Sumitomo Drive Technologies

Fine Cyclo

Backlash-free precision gearboxes

Catalogue 991369 EN 07/2019

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Fine Cyclo series

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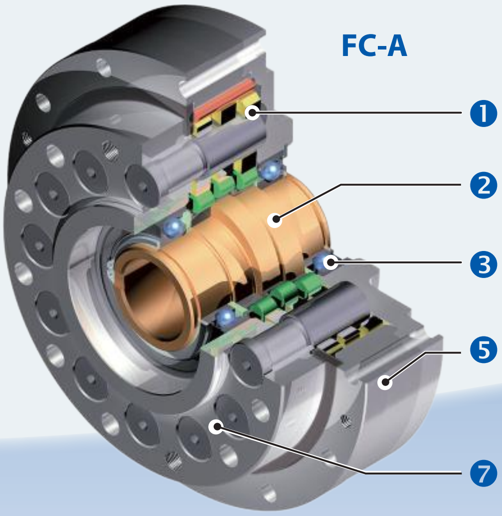
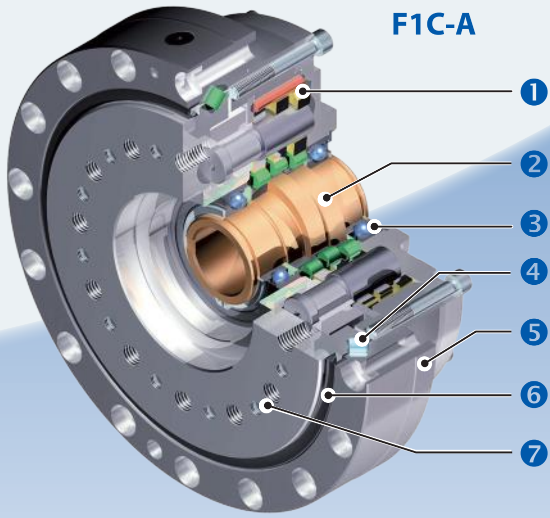
1 The Fine Cyclo reducer

A Series

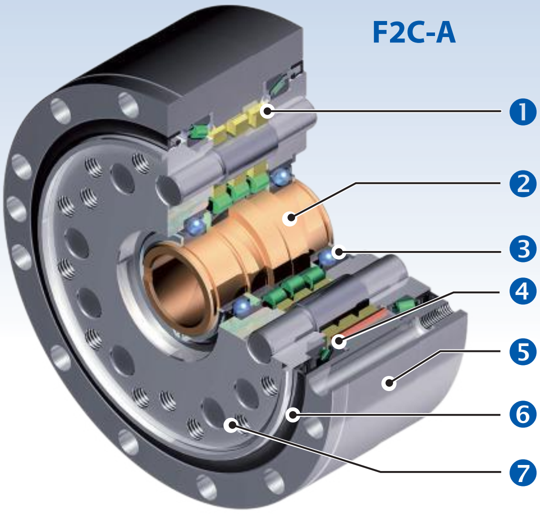
FC-A



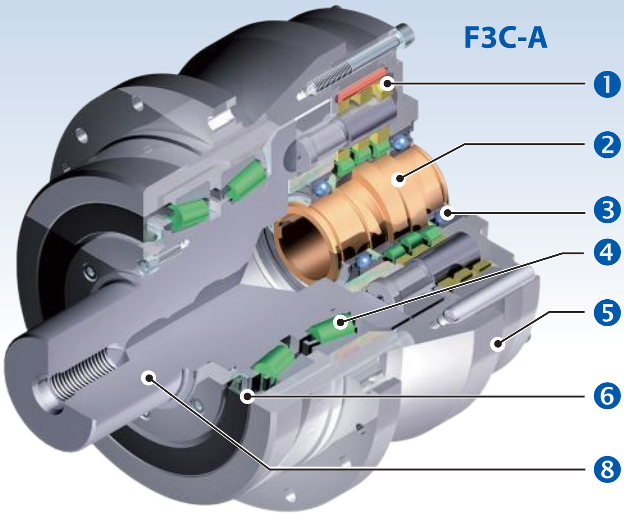
F1C-A



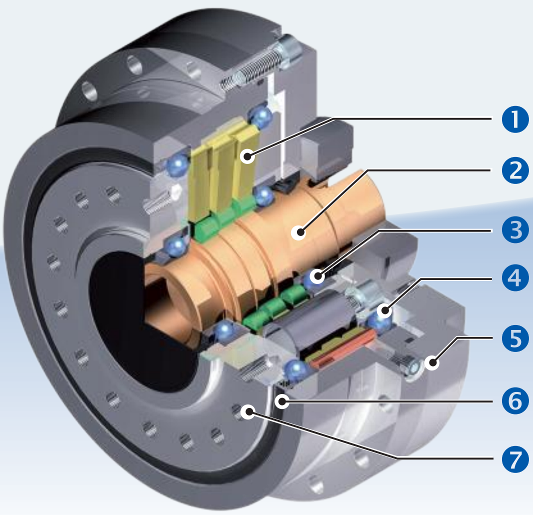
F2C-A



F3C-A

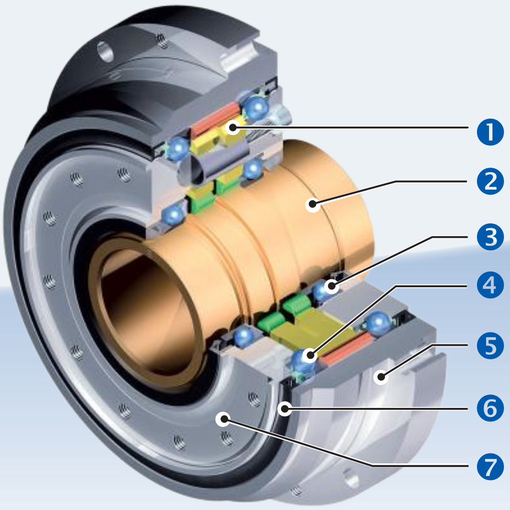


D Series

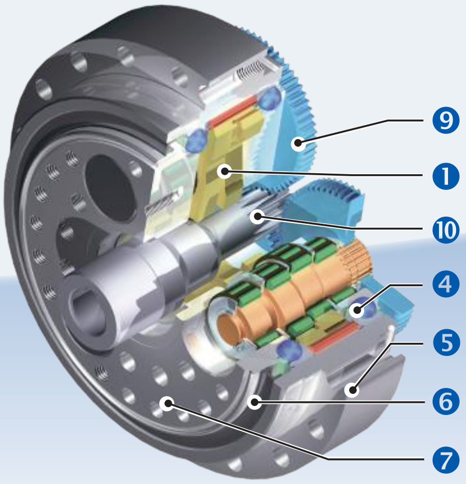


1. Cycloid disc
2. Eccentric input shaft
3. Input shaft bearing
4. Main Bearings
5. Ring gear (housing)
6. Oil seal output side
7. Output flange
8. Output shaft

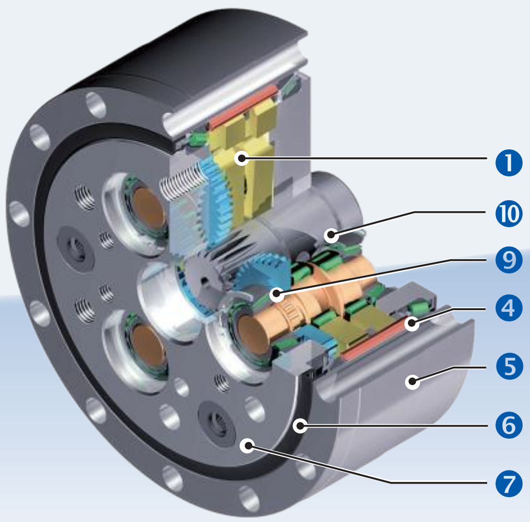
C Series



UA Series



T Series



1. Cycloid disc
2. Eccentric input shaft
3. Input shaft bearing
4. Main Bearings
5. Ring gear (housing)
6. Oil seal output side
7. Output flange
8. Output shaft
9. planetary gears
10. input shaft with spur gear

1.1 Operating principle - Series A, D, and C

The gearbox of the Fine Cyclo series is fundamentally different in principle and function from the helical gearing of competitors' gearmotors. This unique reduction gearbox is an ingenious combination of the following two mechanisms:

- A planetary gear and a fixed internal sun gear (hollow gear). On the Fine Cyclo, the planetary gear has cycloidal cam motion (cycloid disc), and the fixed sun gear has a circular arrangement of ring gear pins. The fixed sun gear has one or two "teeth" more than the "planetary gear" (cycloid disc).
- A spline for constant speed.

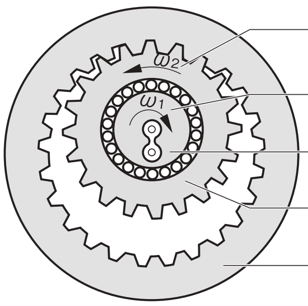


Fig. 1 Principle of the internal planetary gearbox

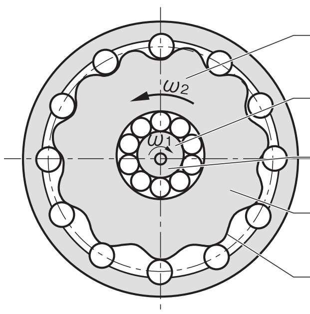


Fig. 2 Epitrochoidal planetary gear, circular arrangement of ring gear pins (PIN) combination

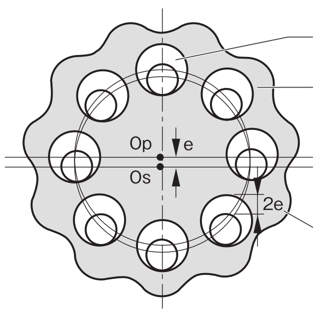


Fig. 3 Internal gearing for constant speed

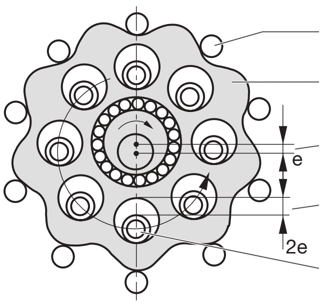


Fig. 4 Planetary sun gear combination and internal gearing for constant speed

In Equation 1 below, P identifies the number of the planetary gear teeth, S that of the sun gear, and ω2 the angular velocity of the planetary gear about its own axis (see Fig. 1). The speed ratio of ω2 to ω1 is represented as follows:

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

The highest velocity ratio is obtained with S greater than P by one or two in this equation.

That is to say, if S−P=1 is applied to Equation 1, the velocity ratio may be calculated using the following equation:

Equation 2 $$\frac{\omega 2}{\omega 1} = -\frac{1}{P}$$

If, on the other hand, S−P=2 is applied to Equation 1, the velocity ratio may be calculated using the following equation:

Equation 3 $$\frac{\omega 2}{\omega 1} = -\frac{2}{P}$$

As the crankshaft rotates at the angular velocity ω1 around the axis of the sun gear, the planetary gear also rotates at the angular velocity:

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

P indicates the number of teeth of the planetary gear and the symbol indicates that the planetary gear rotates in a reverse direction to that of the crankshaft (eccentric).

As shown in Fig. 2, the Fine Cyclo circular teeth (pins) are adapted to the sun gear and the trochoidal teeth to the planetary gear, thereby avoiding mutual obstruction of the spline.

The rotation of the planetary gear around its own axis is caused by a constant speed internal gearing mechanism as shown (see Fig. 4).

In this mechanism, shown in Fig. 4 the pins of the output shaft are evenly spaced on a circle that is concentric to the axis of the sun gear. The pins transmit the rotation of the planetary gear by rolling internally around the circumference of the bores of each planetary 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 crankshaft (eccentric).
This mechanism smoothly transmits the rotation of the planetary gear around its own axis to the output shaft.

1.2 Operating principle Series UA and T

The Series UA and T gearboxes are double-stage and differ from the single-stage series by having 3 eccentric discs (cycloid disc), driven by the input shaft with spur teeth. The cycloid discs are driven via 3 eccentric shafts and not directly by one eccentric input shaft.
The pins and the eccentric shafts in the output shaft are evenly spaced on a circle, which is concentric with the axis of the sun gear. The pins transmit the rotation of the planetary gear by rolling internally around the circumference of the bores of each planetary gear or cycloid disc.

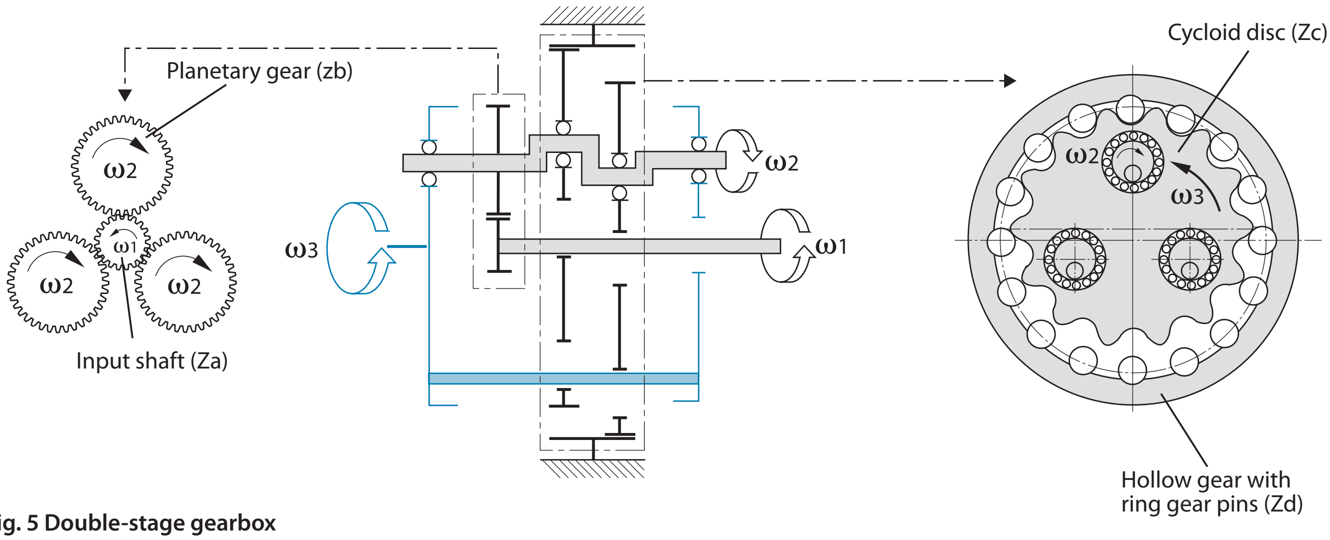


Fig. 5 Double-stage gearbox

If the input shaft rotates with a speed ω1, then the angular velocity of the planetary gear around its own axis is ω2.
If the eccentric shaft rotates with a rotational speed ω2 and the hollow gear is fixed, then the angular velocity of the cycloid discs about their own axis is ω3.
Z is the number of teeth or the number of curve traces or ring gear pins.

Equation 1 $\omega 2 = \frac{Za}{Zb} (\omega 3 - \omega 1) + \omega 3$

Equation 2 $\omega 3 = \left(1 - \frac{Zd}{Zc}\right) \cdot \omega 2$

Partial reduction ratio when the angular velocity of the eccentric shaft gear around the input shaft is equal to 0:

Equation 3 $i1 = \frac{Zb}{Za}$

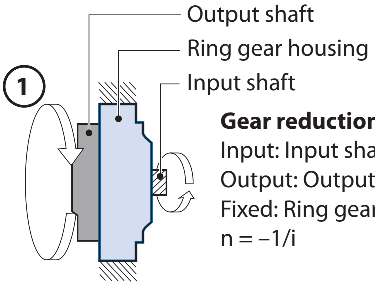
Partial reduction ratio of the trochoid gearing:

Equation 4 $i2 = \frac{Zc}{(Zc - Zd)}$

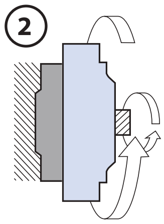
Equation 5 $i = 1 + i1 \cdot (1 - i2)$

Total reduction ratio $i = \omega 1 / \omega 3$

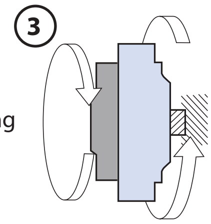
1.3 Speed ratio and rotation direction - Series A, D, and C



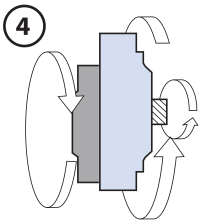
Gear reduction
Input: Input shaft
Output: Output shaft
Fixed: Ring gear housing
n = –1/i



Gear reduction
Input: Input shaft
Output: Ring gear housing
Fixed: Output shaft
n = 1/i+1



Gear reduction
Input: Output shaft
Output: Ring gear housing
Fixed: Input shaft
n= -i/(i-1)

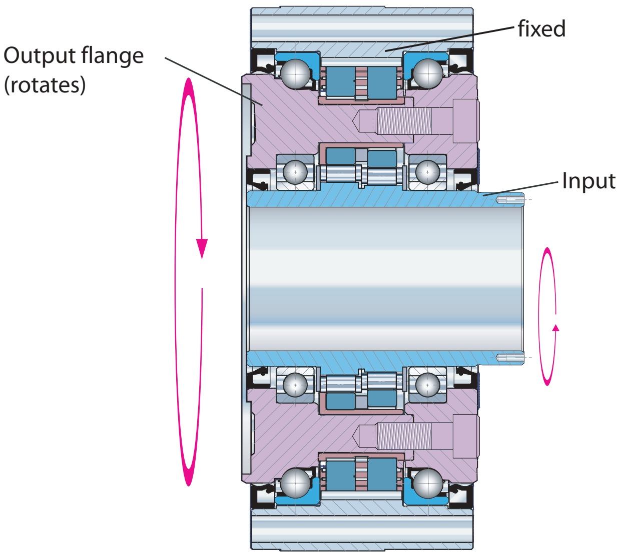


When all elements rotate at the same time, the speed ratio consists of a combination of the representations ① to ③.

n = Speed ratio = (output speed/input speed)
("–" indicates the possible opposite direction)

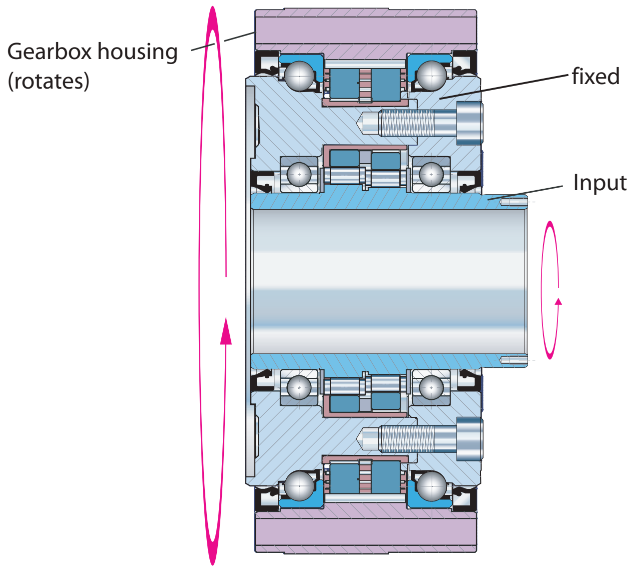
i = reduction ratio

Output flange rotates



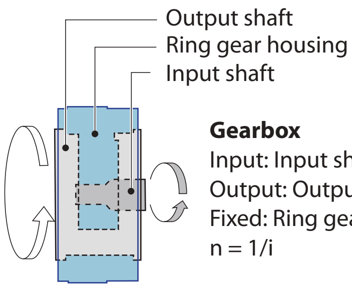
Catalogue reduction

Gearbox housing rotates

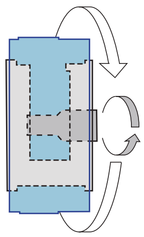


Catalogue gear reduction +1

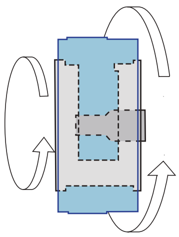
1.4 Speed ratio and direction of rotation Series T and UA



Gearbox
Input: Input shaft
Output: Output shaft
Fixed: Ring gear housing
n = 1/i



Gearbox
Input: Input shaft
Output: Ring gear housing
Fixed: Output shaft
n = -1/i+1



Speed increase ratio
Input: Output shaft
Output: Ring gear housing
Fixed: Input shaft
n = i/(i–1)

1.5 Features and advantages

Compact design

The high reduction ratios, in one or a maximum of two stages, allow for extremely compact designs with a long lifetime. Moreover, due to the different versions available, these gearboxes can be optimally integrated into the machine environment.

Simple installation

The A, D and C Series gearboxes are lubricated for life in the factory, are completely sealed, and maintenance-free. Convenient and simple motor mounting is also taken account of in all ranges.

Precise positioning

In more and more applications, high cycle speed and precise positioning are required in order to increase the efficiency of machines, or to develop new applications. The special Cycloid systems of the Fine Cyclos offer high-precision positioning with maximum dynamics.

Precision gearbox with large hollow shaft bore and high capacity bearing

The C Series gearbox was specifically developed with an extra large hollow shaft bore through which supply lines, shafts, and other media can be passed. The integrated bearing can handle high loads on the output side that may arise when using machine tools, positioning, or during robotics applications.

The right size for every application

The wide range of gearbox series and the many size gradations within each series enable selection of the right gearbox for any precision application.

Gearboxes with external diameters ranging from 115 mm to 570 mm are available. With these, a range of acceleration torques from below 100 Nm up to 30,000 Nm can be covered.

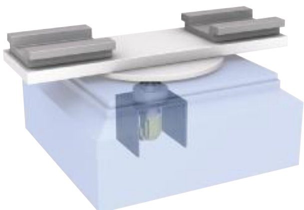
In the event that the emergency stop function is activated, this precision gearbox can even be safely subjected to a load up to 60,000 Nm.

High torsional stiffness and low mass moments of inertia

For these application areas, Sumitomo Drive Technologies has developed highly accurate series of backlash-free precision gearboxes. Compared with conventional gearboxes, the construction principle offers the highest torsional stiffness as well as low mass moments of inertia - ideal for highly dynamic tasks.

1.6 Application Examples

Axle drive for industrial robot



Pallet changer drive

Welding positioner

Machine tool
Automatic pallet pool input

Palletising robot

Liquid crystal transfer robot

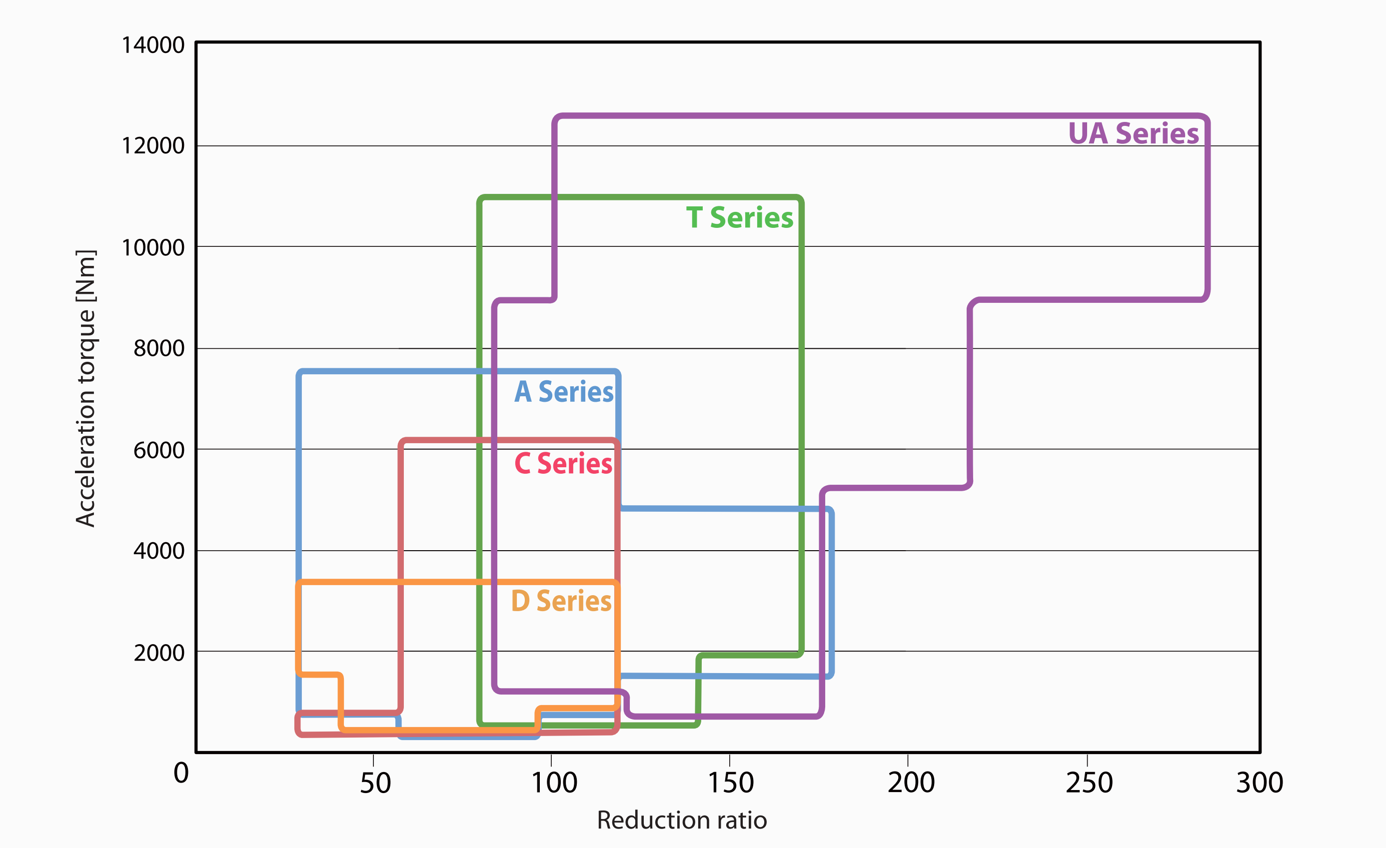
2 Nomenclature

F	2	C	F		–	A35	–	59

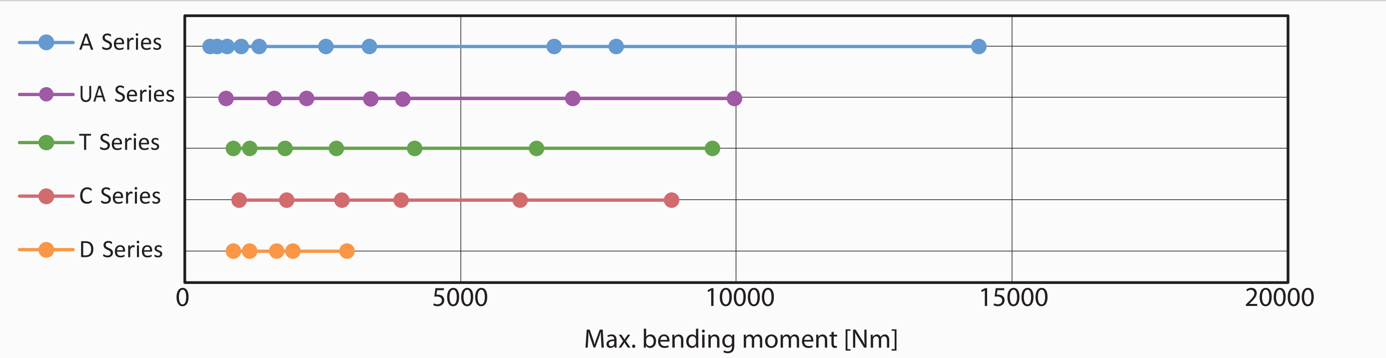
- **59**: Reduction ratio
- **A35**: Series and size
- Standard version: –
  Special version: S
- **F**: Shape of ring gear housing:
  - Cylindrical –
  - Flange F
- **C**: Symbol for Cyclo
- **2**: Bearing:
  - without output side bearing: –
  - integrated cross roller bearing: 1
  - integrated tapered roller bearing: 2
  - tapered roller bearings and output shaft: 3
  - integrated angular ball bearings: 4
- **F**: Symbol for Fine

3 Gearbox selection

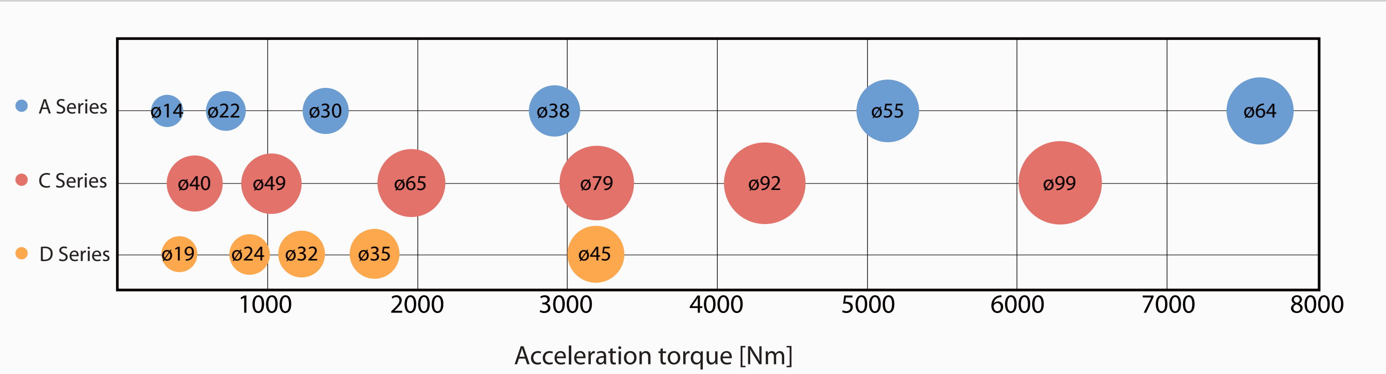
3.1 Reduction ratio and acceleration torque



3.2 Max. bending moment on the output flange



3.3 Max. hollow shaft diameter



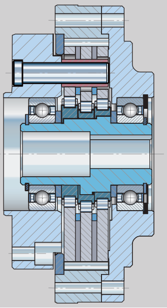
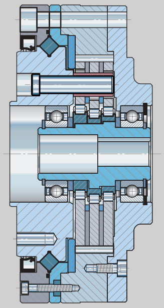
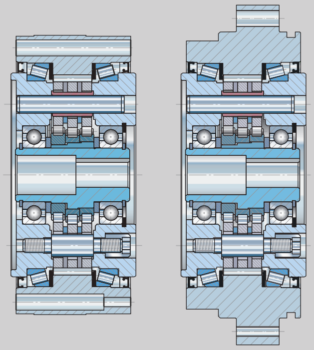
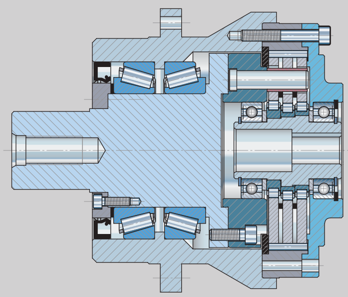
3.4 Reduction ratio and outer diameter

A Series

Available as either a reduction kit without an output side bearing as well as fully sealed versions or a gearbox with output shaft instead of output flange are available.

Special feature: Both a reduction kit without an output side bearing as well as fully sealed versions and a gearbox with output shaft instead of output flange are available.

Optional: Available with motor adapter, customer-specific input shaft, or output flange and other modifications.

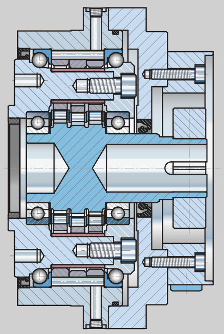
Model		Size	Available single-stage reduction ratios					Outer-Ø flange	Outer-Ø cylinder	Max. hollow shaftØ
			29	59	89	119	179			
FC-		A15G		•	•				115	14
		A25G	•	•	•	•			145	22
		A35G	•	•	•	•			180	30
		A45G	•	•	•	•	•		220	38
		A65G	•	•	•	•	•		270	55
		A75G	•	•	•	•			310	64
F1C-		A15		•	•				140	14
		A25	•	•	•	•			170	22
		A35	•	•	•	•			205	30
		A45G	•	•	•	•	•		265	38
		A65G	•	•	•	•	•		350	55
		A75G	•	•	•	•			430	64
F2C(F)-		A15		•	•			145	126	14
		A25	•	•	•	•		190	156	22
		A35	•	•	•	•		222	186	30
		A45	•	•	•	•	•	256	231	38
F3C-		A15G		•	•				140	
		A25G	•	•	•	•			170	
		A35G	•	•	•	•			200	
		A45G	•	•	•	•	•		250	
		A65G	•	•	•	•	•		300	
		A75G	•	•	•	•			350	

•: available reduction ratio

D Series

Special feature: The gearboxes are supplied with matching clamp ring adapter and motor flange.

Optional: The gearboxes can also be purchased with other mounting options, or without customer-specific flange.

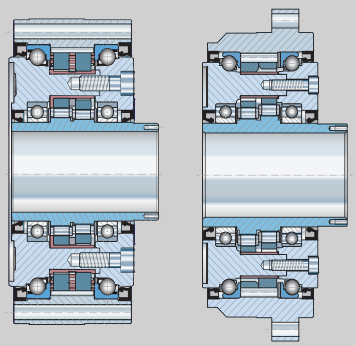
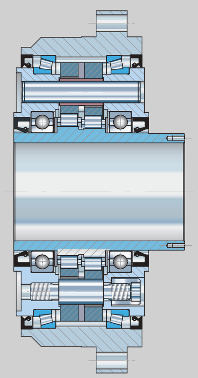
Model		Size	Available single-stage reduction ratios					Outer-Ø flange	Outer-Ø cylinder	Max. hollow shaftØ
			29	41	59	89	119			
F4CF-		D15		•	•	•		145	CF	19
		D25		•	•	•	•	169	CF	24
		D30			•	•	•	187	CF	32
		D35	•		•	•	•	204	CF	35
		D45	•		•	•	•	256	CF	45

•: available reduction ratio; CF = consult factory

C Series

Special feature: The large diameter of the hollow shaft allows for effective use of space for cable or media feed-through.

Optional: Customer-specific customisation of input shaft, output flange, and housing possible.

Model		Size	Available single-stage reduction ratios				Outer-Ø flange	Outer-Ø cylinder	Standard hollow shaftØ
			29	59	89	119			
F4C(F)-		C15	•	•	•	•	CF	160	40
		C25		•	•	•	CF	185	49
		C35		•	•	•	256	CF	65
F2CF-		C45		•	•	•	292	CF	79
		C55		•	•	•	325	CF	92
		C65		•	•	•	362	CF	99

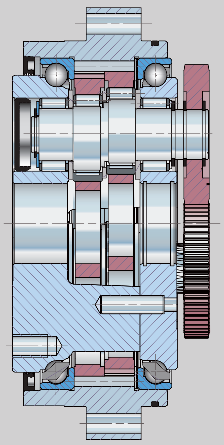
•: available reduction ratio; CF = consult factory

UA Series

Recommended for: Pallet changers, bending heads, tool changers, disc magazines, chain magazines and tilting tables.

Special feature: Upstream spur gear prestage, gearboxes with high positioning and path accuracy, even under highly fluctuating dynamic conditions.

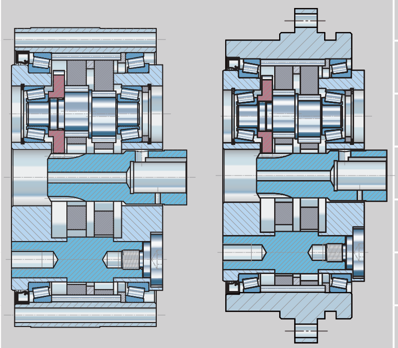
Optional: Motor mounting available on request.

Model		Size	Available double stage reduction ratios				Outer-Ø flange	Outer-Ø cylinder	Max. hollow shaft Ø with keyway (clamp ring design on request)
			50 – 99	100 -149	150 -199	200 -300			
F4CF-		UA15	60 84	91 127	139 171		133	90	28
		UA25	78 88	115 124 145	173		165	110	28
		UA35	82 87	121	152 166		189	130	38
		UA45	82 99	121 130	152 166		224	155	38
		UA55	81 97	126 145	169	241	244	174	42
F2CF-		UA65	89	121 136	155 166 190	239 283	295	210	42
		UA80	93	103 122	155 166 190	239 283	325	238	42

T Series

Special feature: High positioning and path accuracy, even under highly fluctuating dynamic conditions.

Optional: Fitting of motors without key with clamp ring design possible.

Model		Size	Available double stage reduction ratios				Outer-Ø flange	Outer-Ø cylinder	Max. motor shaft Ø with keyway (clamp ring design on request)
			81	118.5	141	171			
F2C(F)-		T155	•	•	•		145	126	14
		T255	•	•	•		190	156	17
		T355	•	•	•		222	186	22
		T455	•	•	•	•	256	231	28
		T555	•	•	•	•	292	261	28
		T655	•	•	•	•	325	296	35
		T755	•	•	•	•	370	331	35

•: available reduction ratio

3.5 Torques and speeds

Maximum permissible input speed $n_{1\ ED}$.
The gearbox can be used within the maximum input speed range indicated in the table however, the max. permissible mean input speed is limited by the duty cycle (%ED).

Model	Size	Reduction ratio i	Max. permissible input speed $n_{1\ ED}$ [min^{-1}] 50% ED	Max. permissible input speed $n_{1\ ED}$ [min^{-1}] 100% ED	Max. acceleration torque [Nm]	Max. torque for Emergency Stop
A Series						
FC- F1C- F2C- F3C-	A15(G)	59 / 89	5600	2800	335	785
	A25(G)	29	3100	1550	721	1930
		59 / 89 / 119	4200	2100	721	1930
	A35(G)	29	2500	1250	1390	3580
		59 / 89 / 119	3300	1650	1390	3580
	A45(G)	29	1900	950	2910	7210
		59 / 89 / 119 / 179	2600	1300	2910	7210
	A65(G)	29	1500	750	5130	13800
		59 / 89 / 119 / 179	2000	1000	5130	13800
	A75(G)	29	1200	600	7610	24000
		59 / 89 / 119	1750	850	7610	24000
D Series						
F4CF-	D15	41	4700	2350	417	834
		59 / 89	5600	2800	417	834
	D25	41	3860	1930	883	1766
		59 / 89 / 119	4200	2100	883	1766
	D30	59 / 89 / 119	3800	1900	1226	2453
	D35	29	2960	1480	1393	3581
		59 / 89 / 119	3300	1650	1717	3581
	D45	29	2240	1120	2914	5827
		59 / 89 / 119	2600	1300	3188	6377
C Series						
F4C(F)-	C15	29	2400	1200	540	1080
		59 / 89 / 119	3200	1600	540	1080
	C25	59 / 89 / 119	2900	1450	1030	2060
	C35	59 / 89 / 119	2100	1050	1962	3924
F2CF-	C45	59 / 89 / 119	1800	900	3188	6377
	C55	59 / 89 / 119	1500	750	4316	8633
	C65	59 / 89 / 119	1400	700	6278	12577

Model	Size	Reduction ratio i	Max. permissible output speed $n_{2\ max}$ [min^{-1}]	Max. acceleration torque [Nm]	Max. torque for Emergency Stop
UA Series					
F4CF-	UA15	60 / 84 / 91 / 127 / 139 / 171	60	625	1250
	UA25	78 / 88 / 115 / 124 / 145 / 173	50	1250	2500
	UA35	82 / 87 / 121 / 152 / 166	40	2250	4500
	UA45	82 / 99 / 121 / 130 / 152 / 166	30	3300	6600
	UA55	81 / 97 / 126 / 145 / 169 / 241	30	5000	10000
F2CF-	UA65	89 / 121 / 136 / 144 / 163 / 171 / 199 / 249	30	8575	17150
	UA80	93 / 103 / 122 / 155 / 166 / 190 / 239 / 283	25	12500	25000
T Series					
F2C(F)-	T155	81 / 118.5 / 141	60	417	834
	T255	81 / 118.5 / 141	50	1030	2060
	T355	81 / 118.5 / 141	40	1960	3920
	T455	81 / 118.5 / 141 / 171	30	3190	6380
	T555	81 / 118.5 / 141 / 171	30	4910	9820
	T655	81 / 118.5 / 141 / 171	25	7850	15700
	T755	81 / 118.5 / 141 / 171	25	11000	22000

3.6 Flow chart and equation of selection

Sumitomo Drive Technologies would be happy to take over the selection and calculation process for you. Please refer to the application data sheet in the appendix.

