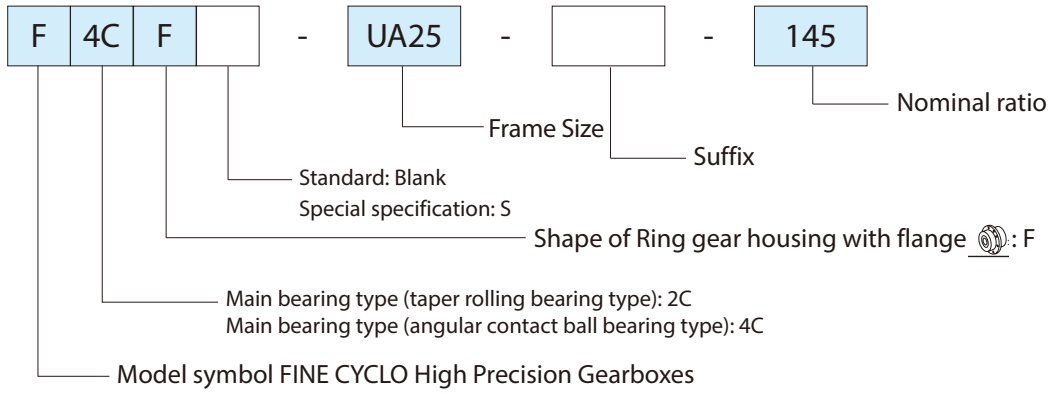


Figure 2. UA65, UA80

2. Application Examples



3. Nomenclature Display



4. Products

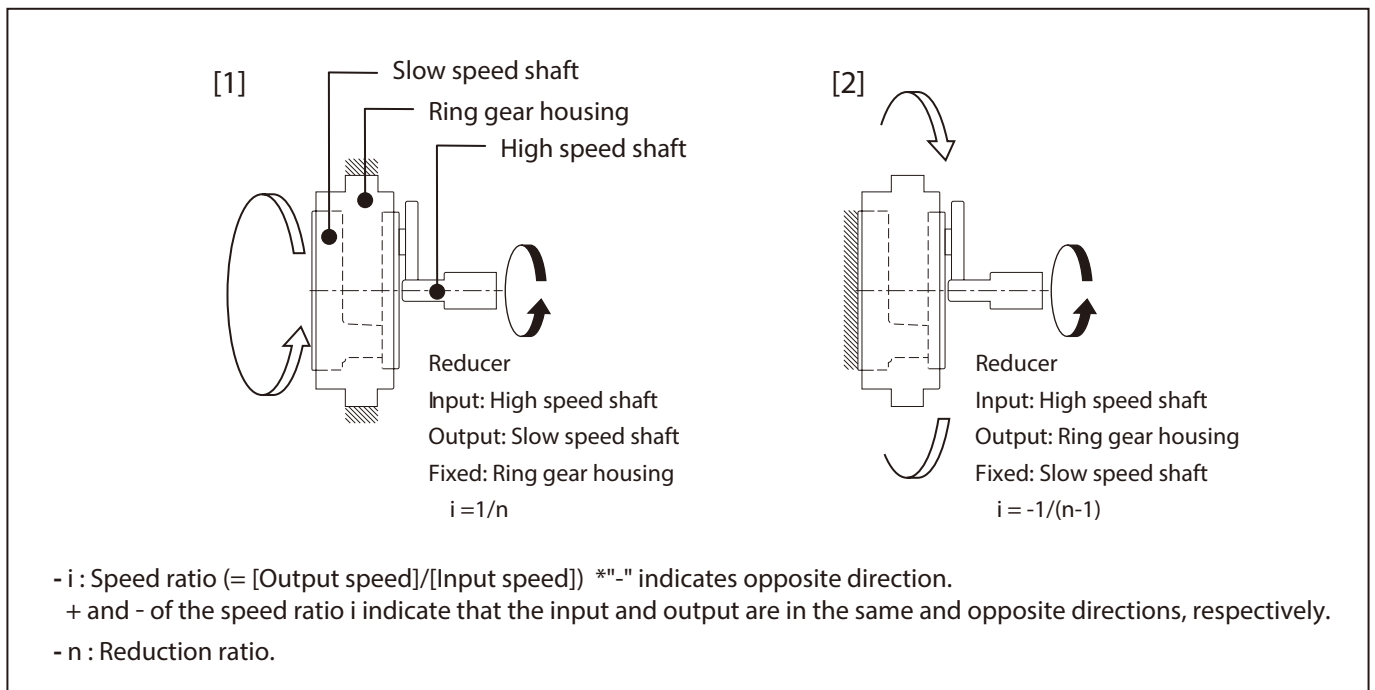
Table 1

Main nomenclature	Frame Size	Rating torque		Reduction ratio					
		N.m	kgf.m						
F4CF	UA15	250	25.5	84	127	139	171		
F4CF	UA25	500	51	88	124	145	173		
F4CF	UA35	900	92	87	121	152	166		
F4CF	UA45	1320	135	82	99	130	152	166	
F4CF	UA55	2000	204	81	97	126	145	169	241
F2CF	UA65	3430	350	89	121	144	171	199	249
F2CF	UA80	5000	510	103	122	155	190	239	283

- The rating torque is the value at the output speed of 15r/min.
- The UA series has the main bearings.
 UA15 to UA55: Angular contact ball bearing
 UA65, UA80 : Taper roller bearing

5. Speed Ratio and Rotation Direction

Figure 3



6. Standard Specifications

Lubrication	Grease lubrication No grease is filled before shipment from the factory, so be sure to prepare the recommended grease and fill it before using the drive. The filling quantity varies according to the mounting direction and peripheral composition of the drive, so for details, see 12-4 "Lubrication" (page 16).	
Ambient conditions	Ambient Temperature	-10 to +40°C (Start failure may occur depending on the capacity and speed of the motor in use, so consult us if you use the drive at about -10 to 0°C .)
	Ambient humidity	85% or less. No condensation.
	Altitude	1000m or lower
	Atmosphere	Free from corrosive gas, volatile gas or no steam. Dust-free and well-ventilated area.
Mounting location	Indoor (Free from dust, water, other liquids) - Mounting in conditions other than the above requires adherence to special specifications. Please consult with us. - Mount in a location that enables easy operation, such as inspection and maintenance. - Mount on a sufficiently rigid member.	
Mounting direction	Though the mounting direction is free, the grease filling quantity varies according to the mounting direction. For details, see 12-4 "Lubrication" (page 16).	
Painting	Paintless	

Note) For preservation, make sufficient rustproofing.

7. UA Series Working Principle

Working Principle In principle, the UA series of FINE CYCLO® High Precision Gearboxes is composed of the following three mechanisms.

- ★ Parallel shaft gear mechanism with involute tooth profiles
- ★ Internal planetary gear mechanism with trochoid curve tooth form with two-teeth difference tooth profile
- ★ Constant speed internal gear mechanism with circular tooth

In the following description, the arrows in the figure indicates the rotation direction of each shaft. The angle speeds ω_1 to ω_3 indicates values with positive input angle speed direction and - (minus) indicates that the input angle speed is opposite to the rotation direction.

Figure 4

Input angle speed: ω_1
Output angle speed: ω_3
Eccentric planetary shaft rotation angle speed: ω_2

Figure 6

The internal planetary gear mechanism with two trochoid teeth and removal mechanism of the output rotation are performed via the eccentric planetary shaft, but they can be grasped individually for each function as shown in the following figures (7 and 8).

Reduction ratio of UA series

From formulas 1 and 2

$$\omega_3 = -\frac{Zd-Zc}{Zc} \times \left\{ -\frac{Za}{Zb} (\omega_1 - \omega_2) + \omega_2 \right\} \dots(\text{Formula 3})$$

If $n = \omega_1/\omega_3$: Overall reduction ratio
 $n_1 = Zb/Za$: Reduction ratio in the case that there is no revolution of the eccentric planetary shaft in the parallel shaft gear mechanism
 $n_2 = Zc/(Zd-Zc)$: Reduction ratio of the internal planetary gear mechanism

then n can be expressed by n_1 and n_2 as shown in the following formula

$$n = n_1 \times (n_2 + 1) + 1 \dots(\text{Formula 4})$$

Figure 5 Parallel shaft gear mechanism

Eccentric shaft gear (teeth number Z_b)
Input shaft gear (teeth number Z_a)

The eccentric planetary shaft revolves at the angle speed of ω_2 rotating. At this time, if the angle speed of ω_1 is applied to the input shaft gear, the rotation angle speed ω_2 of the eccentric planetary shaft is expressed by the following formula.

$$\omega_2 = -\frac{Z_a}{Z_b} (\omega_1 - \omega_2) + \omega_1 \dots(\text{Formula 1})$$

Figure 7 Internal planetary gear mechanism

Planetary gear (teeth number Z_c)
Crank shaft
Circular gear (teeth number Z_d)

If the angle speed of ω_1 is applied to the crank shaft fixing the internal gear, the rotation angle speed of ω_2 of the planetary gear is expressed by the following formula.

$$\omega_2 = -\frac{Z_d-Zc}{Zc} \times \omega_1 \dots(\text{Formula 2})$$

Figure 8 Constant speed gear mechanism

Planetary gear (cycloid disc)
Pin
 O_p : Planetary gear center
 O_s : Internal pin pitch circle center

The planetary gear of the internal planetary gear rotate (ω_2) simultaneously at a low speed with high-speed revolution (ω_1). The constant speed gear mechanism extracts only the rotation by the internal pin located at regular intervals in the center O_s of the crank shaft and concentric circle.

8. Rating

Table 2. Rating table (in the case of usage as a reducer)

Output speed (r/min)			5			10			15			20			25		
Frame Size	Reduction ratio	Actual reduction ratio	Rated output torque (Upper/N·m) (Lower/kgf·m)	Input capacity (kW)	Input speed (r/min)	Rated output torque (Upper/N·m) (Lower/kgf·m)	Input capacity (kW)	Input speed (r/min)	Rated output torque (Upper/N·m) (Lower/kgf·m)	Input capacity (kW)	Input speed (r/min)	Rated output torque (Upper/N·m) (Lower/kgf·m)	Input capacity (kW)	Input speed (r/min)	Rated output torque (Upper/N·m) (Lower/kgf·m)	Input capacity (kW)	Input speed (r/min)
UA15	84	1603/19	348 35.4	0.24	422	282 28.8	0.39	844	250 25.5	0.52	1266	229 23.4	0.64	1687	214 21.9	0.75	2109
	127	127			635			1270			1905			2540			3175
	139	1813/13			697			1395			2092			2789			3487
	171	1883/11			856			1712			2568			3424			4280
UA25	88	1930/22	695 70.9	0.48	439	565 57.6	0.79	877	500 51.0	1.05	1316	459 46.8	1.28	1755	429 43.7	1.49	2193
	124	2105/17			619			1238			1857			2476			3096
	145	145			725			1450			2175			2900			3625
	173	2245/13			863			1727			2590			3454			4317
UA35	87	2003/23	1251 128	0.87	435	1016 104	1.42	871	900 91.7	1.88	1306	826 84.2	2.30	1742	772 78.7	2.69	2177
	121	121			605			1210			1815			2420			3025
	152	2283/15			761			1522			2283			3044			3805
	166	2318/14			828			1656			2484			3311			4139
UA45	82	82	1835 187	1.28	410	1491 152	2.08	820	1320 135	2.76	1230	1211 123	3.38	1640	1132 115	3.95	2050
	99	2073/21			494			987			1481			1974			2468
	130	2213/17			651			1302			1953			2604			3254
	152	2283/15			761			1522			2283			3044			3805
	166	2318/14			828			1656			2484			3311			4139
UA55	81	2187/27	2781 283	1.94	405	2259 230	3.15	810	2000 204	4.19	1215	1835 187	5.12	1620	1716 175	5.99	2025
	97	2328/24			485			970			1455			1940			2425
	126	2516/20			629			1258			1887			2516			3145
	145	2610/18			725			1450			2175			2900			3625
	169	2704/16			845			1690			2535			3380			4225
	241	2892/12			1205			2410			3615			4820			6025
UA65	89	2840/32	4769 486	3.33	444	3874 395	5.41	888	3430 350	7.18	1331	3146 321	8.79	1775	2943 300	10.3	2219
	121	3158/26			607			1215			1822			2429			3037
	144	3317/23			721			1442			2163			2884			3605
	171	2227/13			857			1713			2570			3426			4283
	199	3582/18			995			1990			2985			3980			4975
	249	3741/15			1247			2494			3741			4988			6235
UA80	103	2890/28	6952 709	4.85	516	5647 576	7.87	1032	5000 510	10.5	1548	4587 468	12.8	2064	4290 437	14.9	2580
	122	3049/25			610			1220			1829			2439			3049
	155	3261/21			776			1553			2329			3106			3882
	190	3420/18			950			1900			2850			3800			4750
	239	3579/15			1193			2386			3579			4772			5965
	283	3685/13			1417			2835			4252			5669			7087

Note) 1. Rated output torque

The rated output torque indicates the allowable value of the average load torque of the output shaft. The rated output torque to the output speed of 5r/min or less is the same as that at 5r/min.