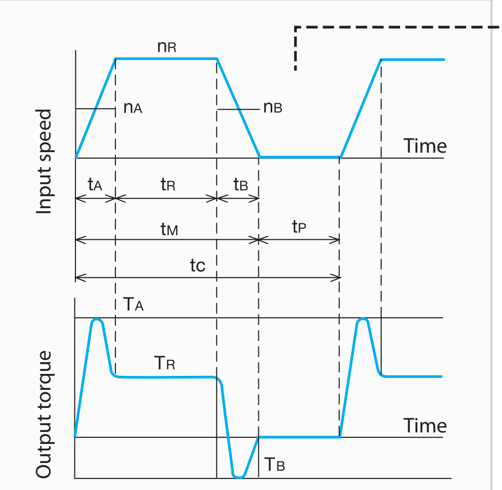
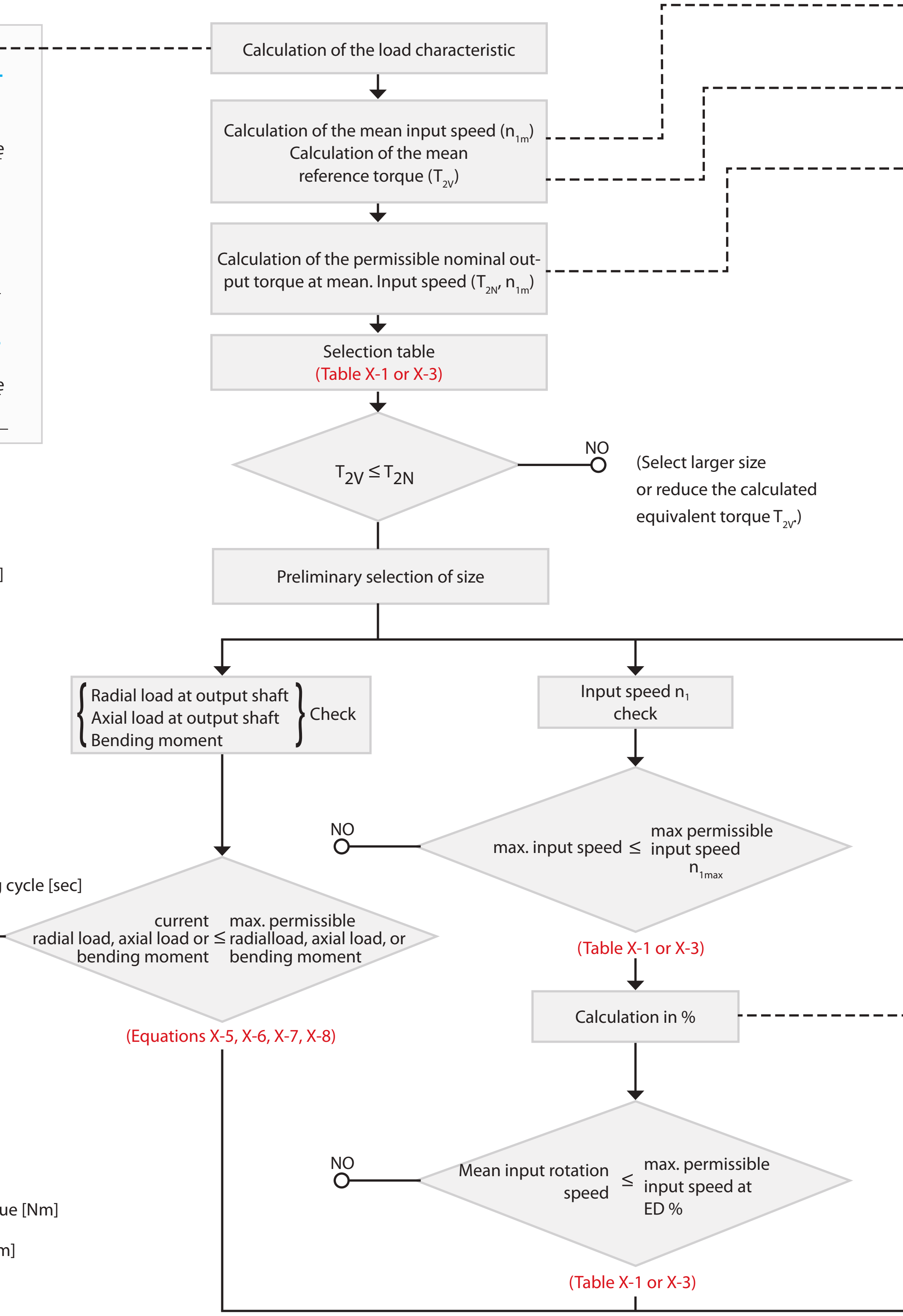


Fig. 6 Load cycle



n_{1A}: Mean input speed during start-up [min^{-1}]

as per **Fig. 6** $\quad n_{1A} = \frac{n_{1R}}{2}$

n_{1R}: Input speed during uniform movement [min^{-1}]

n_{1B}: Mean Input speed during braking [min^{-1}]

as per **Fig. 6** $\quad n_{1B} = \frac{n_{1R}}{2}$

n_{1m} : Mean input speed [min^{-1}]

t : Time [sec.]

t_A : Run-up time [sec.]

t_R : Duration of uniform movement [sec.]

t_B : Braking time [sec.]

t_M : Duration of the movement phase of a working cycle [sec]

t_P : Duration of pauses [sec.]

t_C : Duration of a working cycle [sec.]

T_{2A}: Output side acceleration torque [Nm]

T_{2R}: Output torque at constant speed [Nm]

T_{2B}: Output side braking torque [Nm]

T_{2V}: Reference torque [Nm]

T_{2N}: Nominal output torque [Nm]

$T_{2N\,max}$: Maximum permissible nominal output torque [Nm]

$T_{2N\,600}$: Nominal output torque at n_1 = 600 min^{-1} [Nm]

B_{f2} : Service factor output

ED: Duty cycle %

The tables and equations relating to the references marked red are located in the respective sections covering the series (A, D, C, and T):

	Page number				
	Series:				
	A	D	C	UA	T
Table X-1	p. 24	p. 60	p. 78	p. 96	p. 120
Table X-2	p. 24	p. 60	p. 78	p. 96	p. 120
Table X-3	p. 26	p. 62	p. 80	p. 100	p. 122

	Page number				
	Series:				
	A	D	C	UA	T
Equation X-1	p. 31	p. 67	p. 85	-	-
Equation X-5	from p. 33	p. 69	p. 87	p. 107	p. 127
Equation X-6,7	from p. 33	p. 69	p. 87	p. 107	p. 127
Equation X-8	from p. 33	p. 69	p. 87	p. 107	p. 127

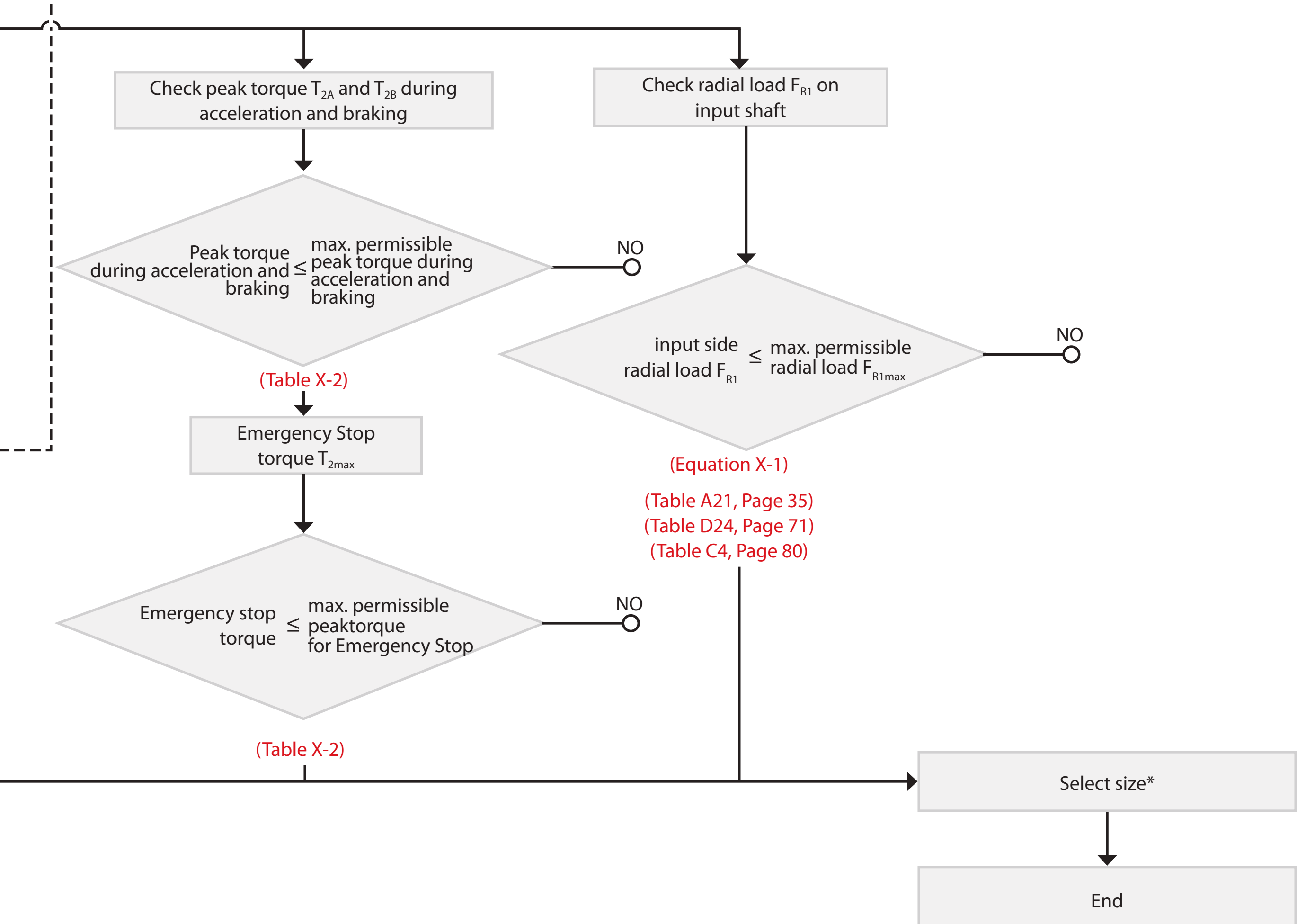
Calculation in load condition as per Fig. 6

Mean input speed	$n_{1m} = \left(\frac{t_A \cdot n_{1A} + t_R \cdot n_{1R} + t_B \cdot n_{1B}}{t_M}\right)$	(Equation - 8)
Mean reference torque	$T_{2V} = \left(\frac{t_A \cdot n_{1A} \cdot T_{2A}^{3} + t_R \cdot n_{1R} \cdot T_{2R}^{3} + t_B \cdot n_{1B} \cdot T_{2B}^{3}}{t_M \cdot n_{1m}}\right)^{1/3} \cdot B_{f(1/1.1/1.6/2)}$	(Equation - 9)
Max. permissible nominal output torque at mean input speed	$T_{2N\,max} = T_{2N,600} \cdot \left(\frac{600}{n_{1m}}\right)^{0.3}$ For single-stage gearboxes; $T_{2N} = T_{2N,15} \cdot \left(\frac{15}{n_{2m}}\right)^{0.3}$ For double-stage gearboxes	(Equation -10)
ED %	$ED\,\% = \left(\frac{t_m}{t_c}\right) \cdot 100\,[\%] = \left(\frac{t_c - t_p}{t_c}\right) \cdot 100\,[\%]$	(Equation -11)

$T_{2N,600}$: Nominal output torque at an input speed of 600 min^{-1} (Table X-3)

Please note the instructions on duty cycle in chapter 4.

If $n_{1m} < 600$ min^{-1}, the value in the table at input speed of 600 min^{-1} applies for T_{2N}.



* When selecting the motor, the input side breakaway torque (BTI) or no-load running torque (NLRT) must be taken into account.

3.6.1 Selection example

Calculation example for Type F4C-C25-119 for the following specification:

T_{2A}	= output side acceleration torque	600 Nm
T_{2R}	= output torque at constant speed	250 Nm
T_{2B}	= output side braking torque	400 Nm
$T_{2\,max}$	= emergency stop torque	1700 Nm (1000 x over the entire lifetime)
n_{1A}	= mean input speed during start-up	1250 min^{-1}
n_{1R}	= input speed during same-shape movement	2500 min^{-1}
n_{1B}	= mean input speed during braking	1250 min^{-1}
t_A	= start-up time	0.3 sec
t_R	= duration of the same-shape movement	3.0 sec
t_B	= time for braking	0.3 sec
t_m	= duration of the movement phase of a working cycle	3.6 sec
t_p	= duration of pause time	3.6 sec
t_c	= duration of a working cycle	7.2 sec
F_{R1}	= radial load on input shaft with force application point 25 mm	driven by timing belt, minor shocks, F_{R1} = 196 N,
F_{R2}	= radial load on the output shaft	Connection with gear, minor shocks, F_{R2} = 4116 N, 55 mm from the side of the flange

It was taken into account that this gearbox is used to operate a robot linkage at uniform load (see Table C4 service factor (B_F), pageS. 80).

Mean input speed

$$n_{1m} = \left(\frac{0.3 \;\; 1250 + 3.0 \cdot 2500 + 0.3 \cdot 1250}{3.6} \right) = 2292\ min^{-1}$$

Mean reference torque

$$T_{2V} = \left(\frac{0.3 \;\; 1250 \cdot 600^3 + 3.0 \cdot 2500 \cdot 250^3 + 0.3 \cdot 1250 \cdot 400^3}{3.6 \cdot 2292} \right)^{1/3} \cdot 1 = 300\ Nm$$

Max. permissible output torque at mean input speed

$$T_{2N\,max} = 568 \cdot \left(\frac{600}{2292} \right)^{0.3} = 380\ Nm \geq 300\ Nm$$ ⇨ Type **F4C-C25-119**

Calculation of ED %

$$ED\,\% = \left(\frac{3.6}{7.2} \right) \cdot 100 = 50\%$$

○ Checking the maximum input speed $n_1 = 2500\ min^{-1} < n_{1\ max} = 3500\ min^{-1}$ (Table C-1)

○ Checking the mean input speed $n_{1m} = 2292\ min^{-1}$ at 50% ED $< n_{1m\ max} = 2900\ min^{-1}$ at 50% ED (Table C-1)

○ Checking the peak torque during acceleration and braking $T_{2A} = 600\ Nm < 1030\ Nm$ (Table C-2)

○ Checking the Emergency Stop torque $T_{2\ max} = 1700\ Nm < 2060\ Nm$ (Table C-2)

○ Max. permissible radial load on input shaft when taking correction factors into account

$$F_{R1\ max} = F_{R1,\ 600} \times \left(\frac{600}{n_{1m}}\right)^{1/3} = 841 \cdot \left(\frac{600}{2292}\right)^{1/3} = 538\ N$$

$$F_{R1} = \frac{F_{R1\ max}}{L_{f1} \cdot C_{f1} \cdot B_{f1}} = \frac{538}{1.14 \cdot 1,25 \cdot 1.2} = 315\ N > 196\ N$$

(Table C4, Equation C-1, see S. 77 et seq.)

○ Checking the max. permissible bending moment T_k

$\ell_r = x - a + \ell_1 = 55 - 43.2 + 162 = 173.8$ mm

Calculated dimension for bending moment ℓ_r

○ Correction factors are used to calculate the external bending moment

$C_{f2} = 1.25$; $B_{f2} = 1.0$

$T_k = C_{f2} \cdot B_{f2} \cdot F_{R2} \cdot \ell_r < T_{k\ max}$

$T_{ke} = 1.25 \cdot 1.0 \cdot 4116 \cdot 173.8 \cdot 10^{-3}$

$T_{ke} = 891\ Nm < 1850\ Nm$

Selection/result ⇨ Type **F4C-C25-119** was selected by using the above evaluation.

4 Explaining the technical details

Stiffness and Lost Motion

If a torque is introduced in the output shaft when the input shaft is stationary, the relation between the distortion angle and the torque can determined from the following hysteresis curve (Fig. 7).

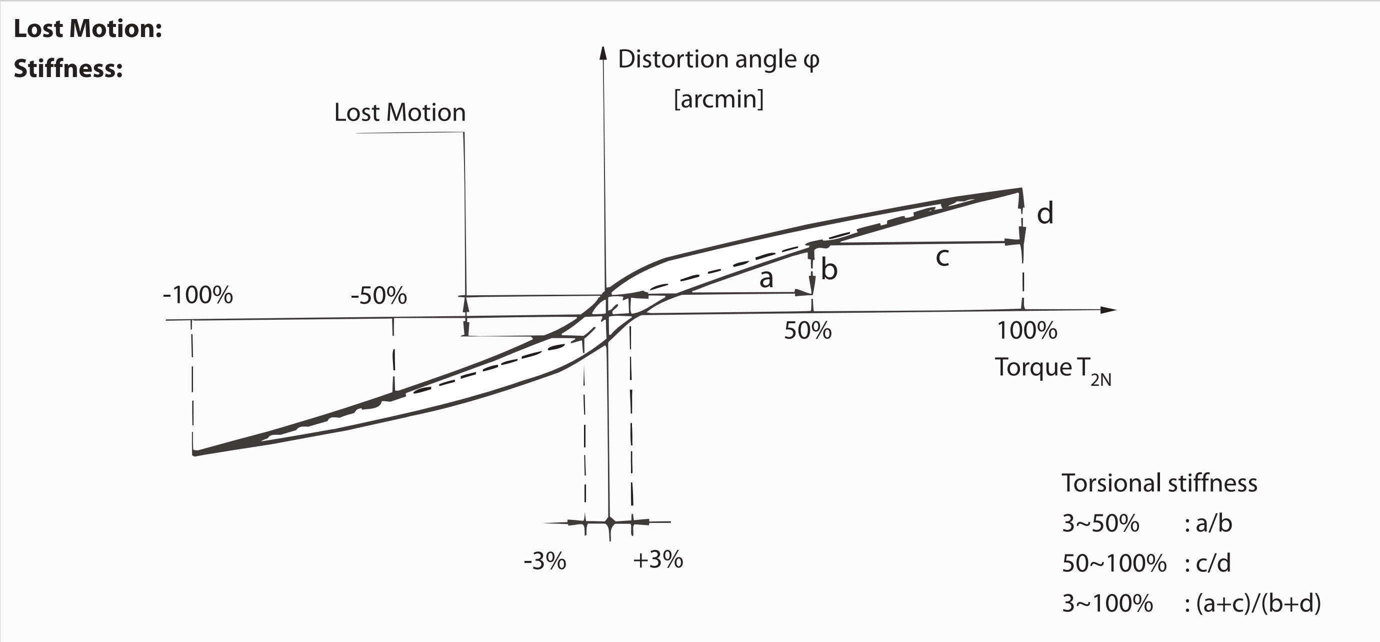


Fig. 7 Hysteresis curve

Lost Motion:	Distortion angle at 3% of nominal torque.
Stiffness:	Inclination of a straight line connecting two points on the hysteresis curve. The table value indicates the average torsional stiffness as a function of the nominal output torque.

Note arcmin means "angular minute"

$$1 \text{ arcmin} = \frac{1°}{60}$$

No-load running torque

No-load running torque must be applied to keep the gearbox in motion without load at the output. The information in the catalogue refers to average values which occur after the gearbox has been run in. State run in time.

Breakaway torque

Specifies the torque which is necessary to "break loose" the load-free gearbox from standstill, i.e. to start a rotational movement. This can take place on either the input (BTI) and the output side (BTO).

Efficiency

Efficiency varies according to speed, load torque, grease temperature, reduction ratio, gearbox size, etc.

The dependency between efficiency and input speed is shown in the figures relevant to the respective series, under measurement conditions with permissible output torque and stable grease temperature.
Variations in models and different reduction ratios are taken into account in the efficiency curve.

Transmission error

The transmission error indicates the deviation of the actual rotation angle of the gearbox from the theoretical value. A defined input-side rotation of the gearbox divided by the reduction ratio gives the theoretical position of the output. The actual angle of rotation varies with a deviation of some angular seconds around this value.

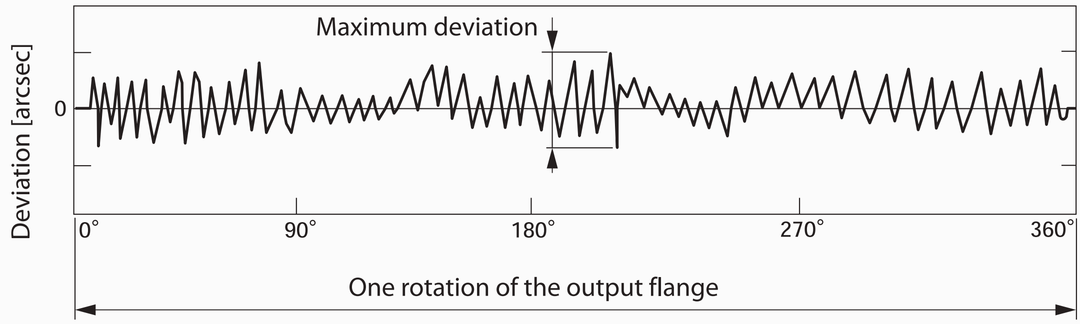


Fig. 8 Typical transmission error

Note arcsec means "angular second"

$$1 \text{ arcsec} = \frac{1°}{3600}$$

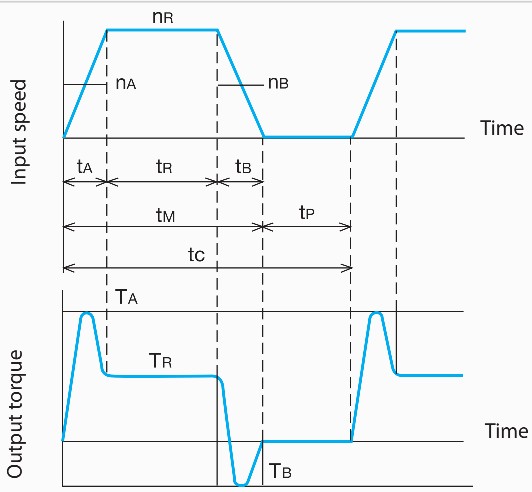
Applications for precision gearboxes generally differentiate between positioning and smooth traverse applications.

For positioning applications only the standstill positions of the gearbox play a role (e.g., tool magazine). Here, the transmission error is usually not important.

For smooth traverse applications, precision is important at every moment of movement (e.g. continuously welding robots). Here, a major transmission error can lead to unsatisfactory results.

Fine Cyclo reducers are ideally suited for both applications. Both single-stage and double-stage gearboxes show only minimal transmission errors. If maximum path accuracy is required, Fine Cyclo double-stage gearboxes provide additional advantages. Please contact Sumitomo Drive Technologies for assistance in choosing the correct gearbox.

Load cycle



The load cycle (t_C) reflects the sequence of movements in the application used. This typically consists of at least one acceleration phase (t_A), one constant speed phase (t_R), one deceleration (t_B), and one pause of movement (t_P).

Duty cycle

The duty cycle is the percentage duration of the movement phase in proportion to the duration of the working cycle within a periodically repeating load cycle. In particular, the speed and duty cycle, as well as the torque and the installation situation (e.g. convection or external heat influence) determine the temperature development in the gearbox. Continuous operation of the gearbox at high speeds or duty cycles lead to overheating and destruction of the gearbox. To avoid this, the temperature of the gearbox housing during operation should not exceed 70 °C.

Therefore, a few basic principles must be taken into account.

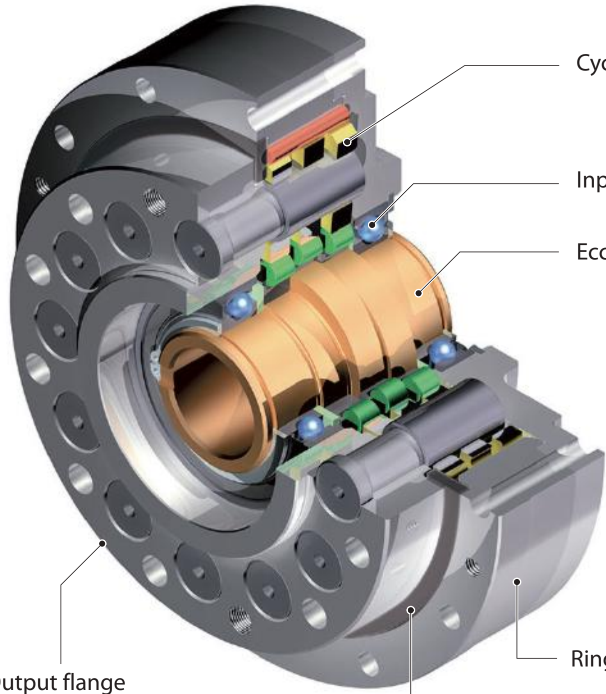
For F_C-A; D; C:
The measuring basis is intermittent duty (S5 operation) on the basis of maximum 10 min running time (t_c), which includes a pause time. This means that it is necessary to check the allowed mean input speed n_{1m} according to the permitted nominal speed for %ED ($n_{1m} < n_{1\,ED}$). For duty cycles of less than 50%, we recommend using 50%ED nominal speeds. For those greater than 50%, we recommend 100%ED nominal speeds, for checking n_{1m}.

For F2C-T , F4CF-UA, F2CF-UA:
The measuring basis for F2C-T is the maximum output speed ($n_{2\,max}$), which corresponds simultaneously to the limit speed allowed in continuous operation (100 %ED). It is therefore necessary to check the maximum occurring speed $n_{2\,max}$ in the movement cycle against the limiting speed $n_{2\,max}$. Checking against a permissible nominal speed according to %ED can be omitted here.

Further:
If the duration of the movement phase of a working cycle t_M is greater than 10 minutes, in the case of continuous duty (S1) or if complex load cycles are performed, please consult Sumitomo Drive Technologies.

5 A Series

FC-A

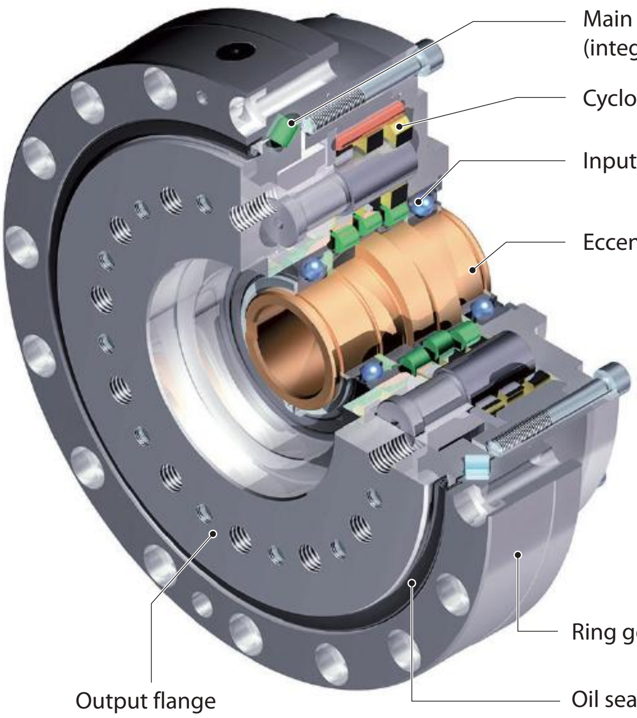


Special feature:

User can use their own bearings, hollow shaft possible, compact reduction kit

- 6 sizes
- Ratios (single-stage) 29/59/89/119/179
- Can be customised to fit individual designs
- Smaller occupied space
- Nominal output torques up to 5140 Nm
- Acceleration torques up to 7610 Nm
- Input speeds up to 6150 min^{-1}
- Lost Motion < 2 arcmin (optional Lost Motion < 1 arcmin)

F1C-A

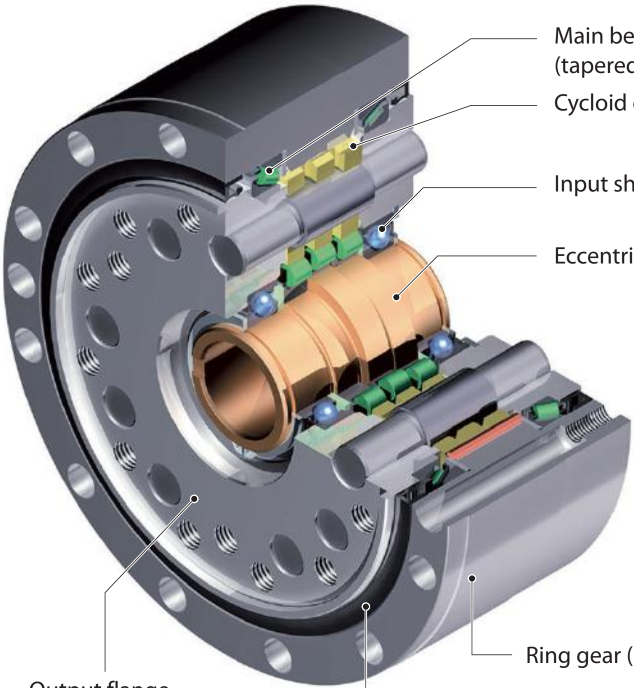


Special feature:

High stiffness, compact design

- 6 sizes
- Reduction ratios (single-stage) 29/59/89/119/179
- Nominal output torques up to 5140 Nm
- Acceleration torques up to 7610 Nm
- Input speeds up to 6150 min^{-1}
- Lost Motion < 2 arcmin (optional Lost Motion < 1 arcmin)

F2C-A

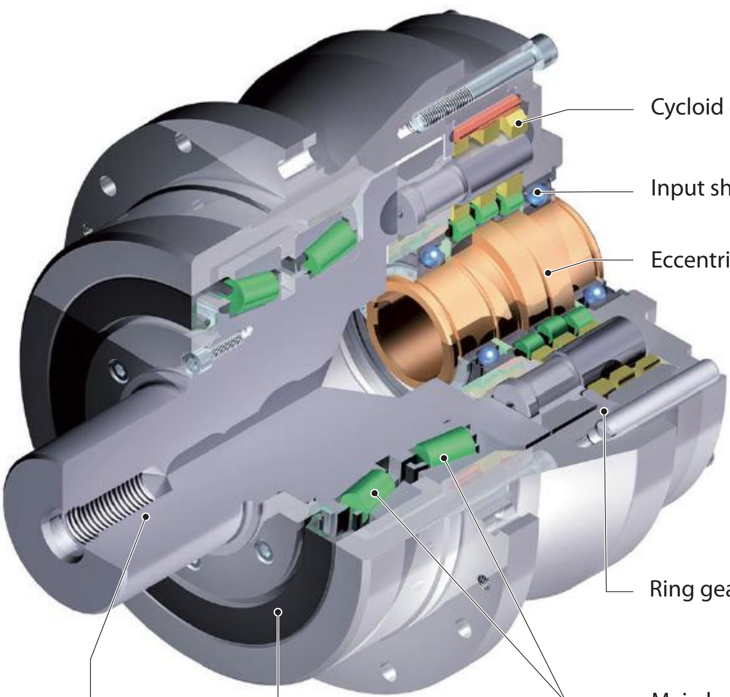


Special feature:

Low noise, high stiffness, compact design

- 4 sizes
- Ratios (single-stage) 29/59/89/119/179
- Tapered roller bearings with high permissible tilting moments
- Nominal output torques up to 1830 Nm
- Acceleration torques up to 2910 Nm
- Input speeds up to 6150 min^{-1}
- Lost Motion < 2 arcmin (optional Lost Motion < 1 arcmin)

F3C-A



Special feature:

Allows high radial forces

- 6 sizes
- Ratios (single-stage) 29/59/89/119/179
- Nominal output torques up to 5140 Nm
- Acceleration torques up to 7610 Nm
- Input speeds up to 6150 min^{-1}
- Lost Motion < 2 arcmin (optional Lost Motion < 1 arcmin)

5.1 Torques according to output speeds

Output speed n_{2m} [min^{-1}]			5			10			15			20			25		
Model	Size	Reduction ratio i	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]
FC- F1C- F2C(F)- F3C-	**A15**	**59**	196	295	0.13	196	590	0.26	174	885	0.34	160	1180	0.42	150	1475	0.49
		89	196	445	0.13	174	890	0.23	154	1335	0.30	141	1780	0.37	132	2225	0.43
	A25	**29**	373	145	0.24	373	290	0.49	373	435	0.73	373	580	0.98	352	725	1.15
		59	460	295	0.30	460	590	0.60	409	885	0.80	376	1180	0.98	351	1475	1.15
		89	460	445	0.30	409	890	0.53	362	1335	0.71	332	1780	0.87	310	2225	1.02
		119	460	595	0.30	375	1190	0.49	332	1785	0.65	304	2380	0.80	285	2975	0.93
	A35	**29**	657	145	0.43	657	290	0.86	657	435	1.29	657	580	1.72	621	725	2.03
		59	879	295	0.58	879	590	1.15	782	885	1.54	718	1180	1.88	671	1475	2.20
		89	879	445	0.58	781	890	1.02	691	1335	1.36	634	1780	1.66	593	2225	1.94
		119	879	595	0.58	716	1190	0.94	634	1785	1.24	581	2380	1.52	544	2975	1.78
	A45	**29**	1390	145	0.91	1390	290	1.82	1390	435	2.73	1390	580	3.64	1313	725	4.30
		59	1830	295	1.20	1830	590	2.40	1629	885	3.20	1494	1180	3.91	1397	1475	4.57
		89	1830	445	1.20	1626	890	2.13	1440	1335	2.83	1321	1780	3.46	1235	2225	4.04
		119	1830	595	1.20	1490	1190	1.95	1319	1785	2.59	1210	2380	3.17			
		179	1623	895	1.06	1318	1790	1.72	1167	2685	2.28						
	A65	**29**	2460	145	1.61	2460	290	3.22	2460	435	4.83	2460	580	6.44	2324	725	7.61
		59	3380	295	2.21	3380	590	4.42	3008	885	5.91	2759	1180	7.22	2581	1475	8.45
		89	3380	445	2.21	3003	890	3.93	2659	1335	5.22	2439	1780	6.39	2281	2225	7.47
		119	3380	595	2.21	2752	1190	3.60	2437	1785	4.79						
		179	2998	895	1.96	2435	1790	3.19									
	A75	**29**	4170	145	2.73	4170	290	5.46	4170	435	8.19	4170	580	10.92	3940	725	12.89
		59	5140	295	3.36	5140	590	6.73	4574	885	8.98	4196	1180	10.99	3924	1475	12.84
		89	5140	445	3.36	4567	890	5.98	4044	1335	7.94	3709	1780	9.71			
		119	5140	595	3.36	4185	1190	5.48	3706	1785	7.28						

Table A1 Rating values (reference value output speed n_{2m})

Size	Max. acceleration and deceleration torque T_{2A}	Peak torque for emergency stop T_{2max}*
	[Nm]	[Nm]
A15	335	785
A25	721	1930
A35	1390	3580
A45	2910	7210
A65	5130	13800
A75	7610	24000

Table A2 Maximum acceleration and peak torque

* Further limitation by maximum transmittable torque of screw fitting Table A28, **Page 38**

30			40			50			60			Max. permissible input speed $n_{1\,max}$ short term [min⁻¹]	Max. permissible input speed $n_{1\,ED}$ [min⁻¹]		Moment of inertia j related to the input shaft [×10⁻⁴ kgm²]
Nominal output torque [Nm]	Input speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min⁻¹]	Max. permissible input power [kW]		50% ED	100% ED	
142	1770	0.56	130	2360	0.68	122	2950	0.80	115	3540	0.90	6150	5600	2800	0.46
125	2670	0.49	115	3560	0.60	107	4450	0.70	102	5340	0.80				
334	870	1.31	306	1160	1.60	286	1450	1.87	271	1740	2.13	4350	3100	1550	1.42
333	1770	1.31	305	2360	1.60	285	2950	1.87	270	3540	2.12	5050	4200	2100	
294	2670	1.15	270	3560	1.41										
269	3570	1.06													
588	870	2.31	539	1160	2.82	504	1450	3.30	477	1740	3.75	3500	2500	1250	4.58
635	1770	2.50	583	2360	3.05	545	2950	3.57				3950	3300	1650	
562	2670	2.21													
1243	870	4.88	1141	1160	5.97	1067	1450	6.98	1010	1740	7.93	2700	1900	950	12.7
1323	1770	5.19	1213	2360	6.35							3150	2600	1300	
1169	2670	4.59													
2201	870	8.64	2019	1160	10.57	1888	1450	12.36				2200	1500	750	49.5
2443	1770	9.59										2350	2000	1000	
3730	870	14.65	3422	1160	17.92							1950	1200	600	110.0
3715	1770	14.59										2000	1750	850	

: 50% ED range   : 100% ED range (but max. 10 min. without pause)

1. T_{2N} = nominal output torque
   Nominal output torque corresponds to the max. permissible average load torque at all output speeds.
   The nominal output torque for speeds less than 5 min^{-1} is equal to the value at 5 min^{-1}.
   The value for the maximum permissible input power is calculated from the nominal output torque at 100%.
   This value takes the efficiency of Fine Cyclo into consideration.
2. n_{1max} = maximum permissible input speed
   However, it must be n_{1m} (mean input speed) < $n_{1\,ED}$.
3. $n_{1\,ED}$ = permissible input speed according to duty cycle
4. T_{2A} = max. Acceleration and braking torque (for fatigue strength at $2 \cdot 10^7$ load cycles)
   Permissible peak torque for normal start and stop procedures.
5. T_{2max} = max. permissible torque for Emergency Stop situations or in the event of heavy shocks (limited by the mechanical strength) (permissible 1000 times during the entire lifetime).
6. The rated torque T_{2N} is calculated using the following equation when the speed is not shown in the table above:

$$T_{2N} = T_{2N,\,600} \left(\frac{600}{n_{1m}} \right)^{0.3}$$

T_{2N} : Rated torque at output speed n_{1m}
$T_{2N,\,600}$: Rated torque at output speed n_{1m} is 600 min^{-1}

5.2 Torques according to input speeds

Input speed n_{1m} [min^{-1}]			4000			3000			2500			2000			1750		
Model	Size	Reduction ratio i	Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]
FC- F1C- F2C(F)- F3C-	A15	59	111	67.8	0.89	121	50.8	0.80	128	42.4	0.71	137	33.9	0.60	142	29.7	0.55
		89	111	44.9	0.65	121	33.7	0.53	128	28.1	0.47	137	22.5	0.40	142	19.7	0.37
	A25	29				230	103	3.12	243	86.2	2.74	260	69.0	2.34	270	60.3	2.14
		59	260	67.8	2.3	284	50.8	1.88	299	42.4	1.6	320	33.9	1.42	333	29.7	1.29
		89	260	44.9	1.53	284	33.7	1.25	299	28.1	1.10	320	22.5	0.94	333	19.7	0.86
		119	260	33.6	1.14	284	25.2	0.93	299	21.0	0.82	320	16.8	0.70	333	14.7	0.64
	A35	29							428	86.2	4.83	458	69.0	4.13	476	60.3	3.76
		59				534	50.8	3.60	573	42.4	3.17	613	33.9	2.71	638	29.7	2.47
		89				543	33.7	2.39	573	28.1	2.10	613	22.5	1.80	638	19.7	1.64
		119				543	25.2	1.79	573	21.0	1.57	613	16.8	1.34	638	14.7	1.23
	A45	29										972	69.0	8.75	1010	60.3	7.97
		59							1190	42.4	6.57	12.80	33.9	5.65	1330	29.7	5.13
		89							1190	28.1	4.36	1280	22.5	3.75	1330	19.7	3.40
		119							1190	21.0	3.26	1280	16.8	2.80	1330	14.7	2.55
		179							1190	14.0	2.17	1280	11.2	1.86	1330	9.78	1.69
	A65	29															
		59										2360	33.9	10.40	2459	29.7	9.51
		89										2360	22.5	6.91	2459	19.7	6.30
		119										2360	16.8	5.17	2459	14.7	4.71
		179										2360	11.2	3.44	2459	9.78	3.13
	A75	29															
		59													3720	29.7	14.5
		89													3720	19.7	9.58
		119													3720	14.7	7.16

Table A3 Rating values (reference value input speed n_{1m})

Size	Max. acceleration and deceleration torque T_{2A}	Peak torque for emergency stop T_{2max}*
	[Nm]	[Nm]
A15	335	785
A25	721	1930
A35	1390	3580
A45	2910	7210
A65	5130	13800
A75	7610	24000

Table A4 Maximum acceleration and peak torque

* Further limitation by maximum transmittable torque of screw fitting Table A28, **Page 38**

1500			1000			750			< 600			Max. permissible input speed $n_{1\,max}$ short term [min⁻¹]	Max. permissible input speed $n_{1\,ED}$ [min⁻¹]		Moment of inertia j related to the input shaft [×10⁻⁴ kgm²]
Nominal output torque [Nm]	Output speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min⁻¹]	Max. permissible input power [kW]		50% ED	100% ED	
149	25.4	0.50	168	16.9	0.37	183	12.7	0.30	196	10.10	0.26	6150	5600	2800	0.46
149	16.9	0.33	168	11.2	0.25	183	8.4	0.20	196	6.74	0.17	6150			
283	51.7	1.92	320	34.5	1.44	349	25.9	1.18	373	20.70	1.00	4350	3100	1550	1.42
349	25.4	1.16	395	16.9	0.87	430	12.7	0.71	460	10.10	0.61	5050	4200	2100	
349	16.9	0.77	395	11.2	0.58	430	8.4	0.47	460	6.74	0.41	5050			
349	12.6	0.77	395	8.4	0.43	430	6.3	0.35	460	5.04	0.30	5050			
499	51.7	3.38	564	34.5	2.54	615	25.9	20.8	657	20.70	1.78	3500	2500	1250	4.58
668	25.4	2.22	754	16.9	1.76	822	12.7	1.27	879	10.10	1.17	3950	3300	1650	
668	16.9	1.47	754	11.2	1.11	822	8.4	0.91	879	6.74	0.77	3950			
668	12.6	1.10	754	8.4	0.83	822	6.3	0.68	879	5.04	0.58	3950			
1060	51.7	7.16	1190	34.5	5.39	1300	25.9	4.41	1390	20.70	3.77	2700	1900	950	12.7
1390	25.4	4.60	1570	16.9	3.48	1710	12.7	2.84	1830	10.10	2.43	3150	2600	1300	
1390	16.9	3.05	1570	11.2	2.30	1710	8.4	1.88	1830	6.74	1.61	3150			
1390	12.6	2.28	1570	8.4	1.72	1770	6.3	1.41	1830	5.04	1.20	3150			
1390	8.38	1.51	1570	5.59	1.15	1710	4.2	0.93	1830	3.35	0.80	3150			
1870	51.7	12.70	2110	34.5	9.50	2300	25.9	7.79	2460	20.70	6.66	2200	1500	750	49.5
2570	25.4	8.54	2900	16.9	6.43	3160	12.7	5.25	3380	6.74	2.98	2350	2000	1000	
2570	16.9	5.66	2900	11.2	4.26	3160	8.43	3.48	3380	5.04	2.23	2350			
2570	12.6	4.23	2900	8.4	3.19	3160	6.3	2.6	3380	5.04	2.23	2350			
2570	8.38	2.81	2900	5.59	2.12	3160	4.19	1.73	3380	3.35	1.48	2350			
			3580	34.5	16.10	3900	25.9	13.2	4170	20.70	11.30	1950	1200	600	110.0
3900	25.4	13.00	4410	16.9	9.76	4810	12.7	7.99	5140	10.10	6.83	2000	1750	850	
3900	16.9	8.60	4410	11.2	6.47	4810	8.43	5.29	5140	6.74	4.53	2000			
3900	12.6	6.43	4410	8.4	4.84	4810	6.3	3.96	5140	5.0	3.39	2000			

: 50% ED range

: 100% ED range (but max. 10 min. without pause)

1. T_{2N} = nominal output torque
   Nominal output torque corresponds to the max. permissible average load torque at all input speeds.
   The nominal output torque for speeds less than 600 min⁻¹ is equal to the value at 600 min⁻¹.
   The value for the maximum permissible input power is calculated from the nominal output torque at 100%.
   This value takes the efficiency of Fine Cyclo into consideration.

2. n_{1max} = maximum permissible input speed
   However, it must be n_{1m} (mean input speed) $< n_{1\,ED}$.

3. $n_{1\,ED}$ = permissible input speed according to duty cycle

4. T_{2A} = max. Acceleration and braking torque (for fatigue strength at $2 \cdot 10^7$ load cycles)
   Permissible peak torque for normal start and stop procedures.

5. T_{2max} = max. permissible torque for Emergency Stop situations or in the event of heavy shocks (limited by the mechanical strength) (permissible 1000 times during the entire lifetime).

6. The rated torque T_{2N} is calculated using the following equation when the speed is not shown in the table above:

$$T_{2N} = T_{2N,\,600}\left(\frac{600}{n_{1m}}\right)^{0.3}$$

T_{2N} : Rated torque at input speed n_{1m}

$T_{2N,600}$: Rated torque at input speed n_{1m} is 600 min⁻¹

5.3 Stiffness and Lost Motion

Size	i	Test torque T_p [Nm]	Lost Motion: Lost Motion [arcmin]	Lost Motion: Domain of definition [Nm]	Torsional stiffness 3% - 50% T_p [Nm/arcmin]	Torsional stiffness 3% - 100% T_p [Nm/arcmin]	Torsional stiffness 50% - 100% T_p [Nm/arcmin]
A15	59	±149	< 2 arcmin standard < 1 arcmin optional	±4.5	15 (14)	20 (18)	28 (24)
	89				15 (14)	20 (18)	28 (24)
A25	29	±349		±11	40 (37)	53 (47)	80 (70)
	59				52 (46)	70 (60)	100 (81)
	89				52 (46)	70 (60)	100 (81)
	119				52 (46)	70 (60)	100 (81)
A35	29	±668		±20	70 (65)	95 (85)	140 (120)
	59				110 (95)	145 (120)	210 (161)
	89				110 (95)	145 (120)	210 (161)
	119				110 (95)	145 (120)	210 (161)
A45	29	±1390		±42	170 (155)	220 (195)	300 (255)
	59				220 (195)	300 (225)	445 (350)
	89				220 (195)	300 (225)	445 (350)
	119				220 (195)	300 (225)	445 (350)
	179				220 (195)	300 (225)	445 (350)
A65	29	±2570		±77	310 (285)	400 (360)	530 (460)
	59				400 (360)	530 (460)	770 (627)
	89				400 (360)	530 (460)	770 (627)
	119				400 (360)	530 (460)	770 (627)
	179				400 (360)	530 (460)	770 (627)
A75	29	±3900		±117	590 (530)	740 (650)	960 (810)
	59				610 (550)	790 (685)	1100 (910)
	89				610 (550)	790 (685)	1100 (910)
	119				610 (550)	790 (685)	1100 (910)

Table A5 **Torsional stiffness**
(...) Values in brackets apply for F3C-A
T_p: Test torque at input speed n_1 = 1500 min^{-1}

Calculation of the twist angle:

1) At a load torque less than 3% T_p

$$\varphi = \frac{\text{Lost Motion}}{2} \cdot \frac{\text{Load torque}}{0.03 \cdot T_p}$$

2) At a load torque greater than 3% T_p (standard case)

$$\varphi = \frac{\text{Lost Motion}}{2} + \frac{\text{Load torque} - (0.03 \cdot T_p)}{\text{Torsional stiffness}}$$

Note	arcmin means "angular minute". Table values for stiffness are average values.

5.4 No-load running torque NLRT

No-load running torque for i = 59, 89, and 119

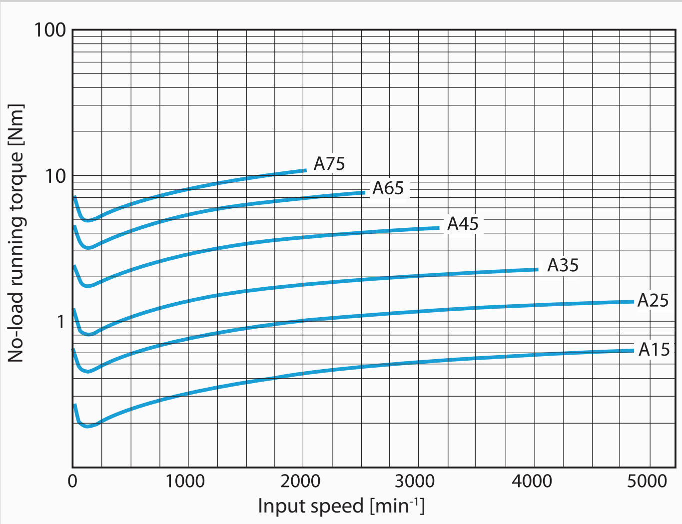


Fig. A1 Input side no-load running torque (i 59-119)

No-load running torque for i = 29

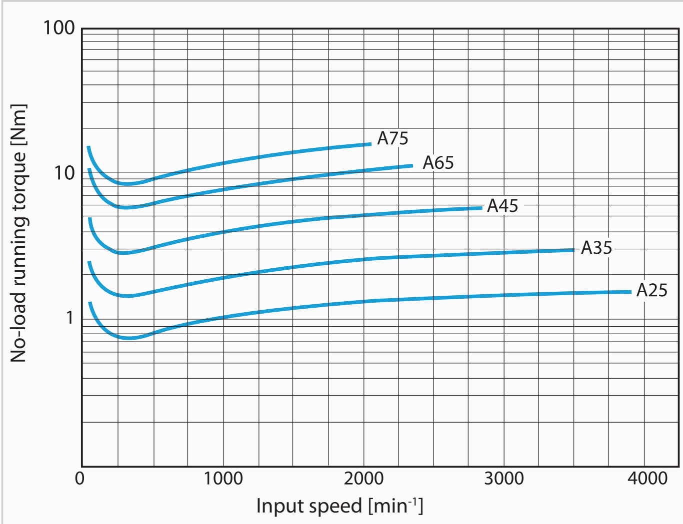


Fig. A2 Input side no-load running torque (i 29)

Note
1. Fig. A1 and Fig. A2 show the average no-load running torques after gearbox is run in (not new condition)
2. Table A6 shows the measuring conditions

5.5 Breakaway torque

Breakaway torque on output side (BTO)

Note
1. Table A7 shows the max. breakaway torque on the output side BTO. Fine Cyclo gearboxes are not self-locking. The BTO is defined as the maximum value (factory-new condition), which steadily decreases during the lifetime.
2. Table A6 shows the measuring conditions

Ring gear housing temperature	approx. 30°C
Precision during assembly	as per chapter 5.9.1, 5.10.1, 5.11.1, 5.12.1
Lubrication	Standard lubrication

Table A6 Measurement conditions

Size	Breakaway torque BTO [Nm]
A15	< 75
A25	< 180
A35	< 245
A45	< 360
A65	< 530
A75	< 700

Table A7 Value of the breakaway torque on the output side (BTO)

Breakaway torque on input side (BTI)

Note
1. Table A8 shows the max. breakaway torque BTI on the input side. BTI is defined as the maximum value (factory-new condition) which steadily decreases during the lifetime.
2. Table A6 shows the measuring conditions

Size	i	Breakaway torque BTI [Nm]
A15	59	< 1
	89	< 0.8
A25	29	< 5.6
	59	< 2.8
	89	< 2.45
	119	< 1.9
A35	29	< 7
	59	< 2.8
	89	< 2.0
	119	< 2
A45	29	< 8
	59	< 4.3
	89	< 3.15
	119	< 2
	179	< 1.8
A65	29	< 9
	59	< 5
	89	< 4.5
	119	< 3.8
	179	< 2.6
A75	29	< 20
	59	< 6.5
	89	< 5.5
	119	< 4.5

Table A8 Value of the breakaway torque on the input side (BTI)

5.6 Efficiency

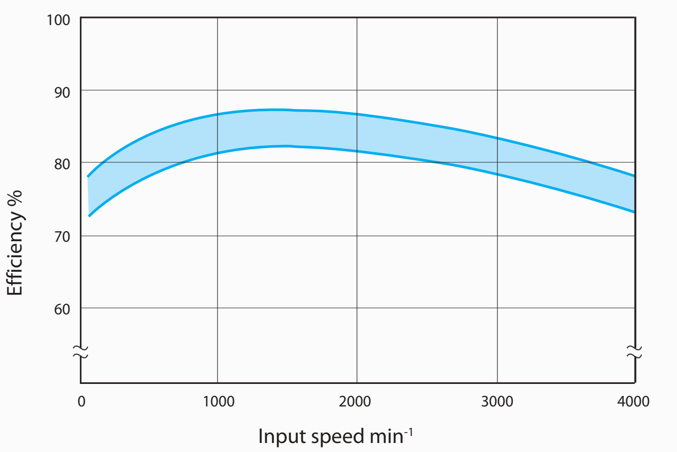


Fig. A3 Efficiency curve

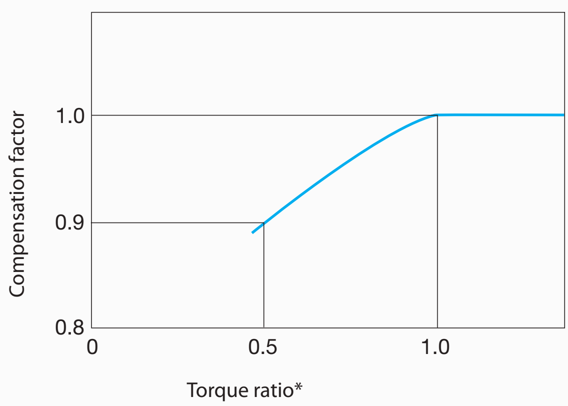


Fig. A4 Compensation curve for efficiency

Fig. A3 shows the correlation between efficiency and input speed. For further information, see "4 Explaining the technical details" on page 18.

$$\text{* Torque ratio} = \frac{\text{Load torque}}{\text{Nominal output torque}}$$

Compensation efficiency = efficiency · compensation factor

Note
1. The efficiency changes if the load torque does not match the nominal torque. Check the compensation factor in the diagram Fig. A4.
2. When the torque ratio is over 1.0, the compensation factor for efficiency is 1.0 (diagram Fig. A4).

5.7 Bearing loads

5.7.1 Maximum permissible radial and axial load on the input shaft

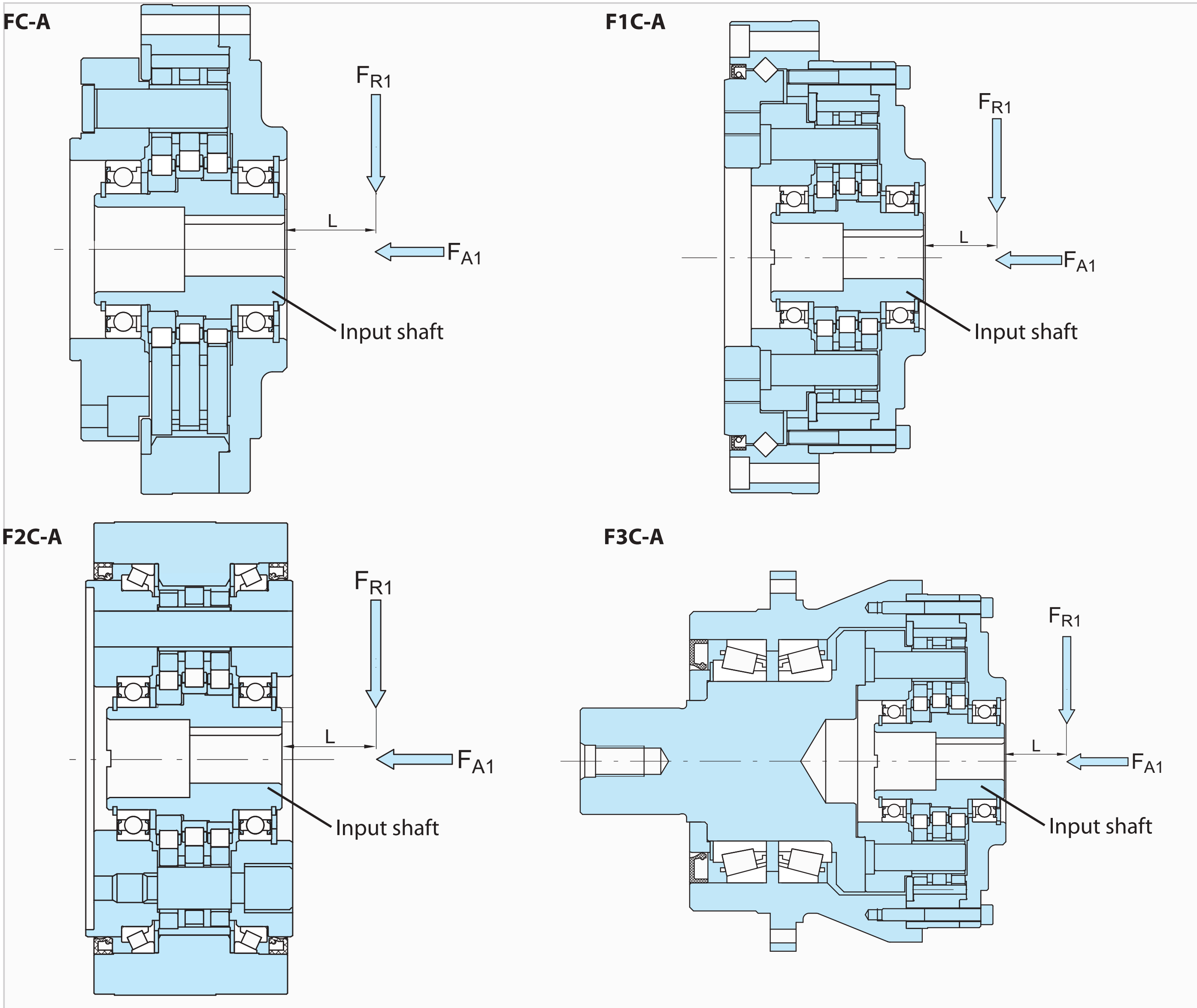


Fig. A5 Load position on input shaft

If a gear or timing belt pulley is mounted on the input shaft, the values for radial load and axial load should be equal to or less than the permissible values. The following equation is used to check whether the shaft load is permissible:

1. Input radial load F_{R1}

$$F_{R1} = 10^3 \cdot \frac{T_{2V}}{\eta \cdot i \cdot r_0} \leq \frac{F_{R1\,max}}{L_{f1} \cdot C_{f1} \cdot B_{f1}} \text{ [N]} \qquad \text{(Equation A-1)}$$

2. Input side axial load F_{A1}

$$F_{A1} \leq \frac{F_{A1\,max}}{C_{f1} \cdot B_{f1}} \text{ [N]} \qquad \text{(Equation A-2)}$$

3. When radial and axial loads co-exist

$$\left(\frac{F_{R1} \cdot L_{f1}}{F_{R1\,max}} + \frac{F_{A1}}{F_{A1max}} \right) \cdot C_{f1} \cdot B_{f1} \leq 1 \qquad \text{(equation A-3)}$$

F_{R1} = input side radial load [N]
T_{2V} = reference torque on output shaft [Nm]
r_0 = pitch circle radius of sprocket, pinion, or timing belt pulley [mm]
$F_{R1\,max}$ = maximum permissible input side radial load [N] (Table A9)
F_{A1} = input side axial load [N]
$F_{A1\,max}$ = max. permissible input side axial load [N] (Table A10)
L_{f1} = load factor input (Table A11)
C_{f1} = correction factor input (Table A12)
B_{f1} = service factor input (Table A13)
L = distance of radial load from front end on input side of the input shaft [mm] (Table A11)
η = 0.8 (efficiency)

Size	Input speed n_{1m} [min^{-1}]								
	4000	3000	2500	2000	1750	1500	1000	750	600
A15	225	245	255	275	295	300	350	390	410
A25	330	360	390	420	440	460	530	580	628
A35		490	520	560	590	620	700	780	835
A45			610	660	690	720	820	900	980
A65				880	930	980	1120	1240	1320
A75					1180	1240	1410	1560	1670

Table A9 Max. permissible input side radial load $F_{R1\,max}$ [N]

$$F_{R1\,max} = F_{R1,600} \left(\frac{600}{n_{1m}}\right)^{1/3}$$

$F_{R1\,max}$ = maximum permissible input side radial load at input speed n_{1m}

$F_{R1,600}$ = Radial load on input side at input speed n_{1m} = 600 min^{-1}

Size	Input speed n_{1m} [min^{-1}]								
	4000	3000	2500	2000	1750	1500	1000	750	600
A15	245	285	315	345	360	390	470	550	610
A25	360	410	450	500	540	580	700	805	880
A35		600	650	725	765	825	1000	1100	1100
A45			1010	1120	1200	1290	1290	1290	1290
A65				1440	1440	1440	1440	1440	1440
A75					2120	2280	2770	3170	3210

Table A10 Max. permissible input side axial load $F_{A1\,max}$ [N]

$$F_{A1\,max} = F_{A1,600} \left(\frac{600}{n_{1m}}\right)^{0.47}$$

$F_{A1\,max}$ = maximum permissible input side axial load at input speed n_{1m}

$F_{A1.600}$ = Axial load on input side at input speed n_{1m} = 600 min^{-1}

L [mm]	Load factor input L_{f1} — Size					
	A15	A25	A35	A45	A65	A75
10	0.90	0.86				
15	0.98	0.93	0.91			
20	1.25	1.00	0.96	0.86		
25	1.56	1.25	1.09	0.94		
30	1.88	1.50	1.30	0.99	0.89	0.89
35	2.19	1.75	1.52	1.13	0.93	0.92
40		2.00	1.74	1.29	0.97	0.96
45			1.96	1.45	1.02	0.99
50			2.17	1.61	1.14	1.09
60				1.94	1.36	1.30
70					1.59	1.52
80					1.82	1.74

Table A11 Load factor input L_{f1}

L = Distance from input side input shaft front end

Correction factor input	C_{f1}
Chain	1
Gear or pinion *	1.25
Timing belt	1.25
V-Belt	1.5

Table A12 Correction factor input C_{f1}

* For helical pinions or bevel gears, please consult Sumitomo Drive Technologies.

Service factor input	B_{f1}
Uniform load	1
Light impacts	1.2
Severe impacts	1.6

Table A13 Service factor input B_{f1}

5.7.2 Main bearings

Fine Cyclo - F1C-A

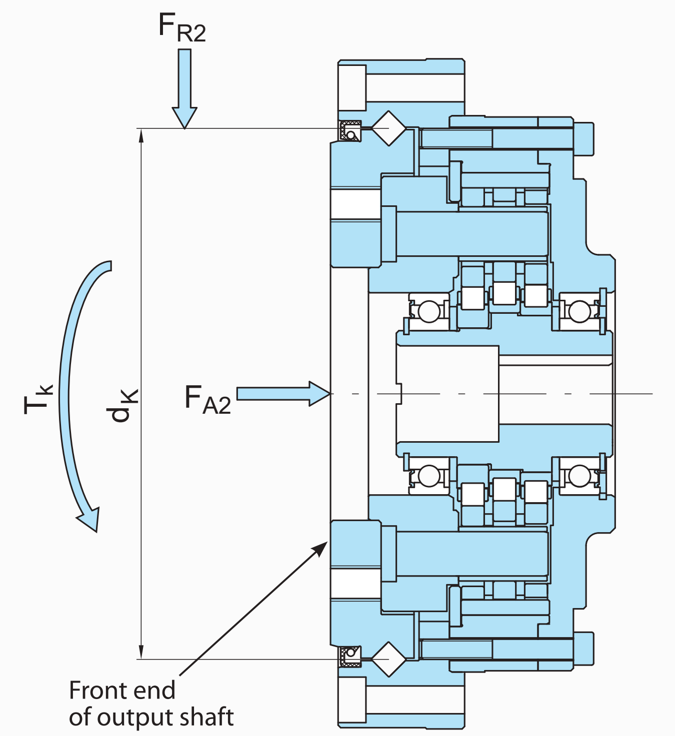


Fig. A6 Load position output

	Load factor	
	Radial load X_L	Axial load Y_L
$\dfrac{F_{A2}}{F_{R2} + \dfrac{2 \cdot 10^3 \cdot T_k}{d_k}} \leq 1.5$	1	0.45
$\dfrac{F_{A2}}{F_{R2} + \dfrac{2 \cdot 10^3 \cdot T_k}{d_k}} > 1.5$	0.67	0.67

F_{A2} = output side axial load [N]
F_{R2} = output side radial load [N]
C_{f2} = correction factor output
B_{f2} = service factor output
d_K = Mean bearing diameter [mm]
$T_{k\,max}$ = maximum permissible bending moment [Nm]
T_k = bending moment [Nm]
φ_1 = tilt angle [arcmin]
Θ_1 = moment stiffness main bearing [Nm/arcmin]
T_{2v} = reference torque [Nm]
d_0 = pitch circle diameter of output element [mm]
C = dynamic load rating
C_0 = static load rating

For power transmission by means of pinion, timing belt, or similar:

$$F_{R2} = C_{f2} \cdot B_{f2} \cdot \frac{2 \cdot 10^3 \cdot T_{2V}}{d_0} \quad \text{(Equation A-9)}$$

Size	Θ_1 [Nm/arcmin]	$T_{k\,max}$ [Nm]	d_k [mm]	C [N]	C_0 [N]
A15	205	460	101	26700	25400
A25	370	770	123	29600	31000
A35	750	1350	149	62300	64500
A45	3500	3350	210	81000	159000
A65	7800	6700	279	170000	325000
A75	15600	14400	340	263000	510000

Table A14 Specification cross roller bearings

1. Moment stiffness

   The moment stiffness is the bending moment at which the output flange is tilted to the tilt angle.

   The tilt angle of the output flange is determined as follows:

$$\varphi_1 = \frac{T_k}{\Theta_1} \quad \text{(Equation A-5)}$$

Correction factor	C_{f2}
Chain	1
Gear or pinion	1.25
Timing belt	1.25
V-Belt	1.5

Table A15 Correction factor output C_{f2}

Service factor	B_{f2}
Uniform load	1
Light impacts	1.2
Severe impacts	1.6

Table A16 Service factor output B_{f2}

A dynamically equivalent load P on the bearing is calculated from these loads.
With the equivalent load P and the mean input speed n_{2m}, it is possible to test whether the output bearing achieves the desired lifetime L_{h10}.

$$P = X_L \left(F_{R2} + \frac{2 \cdot 10^3 \cdot T_K}{d_K} \right) + Y_L \cdot F_{A2} \quad \text{(Equation A-10)}$$

$$L_{h10} = \frac{10^6}{60 \cdot n_{2m}} \left(\frac{C}{P} \right)^{\frac{10}{3}} \quad \text{(Equation A-11)}$$

Fine Cyclo - F2C(F)

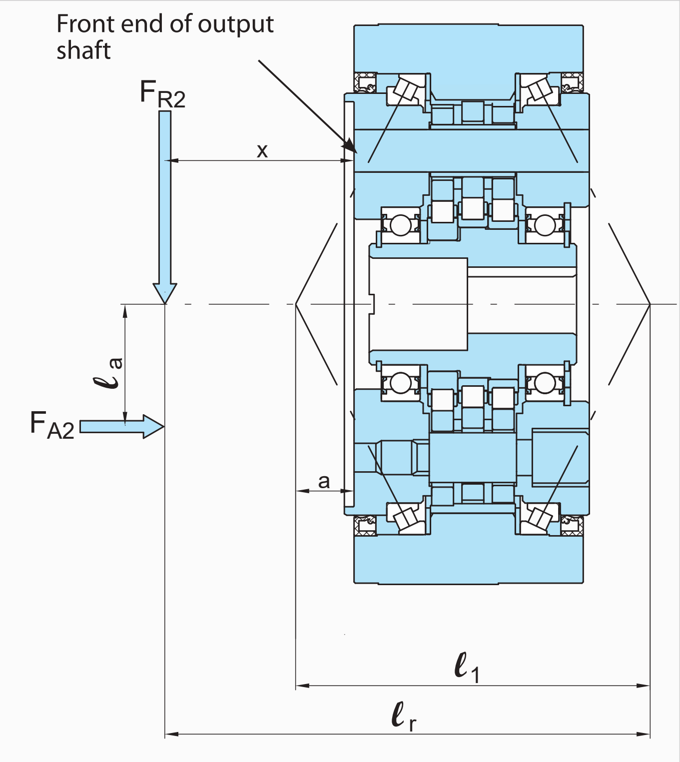


Fig. A7 Distance between the individual loading points

$\ell_r = x - a + \ell_1$ (Equation A-4)

Size	Values of internal bearing distance	
	ℓ_1 [mm]	a [mm]
A15	72.6	6.5
A25	80.4	8.7
A35	108.0	14.5
A45	139.2	20.6

Table A17 Bearing clearances

Note If: $\ell_r > 4 \cdot \ell_1$, please contact Sumitomo Drive Technologies.

1. Moment stiffness

   The moment stiffness is the bending moment at which the output flange is tilted by the tilt angle.

   The tilt angle of the input flange is determined as follows:

$$\varphi_1 = \frac{T_k}{\Theta_1}$$ (Equation A-5)

External bending moment T_k

$$T_k = 10^{-3} \cdot (F_{R2} \cdot \ell_r + F_{A2} \cdot \ell_a)$$ (Equation A-6)

2. Max. permissible bending moment and max. permissible axial load.

   Check the equivalent bending moment and the equivalent axial load using equations A-6, A-7, A-8, and Fig. A8.

Equivalent bending moment T_{ke}

$$T_{ke} = 10^{-3} \cdot (C_{f2} \cdot B_{f2} \cdot F_{R2} \cdot \ell_r + C_{f2} \cdot B_{f2} \cdot F_{A2} \cdot \ell_a) < T_{k\,max}$$ (Equation A-7)

Equivalent axial load F_{A2e} at the output shaft

$$F_{A2e} = F_{A2} \cdot C_{f2} \cdot B_{f2} < F_{A2\,max}$$ (Equation A-8)

F_{A2} = output side axial load [N]
$F_{A2\,max}$ = maximum permissible output side axial load [N]
F_{A2e} = equivalent output side axial load [N]
F_{R2} = output side radial load [N]
C_{f2} = correction factor output (Table A18)
B_{f2} = service factor output (Table A19)
ℓ_1 = bearing clearance [mm] (Table A17)
ℓ_r = calculated dimension for bending moment [mm]
ℓ_a = distance of axial load [mm]
x = distance from radial force to flange collar [mm]
a = correction factor [mm] (Table A17)
T_k = external bending moment [Nm]
$T_{k\,max}$ = maximum permissible bending moment [Nm] (Table A20)
T_{ke} = equivalent bending moment [Nm]
φ_1 = tilt angle [arcmin]
Θ_1 = moment stiffness main bearing [Nm/arcmin] (Table A21)

Correction factor output	C_{f2}
Chain	1
Gear or pinion	1.25
Timing belt	1.25
V-Belt	1.5

Table A18 Correction factor output C_{f2}

Service factor output	B_{f2}
Uniform load	1
Light impacts	1.2
Severe impacts	1.6

Table A19 Service factor output B_{f2}

Size	Max. permissible bending moment $T_{k\,max}$	Max. permissible axial load $F_{A2\,max}$	
		Tension	Compression
	[Nm]	[N]	[N]
A15	608	2450	3920
A25	1030	3920	5400
A35	1620	5400	7850
A45	2550	6870	11800

Table A20 Max. permissible bending moment and max. permissible axial load

Size	Moment stiffness Θ_1
	[Nm/arcmin]
A15	230
A25	400
A35	950
A45	1600

Table A21 Average values for moment stiffness

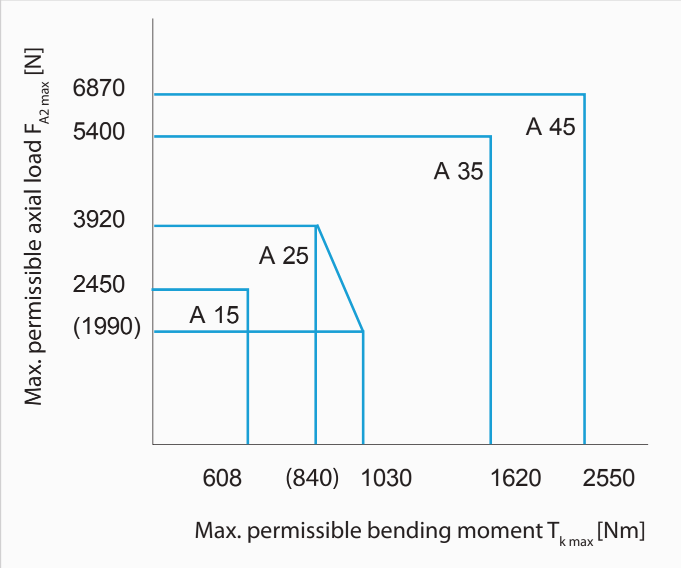


Fig. A8 Max. permissible bending moment and axial load

Fine Cyclo - F3C-A

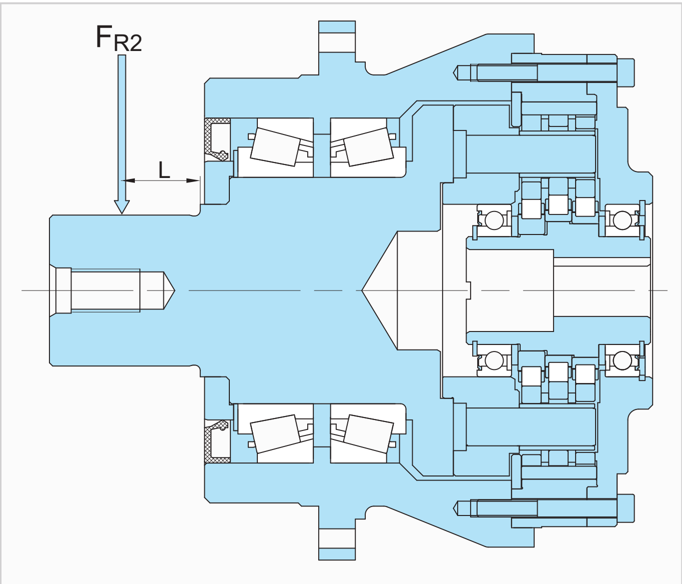


Fig. A9 Load position output

If the output shaft is fitted with a pinion or a disc, a force acts on the shaft. The following equation is used to check whether the shaft load is permissible.

Radial load F_{R2} [kN]

$$F_{R2} = \frac{T_{2V} \cdot L_{f2} \cdot B_{f2} \cdot C_{f2}}{r_0} \leq F_{R2\,zul} \qquad \text{(Equation A-12)}$$

Radial load

F_{R2zul} = permissible radial load [kN]
T_{2V} = reference torque [Nm]
L_f = load factor
B_f = service factor
C_f = correction factor
r_0 = pitch circle radius of the pinion [mm]

Correction factor output	C_{f2}
Chain	1
Gear or pinion	1.25
Timing belt	1.25
V-Belt	1.5

Table A22 Correction factor output C_{f2}

Service factor output	B_{f2}
Uniform load	1
Light impacts	1.2
Severe impacts	1.6

Table A23 Service factor output B_{f2}

n_{2m} [min^{-1}]	Permissible radial load $F_{R2\ zul}$ [kN] for F3C-					
	A15	A25	A35	A45	A65	A75
~ 5	17.4	31.8	44.4	87.9	126	157
10	17.4	31.8	44.4	81.2	114	153
15	17.4	31.8	44.4	71.7	114	135
20	17.4	31.8	44.4	65.6	104	124
25	17.4	31.8	41.1	61.2	97.5	115
30	17.4	29.8	38.8	57.9	92.5	109
35	17.4	28.4	37.0	55.2	88.2	104
40	17.4	27.3	35.5	52.9	84.6	100
50	17.4	25.4	33.2	49.4	78.9	93.5
60	17.4	24.1	31.3	46.6		
80		22.0				

Table A24 Permissible radial load $F_{R2\ zul}$

L [mm]	Load factor L_{f2} for F3C-					
	A15	A25	A35	A45	A65	A75
10	0.91	0.86				
15	0.97	0.92	0.88	0.85		
20	1.03	0.97	0.93	0.88	0.84	
25	1.09	1.03	0.98	0.92	0.88	0.86
30	1.16	1.08	1.02	0.98	0.91	0.89
35	1.22	1.14	1.07	1.00	0.94	0.92
40		1.19	1.12	1.04	0.97	0.95
45		1.25	1.16	1.08	1.00	0.97
50			1.21	1.12	1.03	1.00
60				1.19	1.09	1.05
70				1.27	1.16	1.11
80					1.22	1.16
90					1.28	1.22
100						1.27

Table A25 Load factor L_{f2}

5.8 Lubrication

- The gearboxes of the Fine Cyclo A Series are filled with grease before delivery and are ready to use.
- Reconditioning is recommended after 20,000 operating hours, but at least every 3-5 years.
- The lifetime of the gearbox can be increased by returning it to the factory for overhauling and regreasing.

Specified grease	Manufacturer
CITRAX FA NO. 2	Kyodo Yushi Co., Ltd.
Conditions for use: Ambient temperature -10 °C to +40 °C	

Table A26 Specified grease for the A Series

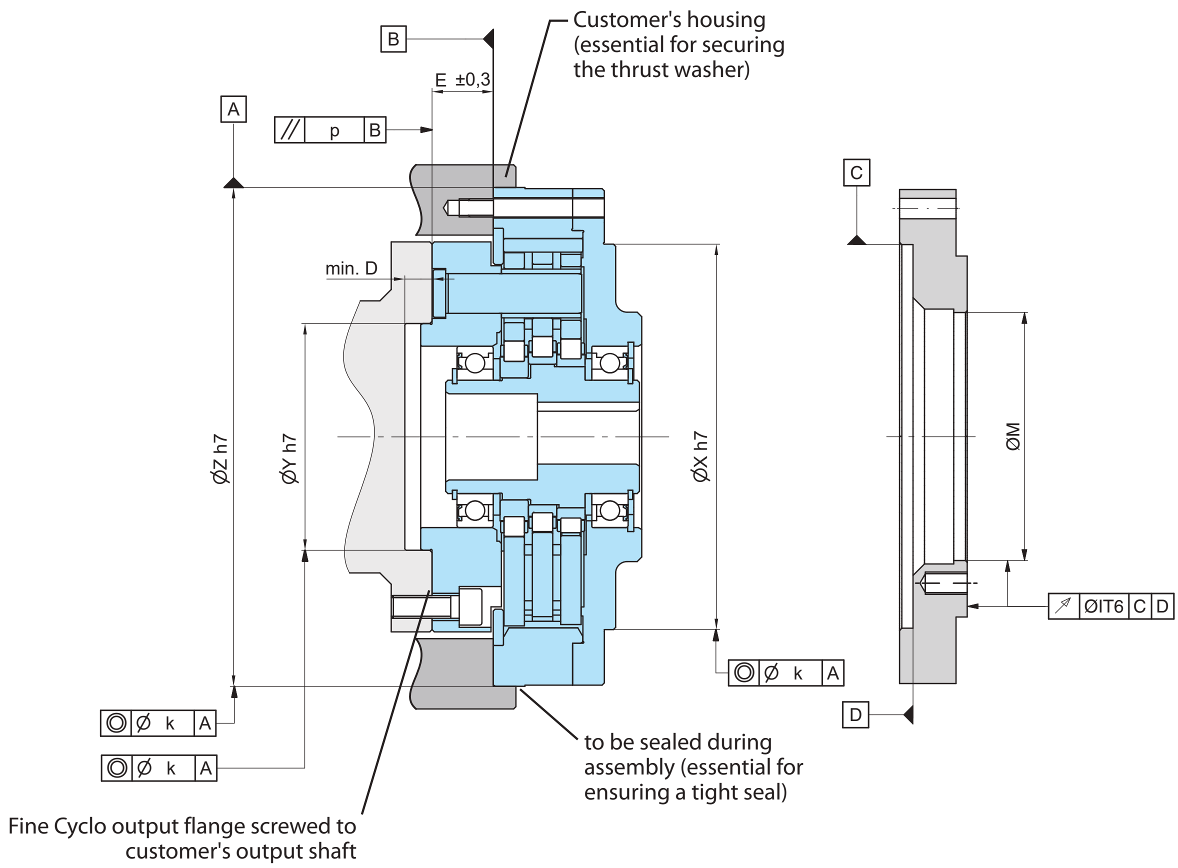
5.9 Model FC-A

5.9.1 Assembly tolerances

In order for the thrust washer to be held by the customer's housing, the internal diameter B must not exceed the specified values. The depth of the output shaft spigot must be equal to or less than dimension "D" to prevent jamming the output flange. Furthermore, dimension "E" must be adhered to. The recommended accuracy of the assembly part (housing and output shaft) must lie within coaxiality "k" and parallelism "p".

The recommended diameters of the centerings of the housing, output shaft, and input side flange are shown schematically below.

To ensure the function, lifetime, and characteristics of the gearbox, the radial run-out of the shaft ends, the coaxiality and the axial run-out of the fastening surface as per EN 50347:2001 are recommended.
When used in high-precision applications, the tolerance according to EN 50347:2001 should be reduced by 50%, which has additional advantages.



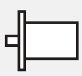
Size	Ø M	Ø X	Ø Y	Ø Z	D	E	k	p
A15	 Motor centering	85	45	115	5	15.5	0.030	0.025
A25		110	60	145	6	21	0.030	0.035
A35		135	80	180	6	24	0.030	0.040
A45		170	100	220	8	27	0.030	0.050
A65		210	130	270	8	33	0.030	0.065
A75		235	150	310	8	38	0.030	0.070

Table A27 (Dimensions in mm)

5.9.2 Tightening torque and maximum permissible transmittable torque for bolts

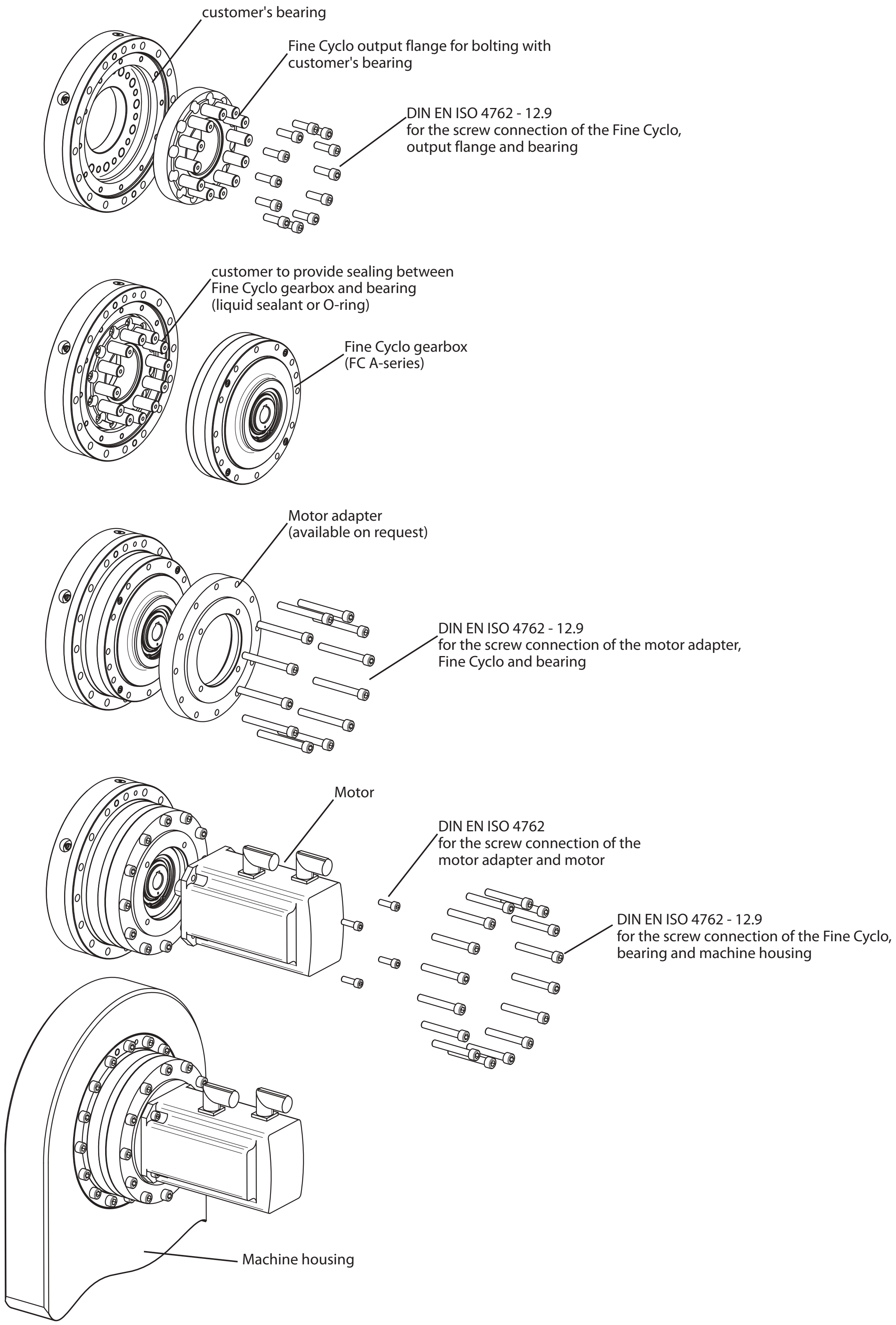
The permissible transmitted torque for bolts and the number, size, and tightening torque for fastening the output side flange and the ring gear housing are listed in Table A28. In the event of an Emergency Stop with corresponding load peaks, the output flange and ring gear housing bolts must all be replaced.

Size	Output flange bolts		Bolts for ring gear (housing)		Max. permissible transmittable torque for bolts [Nm]
	Number and size of bolts	Tightening torque [Nm]	Number and size of bolts	Tightening torque [Nm]	
A15	12 × M5	9.2	8 × M5	9.2	470
A25	12 × M6	16	8 × M6	16	830
A35	12 × M8	39	8 × M8	39	1900
A45	12 × M10	77	12 × M8	39	3550
A65	12 × M12	135	12 × M10	77	7000
A75	12 × M12	135	12 × M10	77	8000

Table A28

- **Bolting:** Use metric hexagon socket head cap screws (DIN 4762, strength category 12.9).
- **Countermeasure for bolts loosening:** Use adhesives (Loctite 262, etc.) or spring washer (DIN 127A).
- **Use spring washers** (DIN 6796) when connecting the gearbox to the flange side, so that the bolt contact faces do not get damaged.