The input capacity is the required input capacity for 100% rated output torque. This value considers the efficiency at the time of deceleration.

2. Allowable peak torque at acceleration and deceleration

Allowable peak torque applied to the output shaft at normal start and stop.

3. Allowable maximum momentary torque

Allowable maximum momentary torque applied instantaneously to the output shaft due to emergency stop, external heavy shock, etc.

This indicates the value in the case of 10³ times of application during the entire lifetime.

30			40			50			Allowable peak torque at acceleration and deceleration (Upper/N-m) (Lower /kgf-m) Note 2	Allowable maximum momentary torque (Upper/N-m) (Lower/kgf-m) Note 3.	Allowable maximum output speed (r/min)	Equivalent on input shaft Upper Moment of inertia ($\times 10^4 \text{kg}\cdot\text{m}^2$) Lower/GD ² ($\times 10^4 \text{kgf}\cdot\text{m}^2$) Note 4.		Mass (kg) Note 6.
Rated output torque (Upper/N-m) (Lower/kgf-m)	Input capacity (kW)	Input speed (r/min)	Rated output torque (Upper/N-m) (Lower/kgf-m)	Input capacity (kW)	Input speed (r/min)	Rated output torque (Upper/N-m) (Lower/kgf-m)	Input capacity (kW)	Input speed (r/min)				*1	*2	
203 20.7	0.85	2531	186 19.0	1.04	3375	174 17.8	1.21	4218	625 64	1250 127	60	0.167 0.667	0.100 0.401	3.9
		3810			5080			6350				0.164 0.658	0.064 0.254	
		4184			5578			6973				0.131 0.525	0.057 0.226	
		5135			6847			8559				0.112 0.449	0.044 0.174	
406 41.4	1.70	2632	373 38.0	2.08	3509	348 35.5	2.43	4386	1250 127	2500 255	50	0.549 2.20	0.271 1.08	6.2
		3715			4953			6191				0.432 1.73	0.184 0.737	
		4350			5800			7250				0.393 1.57	0.152 0.609	
		5181			6908			8635				0.358 1.43	0.122 0.488	
731 74.5	3.06	2613	671 68.4	3.74	3483				2250 229	4500 459	40	1.31 5.26	0.668 2.67	11
		3630			4840							1.05 4.21	0.466 1.87	
		4566			6088							0.919 3.67	0.354 1.42	
		4967			6623							0.878 3.51	0.319 1.28	
1072 109	4.49	2460							3300 336	6600 673	30	2.58 10.3	1.46 5.83	17
		2961										2.24 8.96	1.21 4.82	
		3905										1.84 7.36	0.882 3.53	
		4566										1.66 6.66	0.730 2.92	
		4967										1.58 6.32	0.656 2.62	
1625 166	6.80	2430							5000 510	10000 1019	30	6.09 24.4	3.25 13.0	22
		2910										5.30 21.3	2.75 11.0	
		3774										4.38 17.5	2.11 8.45	
		4350										4.01 16.1	1.81 7.25	
		5070										3.72 14.9	1.52 6.09	
		7230										3.11 12.4	0.983 3.93	
2786 284	11.7	2663							8575 874	17150 1748	30	12.1 48.4	7.20 28.8	38
		3644										9.49 38.0	5.34 21.3	
		4327										8.39 33.6	4.47 17.9	
		5139										7.16 28.7	3.36 13.5	
		5970										6.78 27.1	3.12 12.5	
		7482										5.94 23.8	2.38 9.51	
									12500 1274	25000 2548	25	16.7 66.9	10.4 41.6	56
							14.6 58.3	8.82 35.3						
							12.0 48.1	6.83 27.3						
							10.4 41.5	5.43 21.7						
							8.89 35.6	4.12 16.5						
							8.01 32.0	3.31 13.2						

4. Moment of inertia and GD² indicate the values converted to the input shaft.

To convert these values to inertia (kgf-m-sec²), divide them by g (9.8 m/sec²) for the moment of inertia and by 4g (4x9.8 m/sec²) for GD².

*1: Value including the whole standard input shaft gear.

*2: Value considering only the tooth width of the input shaft gear.

5. This rating is applied for 50%ED or less (10-minute cycle). For over 50%ED (10-minute cycle), contact us.

For calculation of %ED, see Formula 14 on P.12.

6. The mass includes the input shaft gear (standard specification).

9. Engineering Data

9-1. Stiffness and Lost Motion

- Hysteresis curve: Relationship between the load unloaded slowly to zero torque after fixing the input shaft (high-speed shaft) and slowly applying torque up to the rating to the output flange, and the torsion angle of the output flange
- Lost motion: Torsion angle under the load of the rating torque $\times \pm 3\%$
- Stiffness: Inclination of the straight line between two points on the hysteresis curve: the points of rated torque $\times 50\%$ and 100%

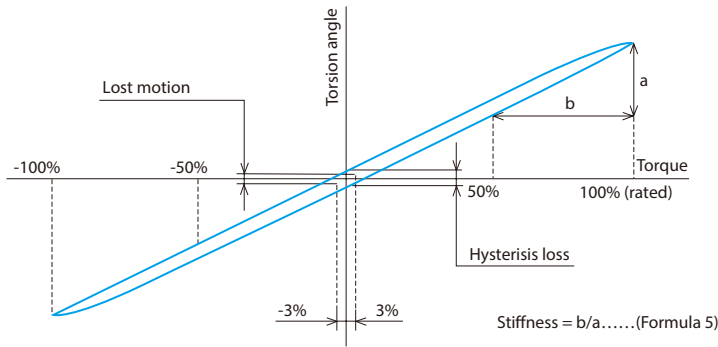


Figure 9. Hysteresis curve

Table 3

Frame Size	Rated output torque At 15r/min Upper stage: N·m Lower stage: kgf·m	Lost motion		Stiffness Upper stage: N·m/arc min Lower stage: kgf·m/arc min
		Measurement torque (\pm) Upper stage: N·m Lower stage: kgf·m	Lost motion arc min	
UA15	250	7.5	0.5	63
	26	0.77		6.4
UA25	500	15		112
	51	1.5		11
UA35	900	27		196
	92	2.8		20
UA45	1320	40		343
	135	4.0		35
UA55	2000	60	530	
	204	6.1	54	
UA65	3430	103	933	
	350	10.5	95	
UA80	5000	150	1300	
	510	15.3	133	

Note) arc min indicates the angle "minute."
The stiffness indicates the average value (representative value).

9-2. Angular Transmission Error

Angle transmission error: Difference between the theoretical output rotation angle and actual output rotation angle when any rotation angle is applied to the input without load (measurement value example)

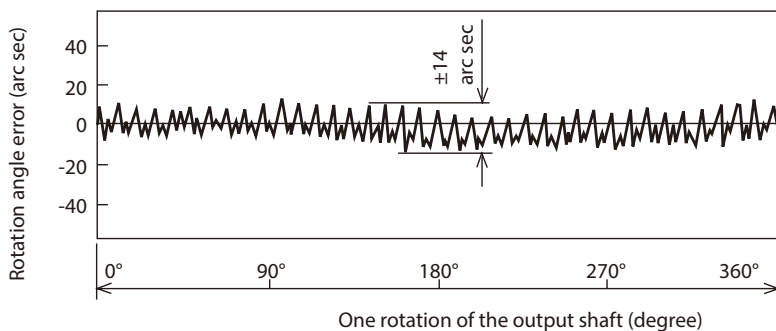


Figure 10. Angle transmission error

9-3. Efficiency

- The efficiency varies according to the output speed, load torque, grease temperature, frame size, etc.
- Figure 11 indicates the average value of the efficiency for the output speed after running-in while the rating load torque and grease temperature are stable.
- If the load torque is not the rated torque, correct the efficiency by the efficiency correction curve of Figure 12.
- Lubrication: Multemp FZ No.00

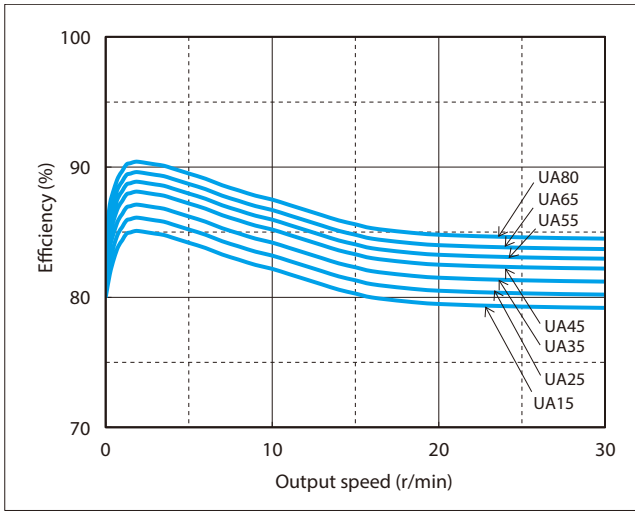


Figure 11. Efficiency curve

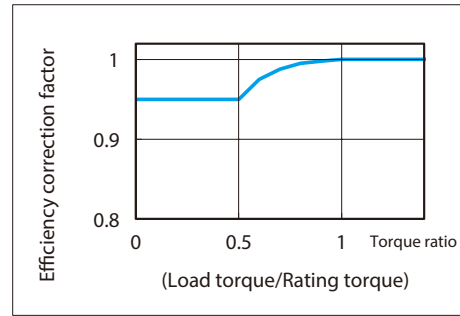


Figure 12. Efficiency correction curve

Corrected efficiency = Efficiency value (Figure 11) × Efficiency correction factor (Figure 12).....(Formula 6)

- Note) 1. If the load torque is less than the rated torque, the efficiency value will be smaller. Calculate the efficiency correction factor from Figure 12.
 2. If the torque ratio is 1.0 or more, the efficiency correction factor will be 1.0.

9-4. No Load Running Torque

- The no load running torque is the torque on the input shaft side required for rotation of the reducer without load.
- Figure 13 shows the average value after running-in.
- Lubrication: Multemp FZ No.00

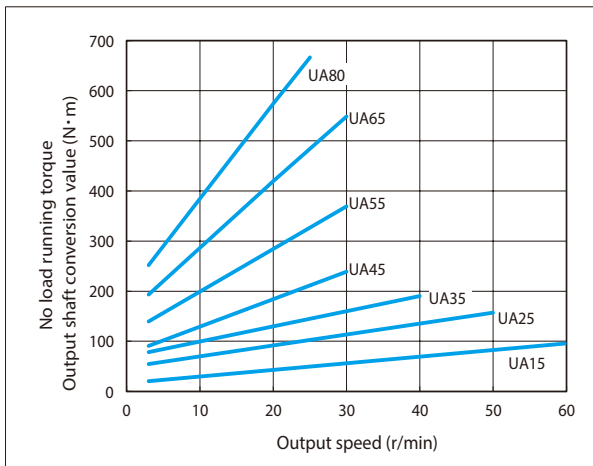


Figure 13 No load running torque value

Note) Figure 13 indicates the output shaft conversion value of the no load running torque, so convert to the value of the input shaft by the following formula.

No load running torque
 Input shaft conversion N·m = Output shaft conversion value/Reduction ratio.....(Formula 7)

9-5. No Load Friction Torque on Output Shaft

- The no load friction torque on output shaft indicates the torque required to start rotation from the output side of reducer without load.
- Table 4 shows the average value after running-in.
- Lubrication: Multemp FZ No.00

Table 4

Frame Size	No load friction torque on output shaft	
	N·m	kgf·m
UA15	20	2
UA25	49	5
UA35	88	9
UA45	108	11
UA55	137	14
UA65	167	17
UA80	196	20

10. Main Bearing

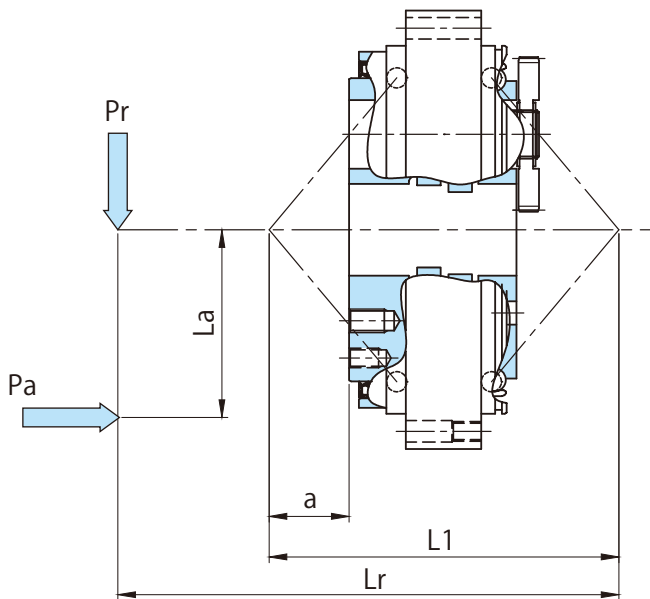


Figure 14. Span between load points

Pr: Actual radial load (N)

Pa: Actual axial load (N)

1. Moment stiffness

Indicates the inclination stiffness of the output flange with the external moment.

External moment M

$$M = Pr \cdot Lr + Pa \cdot La \dots \dots \dots \text{(Formula 8)}$$

2. Allowable moment and Allowable axial load

Refer to (Formula 9), (Formula 10), and Figure 15 for external moment and external axial load.

Equivalent moment Me

$$Me = Cf \cdot Fs1 \cdot Pr \cdot Lr + Cf \cdot Fs1 \cdot Pa \cdot La \dots \dots \dots \text{(Formula 9)}$$

Equivalent axial load Pae

$$Pae = Cf \cdot Fs1 \cdot Pa \dots \dots \dots \text{(Formula 10)}$$

Cf: Coupling factor (Table 8)

Fs1: Shock factor (Table 9)

Table 5. Span between load points

Frame Size	Bearing type	Span between load points	
		L1 mm	a mm
UA15	Angular contact ball bearing	114.2	20.4
UA25	Angular contact ball bearing	131.9	26.0
UA35	Angular contact ball bearing	154.5	34.8
UA45	Angular contact ball bearing	177.5	38.7
UA55	Angular contact ball bearing	205.7	50.9
UA65	Taper roller bearing	183.4	32.7
UA80	Taper roller bearing	215.1	35.9

Table 6. Moment stiffness

Frame Size	Moment stiffness (representative value)	
	N-m/arc min	kgf-m/arc min
UA15	550	56
UA25	833	85
UA35	1127	115
UA45	1500	153
UA55	2500	255
UA65	6000	612
UA80	9000	918

Table 7. Allowable moment, axial load

Frame Size	Allowable moment		Allowable axial load	
	N-m	kgf-m	N	kgf
UA15	883	90	3924	400
UA25	1666	170	5194	530
UA35	2156	220	7840	800
UA45	3430	350	8820	900
UA55	4000	408	10780	1100
UA65	7056	720	11000	1120
UA80	10000	1020	13734	1400

Note) If both moment and axial loads occur, confirm the allowable values with Figure 15.

Table 8. Coupling factor Cf

Load connection factor	Cf
Chain	1
Gear	1.25
Timing belt	1.25
V belt	1.5

Table 9: Shock factor Fs1

Load Classification	Fs1
Uniform load (No shock)	1
Moderate shock	1 to 1.2
Heavy shock	1.4 to 1.6

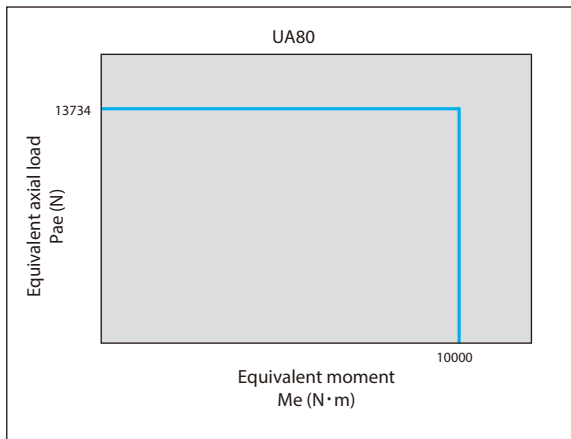
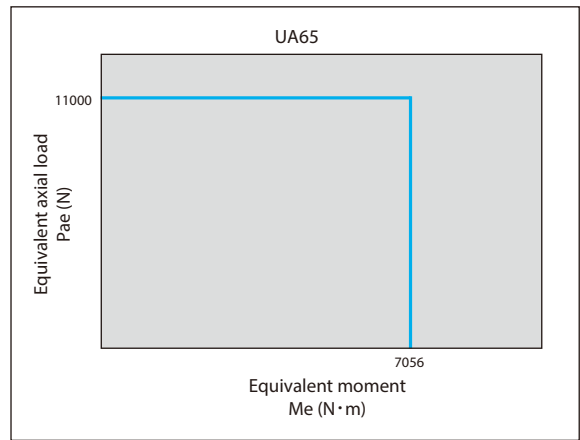
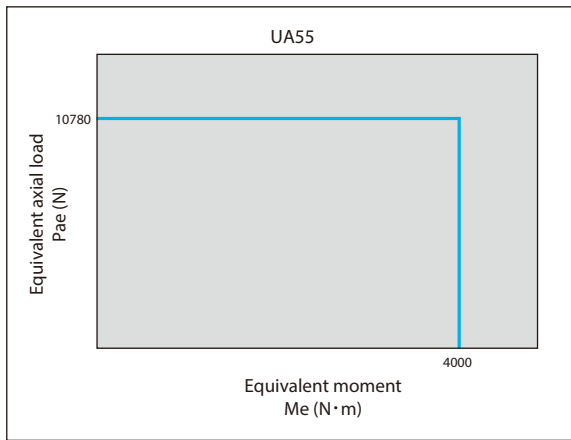
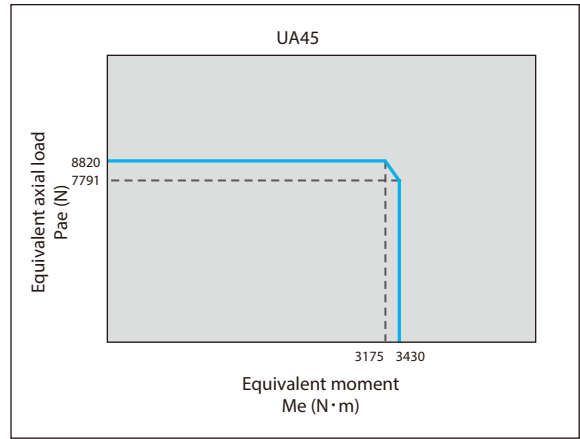
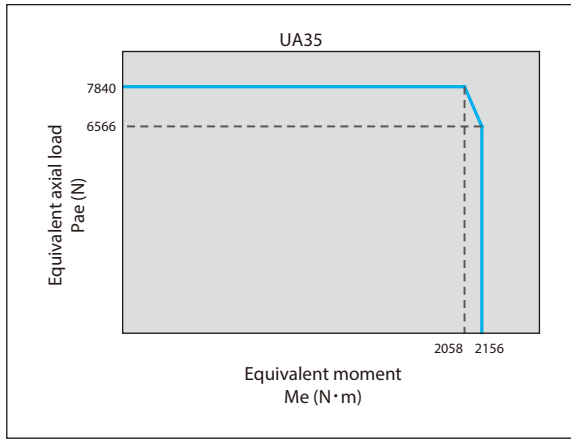
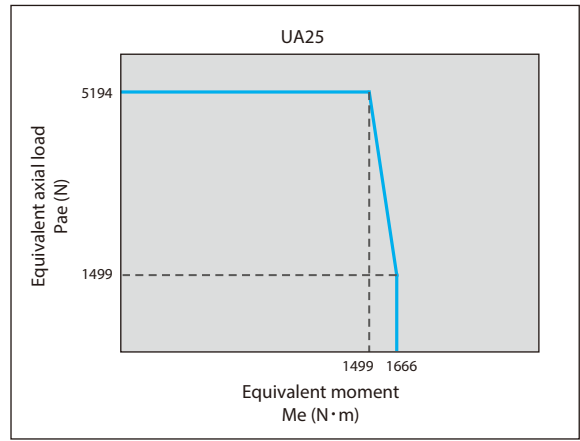
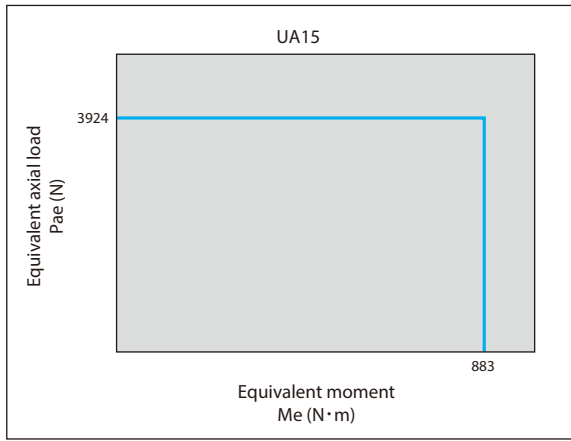


Figure 15. Allowable moment and axial load diagram

11. Selection

11-1. Selection Flow Chart and Calculation Formula

Figure 16

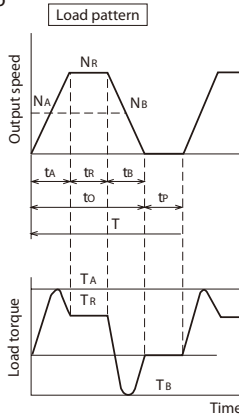


Table 10

Symbol	Name	Symbol	Name
NA	Average output speed at the time of acceleration	t0	Total running time
NR	Output speed with normal running	tP	Stand still time
NB	Average output speed at the time of deceleration	T	Time cycle
tA	Acceleration time	TA	Acceleration peak torque
tR	Normal running time	TR	Normal running torque
tB	Deceleration time	TB	Peak torque at breaking
-	—	TS	Shock torque