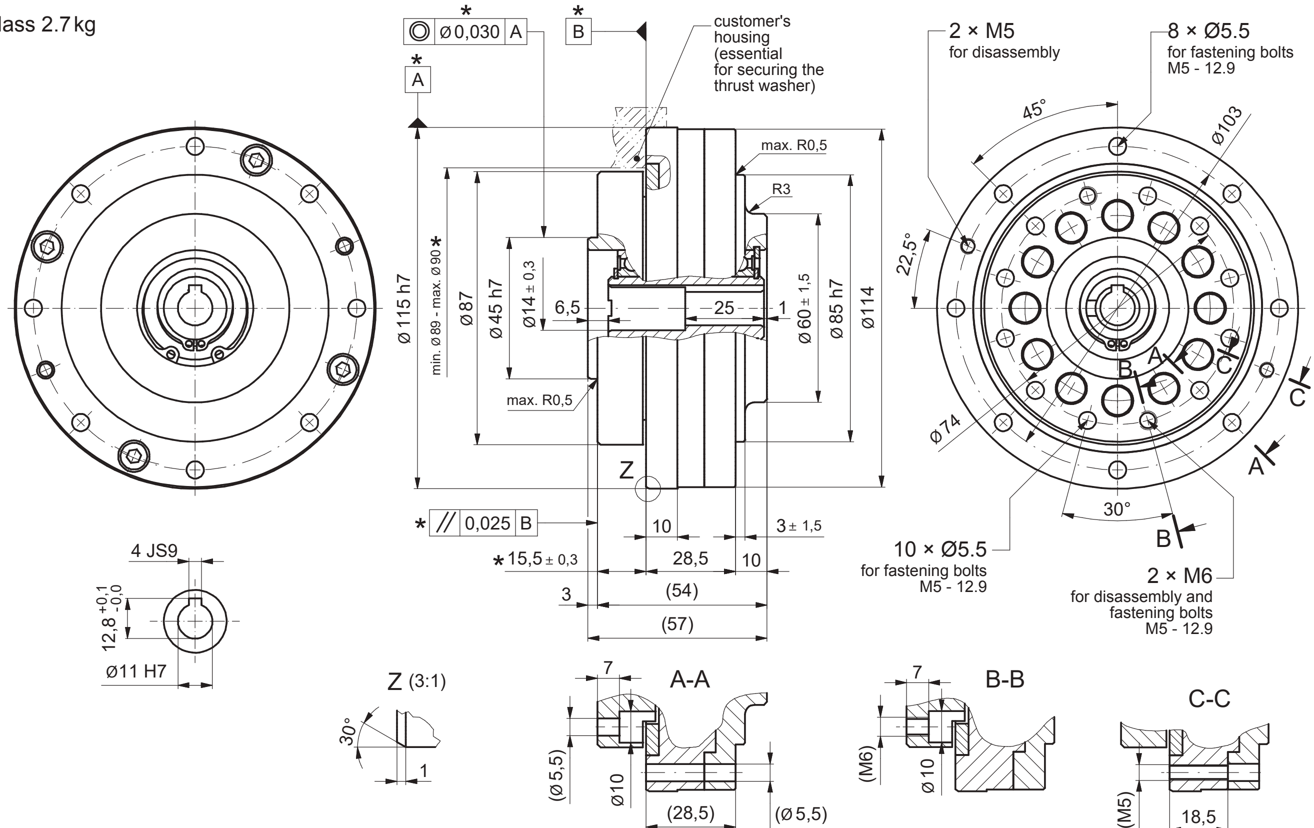
5.9.3 Installation example



5.9.4 Dimensioned drawings

FC-A15G

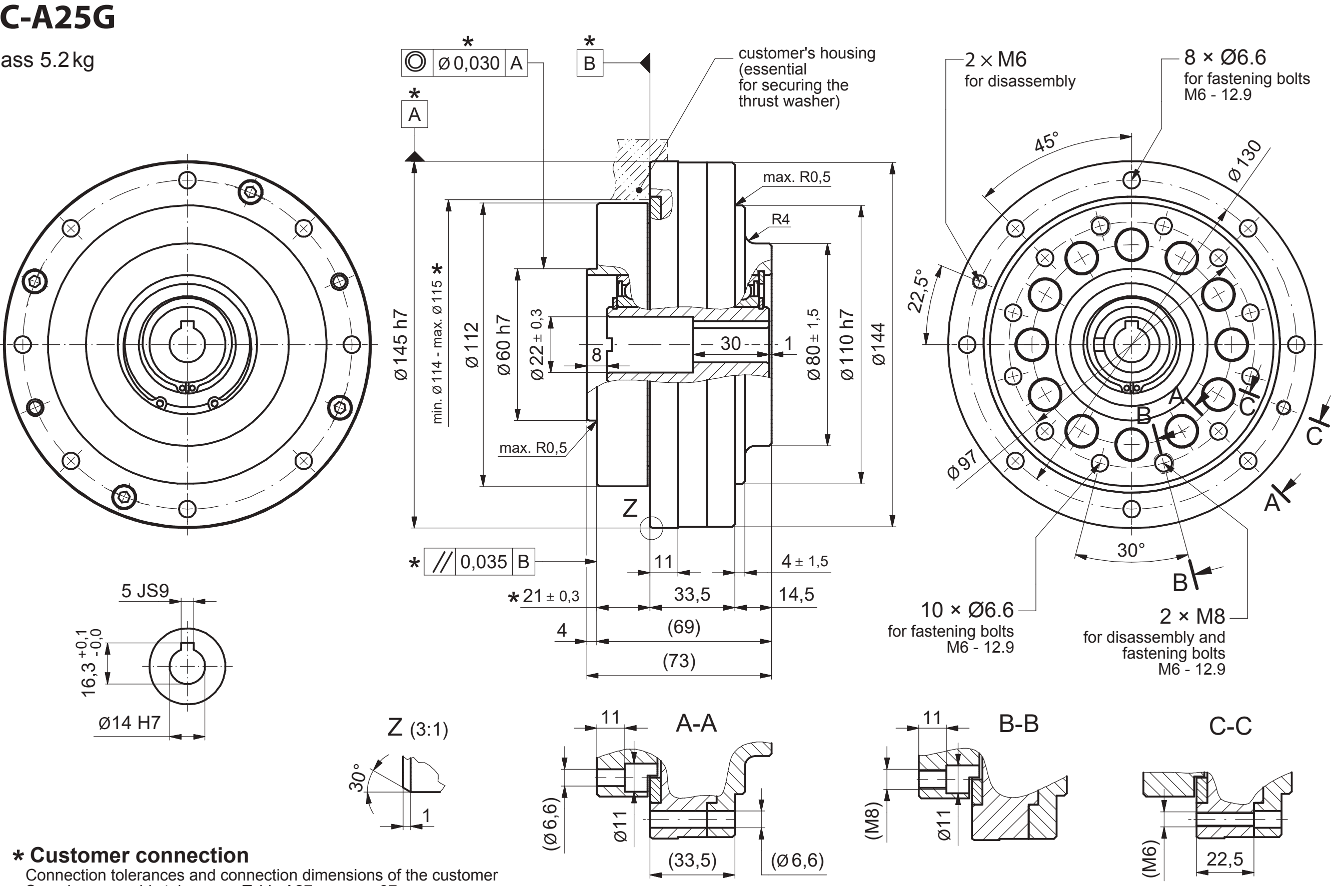
Mass 2.7 kg



* **Customer connection**
Connection tolerances and connection dimensions of the customer
See also assembly tolerances Table A27 on page 37

FC-A25G

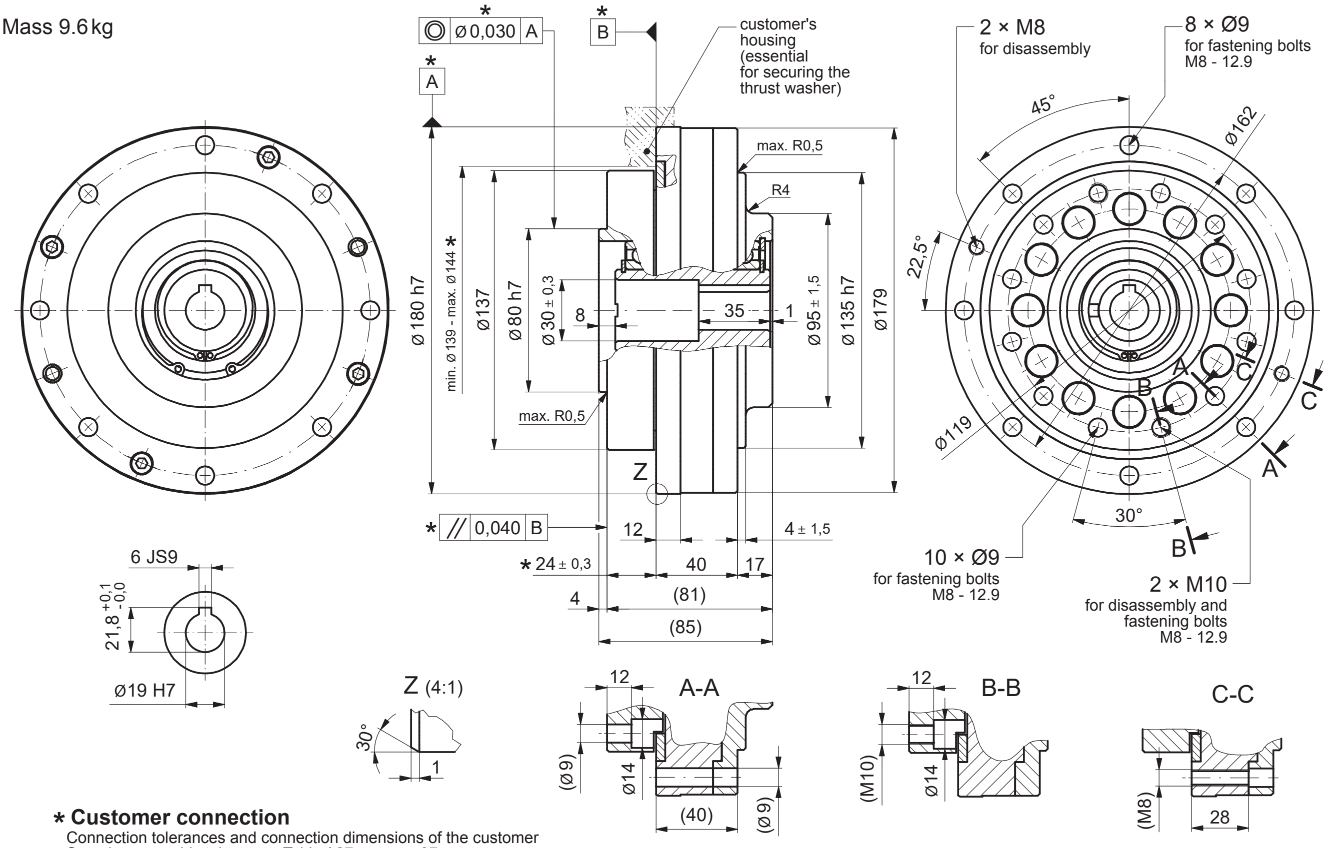
Mass 5.2 kg



* **Customer connection**
Connection tolerances and connection dimensions of the customer
See also assembly tolerances Table A27 on page 37

FC-A35G

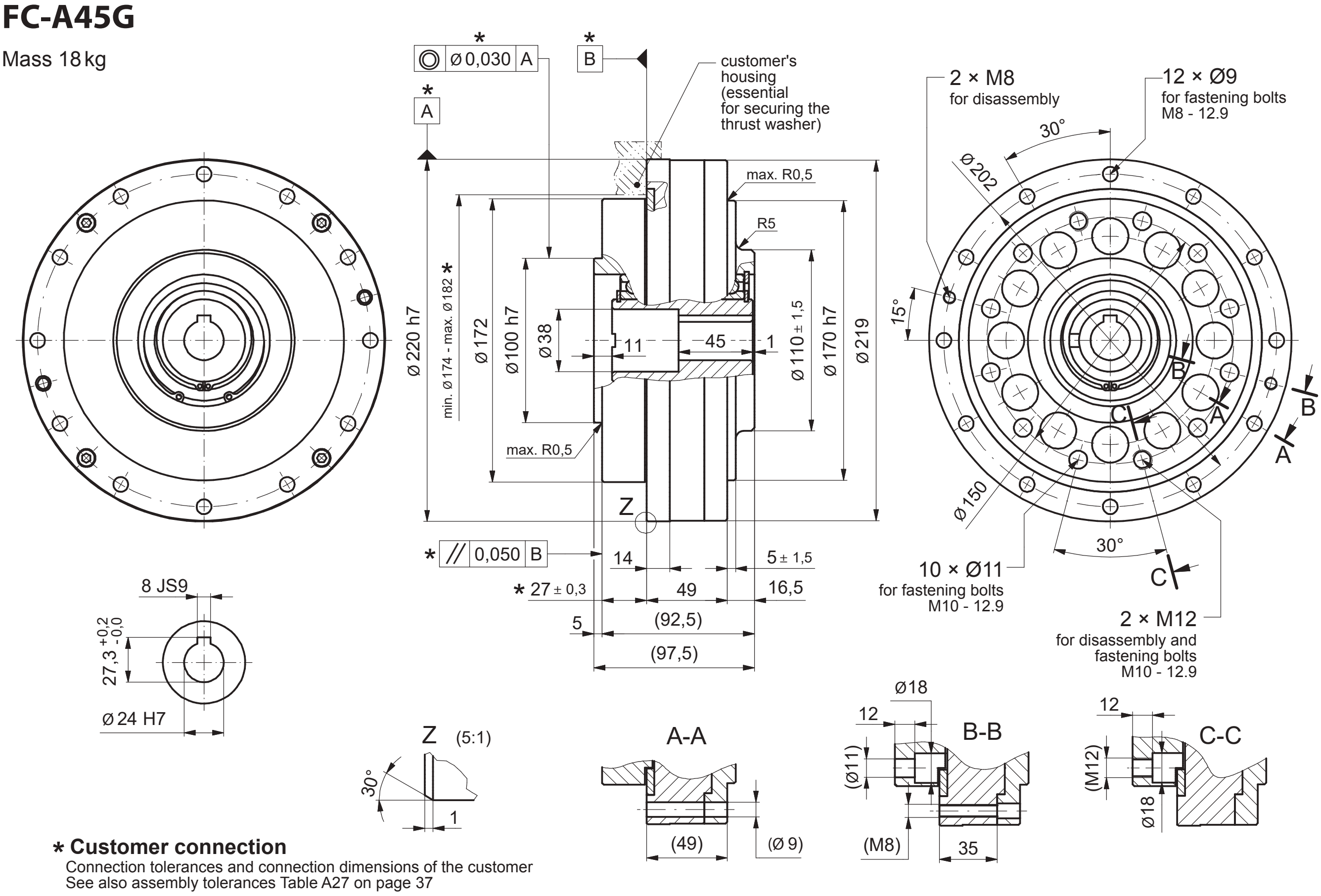
Mass 9.6 kg



* **Customer connection**
Connection tolerances and connection dimensions of the customer
See also assembly tolerances Table A27 on page 37

FC-A45G

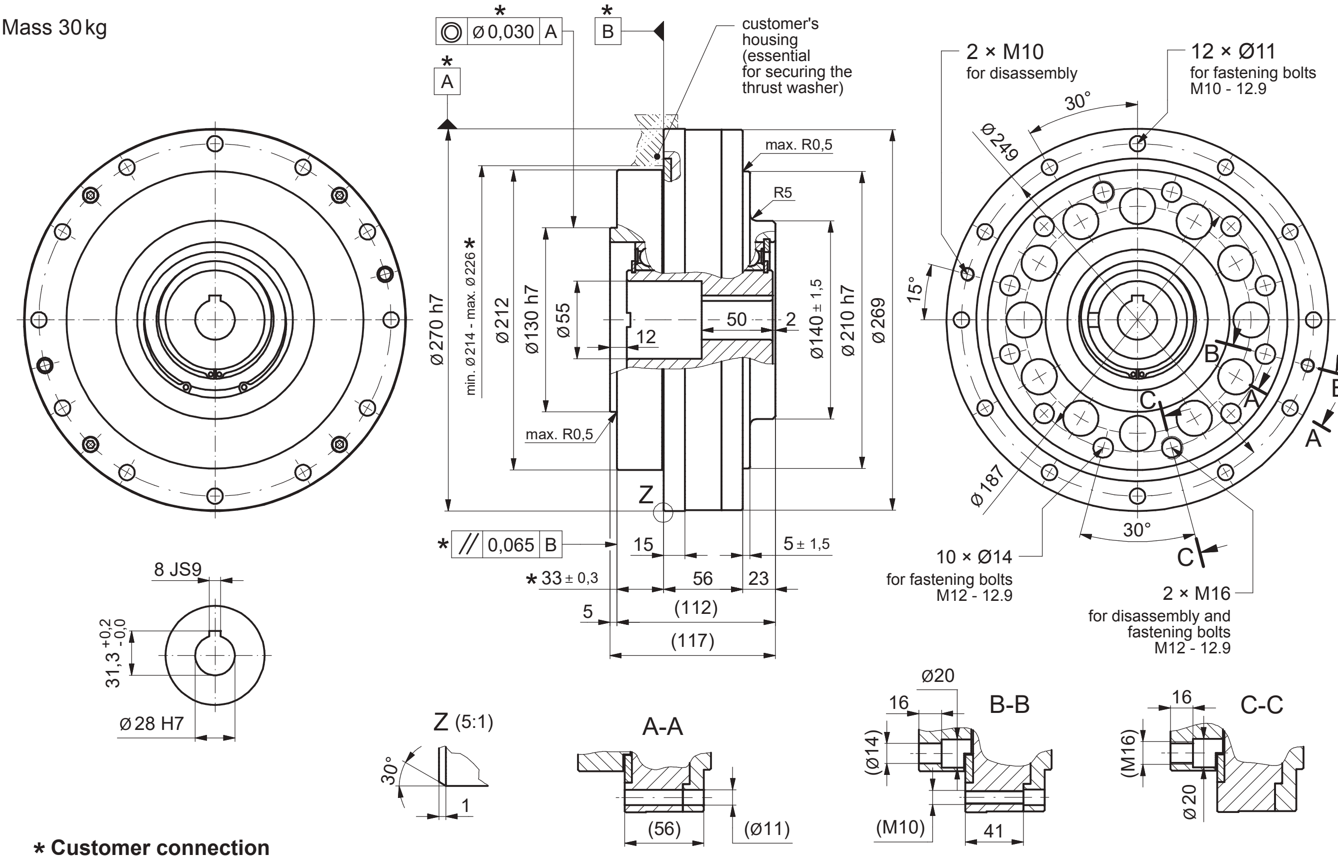
Mass 18 kg



* **Customer connection**
Connection tolerances and connection dimensions of the customer
See also assembly tolerances Table A27 on page 37

FC-A65G

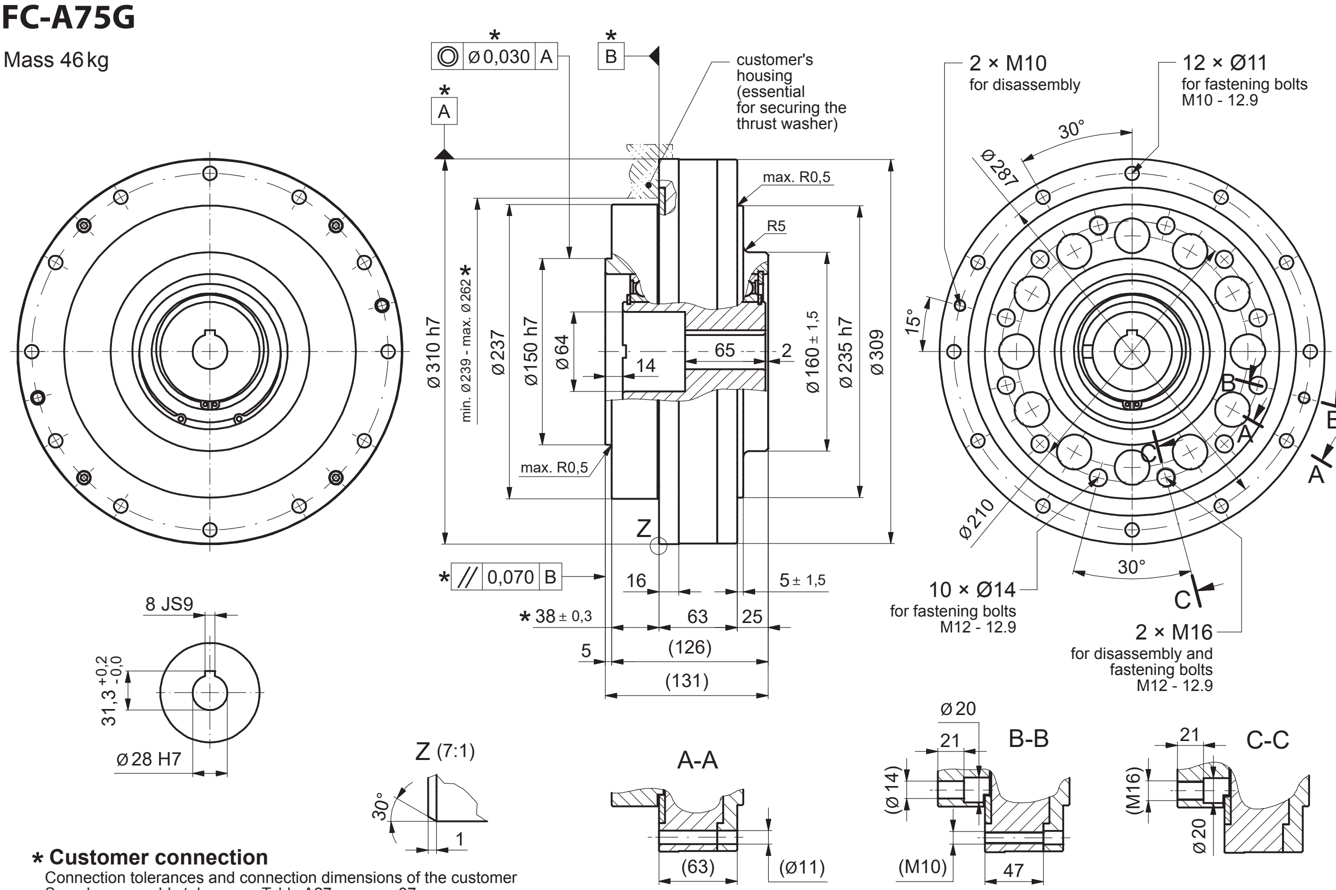
Mass 30 kg



* **Customer connection**
Connection tolerances and connection dimensions of the customer
See also assembly tolerances Table A27 on page 37

FC-A75G

Mass 46 kg

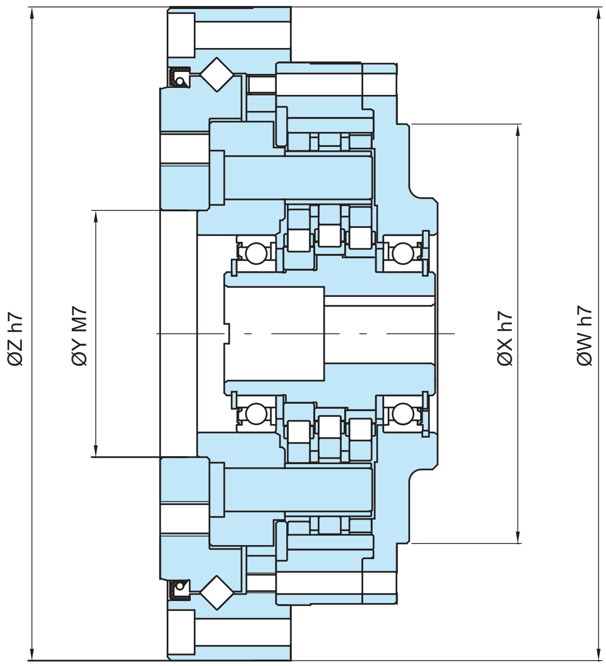


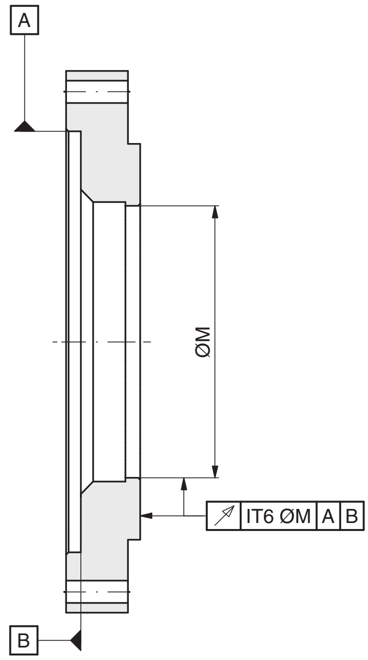
* **Customer connection**
Connection tolerances and connection dimensions of the customer
See also assembly tolerances Table A27 on page 37

5.10 Model F1C-A

5.10.1 F1C-A assembly tolerances

To ensure the function, lifetime, and characteristics of the gearbox, the radial run-out of the shaft ends, the coaxiality and the axial run-out of the fastening surface as per EN 50347:2001 are recommended. When used in high-precision applications, the tolerance according to EN 50347:2001 should be reduced by 50%, which has additional advantages.





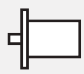
Size	Ø X	Ø Y	Ø Z	Ø M
A15	85	45 h7	140	 Motor centering
A25	110	60 h7	170	
A35	135	80 h7	205	
A45	170	100 M7	265	
A65	210	130 M7	350	
A75	235	150 M7	430	

Table A29 (Dimensions in mm)

5.10.2 Tightening torque and maximum permissible transmittable torque for bolts

The permissible transmitted torque for bolts and the number, size, and tightening torque for fastening the output side flange and the ring gear housing are listed in Table A30. In the event of an Emergency Stop with corresponding load peaks, the output flange and ring gear housing bolts must all be replaced.

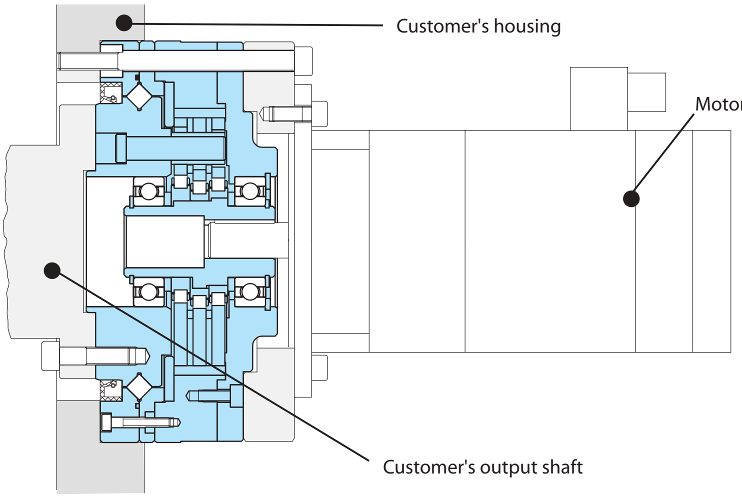
Size	Output flange bolts		Bolts for ring gear (housing)		Max. permissible transmittable torque for bolts [Nm]
	Number and size of bolts	Tightening torque [Nm]	Number and size of bolts	Tightening torque [Nm]	
A15	12 × M6	16	12 × M6	16	750
A25	12 × M8	39	12 × M8	39	1700
A35	12 × M10	77	12 × M10	77	3150
A45	12 × M14	210	16 × M10	77	3550
A65	16 × M16	330	20 × M12	135	7000
A75	16 × M16	330	20 × M12	135	8000

Table A30

- **Bolting:** Use metric hexagon socket head cap screws (DIN 4762, strength category 12.9).
- **Countermeasure for bolts loosening:** Use adhesives (Loctite 262, etc.) or spring washer (DIN 127A).
- **Use spring washers** (DIN 6796) when connecting the gearbox to the flange side, so that the bolt contact faces do not get damaged.

5.10.3 Installation example

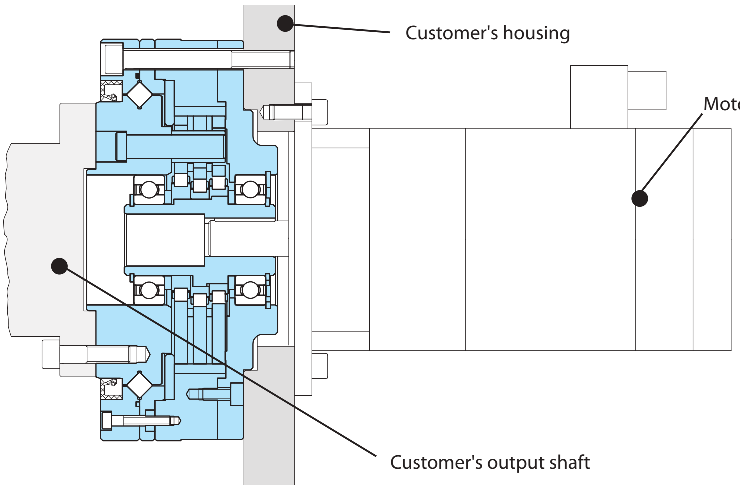
(1)



The motor is connected via an intermediate flange with the Fine Cyclo F1C-A gearbox and bolted onto the customer's housing.

The customer's output shaft is bolted to the output flange of the gearbox.

(2)



The motor and the Fine Cyclo F1C-A gearbox are both bolted onto the customer's housing.

The customer's output shaft is bolted to the output flange of the gearbox.

5.10.4 Lubrication

- The cross roller bearings of the F1C- gearboxes, sizes A45, A65 and A75, are also suitable for all mounting positions, but require regreasing after 4,000 operating hours or at least every 6 months.
- For information on regreasing quantities for the cross roller bearings and on grease types, see Table A31.

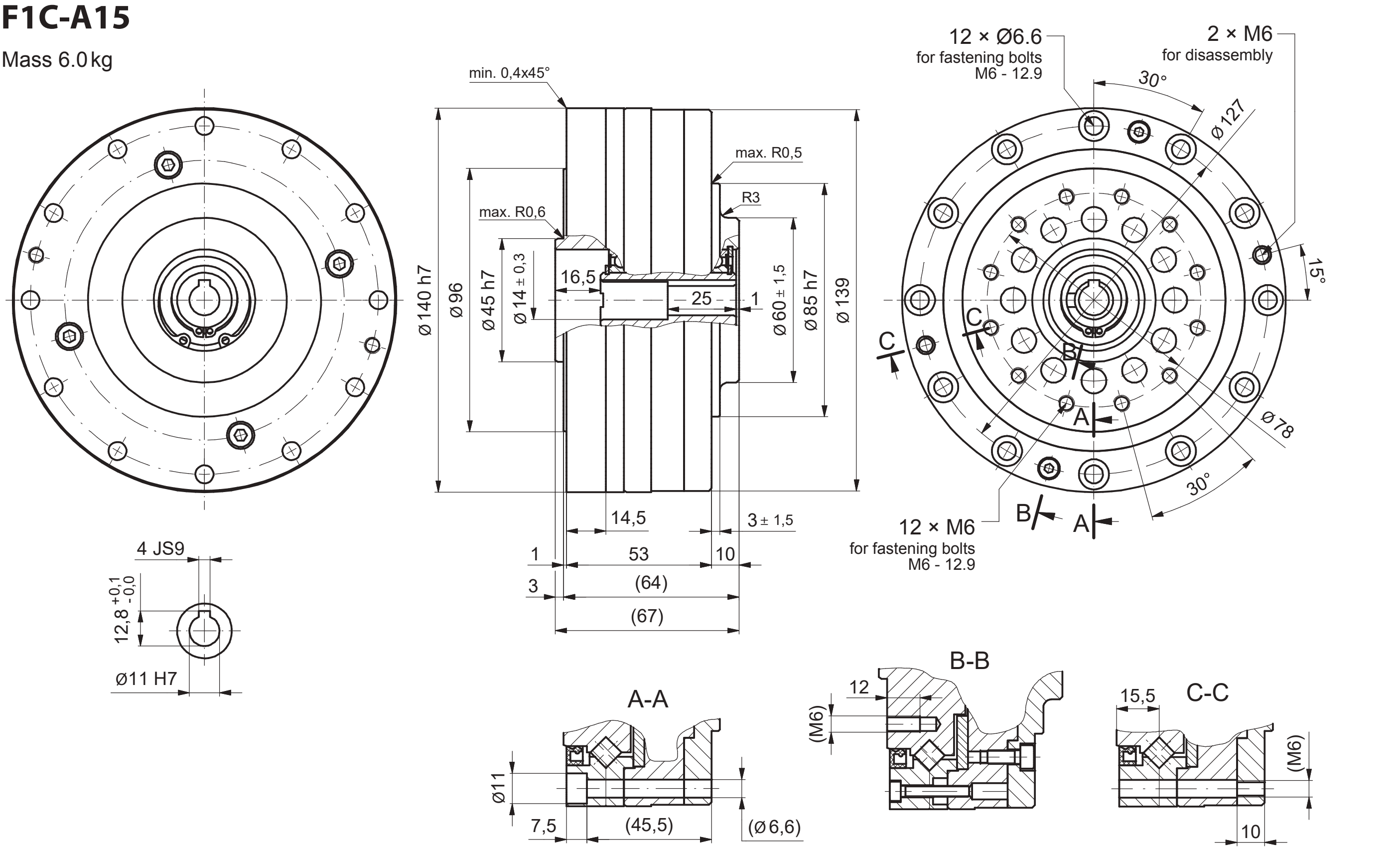
Size	Quantity of grease [g]	Manufacturer	Grease type
A45	~10 - 15	SHELL	GADUS S2 V220 2
A65	~25 - 30		
A75	~45 - 50		

Table A31 Lubrication

5.10.5 Dimensioned drawings

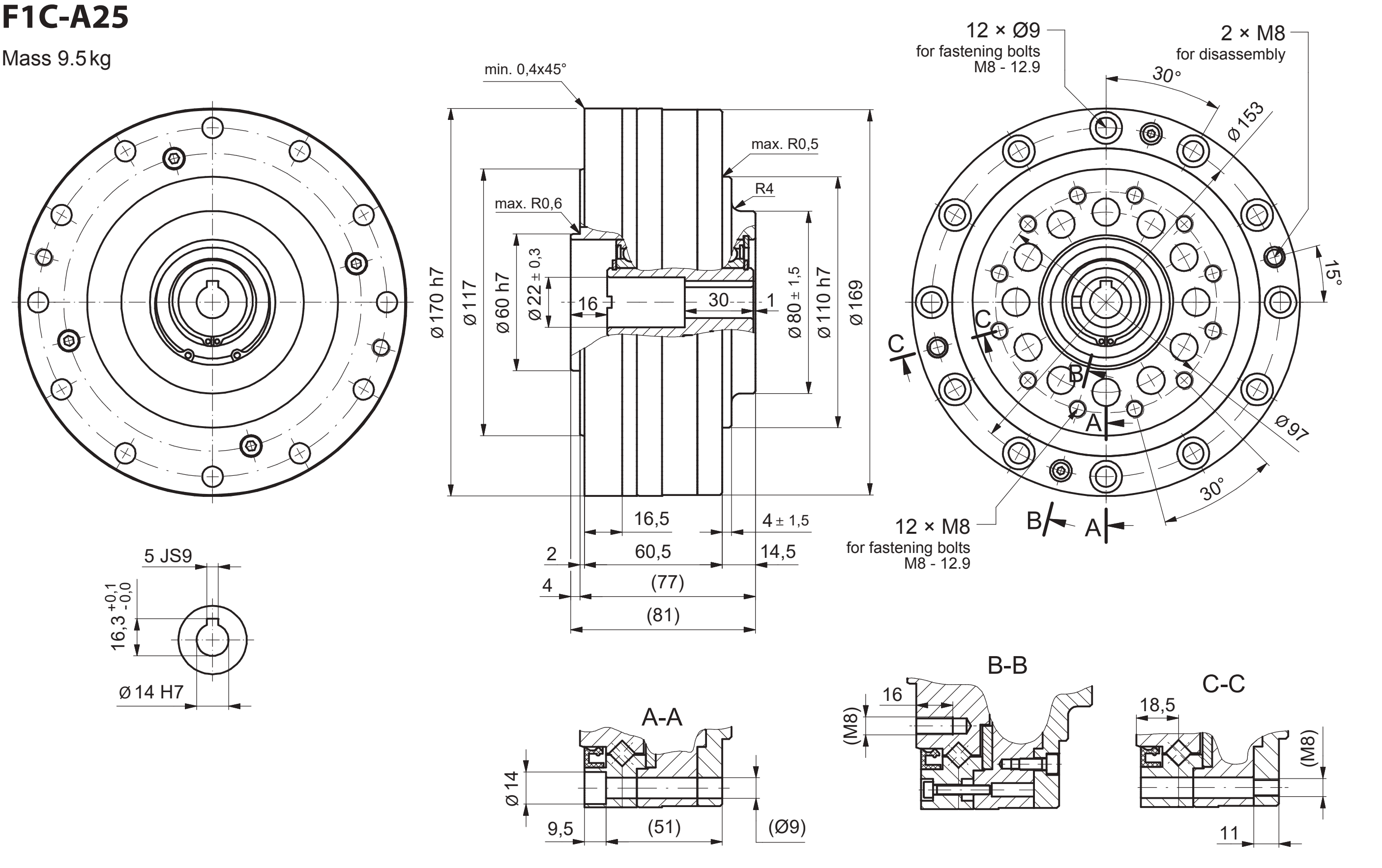
F1C-A15

Mass 6.0 kg



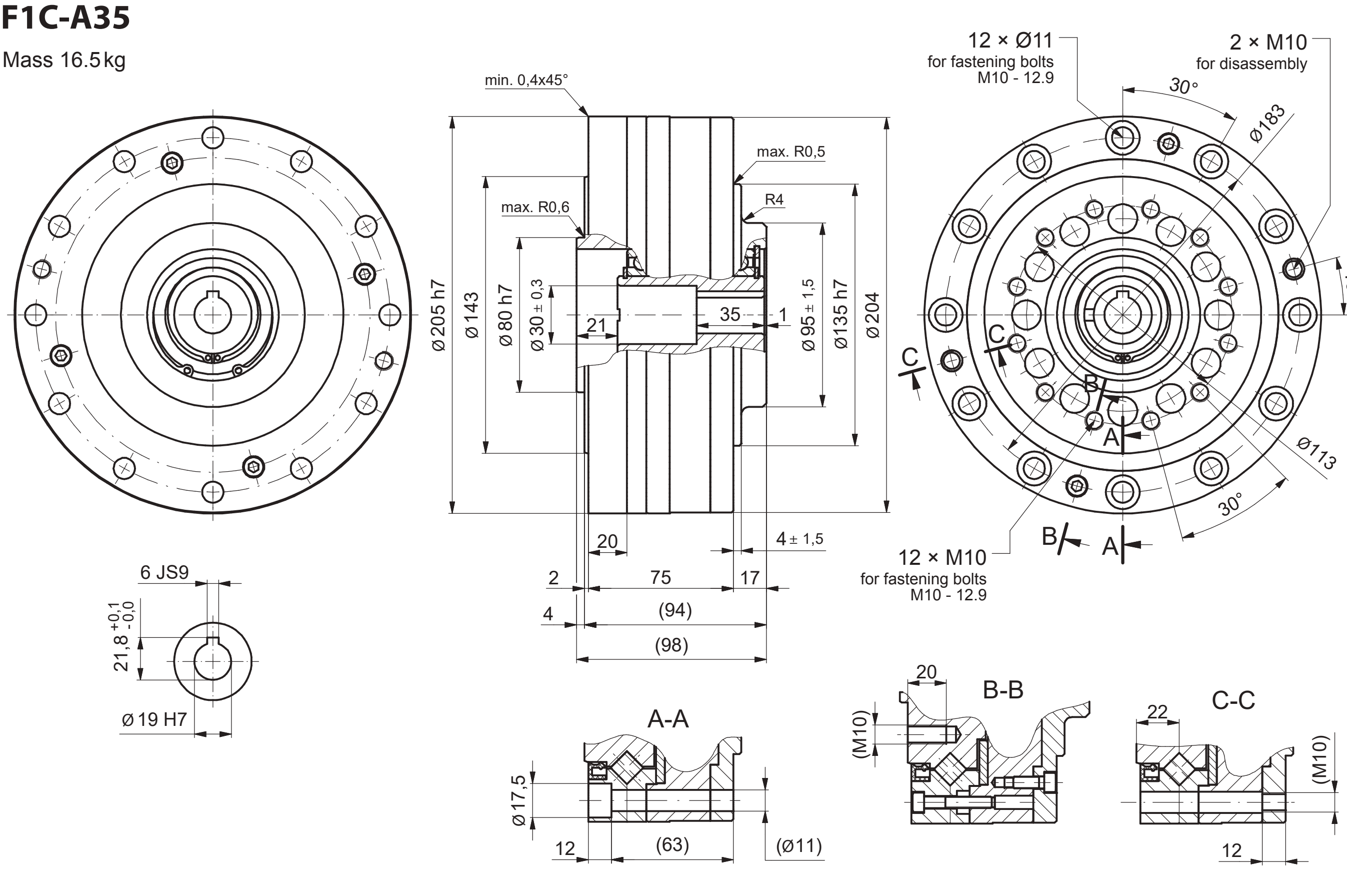
F1C-A25

Mass 9.5 kg



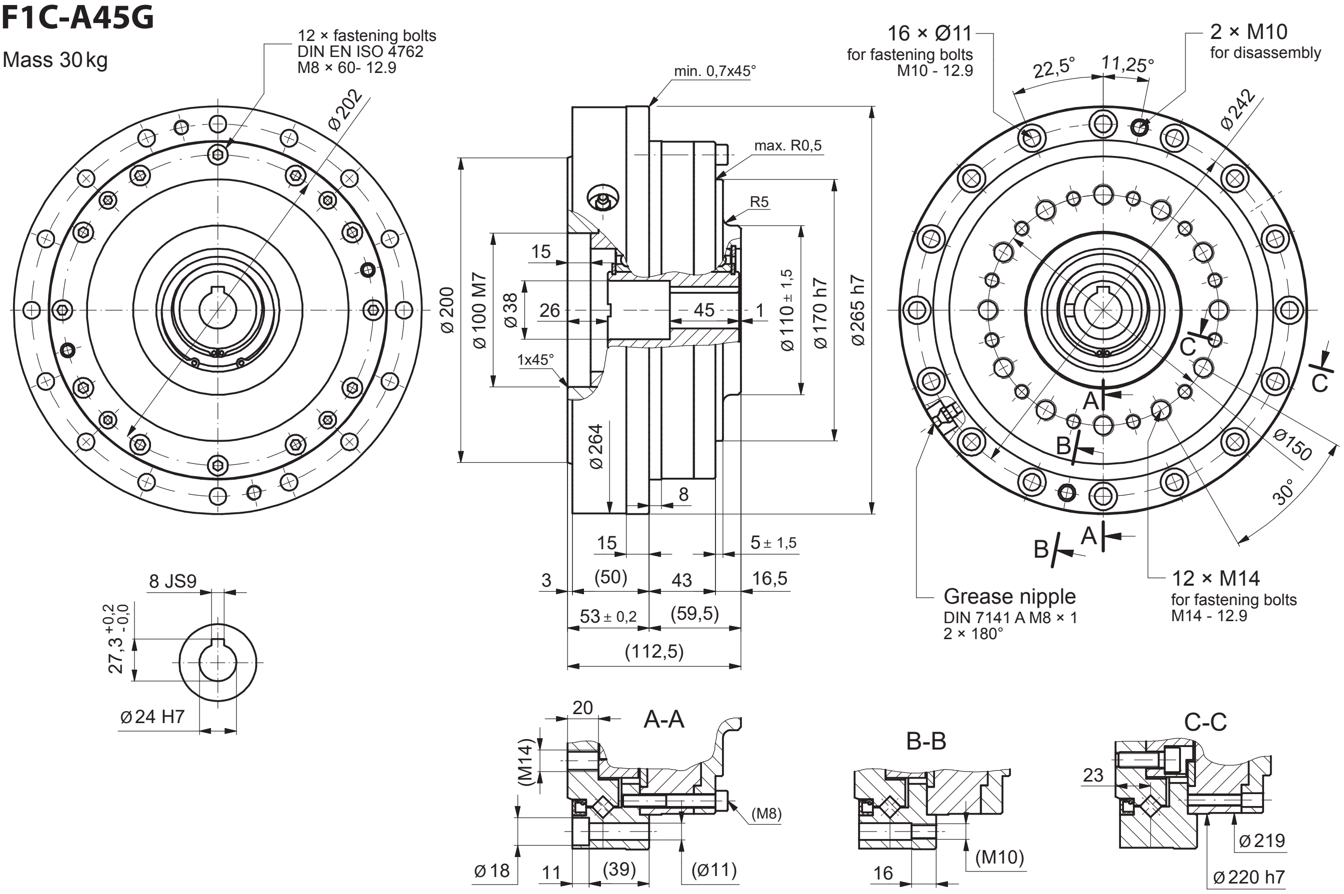
F1C-A35

Mass 16.5 kg



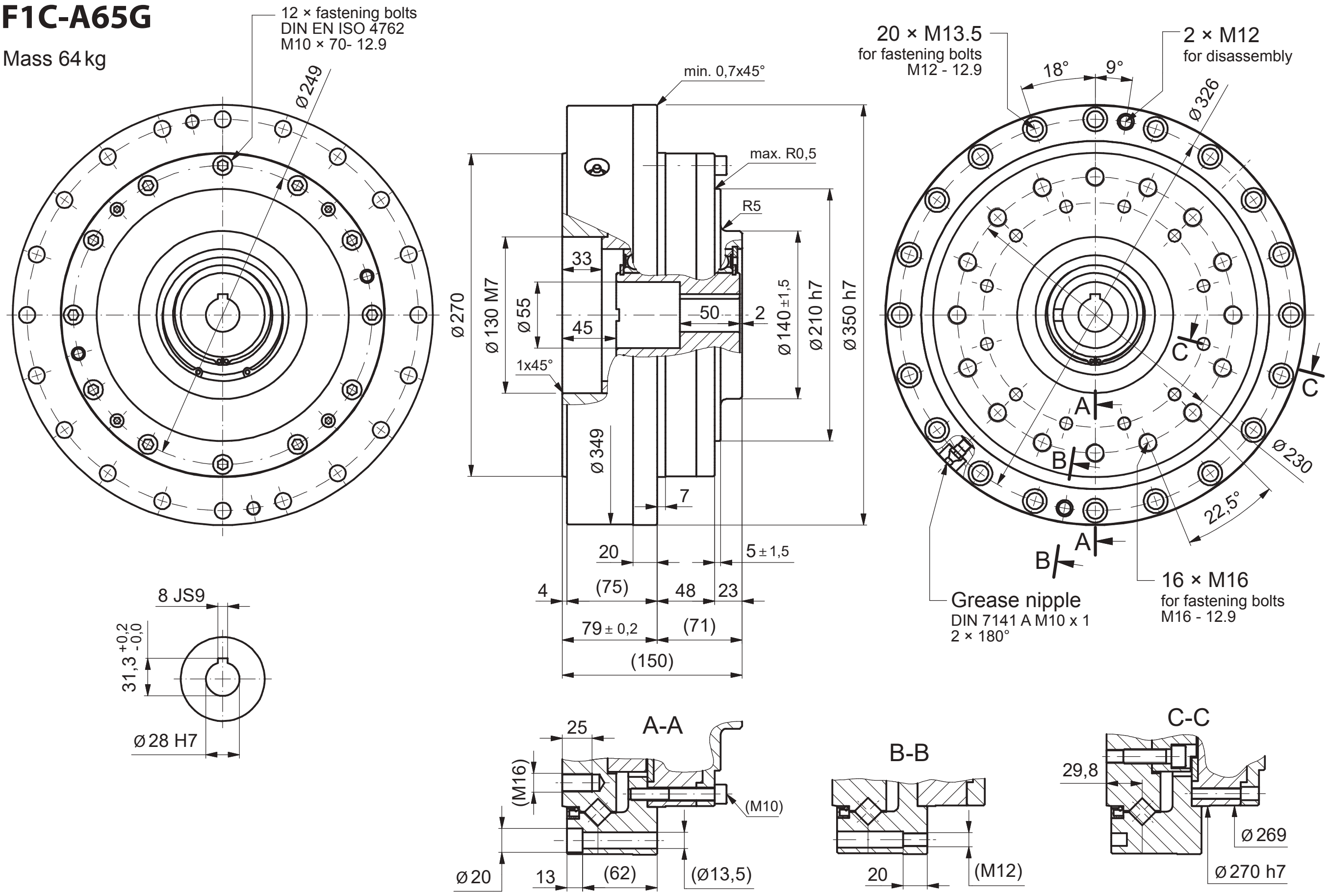
F1C-A45G

Mass 30 kg



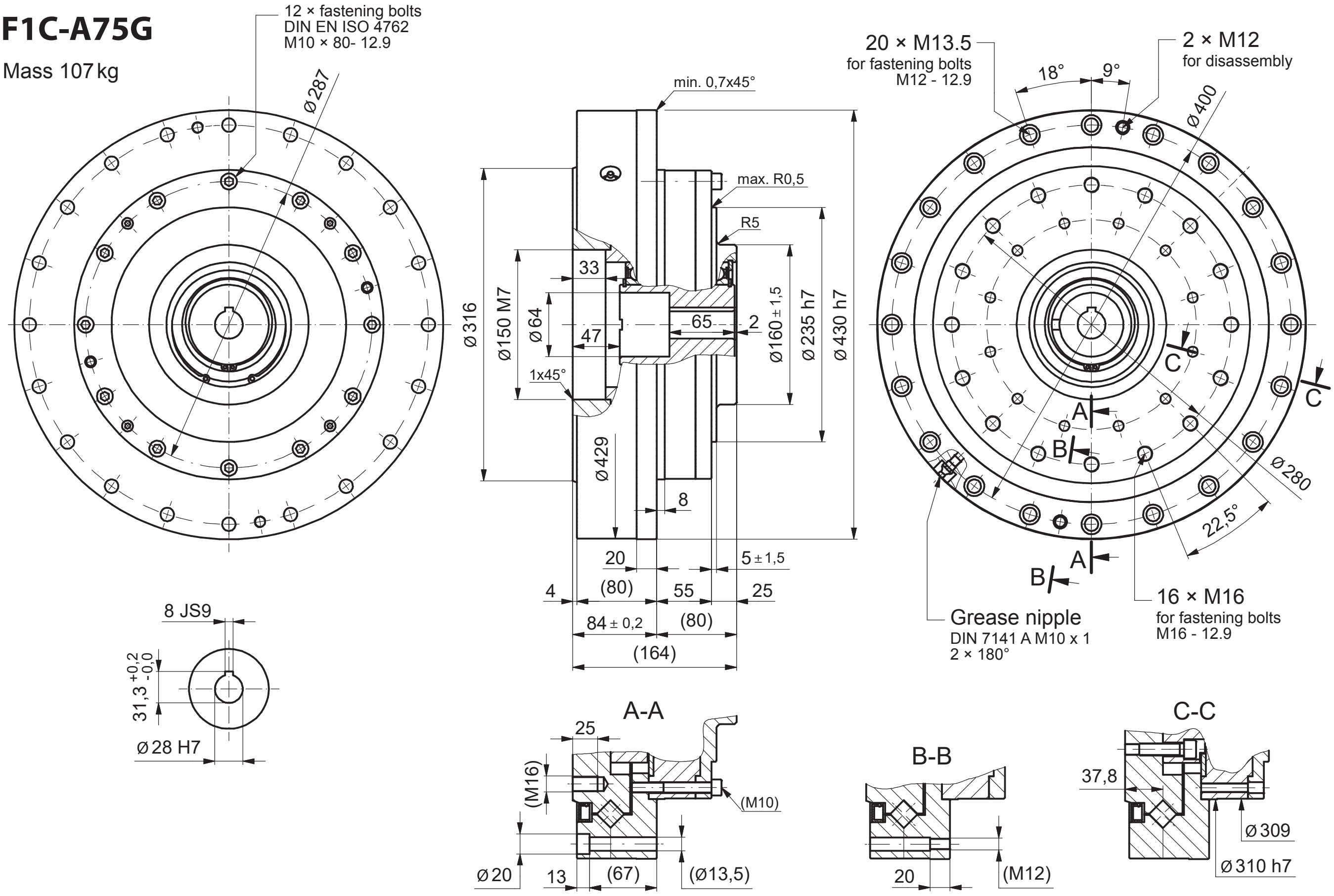
F1C-A65G

Mass 64 kg



F1C-A75G

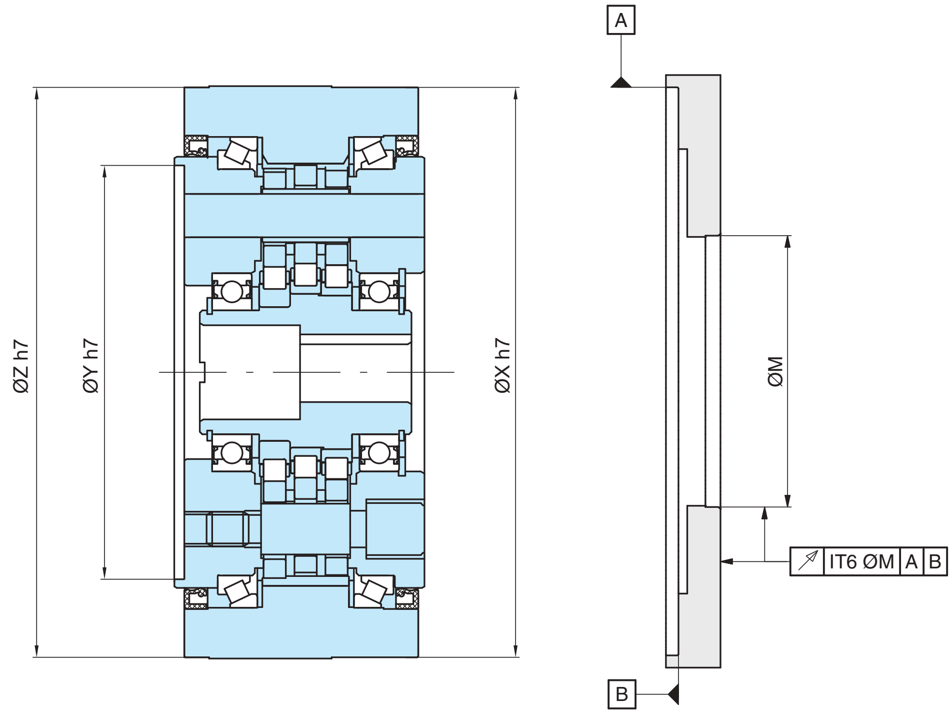
Mass 107 kg



5.11 Model F2C(F)-A

5.11.1 Assembly tolerances

To ensure the function, lifetime, and characteristics of the gearbox, the radial run-out of the shaft ends, the coaxiality and the axial run-out of the fastening surface as per EN 50347:2001 are recommended. When used in high-precision applications, the tolerance according to EN 50347:2001 should be reduced by 50%, which has additional advantages.



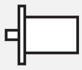
F2C-				
Size	**Ø X**	**Ø Y**	**Ø Z**	**Ø M**
A15	125	84	125	 Motor centering
A25	155	106	155	
A35	185	133	185	
A45	230	167	230	

Table A32 (Dimensions in mm)

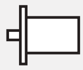
F2CF-				
Size	**Ø X**	**Ø Y**	**Ø Z**	**Ø M**
A15	123	84	124	 Motor centering
A25	160	106	160	
A35	190	133	190	
A45	220	167	220	

Table A33 (Dimensions in mm)

5.11.2 Tightening torque and maximum permissible transmittable torque for bolts

The permissible transmitted torque for bolts and the number, size, and tightening torque for fastening the output side flange and the ring gear housing are listed in Table A34. In the event of an Emergency Stop with corresponding load peaks, the output flange and ring gear housing bolts must all be replaced.

Size F2C(F)-	Output flange bolts		Bolts for ring gear (housing)		Max. permissible transmittable torque for bolts [Nm]
	Number and size of bolts	Tightening torque [Nm]	Number and size of bolts	Tightening torque [Nm]	
A15	12 × M6	16	16 × M6 (8 × M6)*	16	700
A25	12 × M8	39	12 × M8 (16 × M8)*	39	1500
A35	12 × M10	77	16 × M8	39	3200
A45	12 × M14	210	12 × M12 (16 × M10)*	135 (77)*	8200

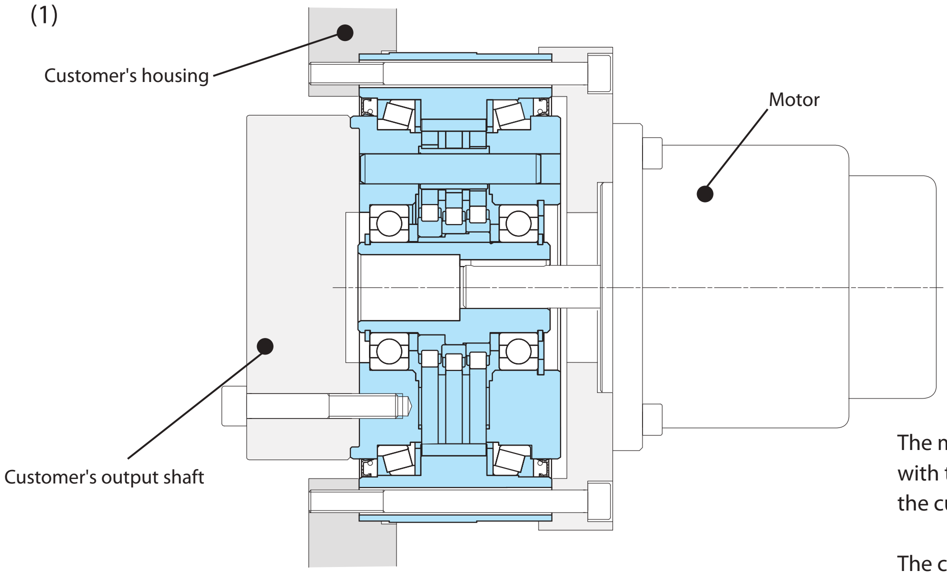
Table A34

* Values in brackets apply only for type F2C**F**-A

- **Bolting:** Use metric hexagon socket head cap screws (DIN 4762, strength category 12.9).
- **Countermeasure for bolts loosening:** Use adhesives (Loctite 262, etc.) or spring washer (DIN 127A).
- **Use spring washers** (DIN 6796) when connecting the gearbox to the flange side, so that the bolt contact faces do not get damaged.

5.11.3 Installation example

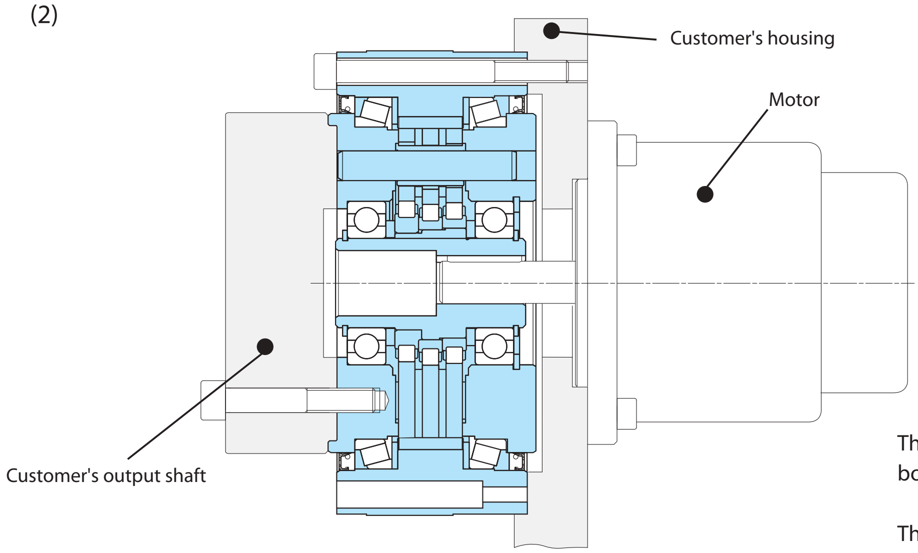
(1)



The motor is connected via an intermediate flange with the Fine Cyclo F2C-A gearbox and bolted onto the customer's housing.

The customer's output shaft is bolted to the output flange of the gearbox.

(2)



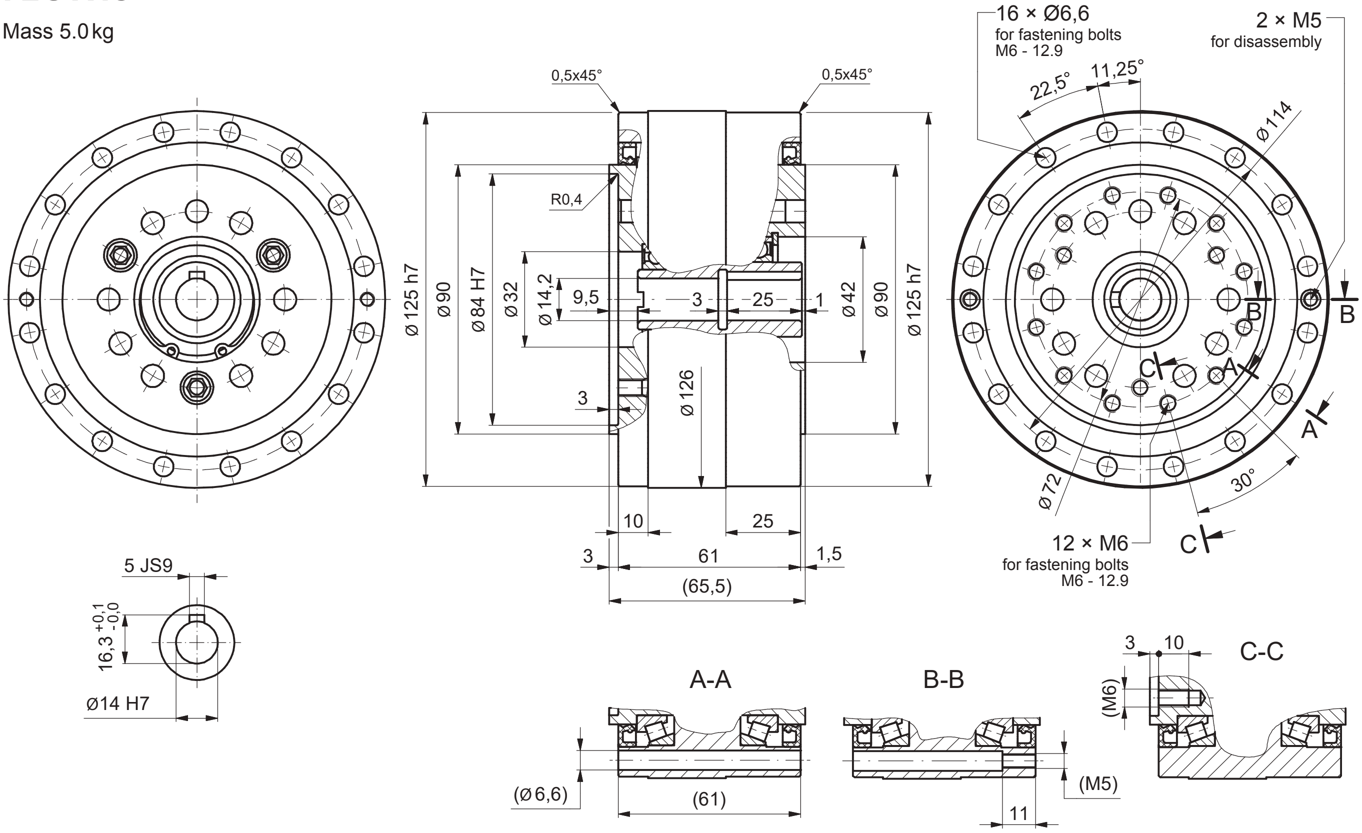
The motor and the Fine Cyclo F2C-A gearbox are both bolted onto the customer's housing.

The customer's output shaft is bolted to the output flange of the gearbox.