Evaluation of the load characteristics

- 1 Calculation of the average output speed N_E
- 2 Calculation of the average output torque T_E

$$N_E = \frac{t_A \cdot N_A + t_R \cdot N_R + t_B \cdot N_B}{t_0} \dots \dots \dots (\text{Formula 11})$$

$$T_E = \left(\frac{t_A \cdot N_A \cdot T_A^{10/3} + t_R \cdot N_R \cdot T_R^{10/3} + t_B \cdot N_B \cdot T_B^{10/3}}{t_0 \cdot N_E} \right)^{0.3} \times F_{S2} \dots \dots \dots (\text{Formula 12})$$

- 3 Calculation of the allowable rated output torque at the average output speed T_{E0}

$$T_{E0} = \left(\frac{15}{N_E} \right)^{0.3} \times T_0 \dots \dots \dots (\text{Formula 13})$$

T0: Rated output torque at the output speed of 15rpm: Table 2 - Rating table

- 4 Calculation of %ED (*if it exceeds 50%ED, reconsider the load characteristics.)

$$\%ED = \frac{t_0}{T} \times 100 \dots \dots \dots (\text{Formula 14})$$

Table 2

Rating table

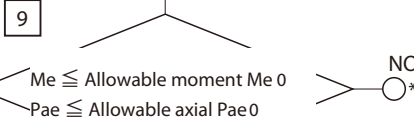
- 5 Select the frame size of $T_E \leq T_{E0}$: $\dots \dots \dots (\text{Formula 15})$

- 6 Select tentative frame size

Evaluation of the main bearing

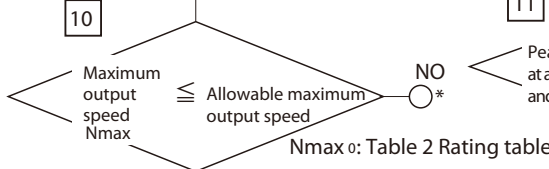
- 7 Calculation of the equivalent moment M_e
- 8 Calculation of the equivalent axial P_{ae}

M_e : Formula 9
 P_{ae} : Formula 10

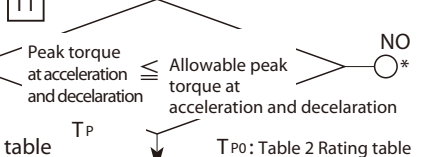


M_{e0} : Figure 15
 P_{ae0} : Figure 15

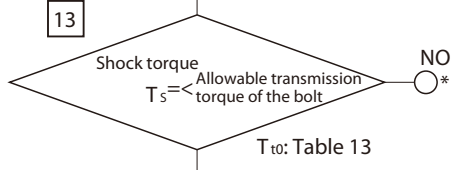
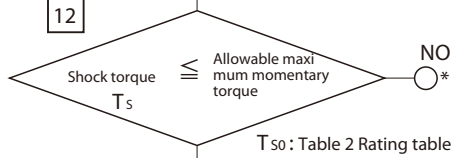
Evaluation of the output speed



Evaluation of the peak torque at acceleration and deceleration



Evaluation of the shock torque



Select of the frame size

Table 11 Fs2 load factor

Load conditions	Fs2
Uniform load (No shock)	1
Moderate shock	1 to 1.2
Heavy shock	1.4 to 1.6

Note) For the * mark parts, return to 6.

11-2. Selection Example

Make confirmation assuming F4CF-UA25-124 (actual reduction ratio: 2105/17) for the following specifications.

(Specifications) T_A : Acceleration peak torque	750 N·m	t_A : Acceleration time	0.3sec
T_R : Normal running torque	400 N·m	t_r : Normal running time	3.0sec
T_B : Peak torque at braking	550 N·m	t_B : Deceleration time	0.3sec
T_S : Shock torque	1600 N·m 1000 times during the whole lifetime	t_P : Stand still time	3.6sec
n_A : Average output speed at the time of acceleration	10.5 r/min	t_o : Total running time	3.6sec
n_R : Output speed with normal running	21.1 r/min	T : Time cycle	7.2sec
n_B : Average output speed at the time of deceleration	10.5 r/min		
P_r : Radial load	1000 N	P_a : Axial load	200 N
l_r : Radial load position	350mm	l_a : Axial load position	50mm

Assume that there is almost no shock when using the drive.

(Calculation) Average output speed $n_E = \frac{0.3 \times 10.5 + 3.0 \times 21.1 + 0.3 \times 10.5}{3.6} = 19.3 \text{ (r/min)}$

Average load torque $T_E = \left(\frac{0.3 \times 10.5 \times 750^{10/3} + 3 \times 21.1 \times 400^{10/3} + 0.3 \times 10.5 \times 550^{10/3}}{3.6 \times 19.3} \right)^{0.3} \times 1.0 = 443 \text{ (N·m)}$

- Allowable rated torque at the average output speed

$$T_{EO} = \left(\frac{15}{19.3} \right)^{0.3} \times 500 = 463 \text{ (N·m)} \geq 443 \text{ (N·m)} (=T_E) \rightarrow \text{Select F4CF-UA25-124 as a tentative frame size.}$$

- Calculation of %ED $\%ED = \frac{3.6}{7.2} \times 100 = 50\%$

- Evaluate of the equivalent moment

$$M_e = 1000 \times 350 \times 10^{-3} + 200 \times 50 \times 10^{-3} = 360 \text{ (N·m)} \leq 1666 \text{ (N·m)} (=M_{e0})$$

- Evaluate of the equivalent axial load

$$P_a = 200 \text{ (N)} \leq 5194 \text{ (N)} (=P_{a0})$$

- Evaluate of the maximum output speed

$$n_{\max} = 21.1 \text{ (r/min)} \leq 50 \text{ (r/min)}$$

- Evaluate of the peak torque at acceleration and deceleration

$$T_p = 750 \text{ (N·m)} \leq 1250 \text{ (N·m)}$$

- Evaluate of the impact torque (maximum momentary torque)

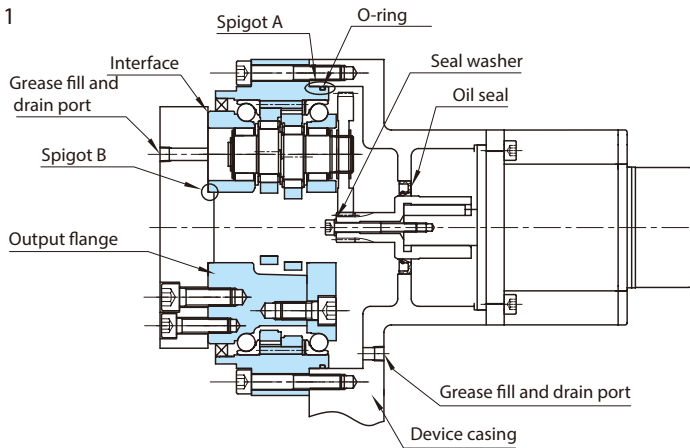
$$T_s = 1600 \text{ (N·m)} \leq 2500 \text{ (N·m)}$$

F4CF-UA25-124 is selected based on the following consideration.

12. Notice for Designing

12-1. Assembly Method and Dimensional precision in assembly

Example for Assembly 1



- The input parts such as motors shall be assembled referring to spigot A.

- Spigot B or D for assembly using output flange. Spigot A or C for assembly using ring gear housing.

- To prevent intrusion of water and dust, apply liquid gasket to the interface.

Example for assembly 2

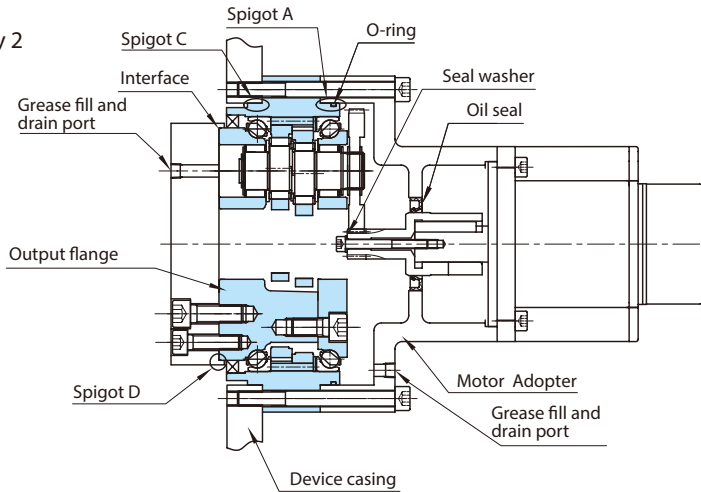


Figure 17 Assembly method

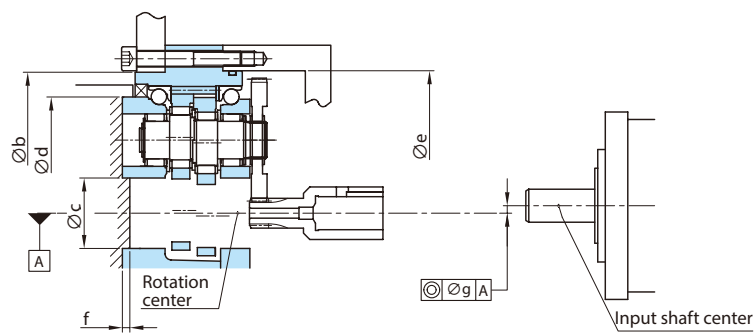


Figure 18 Dimensional precision in Assembly

The dimensional precision in assembly shall be within the allowable values of Table 12.

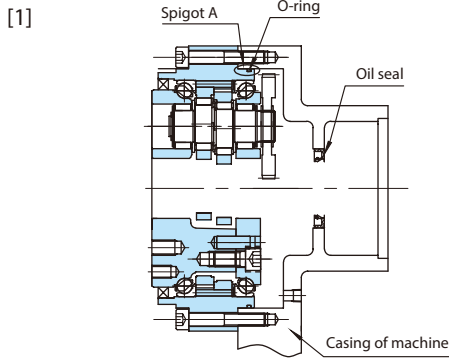
Table 12

Frame Size	Spigot dimension				Spigot depth	Concentricity g against the rotation axis
	b	c	d	e	f	
UA15	$\varnothing 113 \text{ H7/h7}$	$\varnothing 28 \text{ H7/h7}$	$\varnothing 90 \text{ H7/h7}$	$\varnothing 113 \text{ H7/h7}$	6	$\varnothing 0.03$
UA25	$\varnothing 137 \text{ H7/h7}$	$\varnothing 32 \text{ H7/h7}$	$\varnothing 110 \text{ H7/h7}$	$\varnothing 137 \text{ H7/h7}$	8	
UA35	$\varnothing 160 \text{ H7/h7}$	$\varnothing 35 \text{ H7/h7}$	$\varnothing 130 \text{ H7/h7}$	$\varnothing 160 \text{ H7/h7}$		
UA45	$\varnothing 188 \text{ H7/h7}$	$\varnothing 47 \text{ H7/h7}$	$\varnothing 155 \text{ H7/h7}$	$\varnothing 188 \text{ H7/h7}$		
UA55	$\varnothing 208 \text{ H7/h7}$	$\varnothing 42 \text{ H7/h7}$	$\varnothing 174 \text{ H7/h7}$	$\varnothing 208 \text{ H7/h7}$	10	
UA65	$\varnothing 255 \text{ H7/h7}$	$\varnothing 55 \text{ H7/h7}$	$\varnothing 210 \text{ H7/h7}$	$\varnothing 255 \text{ H7/h7}$		
UA80	$\varnothing 284 \text{ H7/h7}$	$\varnothing 62 \text{ H7/h7}$	$\varnothing 238 \text{ H7/h7}$	$\varnothing 284 \text{ H7/h7}$		

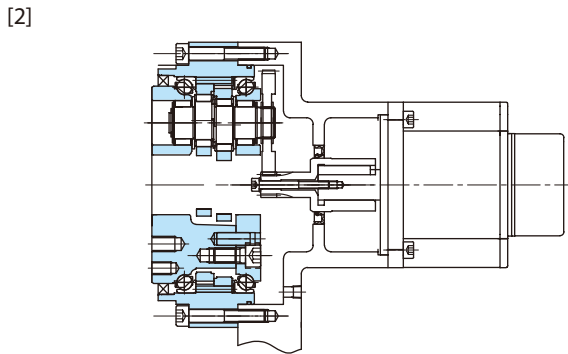
12-2. Assembly Procedure

Figure 19

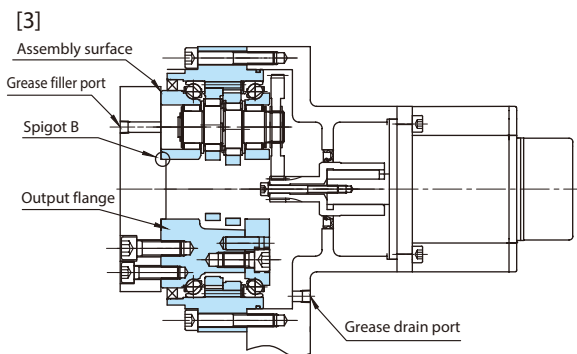
Example for Assembly 1



Fix the FINE CYCLO to the casing of machine with bolts. (Spigot A)
At this time, apply the O-ring to the spigot.
Also prepare a seal mechanism between the input shaft gear and casing of machine.



Fix the input shaft gear to the motor shaft with key and bolts. Align the phase of the input shaft gear and eccentric shaft gear, mount the motor to the FINE CYCLO, and fix it with bolts. (When mounting the servo motor, apply the prevention agent for fretting to the motor shaft in advance.)

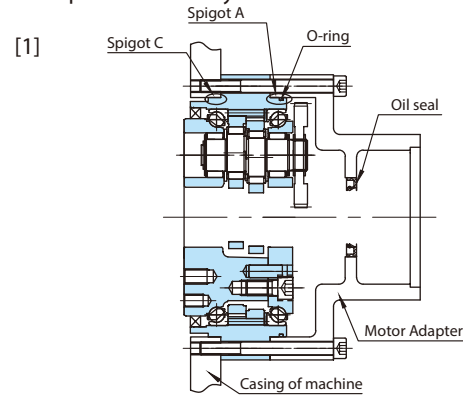


Mount the output shaft of the machine to the output flange with bolts. (Spigot B) At the mounting, apply liquid gasket to the assembly surface. Inject the specified amount of grease from the grease drain port of the casing of machine and then close each grease drain port.

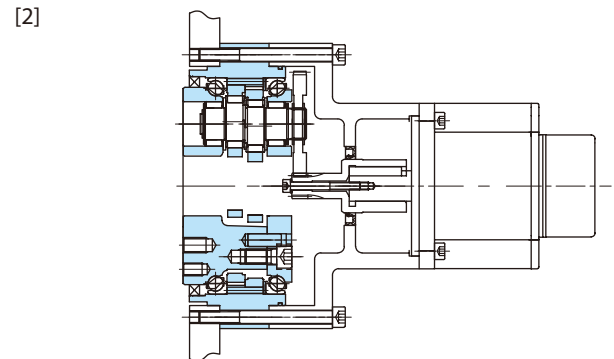
- Note 1) The bolts for mounting of the gear reducer shall be fastened by the specified fastening torque.
2. When mounting the output shaft of the device to the FINE CYCLO output flange with bolts, set the length of the bolts to be shorter than the screw depth shown in the output flange of the outline drawing.
3. When fixing the input shaft gear to the motor with bolts, seal between the input shaft gear and bolt by seal washer, etc.

Recommended liquid gasket: ThreeBond Co.,Ltd.
Liquid gasket ThreeBond 1215

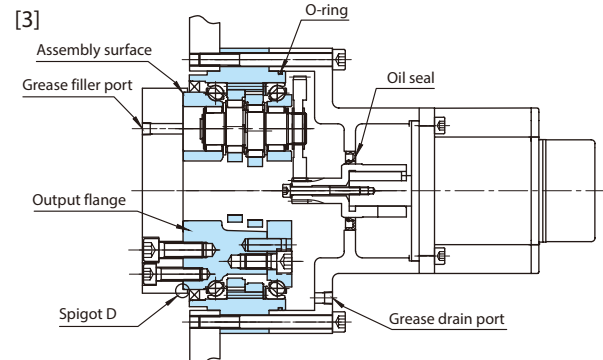
Example for Assembly 2



Fix the FINE CYCLO and motor adapter to the casing of machine by jointly fastening with bolts. (Spigot A and C)
At this time, apply the O-ring to the spigot. Also prepare a seal structure between the input shaft gear and motor adapter.



Fix the input shaft gear to the motor shaft with key and bolts. Align the phase of the input shaft gear and eccentric shaft gear, mount the motor to the FINE CYCLO, and fix it with bolts. (When mounting the servo motor, apply the prevention agent for fretting to the motor shaft in advance.)



Mount the output shaft of the machine to the output flange with bolts. (Spigot D) At this time, apply liquid gasket to the assembly surface. Inject the specified amount of grease from the grease drain port of the motor adapter and then close each grease drain port.

12-3. Bolt Tightening Torque and Allowable Transmission Torque

Table 13

Frame Size	Tightening of the output flange								Tightening of the reducer part					
	Number and size of bolts	Bolt PCD mm	Bolt tightening torque		Allowable transmission torque by bolt (for each pitch)		Allowable transmission torque by bolt (total)		Number and size of bolts	Bolt PCD mm	Bolt tightening torque		Allowable transmission torque by bolt (total)	
			N-m	kgf.cm	N-m	kgf.m	N-m	kgf.m			N-m	kgf.cm	N-m	kgf.m
UA15	15-M6 9-M6	72 48	15.7	160	1075 430	110 44	1505	154	16-M5	123.5	9.1	93	1389	142
UA25	9-M10 6-M10	86 50	76.5	780	2222 861	227 88	3083	315	12-M8	151	38.3	390	3283	335
UA35	15-M10 6-M10	107 72	76.5	780	4608 1240	470 127	5848	597	18-M8	175	38.3	390	5707	582
UA45	18-M10 9-M12	131 93	76.5	780	6770 3493	691 356	10262	1047	18-M10	206	76.5	780	10646	1086
UA55	15-M12 9-M12	140 97	133	1360	8763 3643	894 372	12406	1266	20-M10	226	76.5	780	12977	1324
UA65	21-M12 12-M12	177 136	133	1360	15510 6810	1583 695	22321	2278	18-M12	275	133	1360	20656	2108
UA80	15-M16 9-M16	193 139	331	3380	22498 9722	2296 992	32221	3288	24-M12	305	133	1360	30545	3117

- Bolt: Use hexagon socket head bolts of strength class 12.9 of JIS B 1176.
- Seat scratch prevention measure: Use conical spring washers (JIS B 1252, class 2) when tightening the reducer part.
- As a locking measure, use adhesive (Loctite 262, etc) as well in addition to conical spring washers as mentioned above.
- Coefficient of friction: 0.15

12-4. Lubrication

- For this drive, no grease is filled before shipment, so be sure to prepare the recommended grease (Table 14) and fill the specified filling quantity (Table 15) before operation.
The specified filling quantity is for the drive space. Also fill the device-side space ([1] and [4]) with grease.
Horizontal mounting: Fill grease for about 70% to 80% of the volume of device-side space [1].
Vertical mounting [1]: To prevent rise in the internal pressure, secure about 10 to 20% space of the overall volume (drive space + device-side space [2]) in the device-side space [2].
Vertical mounting [2]: Fill grease for the volume of device-side space [4].
To prevent rise in the internal pressure, secure about 10 to 20% space of the overall volume (drive space + device-side space [3] + device-side space [4]) in the device-side space [3].
Excessive grease filling causes rise in the internal pressure, which causes grease leak and oil seal detachment.
- The specified filling quantity shown in Table 15 is a guideline so confirm the grease level when filling grease.
- For the grease fill position of the output side, see the A dimensions shown in the table and align with the eccentric planetary shaft hole.
- In the initial installation, fill grease from the lower grease fill and discharge hole and surely fill inside the drive with grease.
- Replace grease every 20,000 hours of operation time or every three to five years.

Figure 20

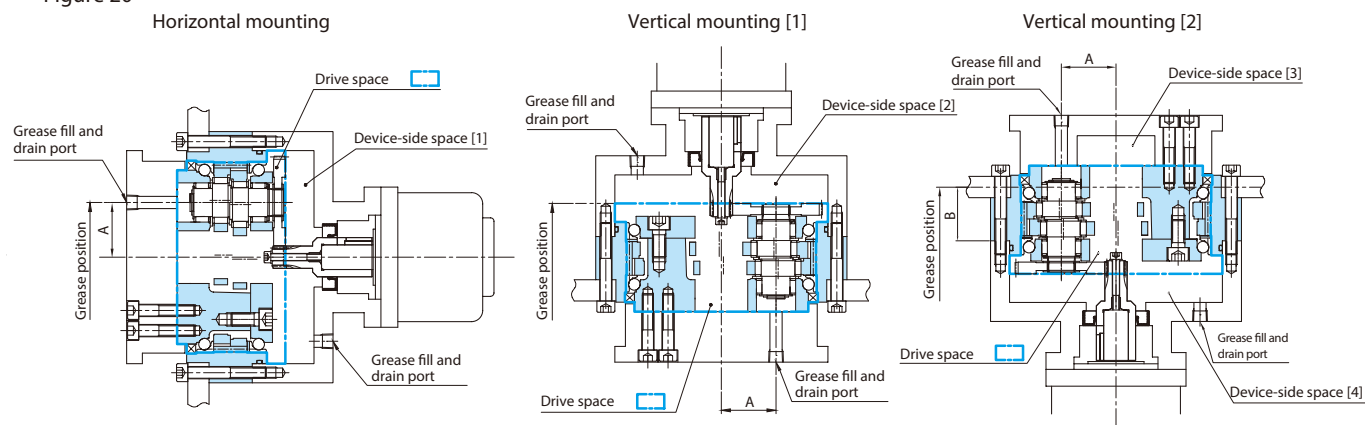


Table 14 Recommended Grease

Lubrication grease name	Supplier
Multemp FZ No.00	Kyodo Yushi Co., Ltd.