5.11.4 Dimensioned drawings

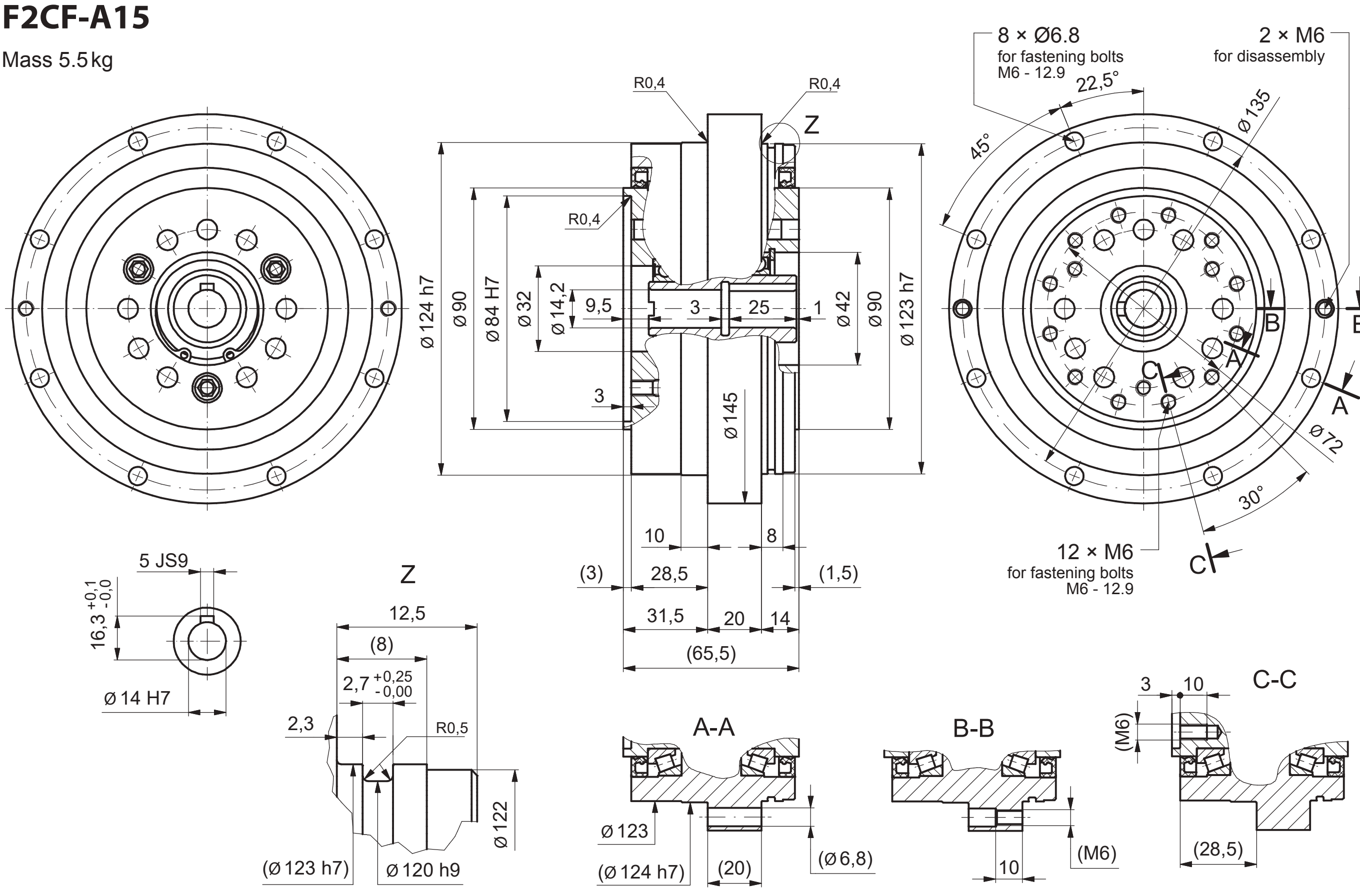
F2C-A15

Mass 5.0 kg



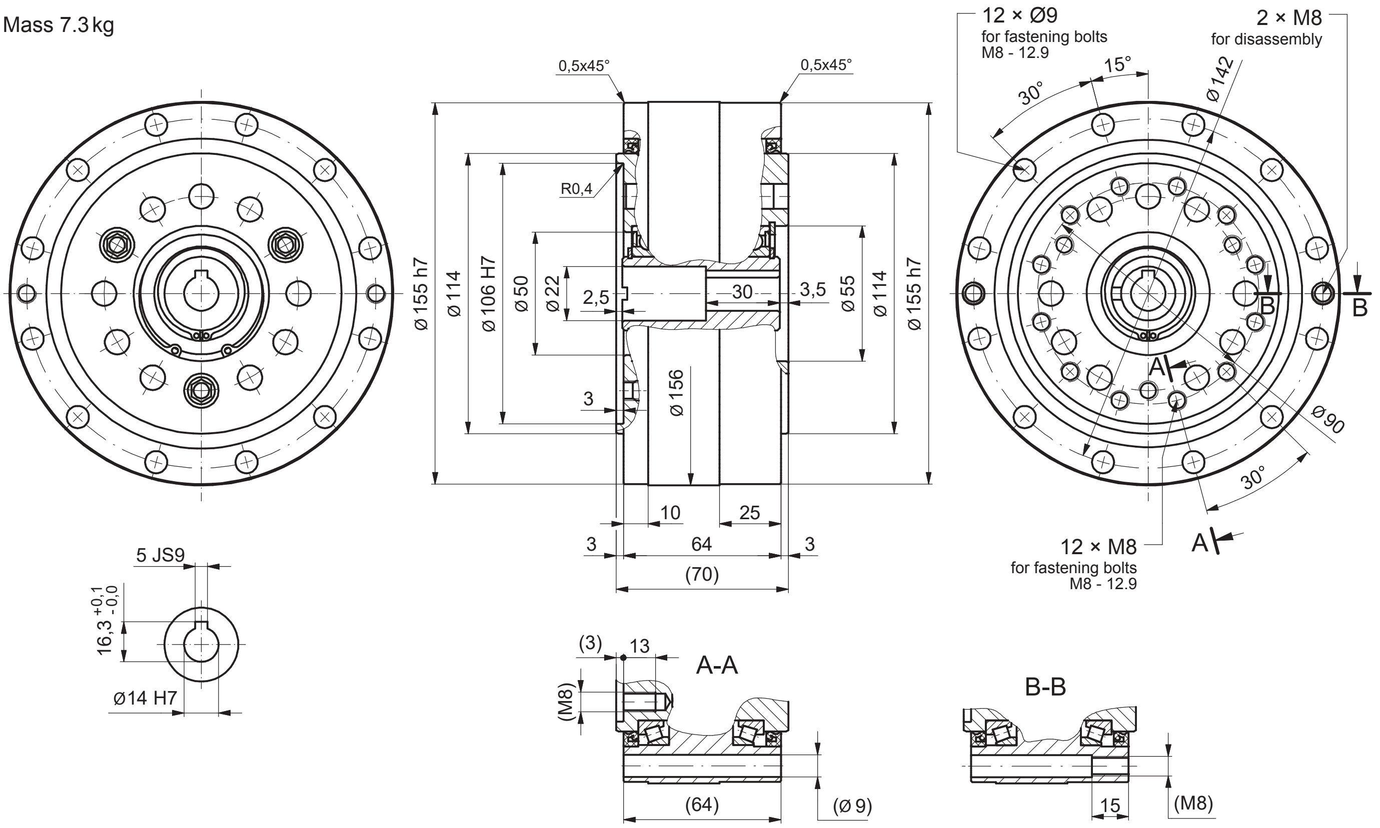
F2CF-A15

Mass 5.5 kg



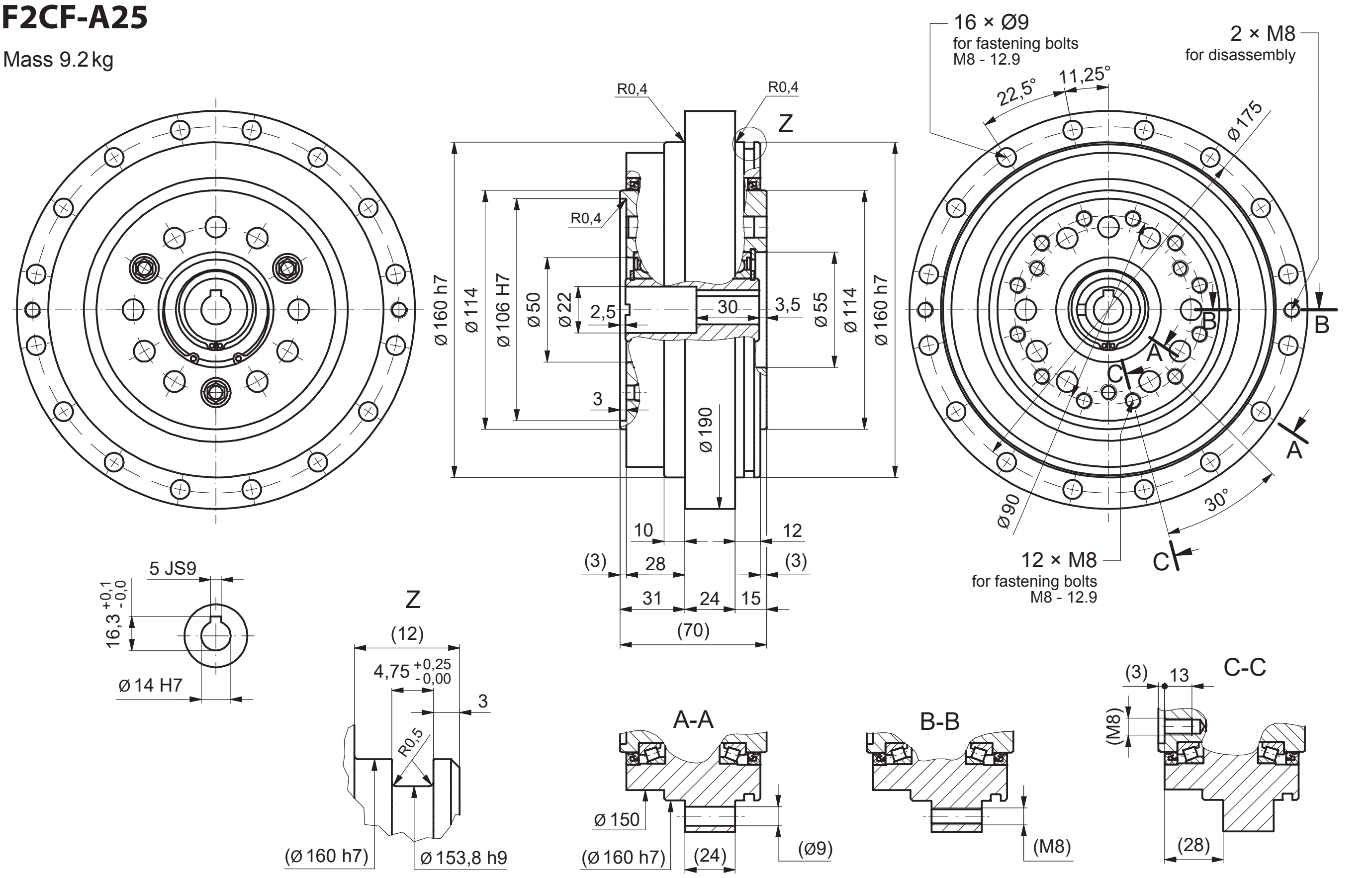
F2C-A25

Mass 7.3 kg



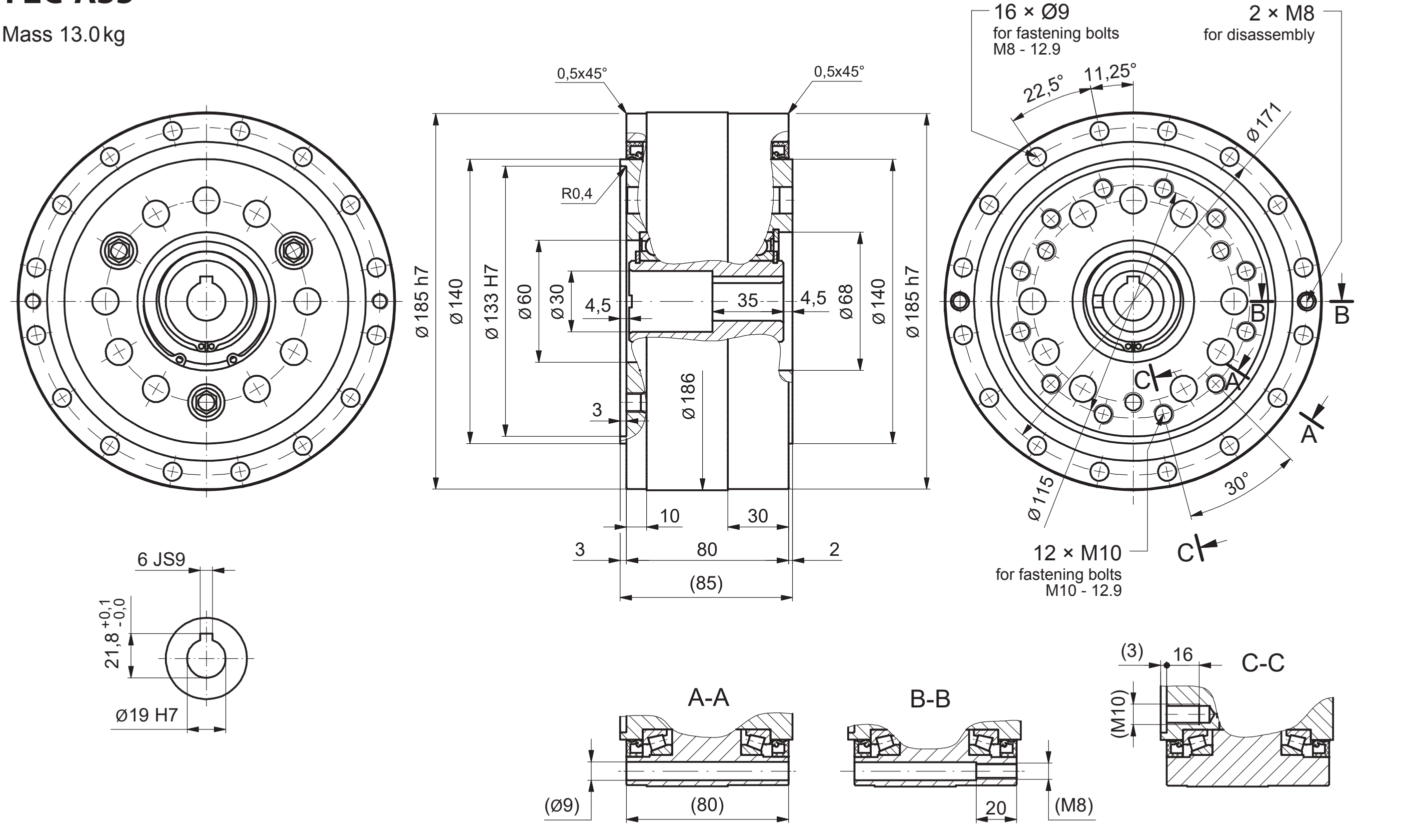
F2CF-A25

Mass 9.2 kg



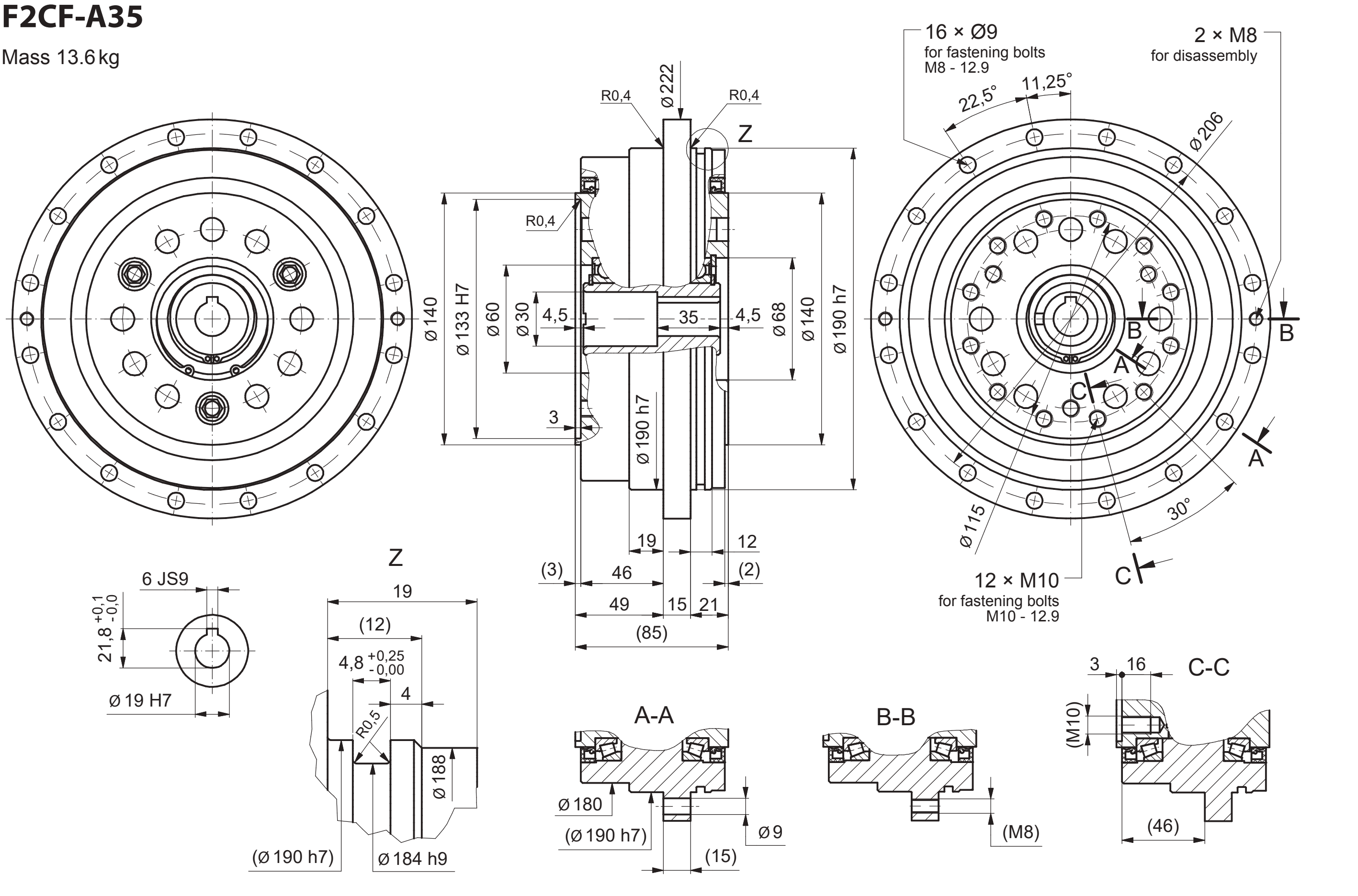
F2C-A35

Mass 13.0 kg



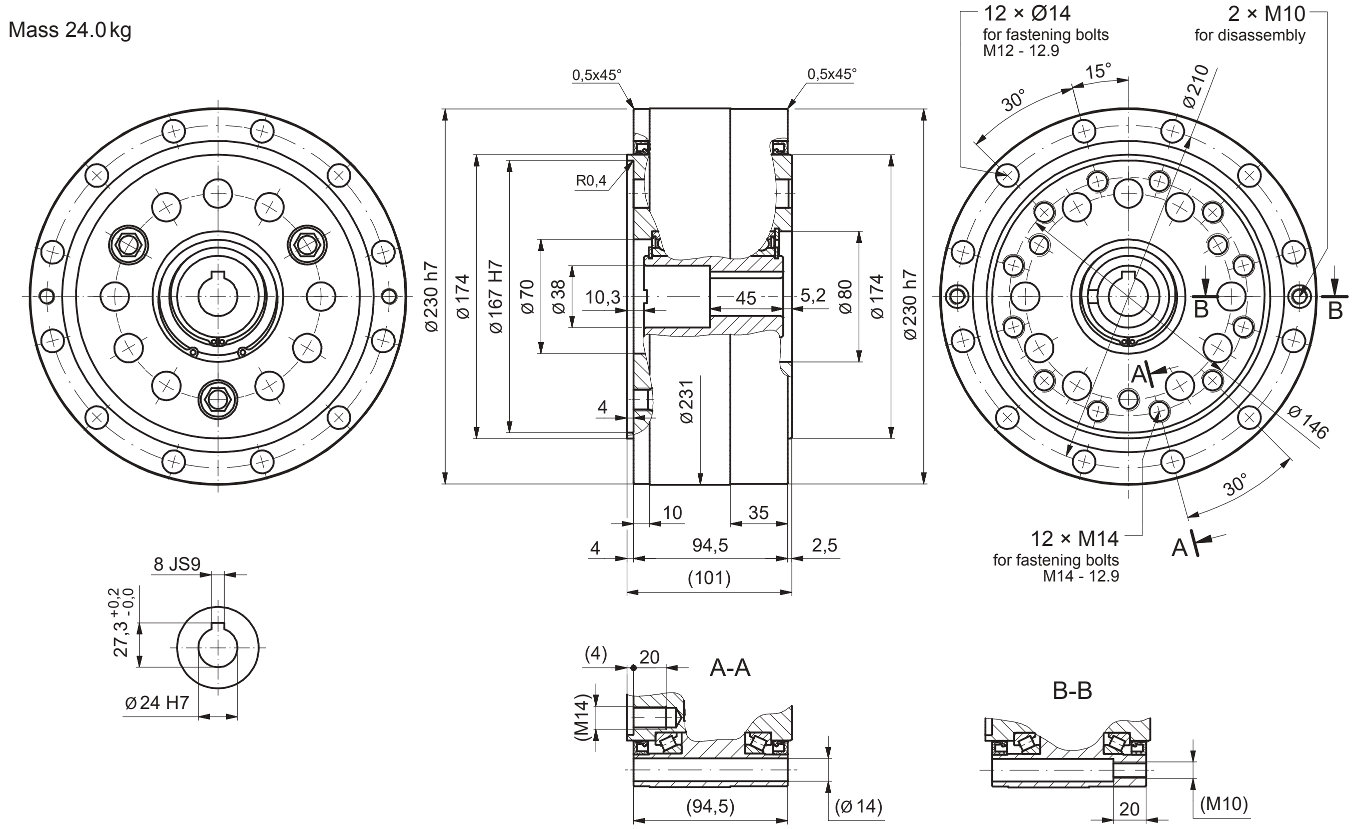
F2CF-A35

Mass 13.6 kg



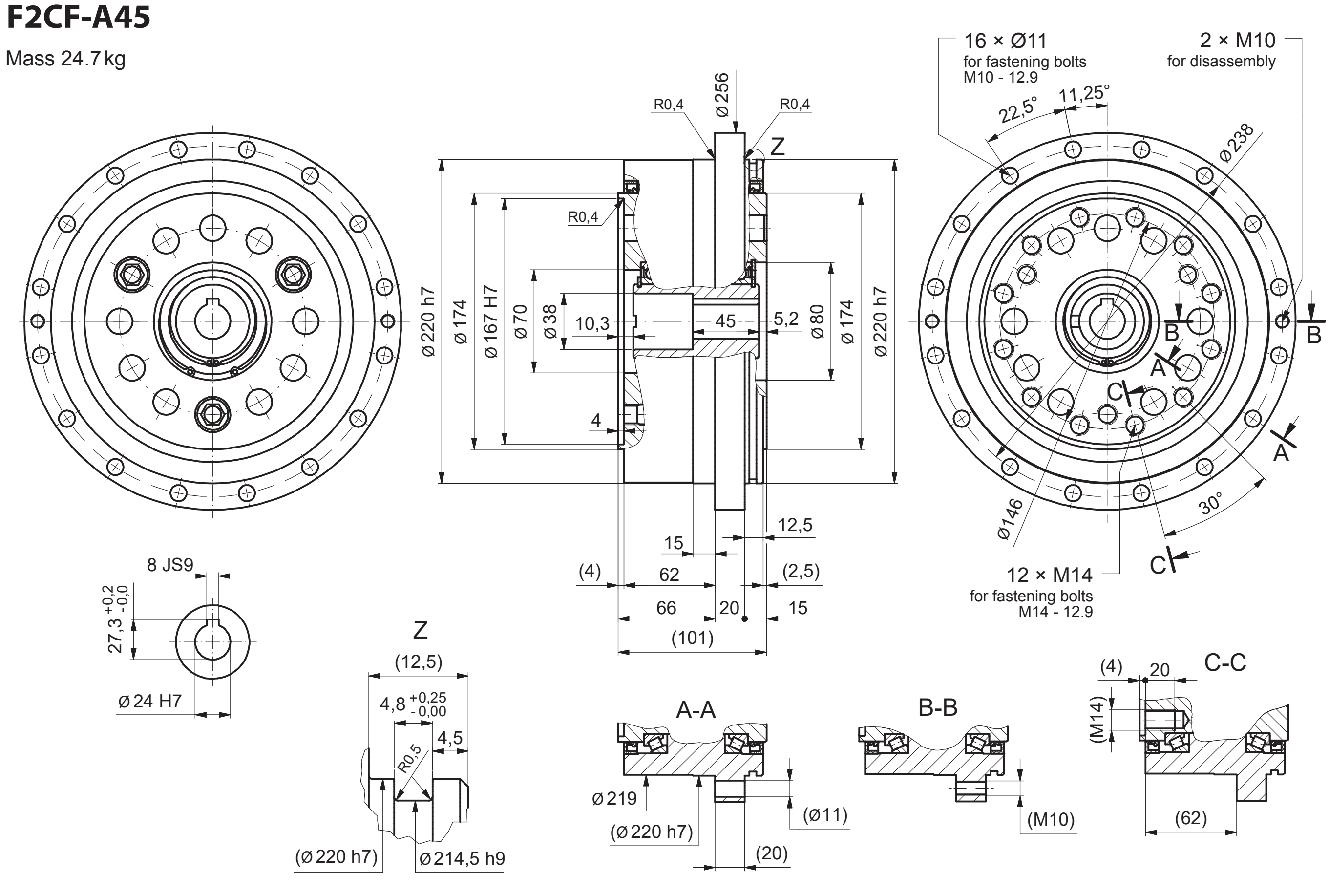
F2C-A45

Mass 24.0 kg



F2CF-A45

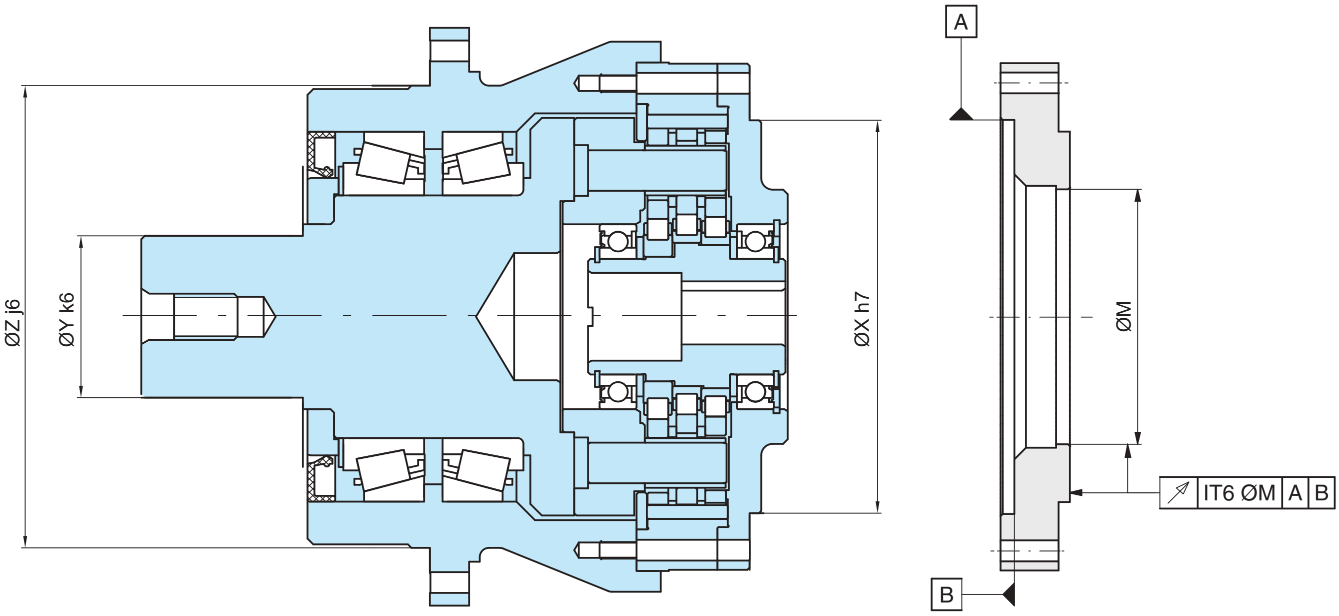
Mass 24.7 kg



5.12 Model F3C-A

5.12.1 Assembly tolerances

To ensure the function, lifetime, and characteristics of the gearbox, the radial run-out of the shaft ends, the coaxiality and the axial run-out of the fastening surface as per EN 50347:2001 are sufficient. When used in high-precision applications, the tolerance according to EN 50347:2001 should be reduced by 50%, which has additional advantages.



Size	Ø X	Ø Y	Ø Z	Ø M
A15	85	35	110	Motor centering
A25	110	45	135	
A35	135	55	160	
A45	170	70	200	
A65	210	90	240	
A75	235	100	280	

Table A35 (Dimensions in mm)

Tightening torque and maximum permissible transmittable torque for bolts

The permissible transmitted torque for bolts and the number, size, and tightening torque for fastening the output side flange and the ring gear housing are listed in Table A36. In the event of an Emergency Stop with corresponding load peaks, the output flange and ring gear housing bolts must all be replaced.

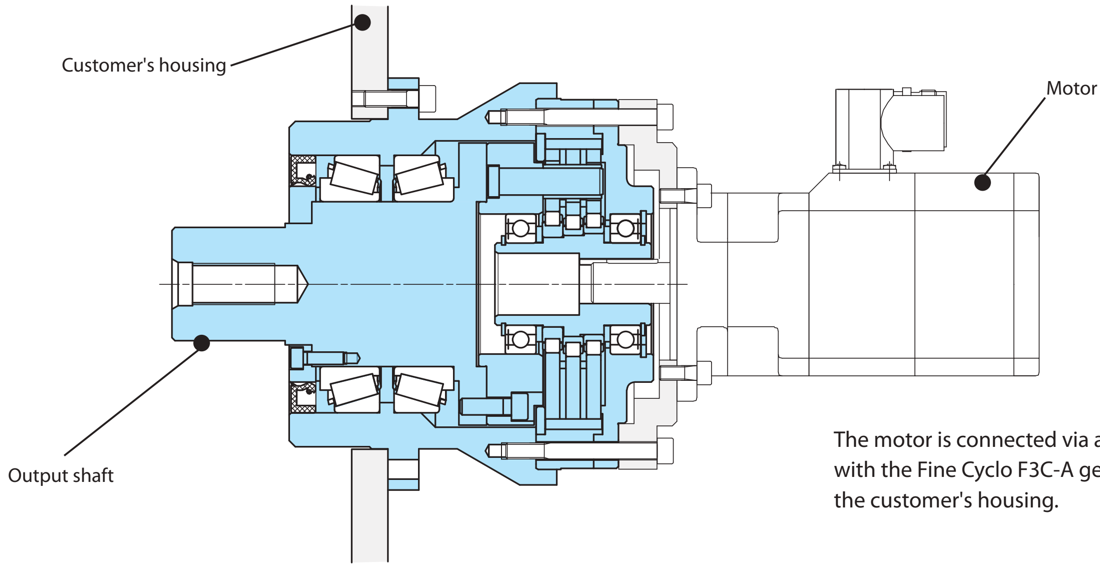
Size F3C-	Bolts for ring gear (housing)		
	Number and size of bolts	Tightening torque [Nm]	Max. permissible transmittable torque for bolts [Nm]
A15G	8 × M6	16	550
A25G	8 × M6	16	1000
A35G	8 × M8	39	2100
A45G	12 × M8	39	4000
A65G	12 × M10	77	7700
A75G	12 × M10	77	9000

Table A36

- **Bolting:** Use metric hexagon socket head cap screws (DIN 4762, strength category 12.9).
- **Countermeasure for bolts loosening:** Use adhesives (Loctite 262, etc.) or spring washer (DIN 127A).

5.12.2 Installation example

(1)

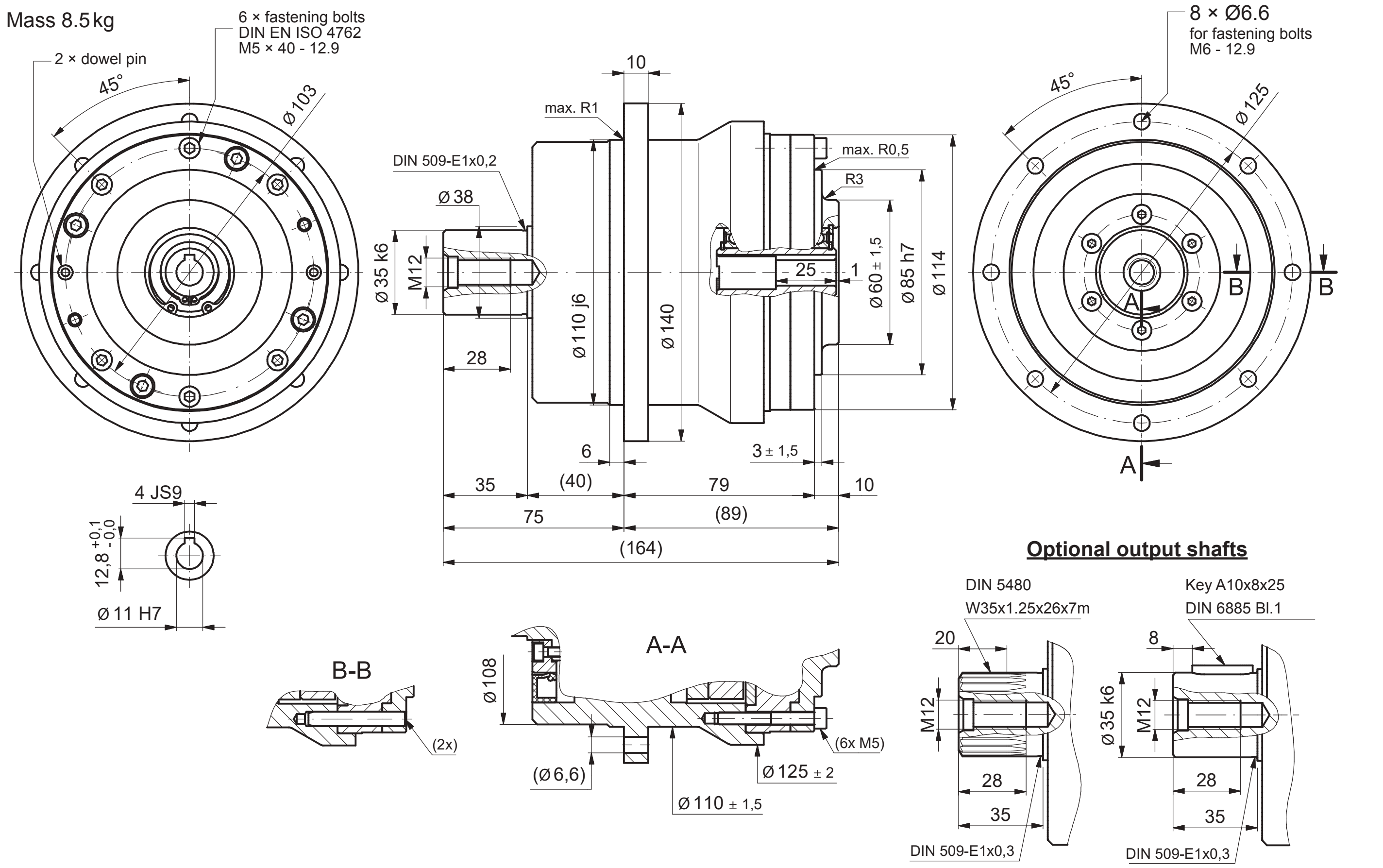


The motor is connected via an intermediate flange with the Fine Cyclo F3C-A gearbox and bolted onto the customer's housing.

5.12.3 Dimensioned drawings

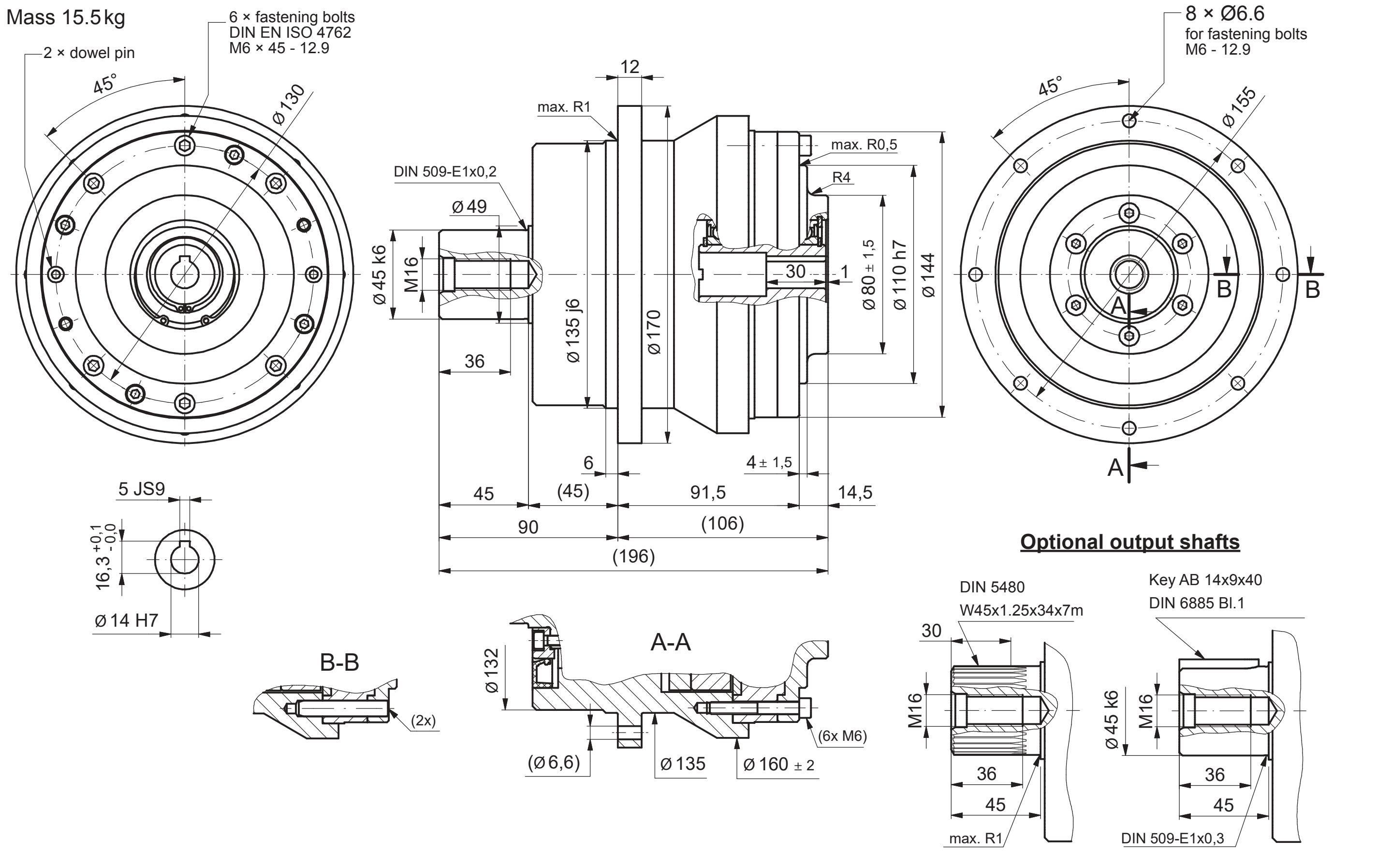
F3C-A15G

Mass 8.5 kg



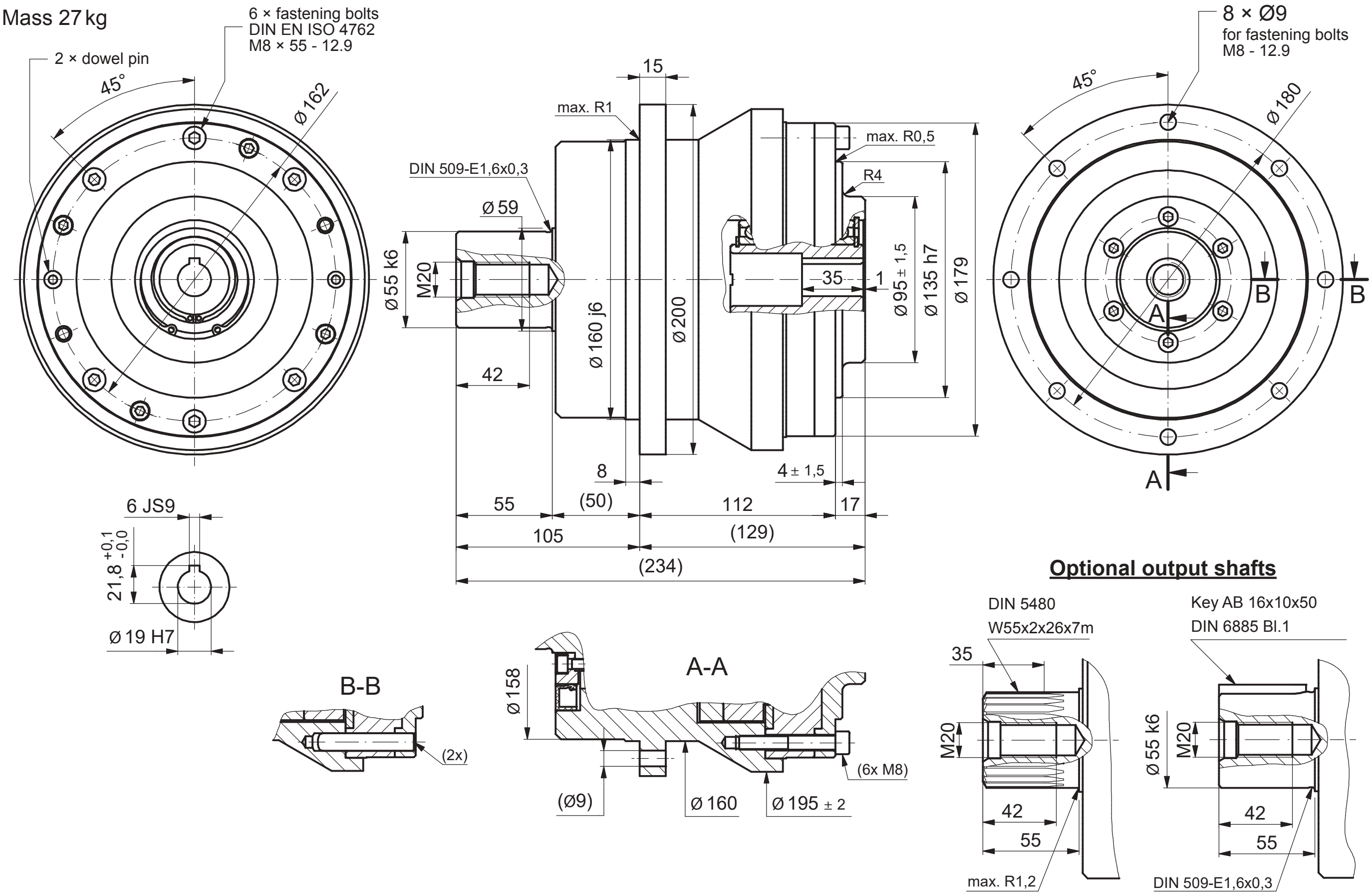
F3C-A25G

Mass 15.5 kg



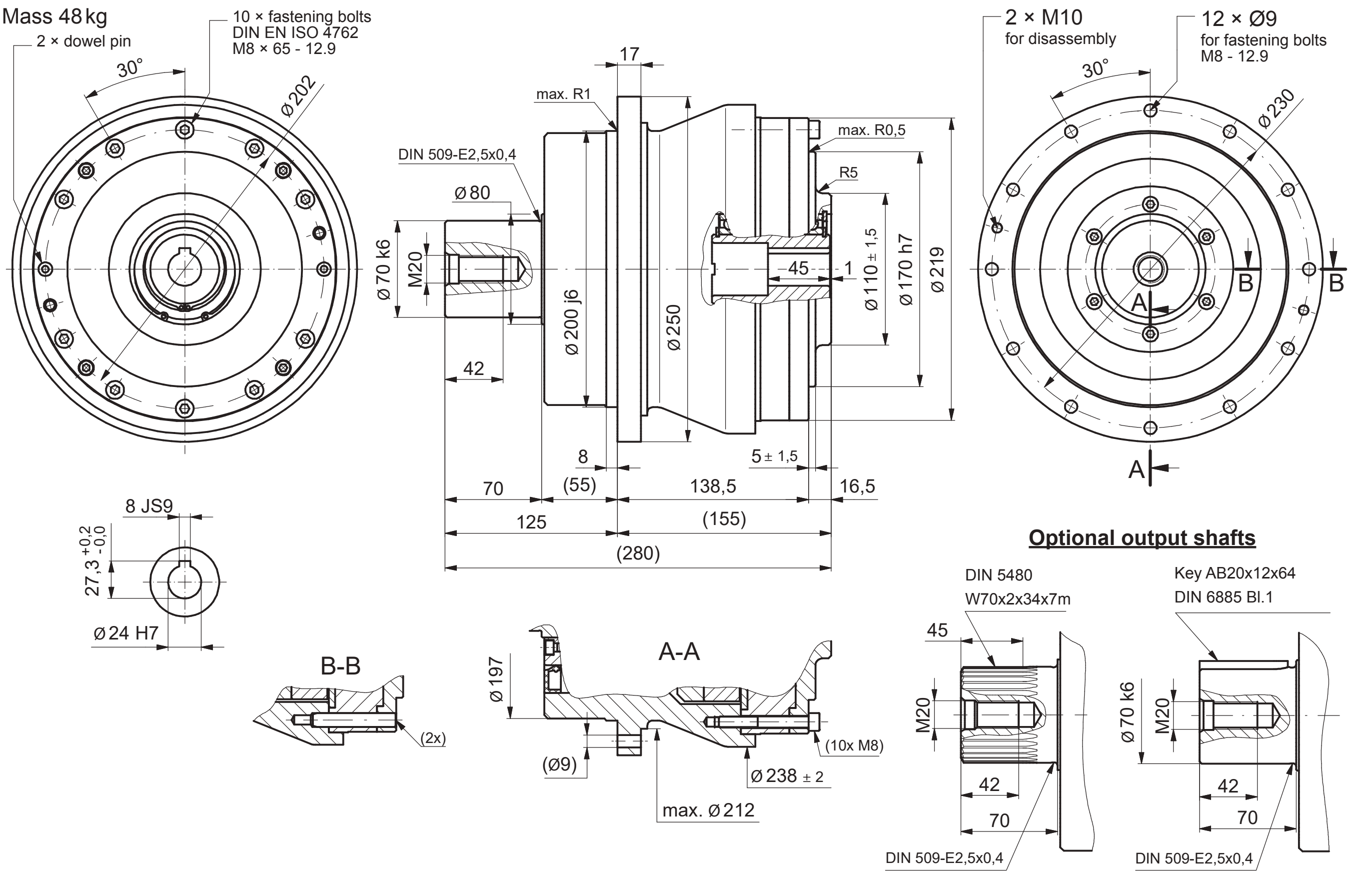
F3C-A35G

Mass 27 kg



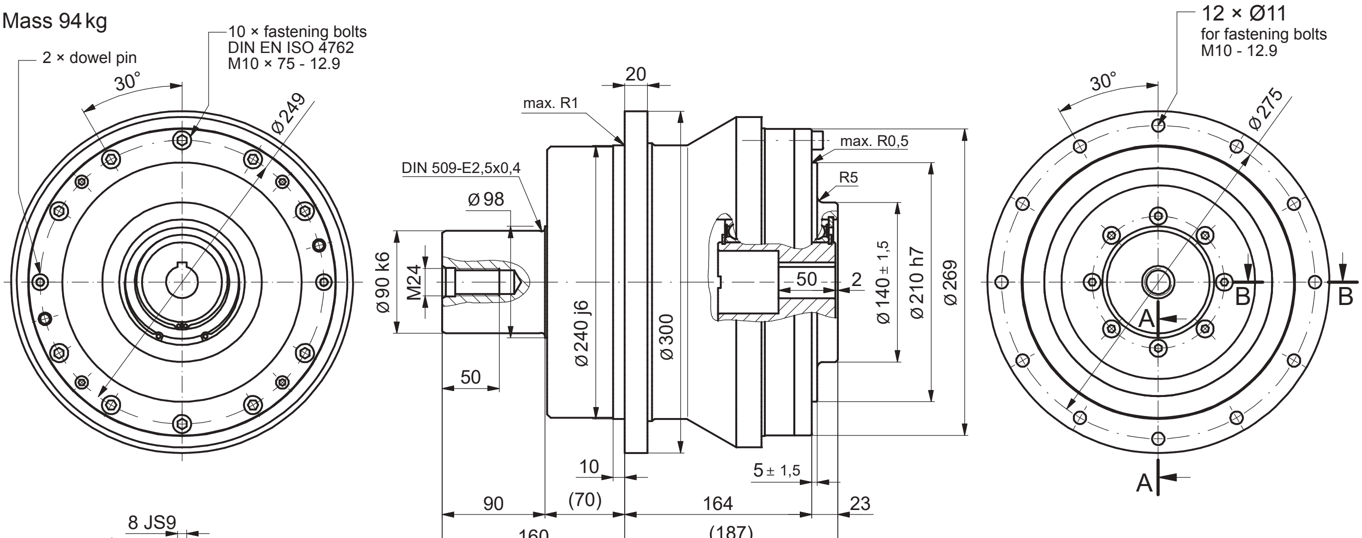
F3C-A45G

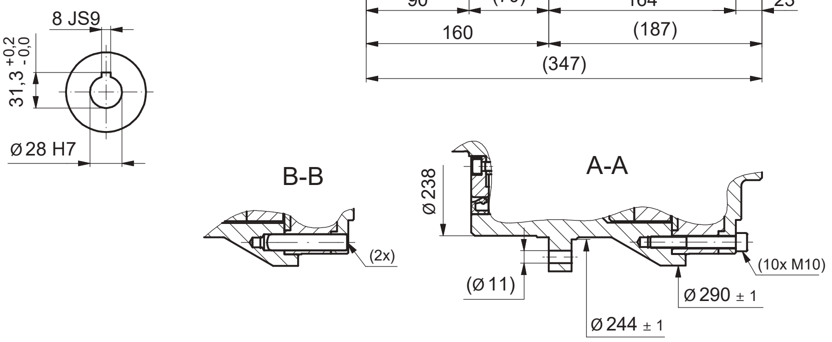
Mass 48 kg



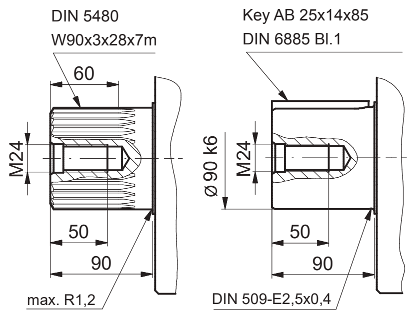
F3C-A65G

Mass 94 kg



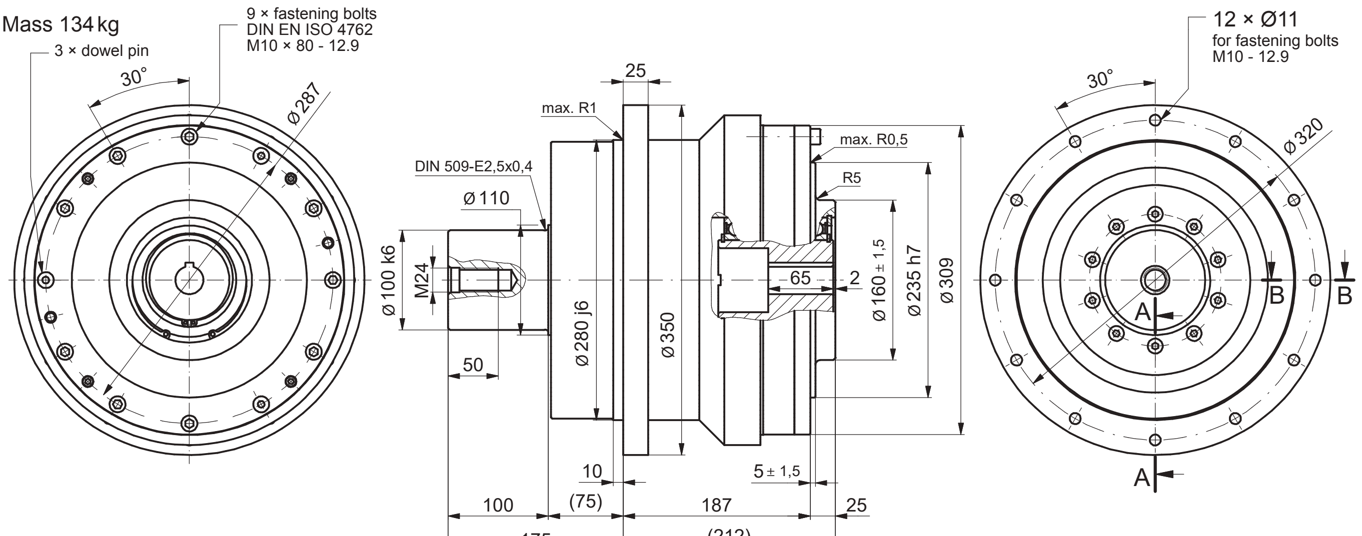


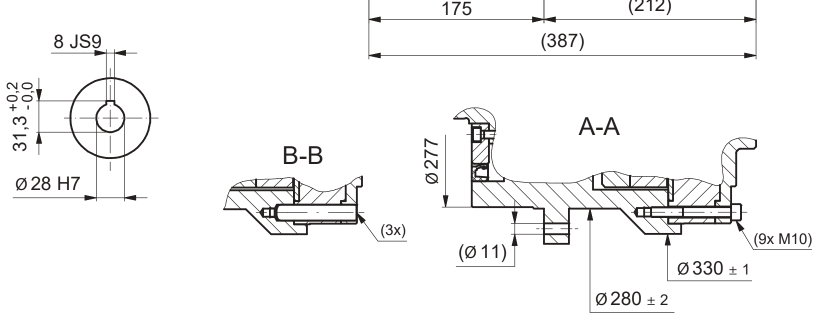
Optional output shafts



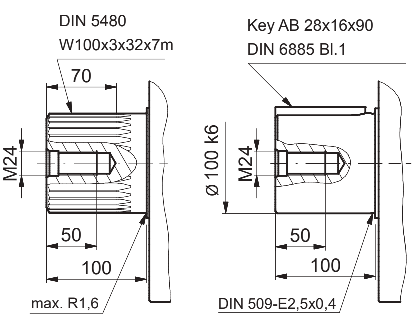
F3C-A75G

Mass 134 kg



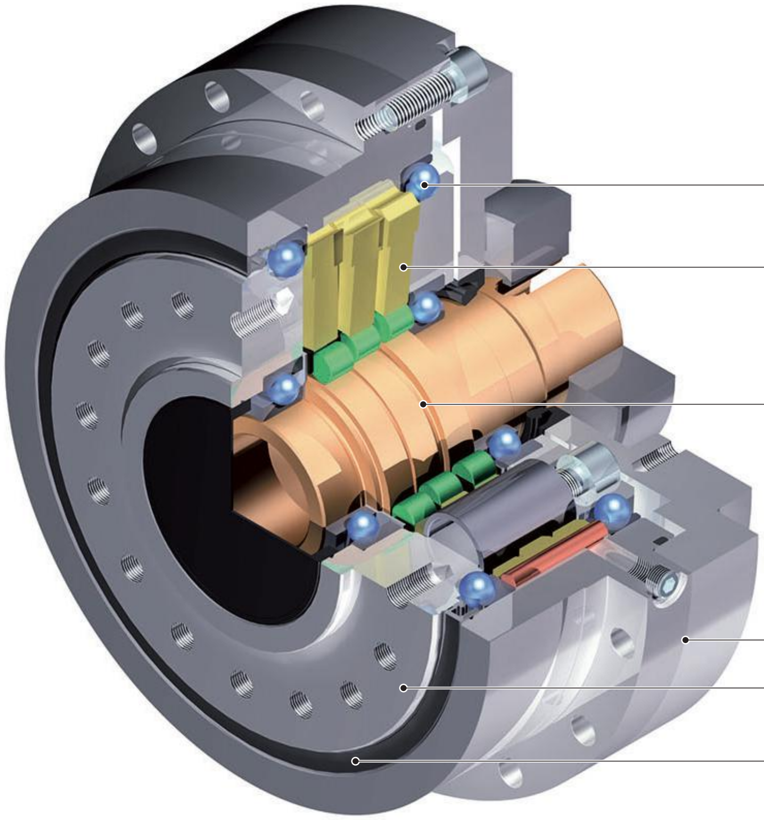


Optional output shafts



6 D Series

F4CF-D



Special feature:

Single-stage flanged gearbox with high power density and improved bearings

- Easy motor mounting with clamp ring and adapter flange
- Also obtainable as basic gearbox with hollow shaft
- 5 sizes
- Ratios (single-stage) 29/41/59/89/119
- Nominal output torques up to 1756 Nm
- Acceleration torques up to 3188 Nm
- Lost motion < 1 arcmin
- Excellent cost efficiency
- High torques
- High permissible tilting moments
- Compact design

6.1 Torques according to output speeds

Output speed n_{2m} [min^{-1}]			5			10			15			20			25		
Model	Size	Reduction ratio i	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]
F4CF-	D15	41	194	205	0.13	194	410	0.25	193	615	0.38	177	820	0.46	165	1025	0.54
		59	226	295	0.15	226	590	0.3	201	885	0.39	184	1180	0.48	173	1475	0.56
		89	226	445	0.15	201	890	0.26	178	1335	0.35	163	1780	0.43	153	2225	0.5
	D25	41	414	205	0.27	414	410	0.54	411	615	0.81	377	820	0.99	353	1025	1.15
		59	487	295	0.32	487	590	0.64	433	885	0.85	398	1180	1.04	372	1475	1.22
		89	487	445	0.32	433	890	0.57	383	1335	0.75	351	1780	0.92	329	2225	1.08
		119	487	595	0.32	397	1190	0.52	351	1785	0.69	322	2380	0.84	301	2975	0.99
	D30	59	635	295	0.42	635	590	0.83	565	885	1.11	518	1180	1.36	485	1475	1.59
		89	635	445	0.42	564	890	0.74	500	1335	0.98	458	1780	1.2	429	2225	1.4
		119	635	595	0.42	517	1190	0.68	458	1785	0.9	420	2380	1.1	393	2975	1.29
	D35	29	657	145	0.43	657	290	0.86	657	435	1.29	657	580	1.72	621	725	2.03
		59	899	295	0.59	899	590	1.18	800	885	1.57	734	1180	1.92	686	1475	2.25
		89	899	445	0.59	799	890	1.05	707	1335	1.39	649	1780	1.7	607	2225	1.99
		119	899	595	0.59	732	1190	0.96	648	1785	1.27	595	2380	1.56	556	2975	1.82
	D45	29	1393	145	0.91	1393	290	1.82	1393	435	2.74	1393	580	3.65	1316	725	4.31
		59	1756	295	1.15	1756	590	2.3	1563	885	3.07	1434	1180	3.75	1341	1475	4.39
		89	1756	445	1.15	1560	890	2.04	1381	1335	2.71	1267	1780	3.32	1185	2225	3.88
		119	1756	595	1.15	1430	1190	1.87	1266	1785	2.49	1161	2380	3.04			

Table D1 Rating values (reference value output speed n_{2m})

Size		Max. acceleration and deceleration torque T_{2A}	Peak torque for Emergency Stop T_{2max}
		[Nm]	[Nm]
D15	41 / 59 / 89	417	834
D25	41 / 59 / 89 /119	883	1766
D30	59 / 89 / 119	1226	2453
D35	29	1393	3581
	59 / 89 / 119	1717	3581
D45	29	2914	5827
	59 / 89 / 119	3188	6377

Table D2 Maximum acceleration and peak torque

30			40			50			60			Max. permissible input speed $n_{1\,max}$ short term [min⁻¹]	Max. permissible input speed $n_{1\,ED}$ [min⁻¹]		Moment of inertia j related to the input shaft [×10⁻⁴ kgm²]	Mass [kg]
Nominal output torque [Nm]	Input speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min⁻¹]	Max. permissible input power [kW]		50% ED	100% ED		
156	1230	0.61	143	1640	0.75	134	2050	0.88	127	2460	1	5650	4700	2350	CF	7
163	1770	0.64	150	2360	0.78	140	2950	0.92	133	3540	1.04	6150	5600	2800	CF	
144	2670	0.57	132	3560	0.69	124	4450	0.81	117	5340	0.92				CF	
334	1230	1.31	306	1640	1.60	286	2050	1.87	271	2460	2.13	4650	3860	1930	CF	12
352	1770	1.38	323	2360	1.69	302	2950	1.98	286	3540	2.25	5050	4200	2100	CF	
311	2670	1.22	285	3560	1.49										CF	
285	3570	1.12													CF	
459	1770	1.8	421	2360	2.2	394	2950	2.58	373	3540	2.93	4550	3800	1900	CF	15.5
406	2670	1.59	372	3560	1.95										CF	
372	3570	1.46													CF	
588	870	2.31	539	1160	2.82	504	1450	3.3	477	1740	3.75	3500	2960	1480	CF	20.5
650	1770	2.55	596	2360	3.12	558	2950	3.65				3950	3300	1650	CF	
574	2670	2.26													CF	
															CF	
1246	870	4.89	1143	1160	5.98	1069	1450	7	1012	1740	7.95	2700	2240	1120	CF	35.5
1269	1770	4.98	1164	2360	6.1							3150	2600	1300	CF	
															CF	
															CF	