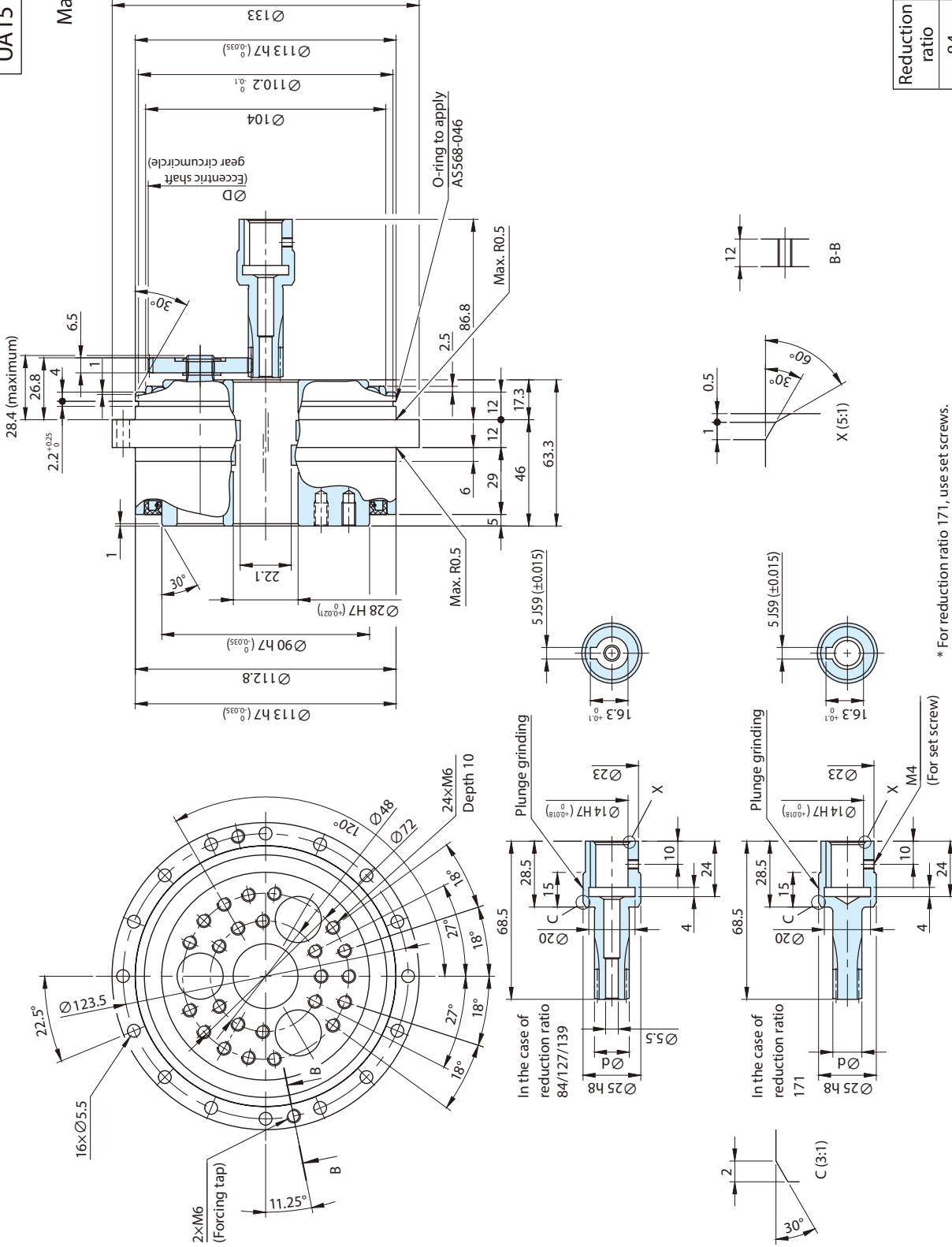
Table 15. Specified grease filling quantity (drive space)

Frame Size	Specified grease filling quantity						Grease fill and discharge hole position	Grease level
	Horizontal mounting		Vertical mounting [1]		Vertical mounting [2]			
	mL	g	mL	g	mL	g	A (mm)	B (mm)
UA15	140	122	175	152	164	143	29	33
UA25	240	209	300	261	261	227	34	34
UA35	360	313	460	400	415	361	39	45
UA45	440	383	560	487	479	417	49	50
UA55	780	679	940	818	860	748	54	65
UA65	1,080	940	1,360	1,180	1,253	1,090	63	74
UA80	1,950	1,700	2,460	2,140	2,293	1,995	71	75

13. Outline Drawing

UA15 outline drawing

Mass 3.9kg



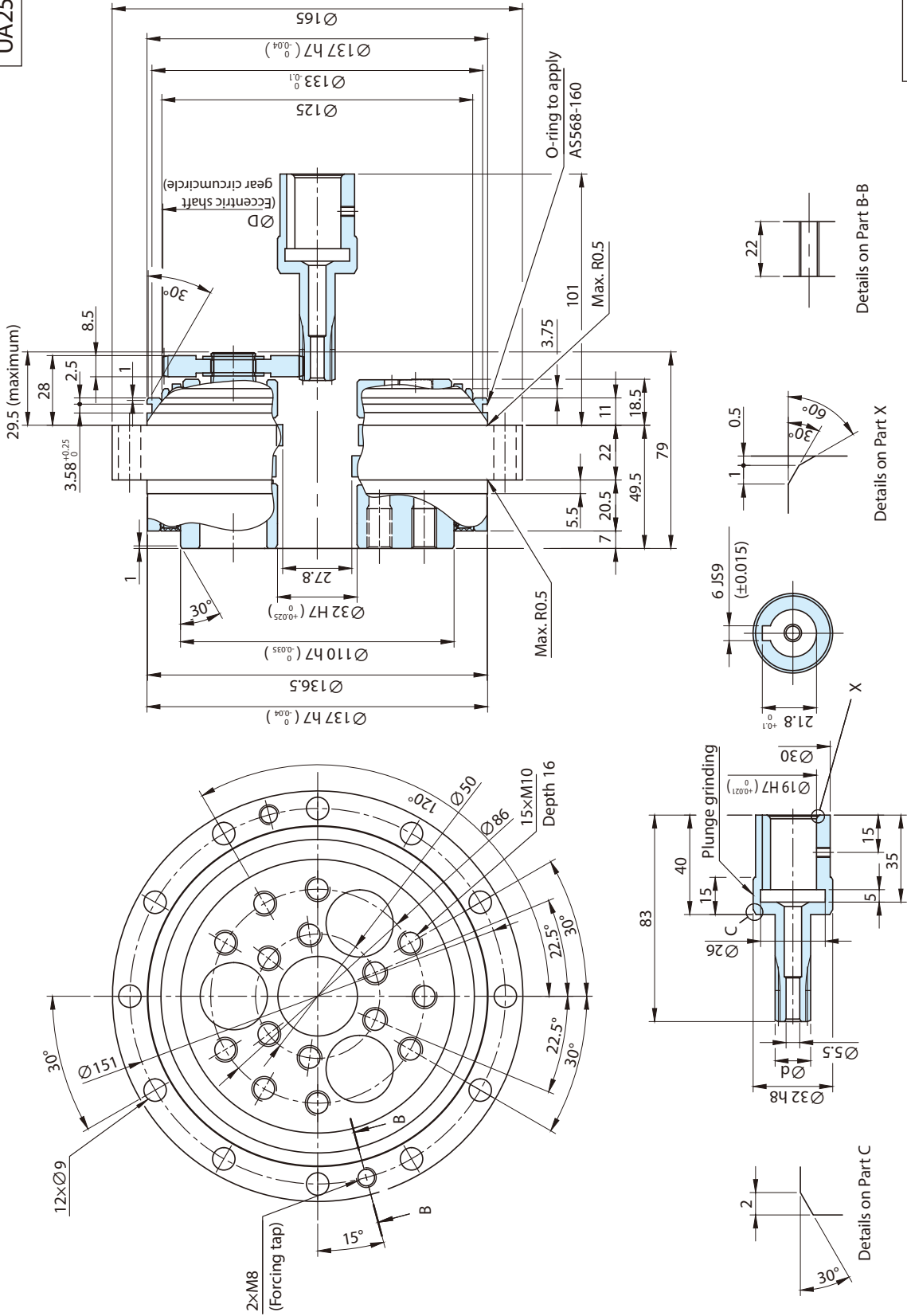
Reduction ratio	Ø d	Ø D
84	19.6	97.4
127	15.1	101.9
139	14.3	102.7
171	12.5	104.5

* For reduction ratio 171, use set screws.

- Precautions**
1. Apply liquid gasket to the mounting surface with the gear reducer to prevent grease leak.
 2. Prepare bolts for mounting, washers, liquid gasket, O-ring, and grease for lubrication by customers. (See P.15 and 16)
 3. Note that the dimensions of the outline drawings may be changed without notice to customers.
 4. No paint in the standard specification.

UA25 outline drawing

Mass 6.2kg

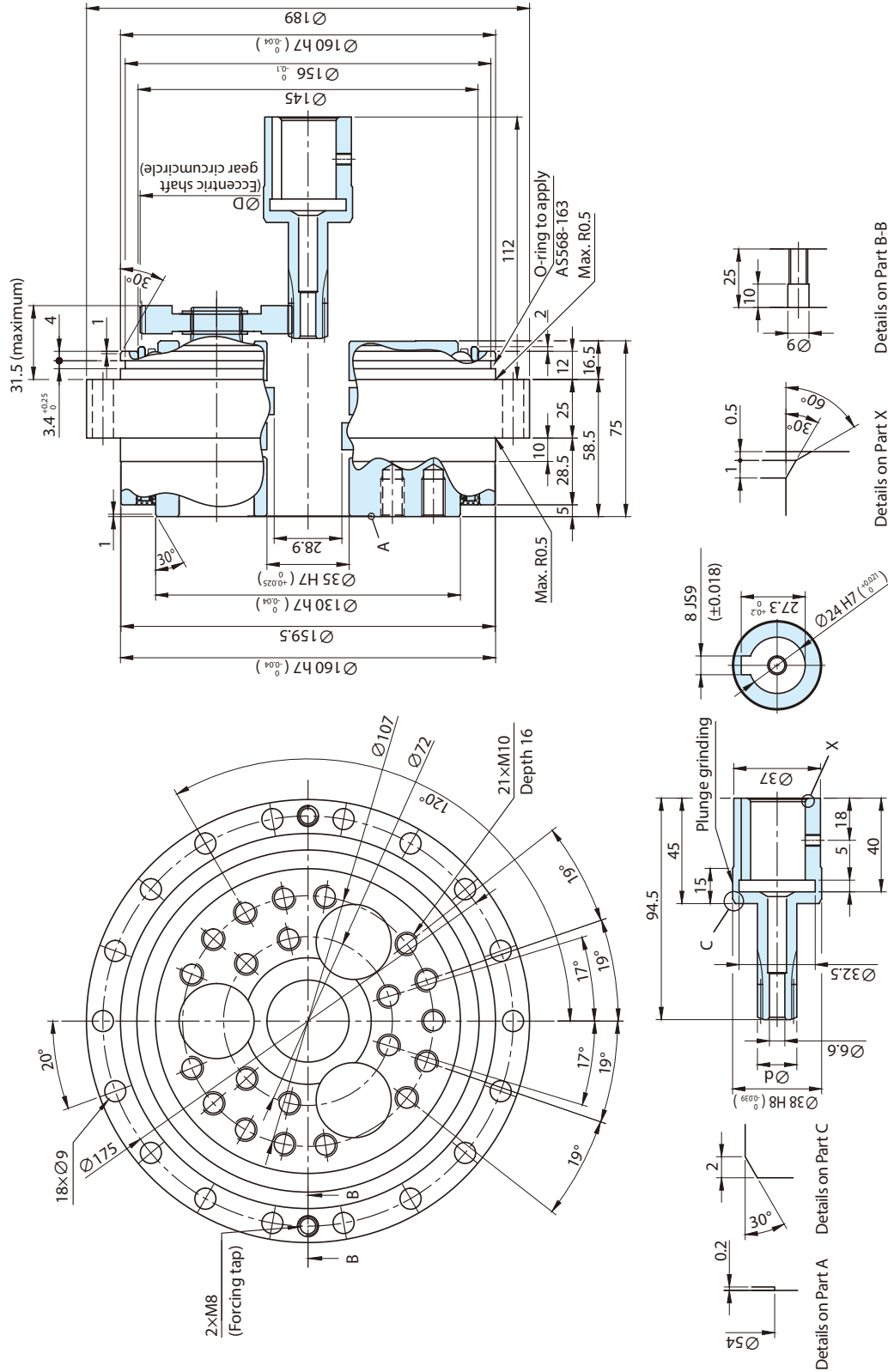


Reduction ratio	$\varnothing d$	$\varnothing D$
88	22.1	116.5
124	17.8	120.8
145	16.0	122.6
173	14.3	124.3

- Precautions**
1. Apply liquid gasket to the mounting surface with the gear reducer to prevent grease leak.
 2. Prepare bolts for mounting, washers, liquid gasket, O-ring, and grease for lubrication by customers. (See P.15 and 16)
 3. Note that the dimensions of the outline dimensions may be changed without notice to customers.
 4. No paint in the standard specification.