: 50% ED range   : 100% ED range (but max. 10 min. without pause) CF= Consult Factory

1. T_{2N} = nominal output torque
   Nominal output torque corresponds to the max. permissible average load torque at all output speeds.
   The nominal output torque for speeds less than 5 min^{-1} is equal to the value at 5 min^{-1}.
   The value for the maximum permissible input power is calculated from the nominal output torque at 100%.
   This value takes the efficiency of Fine Cyclo into consideration.
2. n_{1max} = maximum permissible input speed
   However, it must be n_{1m} (mean input speed) < $n_{1\,ED}$.
3. $n_{1\,ED}$ = permissible input speed according to duty cycle
4. T_{2A} = max. Acceleleration and braking torque (for fatigue strength at $2 \cdot 10^7$ load cycles)
   Permissible peak torque for normal start and stop procedures.
5. T_{2max} = max. permissible torque for Emergency Stop situations or in the event of heavy shocks (limited by the mechanical strength).
   (permissible 1000 x over the entire lifetime)
6. The rated torque T_{2N} is calculated using the following equation when the speed is not shown in the table above:

$$T_{2N} = T_{2N,600} \left(\frac{600}{n_{1m}}\right)^{0.3}$$

T_{2N} : Rated torque at input speed n_{1m}
$T_{2N,600}$: Rated torque at input speed n_{1m} is 600 min^{-1}

6.2 Torques according to input speeds

Input speed n_{1m} [min^{-1}]			4000			3000			2500			2000			1750		
Model	Size	Reduction ratio i	Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]
F4CF-	D15	41	110	97.6	1.12	120	73.2	0.92	127	61	0.81	135	48.8	0.69	141	42.7	0.63
		59	128	67.8	1.13	139	50.8	0.93	147	42.4	0.82	157	33.9	0.7	164	29.7	0.64
		89	128	45	0.75	139	34	0.61	147	28.1	0.54	157	22.5	0.46	164	19.7	0.42
	D25	41				255	73.2	2	270	61	1.72	289	48.8	1.48	300	42.7	1.34
		59	275	67.8	2.44	300	50.8	2	317	42.4	1.76	339	33.9	1.5	353	29.7	1.37
		89	275	45	1.62	300	34	1.32	317	28.1	1.16	339	22.5	1	353	19.7	0.91
		119	275	33.6	1.21	300	25.2	0.99	317	21	0.87	339	16.8	0.75	353	14.7	0.68
	D30	59				392	50.8	2.61	414	42.4	2.3	443	33.9	1.96	461	29.7	1.79
		89				392	33.7	1.73	414	28.1	1.52	443	22.5	1.3	461	19.7	1.19
		119				392	25	1.29	414	21	1.14	443	16.8	0.97	461	14.7	0.89
	D35	29							428	86.2	3.86	458	69.0	3.31	477	60.3	3.01
		59				554	50.8	3.69	586	42.4	3.25	626	33.9	2.78	652	29.7	2.53
		89				554	34	2.44	589	28	2.15	626	23	1.84	652	19.7	1.68
		119							589	21	1.6	626	16.8	1.4	652	14.7	1.25
	D45	29										971	69	7.01	1010	60	6.38
		59							1145	42	6.35	1224	34	5.43	1274	29.7	4.9
		89							1145	28.1	4.21	1224	22.5	3.6	1274	19.7	3.28
		119							1145	21	3.15	1224	16.8	2.69	1274	15	2.45

Table D3 Rating values (reference value input speed n_{1m})

Size		Max. acceleration and deceleration torque T_{2A}	Peak torque for Emergency Stop T_{2max}
		[Nm]	[Nm]
D15	41 / 59 / 89	417	834
D25	41 / 59 / 89 /119	883	1766
D30	59 / 89 / 119	1226	2453
D35	29	1393	3581
	59 / 89 / 119	1717	3581
D45	29	2914	5827
	59 / 89 / 119	3188	6377

Table D4 Maximum acceleration and peak torque

1500			1000			750			600			Max. permissible input speed $n_{1\,max}$ short term [min⁻¹]	Max. permissible input speed $n_{1\,ED}$ [min⁻¹]		Moment of inertia j related to the input shaft [×10⁻⁴ kgm²]	Mass [kg]
Nominal output torque [Nm]	Output speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min⁻¹]	Max. permissible input power [kW]		50% ED	100% ED		
148	36.6	0.57	167	24.4	0.43	182	18.3	0.35	194	14.6	0.3	5650	4700	2350	CF	7
171	25.4	0.57	194	16.9	0.43	211	12.7	0.35	226	10.2	0.24	6150	5600	2800	CF	
171	16.9	0.38	194	11.2	0.28	211	8.43	0.23	226	6.74	0.16				CF	
315	36.6	1.21	355	24.4	0.91	387	18.3	0.74	414	14.6	0.63	4650	3860	1930	CF	12
370	25.4	1.23	418	16.9	0.93	455	12.7	0.76	487	10.2	0.65	5050	4200	2100	CF	
370	16.9	0.81	418	11.2	0.61	455	8.43	0.5	487	6.74	0.43				CF	
370	12.6	0.61	418	8.4	0.46	455	6.3	0.38	487	5.04	0.32				CF	
483	25.4	1.61	545	16.9	1.21	594	12.7	0.99	635	10.2	0.85	4550	3800	1900	CF	15.5
483	16.9	1.06	545	11.2	0.8	594	8.43	0.66	635	6.74	0.56				CF	
483	12.6	0.8	545	8.4	0.6	594	6.3	0.49	635	5.04	0.42				CF	
499	51.7	2.7	564	34.5	2.04	615	25.9	1.67	657	20.7	1.42	3500	2960	1480	CF	20.5
683	25.4	2.27	771	16.9	1.71	840	12.7	1.4	899	10.2	1.2	3950	3300	1650	CF	
683	16.9	1.5	771	11.2	1.13	840	8.43	0.93	899	6.74	0.79				CF	
683	12.6	1.13	771	8.4	0.85	840	6.3	0.69	899	5.04	0.59				CF	
1058	51.7	5.73	1195	34.5	4.32	1303	25.9	3.53	1393	20.7	3.02	2700	2240	1120	CF	35.5
1334	25.4	4.44	1507	16.9	3.34	1643	12.7	2.73	1756	10.2	2.34	3150	2600	1300	CF	
1334	16.9	2.94	1507	11.2	2.22	1643	8.43	1.81	1756	6.74	1.55				CF	
1334	12.6	2.2	1507	8.4	1.66	1643	6.3	1.35	1756	5.04	1.16				CF	

: 50% ED range   : 100% ED range   CF = Consult Factory

1. T_{2N} = nominal output torque
   Nominal output torque corresponds to the max. permissible average load torque at all input speeds.
   The nominal output torque for speeds less than 600 min^{-1} is equal to the value at 600 min^{-1}.
   The value for the maximum permissible input power is calculated from the nominal output torque at 100%.
   This value takes the efficiency of Fine Cyclo into consideration.
2. n_{1max} = maximum permissible input speed
   However, it must be n_{1m} (mean input speed) < $n_{1\,ED}$.
3. $n_{1\,ED}$ = permissible input speed according to duty cycle
4. T_{2A} = max. Acceleleration and braking torque (for fatigue strength at $2 \cdot 10^7$ load cycles)
   Permissible peak torque for normal start and stop procedures.
5. T_{2max} = max. permissible torque for Emergency Stop situations or in the event of heavy shocks (limited by the mechanical strength).
   (permissible 1000 x over the entire lifetime)
6. The rated torque T_{2N} is calculated using the following equation when the speed is not shown in the table above:

$$T_{2N} = T_{2N,600} \left(\frac{600}{n_{1m}}\right)^{0.3}$$

T_{2N} : Rated torque at input speed n_{1m}

$T_{2N,600}$: Rated torque at input speed n_{1m} is 600 min^{-1}

6.3 Stiffness and Lost Motion

Size	i	Test torque T_p [Nm]	Lost Motion		Torsional stiffness 3% - 50% T_p [Nm/arcmin]	Torsional stiffness 3% - 100% T_p [Nm/arcmin]	Torsional stiffness 50% - 100% T_p [Nm/arcmin]
			Lost Motion [arcmin]	Domain of definition [Nm]			
D15	41	±148	< 1	±4.44	33.5	40	49
	59	±171		±5.13			
	89						
D25	41	±315		±9.45	68	85	112
	59	±370		±11.1			
	89						
	119						
D30	59	±483		±14.5	103	130	173
	89						
	119						
D35	29	±499		±15	95	122	167
	59	±683		±20.5	124	160	220
	89						
	119						
D45	29	±1058		±31.7	257	330	450
	59	±1334		±40.02			
	89						
	119						

Table D5 Torsional stiffness

T_p: Test torque at input speed $n_1 = 1500\ min^{-1}$

Calculation of the twist angle:

1) At a load torque less than 3% T_p

$$\varphi = \frac{\text{Lost Motion}}{2} \cdot \frac{\text{Load torque}}{0.03 \cdot T_p}$$

2) At a load torque greater than 3% T_p (standard case)

$$\varphi = \frac{\text{Lost Motion}}{2} + \frac{\text{Load torque} - (0.03 \cdot T_p)}{\text{Torsional stiffness}}$$

Note arcmin means "angular minute".
Table values for stiffness are average values.

6.4 No-load running torque (NLRT)

The quoted values apply to indicated standard constructions in clamp ring design.

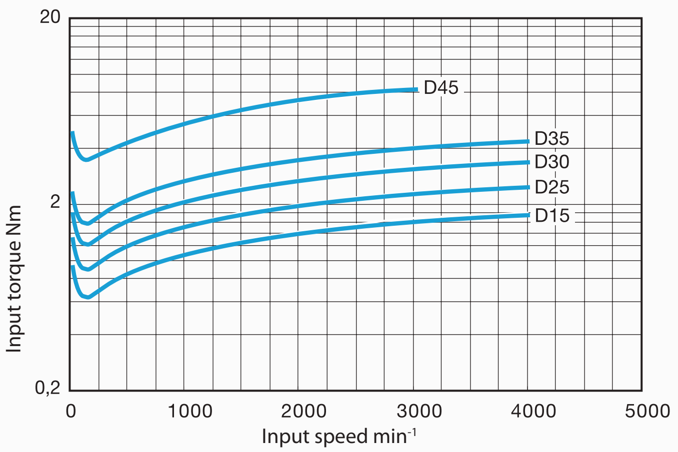


Fig. D1 Input side no-load running torque

Note
1. Fig. D1 shows the average no-load running torque after gearbox is run in. (not factory-new condition)
2. Table D6 shows the measuring conditions

Ring gear housing temperature	approx. 30°C
Precision during assembly	as per 6.8.1
Lubrication	Standard lubrication

Table D6 Measurement conditions

6.5 Breakaway torque

Breakaway torque on output side (BTO)

Note
1. Table D8 shows the max. breakaway torque on the output side BTO. Fine Cyclo gearboxes are not self-locking. The BTO is defined as the maximum value (factory-new condition), which steadily decreases during the lifetime.
2. Table D7 shows the measuring conditions

Precision during assembly	as per 6.8.1
Lubrication	Standard lubrication

Table D7 Measurement conditions

Size	Breakaway torque BTO [Nm]
D15	< 70
D25	< 100
D30	< 120
D35	< 140
D45	< 245

Table D8 Value of the breakaway torque on the output side (BTO)

Breakaway torque on input side (BTI)

Note
1. Table D9 shows the max. breakaway torque BTI on the input side. BTI is defined as the maximum value (factory-new condition) which steadily decreases during the lifetime.
2. Table D7 shows the measuring conditions

Size	Breakaway torque BTI [Nm]
D15	< 0.9
D25	< 1.3
D30	< 1.8
D35	< 3.0
D45	< 5.0

Table D9 Value of the breakaway torque on the input side (BTI)

6.6 Efficiency

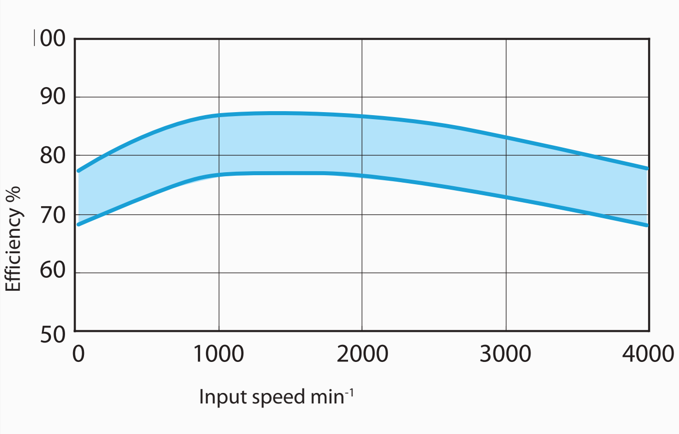


Fig. D2 Efficiency curve

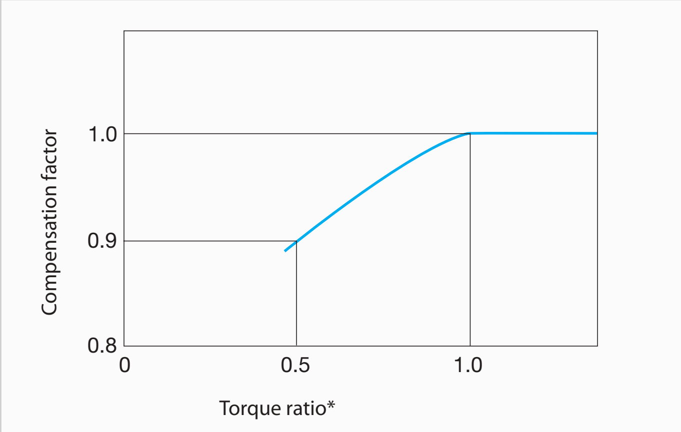


Fig. D3 Compensation curve for efficiency

Fig. D2 shows the correlation between efficiency and input speed. For further information see "4 Explaining the technical details" on page 18.

Note

1. The efficiency changes if the load torque does not match the nominal torque. Check the compensation factor in the diagram Fig. D3.
2. When the torque ratio is over 1.0, the compensation factor for efficiency is 1.0 (diagram Fig. D3).

Compensation efficiency =
efficiency · compensation factor

$$\text{* Torque ratio} = \frac{\text{Load torque}}{\text{Nominal output torque}}$$

6.7 Bearing loads

6.7.1 Maximum permissible radial and axial load on the input shaft

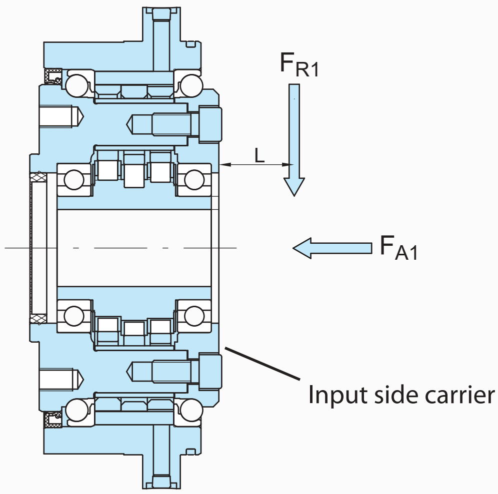


Fig. D4

L [mm]	Load factor input L_{f1}				
	Size				
	D15	D25	D30	D35	D45
10	0.91	0.87			
15	0.99	0.94	0.92	0.91	
20	1.25	1.00	0.98	0.97	0.90
25	1.56	1.25	1.14	1.09	0.94
30	1.88	1.50	1.36	1.30	0.99
35	2.19	1.75	1.59	1.52	1.13
40		2.00	1.82	1.74	1.29
45			2.05	1.96	1.45
50				2.17	1.61
60					1.94

Table D10 Load factor L_{f1}
L = distance from input side carrier

If the input shaft is fitted with a pinion or a disc, axial and radial forces act on the input shaft.
The following equation is used to check whether the shaft load is permissible:

1. Input radial load F_{R1}

$$F_{R1} = 10^3 \cdot \frac{T_{2V}}{\eta \cdot i \cdot r_0} \leq \frac{F_{R1\,max}}{L_{f1} \cdot C_{f1} \cdot B_{f1}} \quad [N] \qquad \text{(Equation D-1)}$$

2. Input side axial load F_{A1}

$$F_{A1} \leq \frac{F_{A1\,max}}{C_{f1} \cdot B_{f1}} [N] \qquad \text{(Equation D-2)}$$

3. When radial and axial loads co-exist

$$\left(\frac{F_{R1} \cdot L_{f1}}{F_{R1\,max}} + \frac{F_{A1}}{F_{A1\,max}}\right) \cdot C_{f1} \cdot B_{f1} \leq 1 \qquad \text{(Equation D-3)}$$

F_{R1} = input side radial load [N]
T_{2V} = reference torque on output shaft [Nm]
d_0 = pitch circle diameter of sprocket, pinion [mm]
$F_{R1\,max}$ = maximum permissible input side radial load [N]
F_{A1} = input side axial load [N]
$F_{A1\,max}$ = maximum permissible input side axial load [N]
L_{f1} = load factor input (Table D10)
C_{f1} = correction factor input (Table D11)
B_{f1} = service factor input (Table D12)
L = Distance of radial force from input side carrier on gearboxes without motor adapter (Table D10)
η = 0.8 (efficiency)

Correction factor input	C_{f1}
Chain	1
Gear or pinion *	1.25
Toothed belt	1.25
V-Belt	1.5

Table D11 Correction factor input C_{f1}

* For helical pinions or bevel gears, please consult Sumitomo Drive Technologies.

Load conditions input	B_{f1}
Uniform load	1
Light impacts	1.2
Severe impacts	1.6

Table D12 Service factor input B_{f1}

Size	Input speed n_{1m} [min^{-1}] (input side radial load [N])								
	4000	3000	2500	2000	1750	1500	1000	750	600
D15	226	245	265	284	294	314	335	392	422
D25	334	373	392	422	441	461	530	589	628
D30		432	461	500	520	549	628	687	746
D35		491	520	559	589	618	706	785	844
D45			608	657	687	726	824	912	981

Table D13 max. permissible input side radial load $F_{R1\,max}$

Size	Input speed n_{1m} [min^{-1}] (input side axial load [N])								
	4000	3000	2500	2000	1750	1500	1000	750	600
D15	245	284	314	343	363	392	471	549	608
D25	363	412	451	500	540	579	697	804	883
D30		520	569	638	677	726	883	1001	1118
D35		540	589	657	706	755	922	1059	1167
D45			1010	1118	1197	1295	1570	1795	2001

Table D14 max. permissible input side axial load $F_{A1\,max}$

Calculation of the max. permissible radial load on the input shaft

Calculation of the max. permissible radial load using the following equation when the speed is not shown in the table above.

$$F_{R1\,max} = F_{R1,600} \left(\frac{600}{n_{1m}} \right)^{1/3}$$

$F_{R1\,max}$ = maximum permissible input side radial load at input speed n_{1m}

$F_{R1,600}$ = Radial load on input side at input speed n_{1m} = 600 min^{-1}

Calculation of the max. permissible axial load on the input shaft

Calculation of the max. permissible axial load using the following equation when the speed is not shown in the table above.

$$F_{A1\,max} = F_{A1,600} \left(\frac{600}{n_{1m}} \right)^{0.47}$$

$F_{A1\,max}$ = maximum permissible input side axial load at input speed n_{1m}

$F_{A1.600}$ = Input side axial load at input speed n_{1m} = 600 min^{-1}

6.7.2 Main bearings

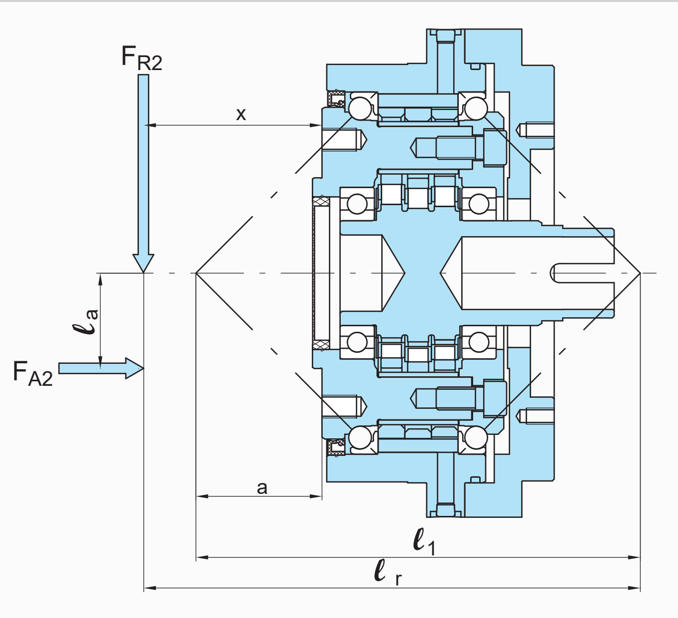


Fig. D5 Distance between the individual loading points

$$\ell_r = x - a + \ell_1 \quad \text{(Equation D-4)}$$

Size	Values of internal bearing distance	
	ℓ_1 [mm]	a [mm]
D15	119	23.6
D25	139	23.4
D30	157	24.5
D35	170	40.5
D45	206	52.4

Table D15 Bearing spacing dimensions (mm)

Note If: $\ell_r > 4 \cdot \ell_1$ please contact Sumitomo Drive Technologies.

1. Moment stiffness

   The moment stiffness is the bending moment at which the output flange is tilted to the tilt angle.

   The tilt angle of the input flange is determined as follows:

$$\varphi_1 = \frac{T_k}{\Theta_1} \quad \text{(Equation D-5)}$$

External bending moment T_k

$$T_k = 10^{-3} \cdot (F_{R2} \cdot \ell_r + F_{A2} \cdot \ell_a) \quad \text{(Equation D-6)}$$

2. Max. permissible bending moment and max. permissible axial load.

   Check the equivalent bending moment and the equivalent axial load using the equations D-6, D-7, D-8, and Fig. D6 .

Equivalent bending moment T_{ke} at output

$$T_{ke} = 10^{-3} \cdot (C_{f2} \cdot B_{f2} \cdot F_{R2} \cdot \ell_r + C_{f2} \cdot B_{f2} \cdot F_{A2} \cdot \ell_a) < T_{k\,max} \quad \text{(Equation D-7)}$$

Equivalent axial load F_{A2e} at the output shaft

$$F_{A2e} = F_{A2} \cdot C_{f2} \cdot B_{f2} < F_{A2\,max} \quad \text{(Equation D-8)}$$

F_{A2} = output side axial load [N]
$F_{A2\,max}$ = maximum permissible output side axial load [N]
F_{A2e} = equivalent input side axial load [N]
F_{R2} = output side radial load [N]
C_{f2} = correction factor output (Table D17)
B_{f2} = service factor output (Table D18)
ℓ_1 = bearing clearance [mm] (Table D15)
ℓ_r = calculated dimension for bending moment [mm]
ℓ_a = distance of axial load [mm]
x = distance from radial force to flange collar [mm]
a = correction factor [mm] (Table D15)
T_k = external bending moment [Nm]
$T_{k\,max}$ = maximum bending moment [Nm] (Table D19)
T_{ke} = equivalent bending moment [Nm]
φ_1 = tilt angle [arcmin]
Θ_1 = moment stiffness main bearing [Nm/arcmin] (Table D16)

Size	Moment stiffness Θ_1 [Nm/arcmin]
D15	510
D25	833
D30	1127
D35	1470
D45	2450

Table D16 Moment stiffness averages

Size	Max. permissible bending moment $T_{k\,max}$ [Nm]	Max. permissible axial load $F_{A2\,max}$ [N]
D15	883	3924
D25	1177	3924
D30	1668	5199
D35	1962	7848
D45	2943	10791

Table D19 Maximum bending moment and maximum permissible output side axial load

Correction factor output	C_{f2}
Chain	1
Gear or pinion	1.25
Timing belt	1.25
V-Belt	1.5

Table D17 Correction factor output C_{f2}

Service factor output	B_{f2}
Uniform load (no shock)	1
Light impacts	1.2
Severe impacts	1.6

Table D18 Service factor output B_{f2}

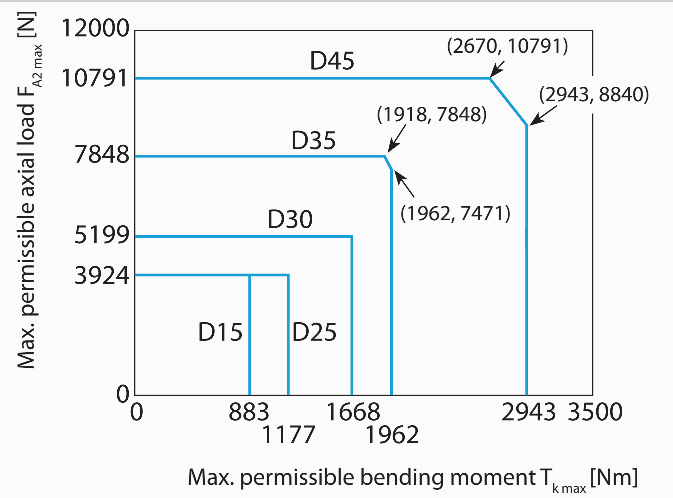
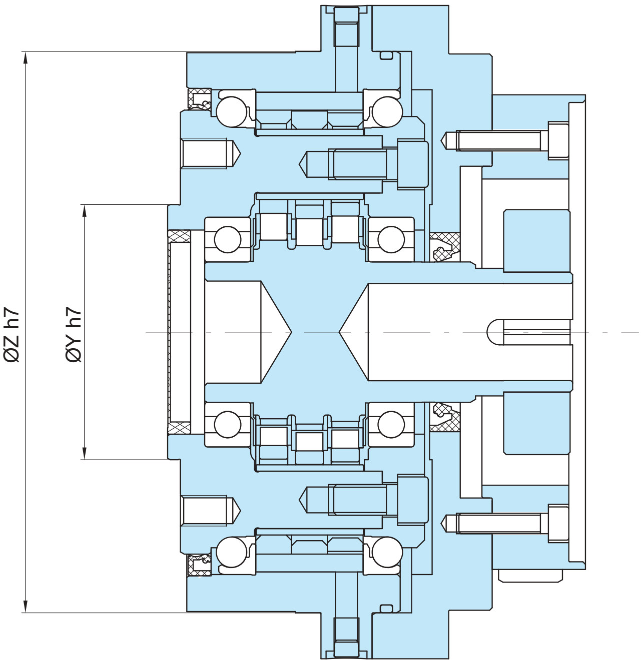


Fig. D6 Max. permissible bending moment and axial load

6.8 Assembly specifications and tolerances

6.8.1 Assembly tolerances

To ensure the function, lifetime, and characteristics of the gearbox, the radial run-out of the shaft ends, the coaxiality and the axial run-out of the fastening surface as per EN 50347:2001 are sufficient. When used in high-precision applications, the tolerance according to EN 50347:2001 should be reduced by 50%, which has additional advantages.



Size	Ø Z	Ø Y
D15	124	47
D25	145	113
D30	163	100
D35	174	75
D45	220	100

Table D20
(Dimensions in mm)

6.8.2 Tightening torque and maximum permissible transmittable torque for bolts

The permissible transmitted torque for bolts and the number, size, and tightening torque for fastening the output side flange and the ring gear housing are listed in Table D21. In the event of an Emergency Stop with corresponding load peaks, the output flange and ring gear housing bolts must all be replaced.

Size	Output flange bolts		Ring gear housing		Max. permissible transmittable torque for bolts [Nm]
	Number and size of bolts	Tightening torque [Nm]	Number and size of bolts	Tightening torque [Nm]	
D15	12 × M8	38.3	12 × M6	15.7	1478
D25	12 × M8	38.3	16 × M6	15.7	2065
D30	16 × M8	38.3	16 × M6	15.7	2786
D35	12 × M10	76.5	16 × M8	38.3	3962
D45	16 × M12	133	16 × M10	76.5	9347

Table D21

- **Bolting:** Use metric hexagon socket head cap screws (DIN 4762, strength category 12.9).
- **Countermeasure for bolts loosening:** Use adhesives (Loctite 262, etc.) or spring washer (DIN 127A).
- **Use spring washers** (DIN 6796) when connecting the gearbox to the flange side, so that the bolt contact faces do not get damaged.

6.8.3 Motor mounting with clamp ring

D Series gearboxes are mounted on the motor using a clamp ring as standard.

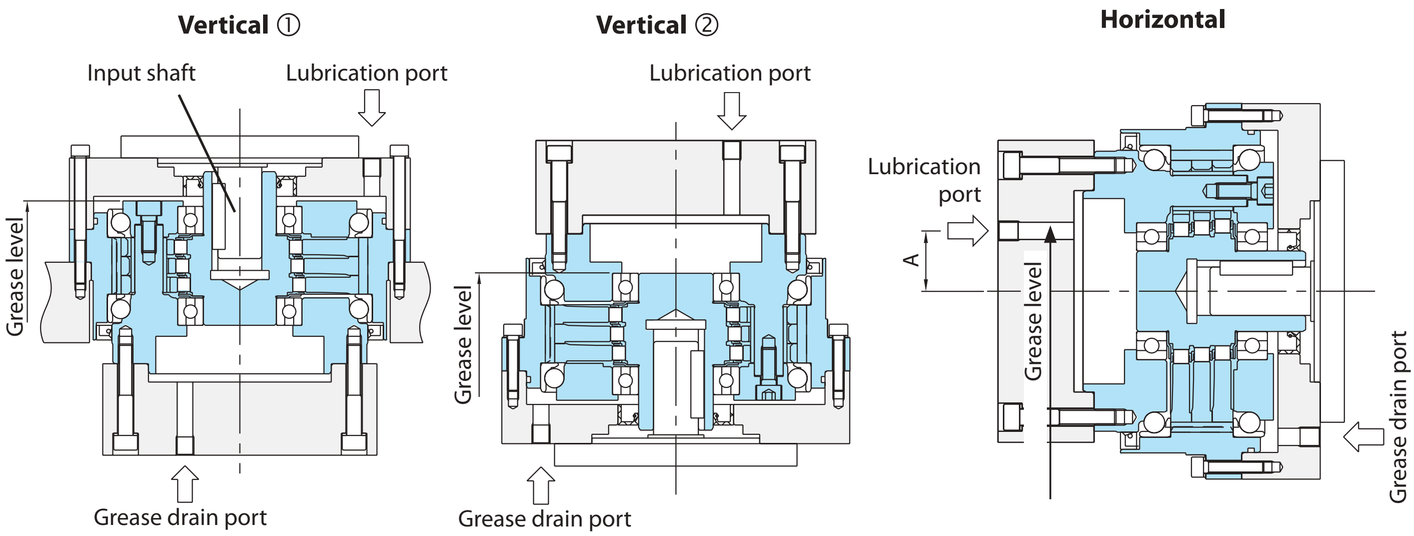
The permissible transferable torque and the tightening torque for the clamping screw are listed in Table D22.

If there is no dimensional drawing for the version, or if it is not a standard version in the D Series, please contact Sumitomo Drive Technologies.

Motor shaft diameter [mm]	Clamping screw tightening torque [Nm]	Transmittable torque T_1 [Nm]
Ø9	5.5	6
Ø10	5.5	6.5
Ø11	5.5	7.5
Ø14	5.5	11
Ø16	9.5	15
Ø17	9.5	16.5
Ø19	9.5	21
Ø22	23	39
Ø24	23	49
Ø28	46	79
Ø30	46	85
Ø32	46	105
Ø38	117	269

Table D22 Screw tightening torque and permissible input torque values for drive shafts having a clamp ring F4CF-D

6.8.4 Lubrication



- For gearboxes that are not sealed, delivery does not include lubricant (grease filling). Upon receipt, the customer must therefore fill it with the appropriate amount (Table D24) of the recommended grease(Table D23).
- Use the quantity quoted in Table D24 as an approximate value; check the grease level.
- Fit the lubrication port and the grease drain on the output side. (See "A" and Table D24)
- When adding grease for the first time, use the lower opening to ensure grease circulation.
- Reconditioning is recommended after 20,000 operating hours, but at least every 3-5 years.
- The lifetime of the gearbox can be increased by returning it to the factory for overhauling and regreasing.

Specified grease	Manufacturer
Multemp FZ No. 00	Kyodo Yushi Co., Ltd.
Conditions for use: Ambient temperature -10 °C to +40 °C	

Table D23 Specified grease

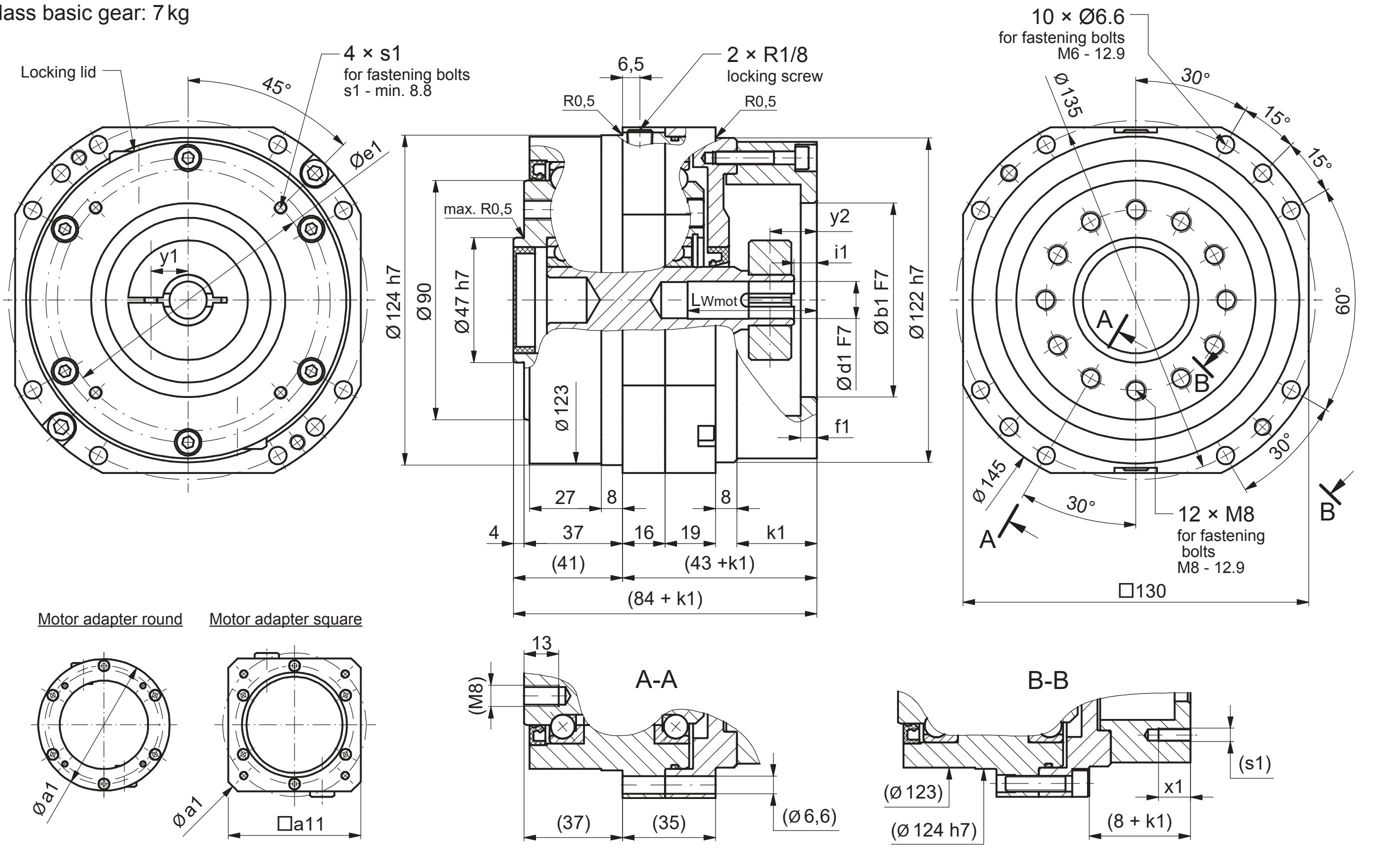
Size	Quantity of grease [g]			Lubrication port distance A [mm]
	Vertical ①	Vertical ②	Horizontal	
D15	55	40	50	20
D25	100	45	95	26
D30	220	85	200	29
D35	190	150	160	34
D45	320	260	270	39

Table D24 (if delivered without grease filling)

6.9 Dimensioned drawings

F4CF-D15

Mass basic gear: 7 kg



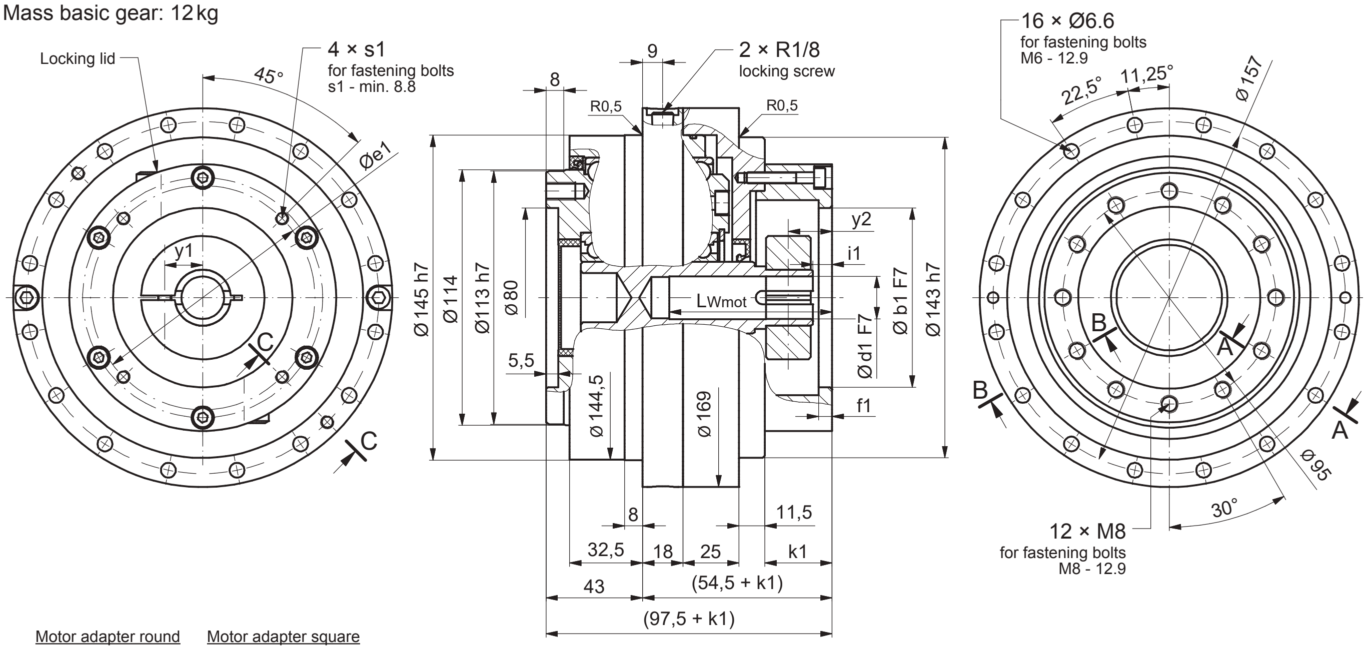
Motor connection dimensions F4CF-D15

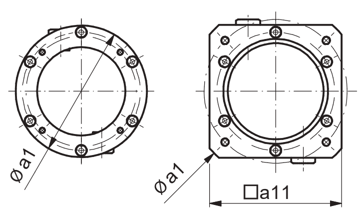
Motor code	Hole for shaft	Min./Max. Length of motor shaft	Centering F7	Spigot seat depth	Pitch circle Ø	Thread in gearbox flange	Thread depth	Flange diameter	Flange square dimen-sion	Flange width	Shaft recess without bushing	Shaft recess with bushing	Positional dimensions locking lid	
	Ød1	$L_{w\ Mot\ min/max}$	Øb1	f1	Øe1	4x s1	x1	Øa1	□a11	k1	i1		y1	y2
	mm													
C06G	9	24.0 / 47.5	40	5.5	63	M4	7.5	119	-	29	-	6.5	17	16.5
C08G		24.0 / 47.5	40	5.5	63	M5	7.5	119	-	29	-	6.5	17	16.5
D30G	10	25.0 / 48.5	80	6	100	M6	14	119	-	30	-	7.5	18.5	16.5
E08G	11	24.0 / 47.5	40	5.5	63	M5	7.5	119	-	29	-	6.5	17	16.5
E10G		24.0 / 47.5	50	5.5	70	M4	7.5	119	-	29	-	6.5	17	16.5
E11G		24.0 / 47.5	60	5.5	75	M5	7.5	119	-	29	-	6.5	18.5	16.5
H10G	14	24.0 / 47.5	50	5.5	70	M4	7.5	119	-	29	7.5	-	17	16.5
H25G		24.0 / 47.5	50	5.5	70	M5	7.5	119	-	29	7.5	-	17	16.5
H20G		24.0 / 47.5	50	6	95	M6	14	119	-	29	7.5	-	17	16.5
H11G		24.0 / 47.5	60	5.5	75	M5	7.5	119	-	29	7.5	-	18.5	16.5
H12G		24.0 / 47.5	60	5.5	75	M6	7.5	119	-	29	7.5	-	18.5	16.5
H18G		25.5 / 49.0	70	6	90	M6	14	119	-	30.5	9	-	18.5	17
H30G		25.0 / 48.5	80	6	100	M6	14	119	-	30	8.5	-	18.5	16.5
H30L		34.0 / 57.5	80	6	100	M6	14	119	-	39	8.5	-	18.5	25.5
H35G		25.0 / 48.5	95	6	115	M8	17	138	120	30	8.5	-	18.5	18
H50G		25.0 / 48.5	110	6	130	M8	17	158	120	30	8.5	-	25	18
H60L		36.5 / 60.0	110	8	145	M8	17	158	120	41.5	20	-	25	29.5
J18G	16	30.0 / 73.0	70	6	90	M6	14	119	-	30.5	-	8	18.5	17
J30L		38.5 / 81.5	80	6	100	M6	14	119	-	39	-	16.5	18.5	25.5
J60G		29.5 / 72.5	110	6.5	145	M8	17	158	120	30	-	7.5	25	18
K60L	17	43.0 / 84.0	110	8	145	M8	17	158	120	41.5	-	19	25	29.5
M30G	19	29.5 / 72.5	80	6	100	M6	14	119	-	30	8.5	-	18.5	16.5
M30L		38.5 / 81.5	80	6	100	M6	14	119	-	39	8.5	-	18.5	25.5
M35G		29.5 / 72.5	95	6	115	M8	17	138	120	30	8.5	-	18.5	18
M45G		29.5 / 72.5	95	6	130	M8	17	158	120	30	8.5	-	25	18
M50G		29.5 / 72.5	110	6	130	M8	17	158	120	30	8.5	-	25	18
M60G		29.5 / 72.5	110	6.5	145	M8	17	158	120	30	8.5	-	25	18
M60L		43.0 / 84.0	110	8	145	M8	17	158	120	41.5	20	-	25	29.5

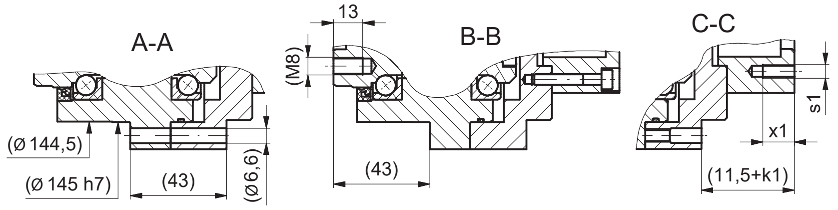
Note Other motor mounting dimensions available on request.