UA35 outline drawing

Mass 11kg



Details on Part X Details on Part B-B

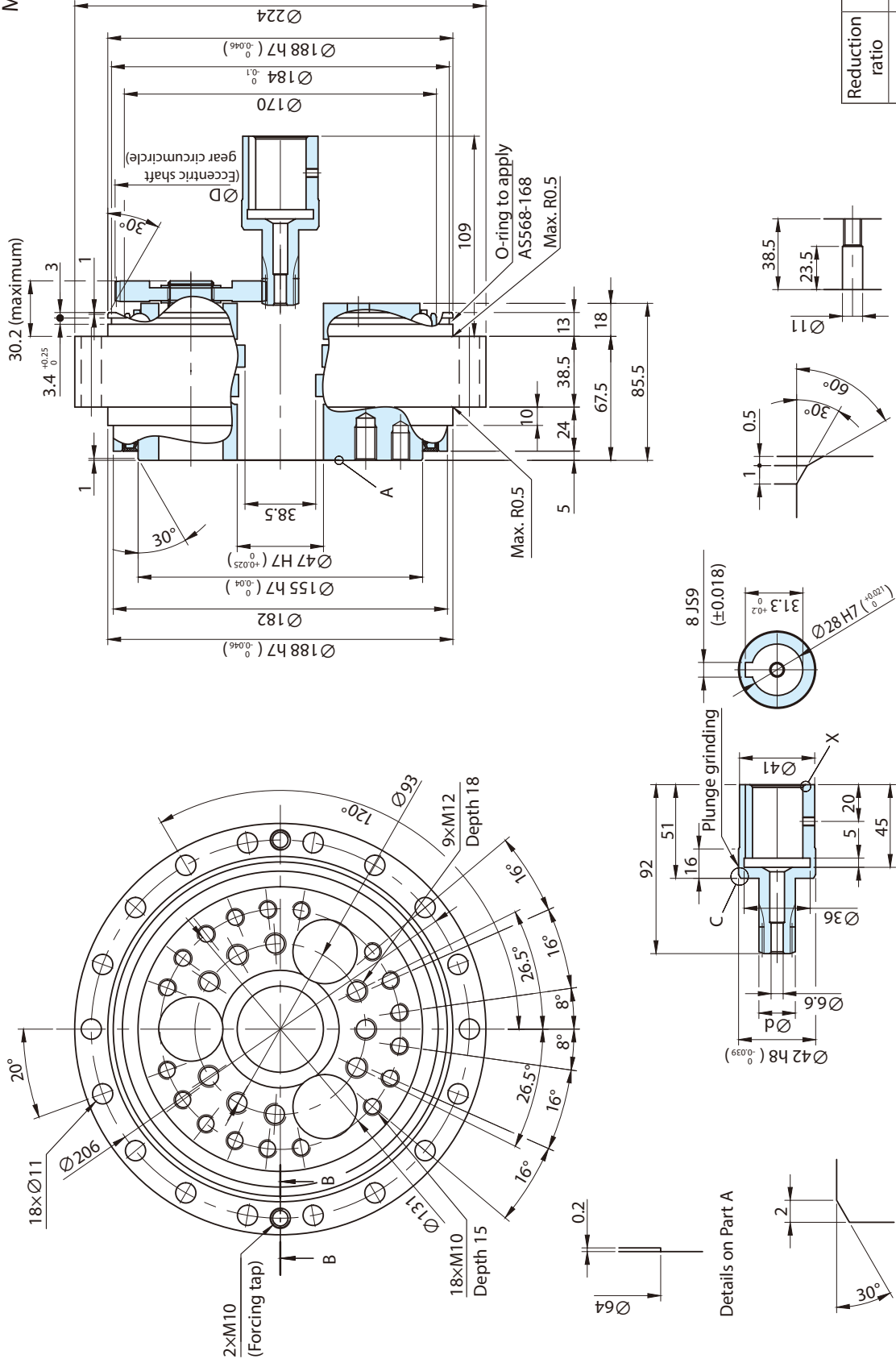
Details on the input shaft gear

Reduction ratio	Ø d	Ø D
87	25.6	134.4
121	20.8	139.2
152	17.8	142.2
166	16.8	143.2

- Precautions**
1. Apply liquid gasket to the mounting surface with the gear reducer to prevent grease leak.
 2. Prepare bolts for mounting, washers, liquid gasket, O-ring, and grease for lubrication by customers. (See P.15 and 16)
 3. Note that the dimensions of the outline dimensions may be changed without notice to customers.
 4. No paint in the standard specification.

UA45 outline drawing

Mass 17kg



Details on Part B-B

Details on Part X

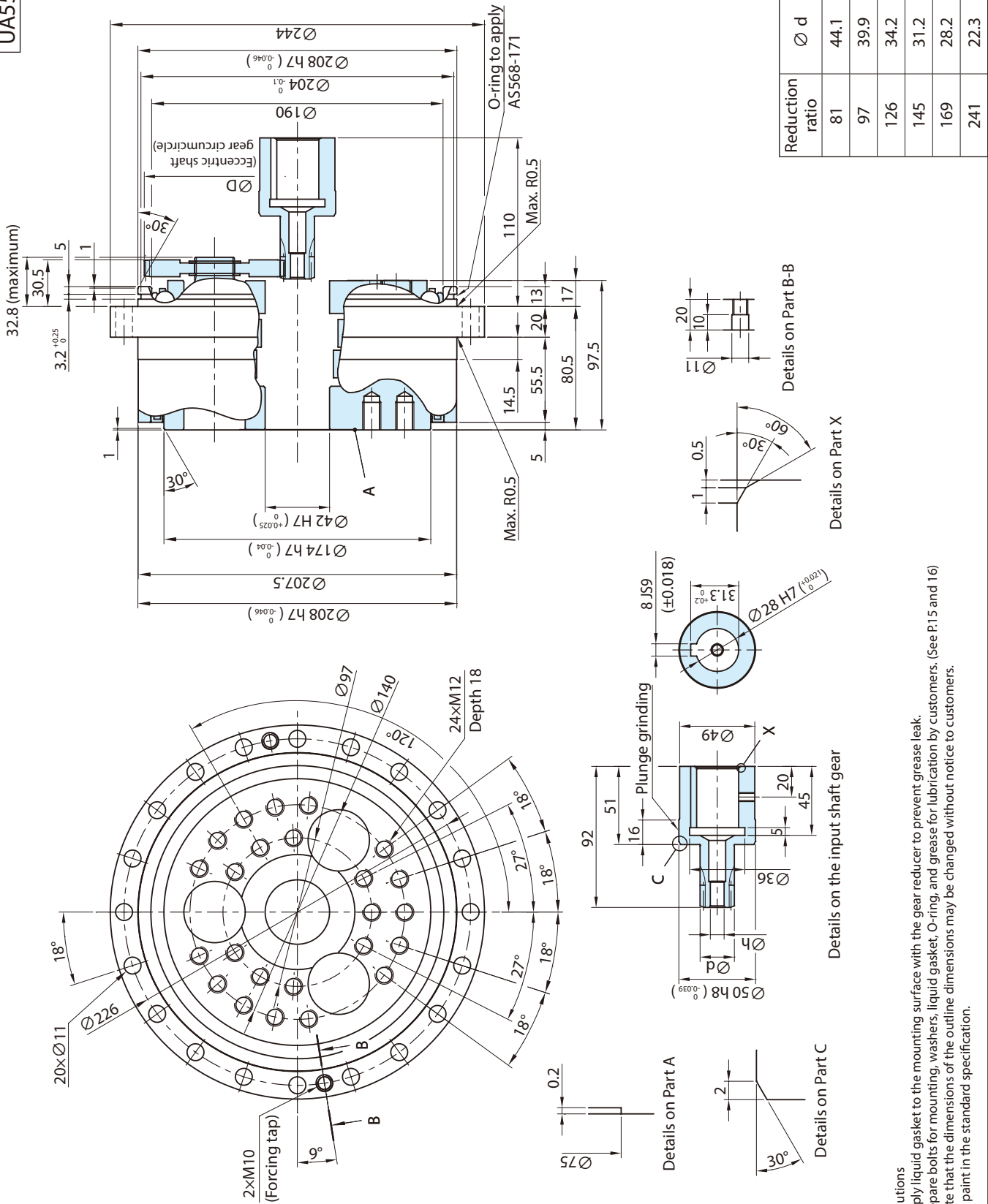
Details on the input shaft gear

Details on Part C

- Precautions**
1. Apply liquid gasket to the mounting surface with the gear reducer to prevent grease leak.
 2. Prepare bolts for mounting, washers, liquid gasket, O-ring, and grease for lubrication by customers. (See P.15 and 16)
 3. Note that the dimensions of the outline dimensions may be changed without notice to customers.
 4. No paint in the standard specification.

UA55 outline drawing

Mass 22kg

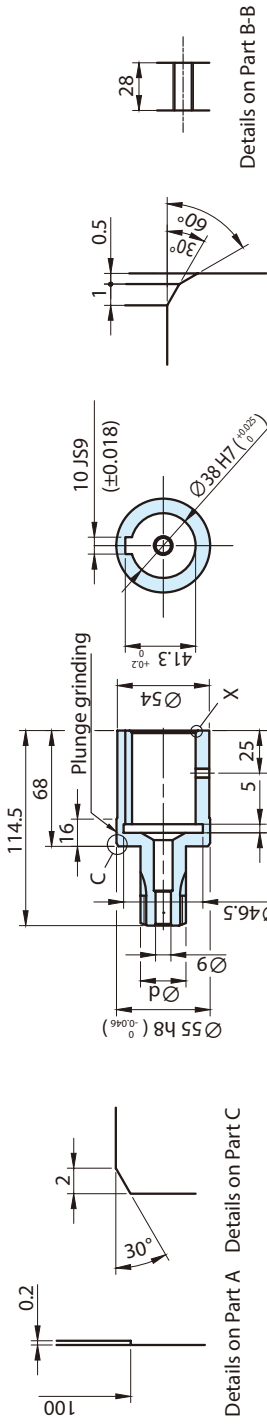
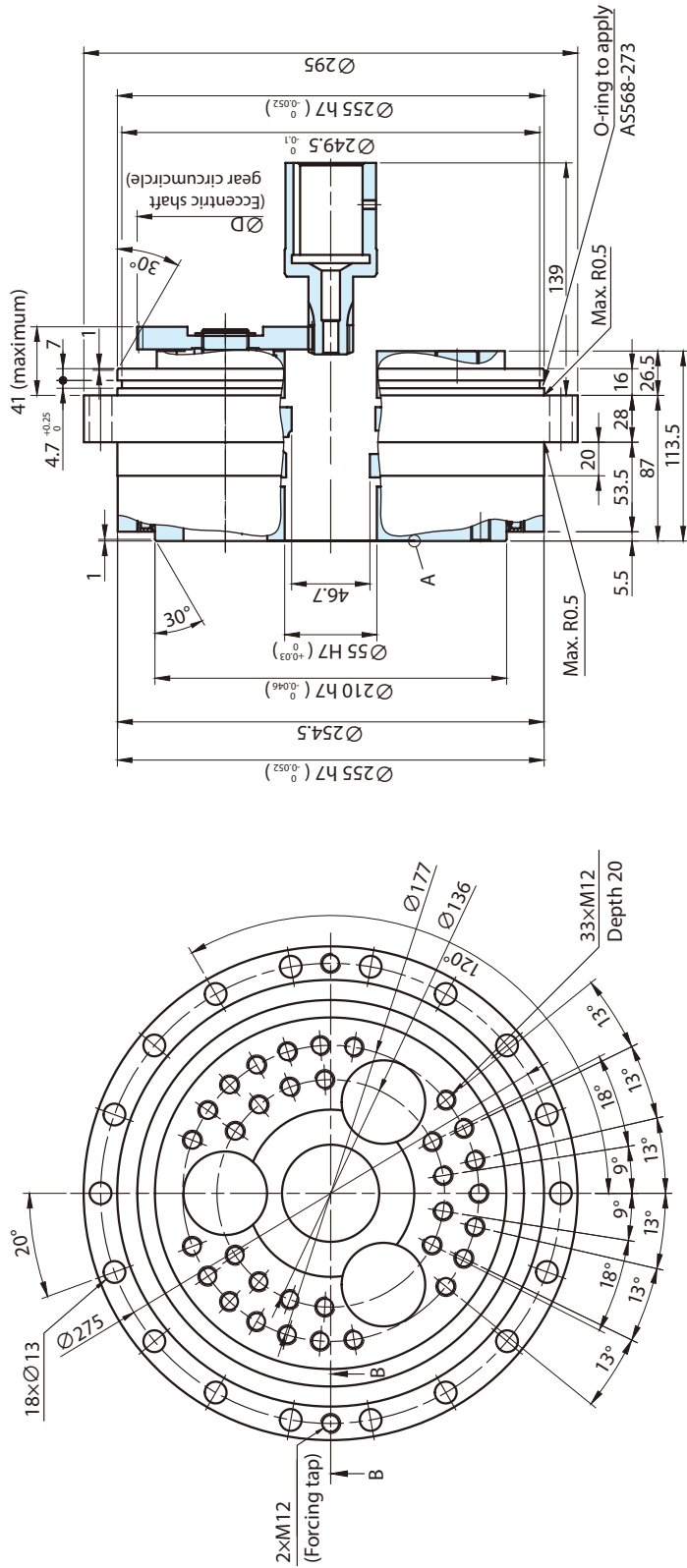


Reduction ratio	$\varnothing d$	$\varnothing h$	$\varnothing D$
81	44.1	9	177.9
97	39.9	9	182.1
126	34.2	9	187.8
145	31.2	9	190.8
169	28.2	9	193.8
241	22.3	6.6	199.7

- Precautions**
1. Apply liquid gasket to the mounting surface with the gear reducer to prevent grease leak.
 2. Prepare bolts for mounting, washers, liquid gasket, O-ring, and grease for lubrication by customers. (See P.15 and 16)
 3. Note that the dimensions of the outline dimensions may be changed without notice to customers.
 4. No paint in the standard specification.

UA65 outline drawing

Mass 38kg

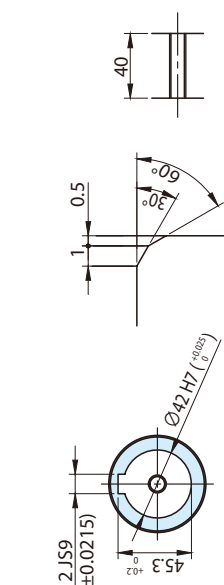
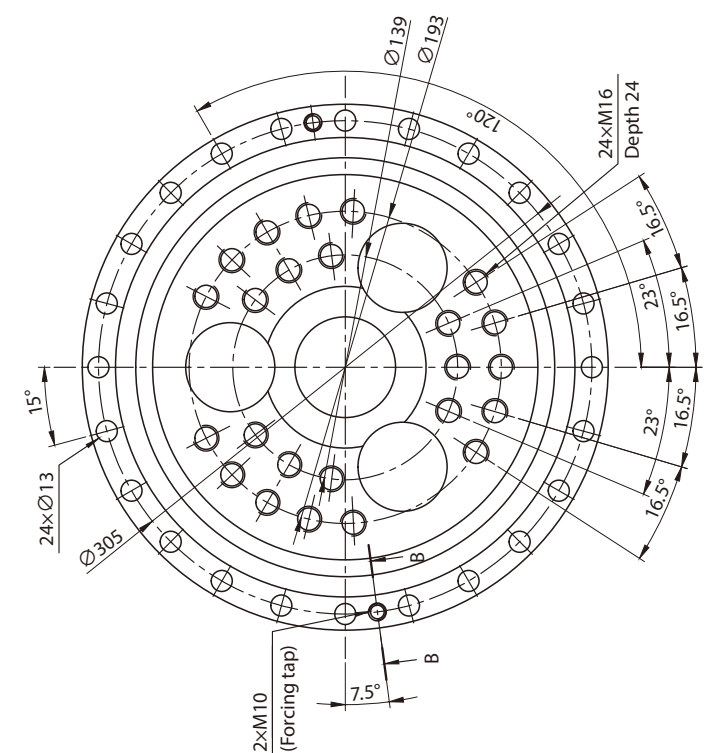
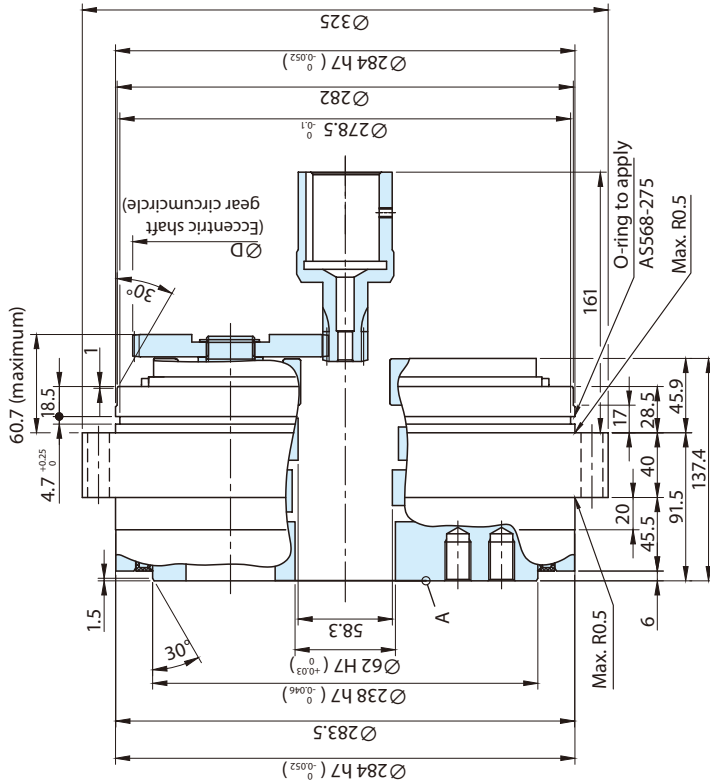


Reduction ratio	$\text{Ø} d$	$\text{Ø} D$
89	51.0	207.0
121	42.6	215.4
144	38.4	219.6
171	36.1	225.5
199	31.2	226.8
249	26.7	231.3

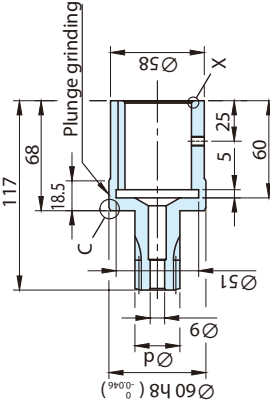
- Precautions**
1. Apply liquid gasket to the mounting surface with the gear reducer to prevent grease leak.
 2. Prepare bolts for mounting, washers, liquid gasket, O-ring, and grease for lubrication by customers. (See P.15 and 16)
 3. Note that the dimensions of the outline dimensions may be changed without notice to customers.
 4. No paint in the standard specification.

UA80 outline drawing

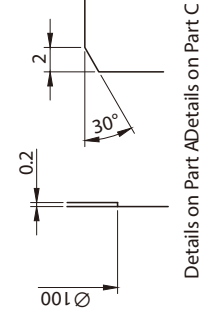
Mass 56kg



Details on Part X Details on Part B-B



Details on the input shaft gear



Details on Part A Details on Part C

Reduction ratio	Ø d	Ø D
103	53.2	237.3
122	48.3	242.2
155	41.3	249.2
190	36.4	254.1
239	31.1	259.4
283	27.8	262.7

- Precautions**
1. Apply liquid gasket to the mounting surface with the gear reducer to prevent grease leak.
 2. Prepare bolts for mounting, washers, liquid gasket, O-ring, and grease for lubrication by customers. (See P.15 and 16)
 3. Note that the dimensions of the outline dimensions may be changed without notice to customers.
 4. No paint in the standard specification.

14. Other

The specification shown in this document is based on our evaluation method. Evaluate the performance and durability in the condition of installation in the drive considering the field usage conditions, etc. and confirm that there is no problem, by yourself, before using this product.

Be sure not to perform disassembly, inspection, repair, and overhaul in cases of abnormalities of this product by yourself because they have to be performed by our skilled workers with special jigs and tools and expertise.

Note that the specifications and dimensions shown in this document may be changed without notice to customers.

Warranty standard

The scope of warranty of our delivered products is limited only to what we manufactured.

Warranty Period	The warranty period for the Products shall be 18 months after the commencement of delivery or 18 months after the shipment of the Products from the seller's works or 12 months from the Products coming into operation, whichever comes first.
Warranty Condition	In the event that any problem or damage to the Product arises during the "Warranty Period" from defects in the Product whenever the Product is properly installed and combined with the Buyer's equipment or machines, maintained as specified in the maintenance manual, and properly operated under the conditions described in the catalog or as otherwise agree upon in writing between the Seller and the Buyer or its customers; the Seller will provide, at its sole discretion, appropriate repair or replacement of the Product without charge at a designated facility, except as stipulated in the "Warranty Exclusions" as described below. However, if the Product is installed or integrated into the Buyer's equipment or machines, the Seller shall not reimburse the cost of : removal or re-installation of the Product or other incidental costs related thereto, any lost opportunity, any profit loss or other incidental or consequential losses or damages incurred by the Buyer or its customers.
Warranty Exclusions	Notwithstanding the above warranty, the warranty as set forth herein shall not apply to any problem or damage to the Product that is caused by : 1. installation, connection, combination or integration of the Product in or to the other equipment or machine that is rendered by any person or entity other than the Seller ; 2. insufficient maintenance or improper operation by the Buyer or its customers, such that the Product is not maintained in accordance with the maintenance manual provided or designated by the Seller ; 3. improper use or operation of the Product by the Buyer or its customers that is not informed to the Seller, including, without limitation, the Buyer's or its customers, operation of the Product not in conformity with the specifications, or use of lubricating oil in the Product that is not recommended by the Seller ; 4. any problem or damage on any equipment or machine to which the Product is installed, connected or combined or on any specifications particular to the Buyer or its customers ; 5. any changes, modifications, improvements or alterations to the Product or those functions that are rendered on the Product by any person or entity other than the Seller ; 6. any parts in the Product that are supplied or designated by the Buyer or its customers ; 7. earthquake, fire, flood, sea-breeze, gas, thunder, acts of God or any other reasons beyond the control of the Seller ; 8. normal wear and tear, or deterioration of the Product's parts, such as bearings, oil-seals ; 9. any other troubles, problems or damage to the Product that are not attributable to the Seller.

Safety Precautions

- Observe the safety rules necessary for the installation location and device in use.
(Ordinance on Industrial Safety and Health, facility's electrical codes, interior wiring code, plant explosion proofing guide, Building Standards Act, etc.)
- Select the product suitable for your operating environment and purpose.
- If you use the product for any devices for which a breakdown of the product is expected to cause a great loss of human life or facility such as systems for human transport, hoisting equipment, etc., install a protection device in the device side for safety.
- When the unit is used in food processing applications, machines for cleanroom and so on, vulnerable to oil contamination, install an oil pan or other such device to cope with oil leakage due to breakdown or failure;