F4CF-D25

Mass basic gear: 12 kg







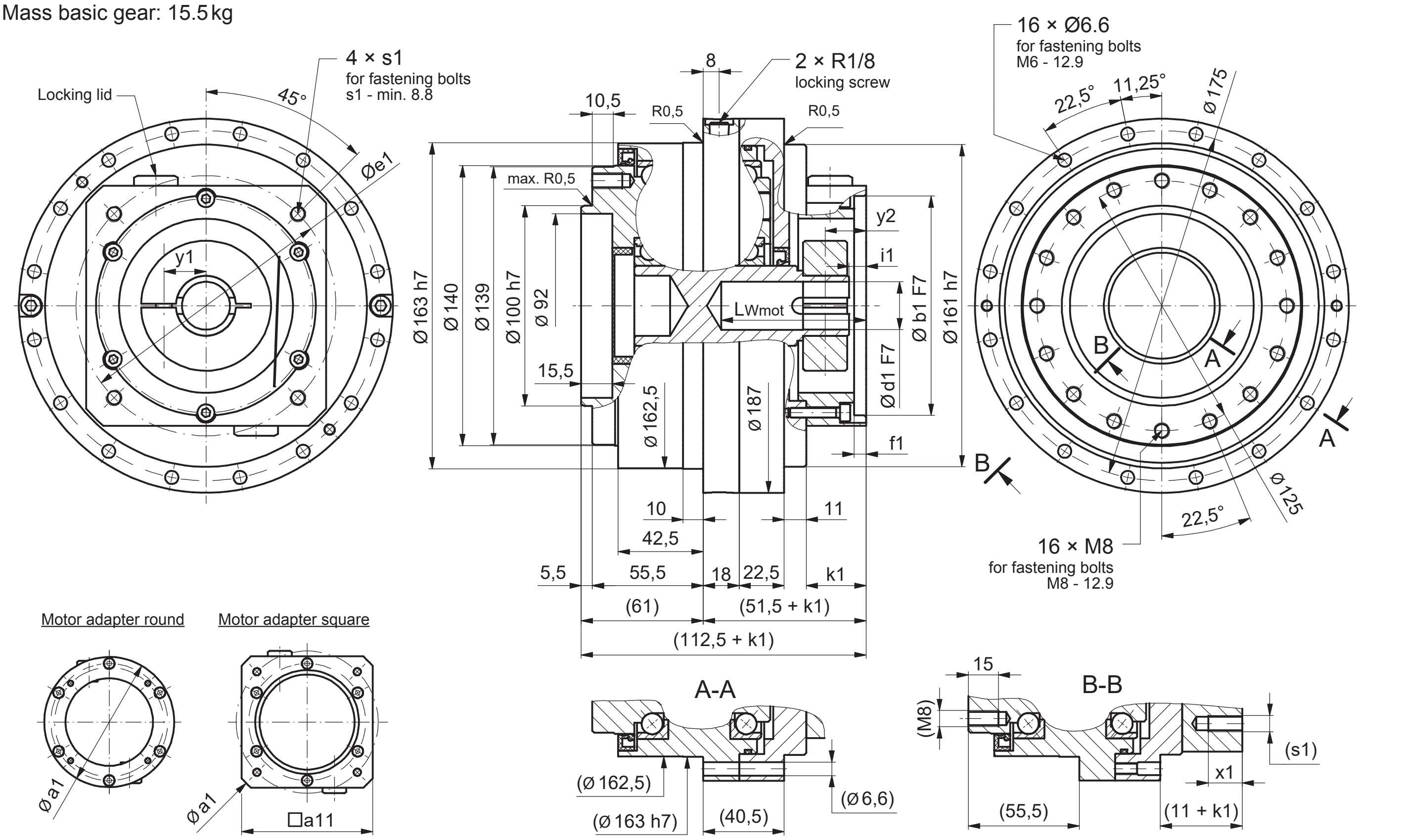
Motor connection dimensions F4CF-D25

Motor code	Hole for shaft	Min./Max. Length of motor shaft	Centering F7	Spigot seat depth	Pitch circle Ø	Thread in gearbox flange	Thread depth	Flange diameter	Flange square dimen-sion	Flange width	Shaft recess without bushing	Shaft recess with bushing	Positional dimensions locking lid	
	Ød1	$L_{w\,Mot\ min/max}$	Øb1	f1	Øe1	4x s1	x1	Øa1	□a11	k1	i1		y1	y2
	mm													
D30G	10	25.0 / 48.5	80	6	100	M6	14	119	-	30	-	7.5	18.5	16.5
H10G		24.0 / 47.5	50	5.5	70	M4	7.5	119	-	29	7.5	-	17	16.5
H25G		24.0 / 47.5	50	5.5	70	M5	7.5	119	-	29	7.5	-	17	16.5
H20G		24.0 / 47.5	50	6	95	M6	14	119	-	29	7.5	-	17	16.5
H11G		24.0 / 47.5	60	5.5	75	M5	7.5	119	-	29	7.5	-	18.5	16.5
H12G		24.0 / 47.5	60	5.5	75	M6	7.5	119	-	29	7.5	-	18.5	16.5
H18G	14	25.5 / 49.0	70	6	90	M6	14	119	-	30.5	9	-	18.5	17
H30G		25.0 / 48.5	80	6	100	M6	14	119	-	30	8.5	-	18.5	16.5
H30L		34.0 / 57.5	80	6	100	M6	14	119	-	39	8.5	-	18.5	25.5
H35G		25.0 / 48.5	95	6	115	M8	17	138	120	30	8.5	-	18.5	18
H50G		25.0 / 48.5	110	6	130	M8	17	158	120	30	8.5	-	25	18
H60L		36.5 / 60.0	110	8	145	M8	17	158	120	41.5	20	-	25	29.5
J18G		30.0 / 73.0	70	6	90	M6	14	119	-	30.5	-	8	18.5	17
J30L	16	38.5 / 81.5	80	6	100	M6	14	119	-	39	-	16.5	18.5	25.5
J60G		29.5 / 72.5	110	6.5	145	M8	17	158	120	30	-	7.5	25	18
K60L	17	43.0 / 84.0	110	8	145	M8	17	158	120	41.5	-	19	25	29.5
M30G		29.5 / 72.5	80	6	100	M6	14	119	-	30	8.5	-	18.5	16.5
M30L		38.5 / 81.5	80	6	100	M6	14	119	-	39	8.5	-	18.5	25.5
M35G		29.5 / 72.5	95	6	115	M8	17	138	120	30	8.5	-	18.5	18
M45G	19	29.5 / 72.5	95	6	130	M8	17	158	120	30	8.5	-	25	18
M50G		29.5 / 72.5	110	6	130	M8	17	158	120	30	8.5	-	25	18
M60G		29.5 / 72.5	110	6.5	145	M8	17	158	120	30	8.5	-	25	18
M60L		43.0 / 84.0	110	8	145	M8	17	158	120	41.5	20	-	25	29.5
N60G	22	31.5 / 72.5	110	6.5	145	M8	17	158	120	30	-	7.5	25	18
Z35G		31.5 / 72.5	95	6	115	M8	17	138	120	30	8.5	-	18.5	18
Z50G	24	31.5 / 72.5	110	6	130	M8	17	158	120	30	8.5	-	25	18
Z70G		31.5 / 72.5	130	6	165	M10	20	188	144	30	8.5	-	25	18

Note Other motor mounting dimensions available on request.

F4CF-D30

Mass basic gear: 15.5 kg



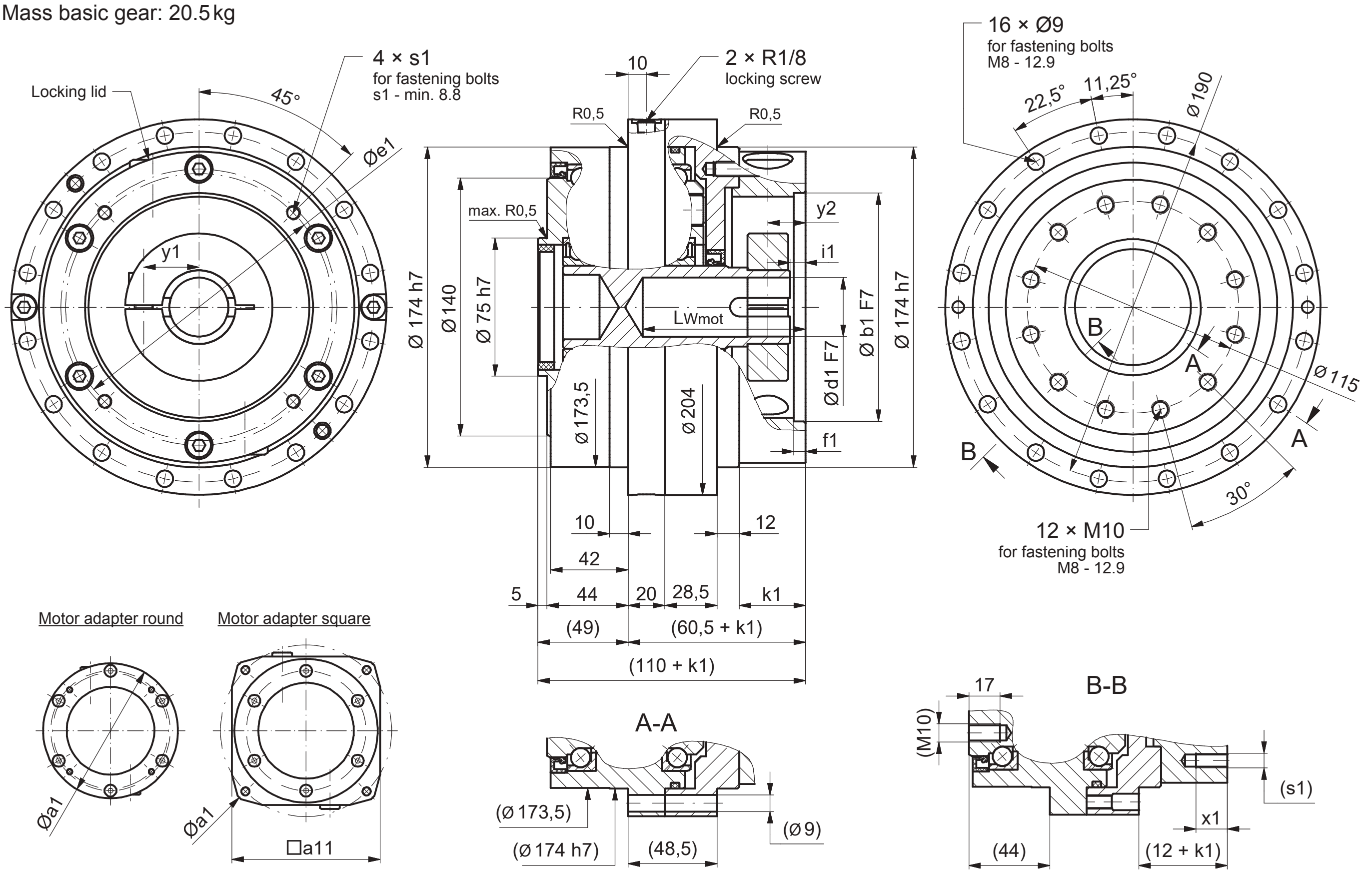
Motor connection dimensions F4CF-D30

Motor code	Hole for shaft	Min./Max. Length of motor shaft	Centering F7	Spigot seat depth	Pitch circle Ø	Thread in gearbox flange	Thread depth	Flange diameter	Flange square dimen-sion	Flange width	Shaft recess without bushing	Shaft recess with bushing	Positional dimensions locking lid	
	Ød1	$L_{w\ Mot\ min/max}$	Øb1	f1	Øe1	4x s1	x1	Øa1	□a11	k1	i1		y1	y2
	mm													
H35G	14	25.0 / 48.5	95	6	115	M8	17	138	120	30	8.5	-	18.5	18
H50G	14	25.0 / 48.5	110	6	130	M8	17	158	120	30	8.5	-	25	18
H60L	14	36.5 / 60.0	110	8	145	M8	17	158	120	41.5	20	-	25	29.5
J18G	16	30.0 / 73.0	70	6	90	M6	14	119	-	30.5	-	8	18.5	17
J30L	16	38.5 / 81.5	80	6	100	M6	14	119	-	39	-	16.5	18.5	25.5
J60G	16	29.5 / 72.5	110	6.5	145	M8	17	158	120	30	-	7.5	25	18
K60L	17	43.0 / 84.0	110	8	145	M8	17	158	120	41.5	-	19	25	29.5
M30G	19	29.5 / 72.5	80	6	100	M6	14	119	-	30	8.5	-	18.5	16.5
M30L	19	38.5 / 81.5	80	6	100	M6	14	119	-	39	8.5	-	18.5	25.5
M35G	19	29.5 / 72.5	95	6	115	M8	17	138	120	30	8.5	-	18.5	18
M45G	19	29.5 / 72.5	95	6	130	M8	17	158	120	30	8.5	-	25	18
M50G	19	29.5 / 72.5	110	6	130	M8	17	158	120	30	8.5	-	25	18
M60G	19	29.5 / 72.5	110	6.5	145	M8	17	158	120	30	8.5	-	25	18
M60L	19	43.0 / 84.0	110	8	145	M8	17	158	120	41.5	20	-	25	29.5
N60G	22	31.5 / 72.5	110	6.5	145	M8	17	158	120	30	-	7.5	25	18
Z35G	24	31.5 / 72.5	95	6	115	M8	17	138	120	30	8.5	-	18.5	18
Z50G	24	31.5 / 72.5	110	6	130	M8	17	158	120	30	8.5	-	25	18
Z70G	24	31.5 / 72.5	130	6	165	M10	20	188	144	30	8.5	-	25	18
Q60G	28	31.5 / 88.5	110	6.5	145	M8	17	158	120	30	-	7.5	25	18
Q60L	28	43.0 / 100.0	110	8	145	M8	17	158	120	41.5	-	19	25	29.5
Q70G	28	31.5 / 88.5	130	6	165	M10	20	188	144	30	-	7.5	25	18
S70G	32	31.5 / 88.5	130	6	165	M10	20	188	144	30	8.5	-	25	18

Note Other motor mounting dimensions available on request.

F4CF-D35

Mass basic gear: 20.5 kg



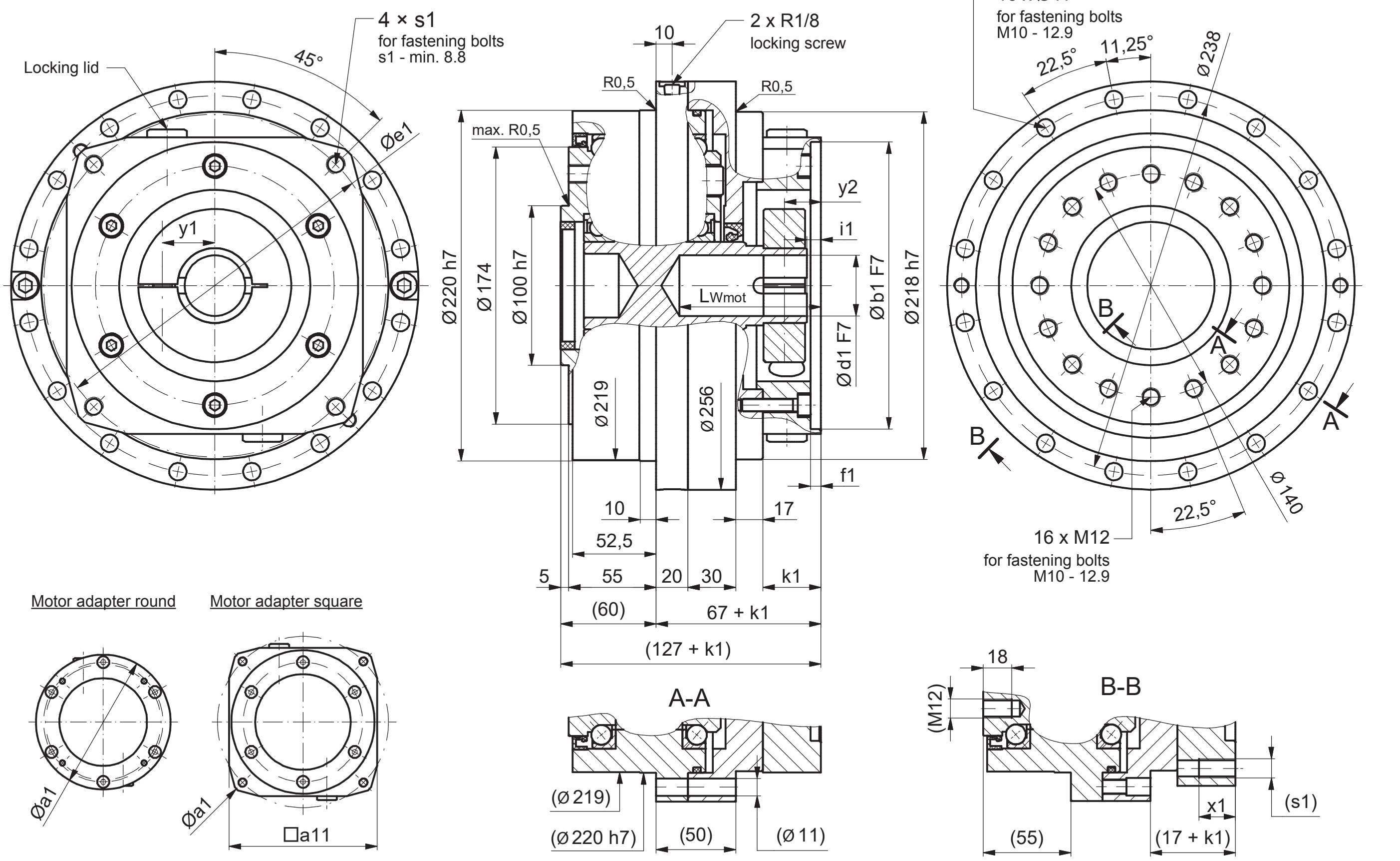
Motor connection dimensions F4CF-D35

Motor code	Hole for shaft	Min./Max. Length of motor shaft	Centering F7	Spigot seat depth	Pitch circle Ø	Thread in gearbox flange	Thread depth	Flange diameter	Flange square dimension	Flange width	Shaft recess without bushing	Shaft recess with bushing	Positional dimensions locking lid	
	Ød1	$L_{w\,Mot\ min/max}$	Øb1	f1	Øe1	4x s1	x1	Øa1	□a11	k1	i1		y1	y2
	mm													
H35G	14	25.0 / 48.5	95	6	115	M8	17	138	120	30	8.5	-	18.5	18
H50G		25.0 / 48.5	110	6	130	M8	17	158	120	30	8.5	-	25	18
H60L		36.5 / 60.0	110	8	145	M8	17	158	120	41.5	20	-	25	29.5
J18G	16	30.0 / 73.0	70	6	90	M6	14	119	-	30.5	-	8	18.5	17
J30L		38.5 / 81.5	80	6	100	M6	14	119	-	39	-	16.5	18.5	25.5
J60G		29.5 / 72.5	110	6.5	145	M8	17	158	120	30	-	7.5	25	18
K60L	17	43.0 / 84.0	110	8	145	M8	17	158	120	41.5	-	19	25	29.5
M30G	19	29.5 / 72.5	80	6	100	M6	14	119	-	30	8.5	-	18.5	16.5
M30L		38.5 / 81.5	80	6	100	M6	14	119	-	39	8.5	-	18.5	25.5
M35G		29.5 / 72.5	95	6	115	M8	17	138	120	30	8.5	-	18.5	18
M45G		29.5 / 72.5	95	6	130	M8	17	158	120	30	8.5	-	25	18
M50G		29.5 / 72.5	110	6	130	M8	17	158	120	30	8.5	-	25	18
M60G		29.5 / 72.5	110	6.5	145	M8	17	158	120	30	8.5	-	25	18
M60L		43.0 / 84.0	110	8	145	M8	17	158	120	41.5	20	-	25	29.5
N60G	22	31.5 / 72.5	110	6.5	145	M8	17	158	120	30	-	7.5	25	18
Z35G	24	31.5 / 72.5	95	6	115	M8	17	138	120	30	8.5	-	18.5	18
Z50G		31.5 / 72.5	110	6	130	M8	17	158	120	30	8.5	-	25	18
Z70G		31.5 / 72.5	130	6	165	M10	20	188	144	30	8.5	-	25	18
Q60G	28	31.5 / 88.5	110	6.5	145	M8	17	158	120	30	-	7.5	25	18
Q60L		43.0 / 100.0	110	8	145	M8	17	158	120	41.5	-	19	25	29.5
Q70G		31.5 / 88.5	130	6	165	M10	20	188	144	30	-	7.5	25	18
R50G	30	31.5 / 88.5	110	6	130	M8	17	169	-	36	-	7.5	24	20.5
S70G	32	31.5 / 88.5	130	6	165	M10	20	188	144	30	8.5	-	25	18
T76G	35	37.0 / 94.0	114.3	6	200	M12	23	223	176	41.5	14	13	33	26.5

Note Other motor mounting dimensions available on request.

F4CF-D45

Mass basic gear: 35.5 kg



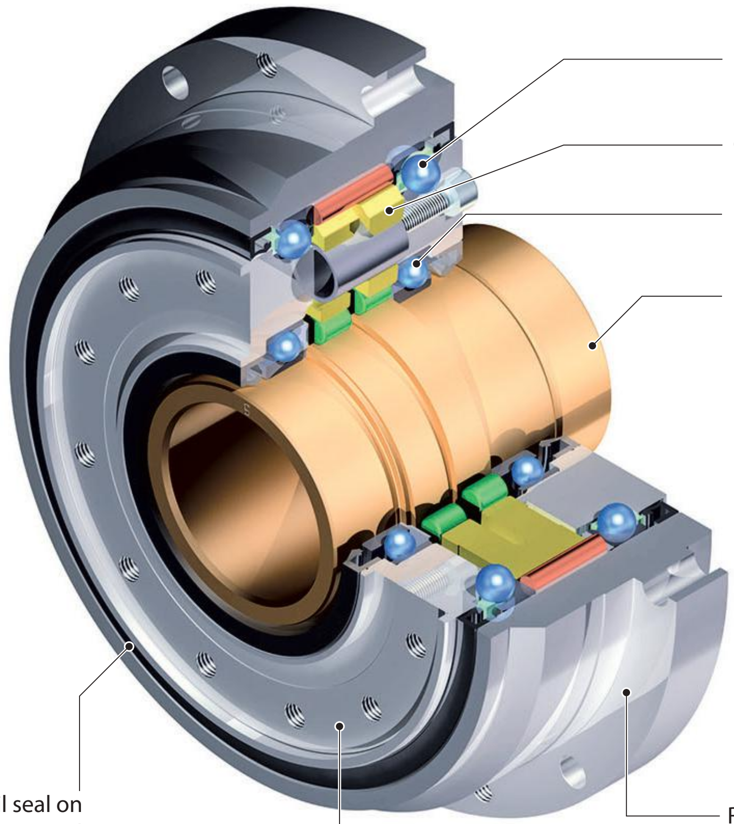
Motor connection dimensions F4CF-D45

Motor code	Hole for shaft	Min./Max. Length of motor shaft	Centering F7	Spigot seat depth	Pitch circle Ø	Thread in gearbox flange	Thread depth	Flange diameter	Flange square dimension	Flange width	Shaft recess without bushing	Shaft recess with bushing	Positional dimensions locking lid	
	Ød1	$L_{w\,Mot\ min/max}$	Øb1	f1	Øe1	4x s1	x1	Øa1	□a11	k1	i1		y1	y2
	mm													
H35G		25.0 / 48.5	95	6	115	M8	17	138	120	30	8.5	-	18.5	18
H50G	14	25.0 / 48.5	110	6	130	M8	17	158	120	30	8.5	-	25	18
H60L		36.5 / 60.0	110	8	145	M8	17	158	120	41.5	20	-	25	29.5
J18G		30.0 / 73.0	70	6	90	M6	14	119	-	30.5	-	8	18.5	17
J30L	16	38.5 / 81.5	80	6	100	M6	14	119	-	39	-	16.5	18.5	25.5
J60G		29.5 / 72.5	110	6.5	145	M8	17	158	120	30	-	7.5	25	18
K60L	17	43.0 / 84.0	110	8	145	M8	17	158	120	41.5	-	19	25	29.5
M30G		29.5 / 72.5	80	6	100	M6	14	119	-	30	8.5	-	18.5	16.5
M30L		38.5 / 81.5	80	6	100	M6	14	119	-	39	8.5	-	18.5	25.5
M35G		29.5 / 72.5	95	6	115	M8	17	138	120	30	8.5	-	18.5	18
M45G	19	29.5 / 72.5	95	6	130	M8	17	158	120	30	8.5	-	25	18
M50G		29.5 / 72.5	110	6	130	M8	17	158	120	30	8.5	-	25	18
M60G		29.5 / 72.5	110	6.5	145	M8	17	158	120	30	8.5	-	25	18
M60L		43.0 / 84.0	110	8	145	M8	17	158	120	41.5	20	-	25	29.5
N60G	22	31.5 / 72.5	110	6.5	145	M8	17	158	120	30	-	7.5	25	18
Z35G		31.5 / 72.5	95	6	115	M8	17	138	120	30	8.5	-	18.5	18
Z50G	24	31.5 / 72.5	110	6	130	M8	17	158	120	30	8.5	-	25	18
Z70G		31.5 / 72.5	130	6	165	M10	20	188	144	30	8.5	-	25	18
Q60G		31.5 / 88.5	110	6.5	145	M8	17	158	120	30	-	7.5	25	18
Q60L	28	43.0 / 100.0	110	8	145	M8	17	158	120	41.5	-	19	25	29.5
Q70G		31.5 / 88.5	130	6	165	M10	20	188	144	30	-	7.5	25	18
R50G	30	31.5 / 88.5	110	6	130	M8	17	169	-	36	-	7.5	24	20.5
S70G	32	31.5 / 88.5	130	6	165	M10	20	188	144	30	8.5	-	25	18
T76G	35	37.0 / 94.0	114.3	6	200	M12	23	223	176	41.5	14	13	33	26.5
U80G	38	32.0 / 89.0	180	6.5	215	M12	23	237	168	36.5	9	-	30	21.5

Note Other motor mounting dimensions available on request.

7 C Series

F4C(F)-C
F2CF-C



Special feature:
The large diameter of the hollow shaft allows for effective use of space for the cable or media

- 6 sizes
- Ratios (single-stage) 29/59/89/119
- Nominal output torques up to 4328 Nm
- Acceleration torques up to 6278 Nm
- Hollow shaft diameter from 40 to 99 mm
- Completely sealed and maintenance-free
- Lost Motion < 1

7.1 Torques according to output speeds

Output speed n_{2m} [min^{-1}]			5			10			15			20		
Model	Size	Reduction ratio i	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]
F4CF-	C15	29	276	145	0.19	276	290	0.39	276	435	0.58	276	580	0.77
		59	296	295	0.21	296	590	0.41	263	885	0.55	242	1180	0.67
		89	296	445	0.21	263	890	0.37	233	1335	0.49	214	1780	0.6
		119	296	595	0.21	241	1190	0.34	213	1785	0.45	196	2380	0.55
F4C-	C25	59	568	295	0.4	568	590	0.79	505	885	1.06	464	1180	1.29
		89	568	445	0.4	505	890	0.7	447	1335	0.94	410	1780	1.14
		119	568	595	0.4	463	1190	0.65	410	1785	0.86	376	2380	1.05
F4CF-	C35	59	1082	295	0.76	1082	590	1.51	963	885	2.02	883	1180	2.47
		89	1082	445	0.76	961	890	1.34	851	1335	1.78	781	1780	2.18
		119	1082	595	0.76	881	1190	1.23	780	1785	1.63	716	2380	2
F2CF-	C45	59	1758	295	1.23	1758	590	2.45	1565	885	3.28	1435	1180	4.01
		89	1758	445	1.23	1562	890	2.18	1383	1335	2.90	1269	1780	3.54
		119	1758	595	1.23	1432	1190	2	1268	1785	2.65			
	C55	59	2705	295	1.89	2705	590	3.78	2407	885	5.04	2208	1180	6.17
		89	2705	445	1.89	2403	890	3.36	2128	1335	4.46			
		119	2705	595	1.89	2203	1190	3.08						
	C65	59	4328	295	3.02	4328	590	6.04	3852	885	8.07	3533	1180	9.87
		89	4328	445	3.02	3845	890	5.37	3405	1335	7.13			
		119	4328	595	3.02	3524	1190	4.92						

Table C1 **Rating values (reference value output speed n_{2m})**

Size	Max. acceleration and deceleration torque T_{2A}	Peak torque for Emergency Stop T_{2max}
	[Nm]	[Nm]
C15	540	1080
C25	1030	2060
C35	1962	3924
C45	3188	6377
C55	4316	8633
C65	6278	12577

Table C2 **Maximum acceleration and peak torque**

25			30			Max. permissible input speed $n_{1\,max}$ short term [min^{-1}]	Max. permissible input speed $n_{1\,ED}$ [min^{-1}]		Moment of inertia j related to the input shaft [$\times 10^{-4}\,kgm^2$]	Mass [kg]
Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]		50% ED	100% ED		
261	725	0.91	247	870	1.03	3350	2400	1200	3.52	
226	1475	0.79	214	1770	0.9				3.51	6
200	2225	0.7	189	2670	0.79	4000	3200	1600	3.5	
183	2975	0.64							3.49	
434	1475	1.51	411	1770	1.72				8.2	
383	2225	1.34	363	2670	1.52	3500	2900	1450	8.2	12.5
									8.2	
826	1475	2.88	782	1770	3.28				32.8	
						2500	2100	1050	32.7	21
									32.7	
1342	1475	4.69	1271	1770	5.32				69.6	
						2100	1800	900	69.4	32
									69.3	
2065	1475	7.21							129.4	
						1800	1500	750	129.0	45
									128.8	
									223.6	
						1700	1400	700	222.9	62
									222.6	

: 50% ED range   : 100% ED range

1. T_{2N} = nominal output torque
   Nominal output torque corresponds to the max. permissible average load torque at all output speeds.
   The nominal output torque for speeds less than 5 min^{-1} is equal to the value at 5 min^{-1}.
   The value for the maximum permissible input power is calculated from the nominal output torque at 100%.
   This value takes the efficiency of Fine Cyclo into consideration.

2. n_{1max} = maximum permissible input speed
   However, it must be n_{1m} (mean input speed) < $n_{1\,ED}$.

3. $n_{1\,ED}$ = permissible input speed according to duty cycle

4. T_{2A} = max. Acceleleration and braking torque (for fatigue strength at $2 \cdot 10^7$ load cycles)
   Permissible peak torque for normal start and stop procedures.

5. T_{2max} = max. permissible torque for Emergency Stop situations or in the event of heavy shocks (limited by the mechanical strength) (permissible 1000 times during the entire lifetime).

6. The rated torque T_{2N} is calculated using the following equation when the speed is not shown in the table above:

$$T_{2N} = T_{2N,\,600} \left(\frac{600}{n_{1m}}\right)^{0.3}$$

T_{2N} : Rated torque at input speed n_{1m}
$T_{2N,\,600}$: Rated torque at input speed n_{1m} is 600 min^{-1}

7.2 Torques according to input speeds

Input speed n_{1m} [min^{-1}]			2500			2000			1750			1500		
Model	Size	Reduction ratio i	Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]
F4CF-	C15	29	180	86.2	2.17	192	69	1.85	200	60.3	1.69	210	51.7	1.51
		59	193	42.4	1.14	206	33.9	0.98	215	29.7	0.89	225	25.4	0.8
		89	193	28.1	0.76	206	22.5	0.65	215	19.7	0.59	225	16.9	0.53
		119	193	21	0.57	206	16.8	0.48	215	14.7	0.44	225	12.6	0.4
F4C-	C25	59	370	42.4	2.19	396	33.9	1.87	412	29.7	1.7	432	25.4	1.53
		89	370	28.1	1.45	396	22.5	1.24	412	19.7	1.13	432	16.9	1.01
		119	370	21	1.08	396	16.8	0.93	412	14.7	0.84	432	12.6	0.76
F4CF-	C35	59				754	33.9	3.56	785	29.7	3.24	822	25.4	2.91
		89				754	22.5	2.36	785	19.7	2.15	822	16.9	1.93
		119				754	16.8	1.77	785	14.7	1.61	822	12.6	1.44
F2CF-	C45	59							1275	29.7	5.27	1336	25.4	4.73
		89							1275	19.7	3.5	1336	16.9	3.14
		119							1275	14.7	2.61	1336	12.6	2.35
	C55	59										2055	25.4	7.28
		89										2055	16.9	4.83
		119										2055	12.6	3.61
	C65	59												
		89												
		119												

Table C3 Rating values (reference value input speed n_{1m})

Size	Max. acceleration and deceleration torque T_{2A}	Peak torque for Emergency Stop T_{2max}
	[Nm]	[Nm]
C15	540	1080
C25	1030	2060
C35	1962	3924
C45	3188	6377
C55	4316	8633
C65	6278	12577

Table C4 Maximum acceleration and peak torque

1000			750			< 600				Max. permissible input speed $n_{1\,ED}$ [min⁻¹]			
Nominal output torque [Nm]	Output speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min⁻¹]	Max. permissible input power [kW]	Max. permissible input speed $n_{1\,max}$ short term [min⁻¹]	50% ED	100% ED	Moment of inertia j related to the input shaft [×10⁻⁴ kgm²]	Mass [kg]
237	34.5	1.14	258	25.9	0.93	276	21	0.8	3350	2400	1200	3.52	
254	16.9	0.6	277	12.7	0.49	296	10	0.42				3.51	6
254	11.2	0.4	277	8.4	0.33	296	7	0.28	4000	3200	1600	3.5	
254	8.4	0.3	277	6.3	0.24	296	5	0.21				3.49	
487	16.9	1.15	531	12.7	0.94	568	10.2	0.81				8.3	
487	11.2	0.76	531	8.4	0.62	568	6.7	0.53	3500	2900	1450	8.2	12.5
487	8.4	0.57	531	6.3	0.47	568	5	0.4				8.2	
928	16.9	2.19	1012	12.7	1.79	1082	10.2	1.53				32.8	
928	11.2	1.45	1012	8.4	1.19	1082	6.7	1.02	2500	2100	1050	32.7	21
928	8.4	1.09	1012	6.3	0.89	1082	5	0.76				32.7	
1508	16.9	3.56	1644	12.7	2.91	1758	10.2	2.49				69.6	
1508	11.2	2.36	1644	8.4	1.93	1758	6.7	1.65	2100	1800	900	69.4	32
1508	8.4	1.77	1644	6.3	1.44	1758	5	1.24				69.3	
2321	16.9	5.48	2530	12.7	4.48	2705	10.2	3.83				129.4	
2321	11.2	3.63	2530	8.4	2.97	2705	6.7	2.54	1800	1500	750	129.0	45
2321	8.4	2.72	2530	6.3	2.22	2705	5	1.9				128.8	
3713	16.9	8.77	4048	12.7	7.17	4328	10.2	6.14				223.6	
3713	11.2	5.82	4048	8.4	4.75	4328	6.7	4.07	1700	1400	700	222.9	62
3713	8.4	4.35	4048	6.3	3.56	4328	5	3.04				222.6	

: 50% ED range : 100% ED range

1. T_{2N} = nominal output torque
   Nominal output torque corresponds to the max. permissible average load torque at all input speeds.
   The nominal output torque for speeds less than 600 min⁻¹ is equal to the value at 600 min⁻¹.
   The value for the maximum permissible input power is calculated from the nominal output torque at 100%.
   This value takes the efficiency of Fine Cyclo into consideration.
2. n_{1max} = maximum permissible input speed
   However, it must be n_{1m} (mean input speed) < $n_{1\,ED}$.
3. $n_{1\,ED}$ = permissible input speed according to duty cycle
4. T_{2A} = max. Acceleleration and braking torque (for fatigue strength at $2 \cdot 10^7$ load cycles)
   Permissible peak torque for normal start and stop procedures.
5. T_{2max} = max. permissible torque for Emergency Stop situations or in the event of heavy shocks (limited by the mechanical strength) (permissible 1000 times during the entire lifetime).
6. The rated torque T_{2N} is calculated using the following equation when the speed is not shown in the table above:

$$T_{2N} = T_{2N,\,600}\left(\frac{600}{n_{1m}}\right)^{0.3}$$

T_{2N} : Rated torque at input speed n_{1m}

$T_{2N,\,600}$: Rated torque at input speed n_{1m} is 600 min⁻¹

7.3 Stiffness and Lost Motion

Size	i	Test torque T_p [Nm]	Lost Motion		Torsional stiffness 3% - 50% T_p [Nm/arcmin]	Torsional stiffness 3% - 100% T_p [Nm/arcmin]	Torsional stiffness 50% - 100% T_p [Nm/arcmin]
			Lost Motion [arcmin]	Domain of definition [Nm]			
C15	29	±215	< 1	±6.5	40	69	77
	59						
	89						
	119						
C25	59	±412		±12.4	71	115	128
	89						
	119						
C35	59	±785		±23.5	200	259	294
	89						
	119						
C45	59	±1275		±38.3	353	404	491
	89						
	119						
C55	59	±1962		±58.9	588	635	687
	89						
	119						
C65	59	±3139		±94.2	765	918	1030
	89						
	119						

Table C5 Torsional stiffness
T_p: Test torque at input speed $n_1 = 1750\ min^{-1}$

Calculation of the twist angle:

1) At a load torque less than 3% T_p

$$\varphi = \frac{\text{Lost Motion}}{2} \cdot \frac{\text{Load torque}}{0.03 \cdot T_p}$$

2) At a load torque greater than 3% T_p (standard case)

$$\varphi = \frac{\text{Lost Motion}}{2} + \frac{\text{Load torque} - (0.03 \cdot T_p)}{\text{Torsional stiffness}}$$

Note arcmin means "angular minute".
Table values for stiffness are average values.

7.4 No-load running torque NLRT

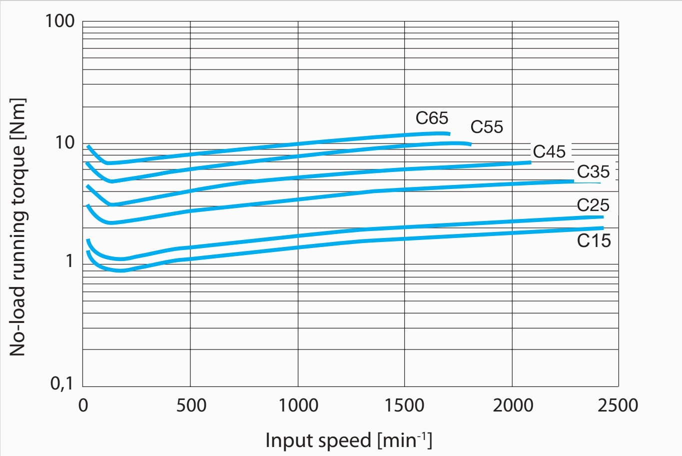


Fig. C1 Input side no-load running torque

Note
1. Fig. C1 shows the average no-load running torque after gearbox is run in (not factory-new condition).
2. Table C6 shows the measuring conditions.

Ring gear housing temperature	approx. 30 °C
Precision during assembly	as per 7.8.1
Lubrication	Standard lubrication

Table C6 Measurement conditions

7.5 Breakaway torque

Indicates the necessary torque for breakaway of the gearbox on the input or output side, after stop without output side load.

Breakaway torque on output side (BTO)

Note
1. Table C8 shows the max. breakaway torque on the output side BTO. Fine Cyclo gearboxes are not self-locking. The BTO is defined as the maximum value (factory-new condition), which steadily decreases during the lifetime.
2. Table C7 shows the measuring conditions

Precision during assembly	as per 7.8.1
Lubrication	Standard lubrication

Table C7 Measurement conditions

Size	i	Breakaway torque BTO [Nm]
C15	29	< 70
	59	< 70
	89	< 128
	119	< 128
C25	59	< 200
	89	< 220
	119	< 240
C35	59	< 300
	89	< 415
	119	< 550
C45	59	< 340
	89	< 550
	119	< 715
C55	59	< 600
	89	< 810
	119	< 1000
C65	59	< 700
	89	< 1000
	119	< 2100

Table C8 Value of the breakaway torque on the output side (BTO)

Breakaway torque on input side (BTI)

Note
1. Table C9 shows the max. breakaway torque BTI on the input side. BTI is defined as the maximum value (factory-new condition) which steadily decreases during the lifetime.
2. Table C7 shows the measuring conditions

Size	Breakaway torque BTI [Nm]
C15	< 2.4
C25	< 3.5
C35	< 4.5
C45	< 6.5
C55	< 9.0
C65	< 11.5

Table C9 Value of the breakaway torque on the input side (BTI)

7.6 Efficiency

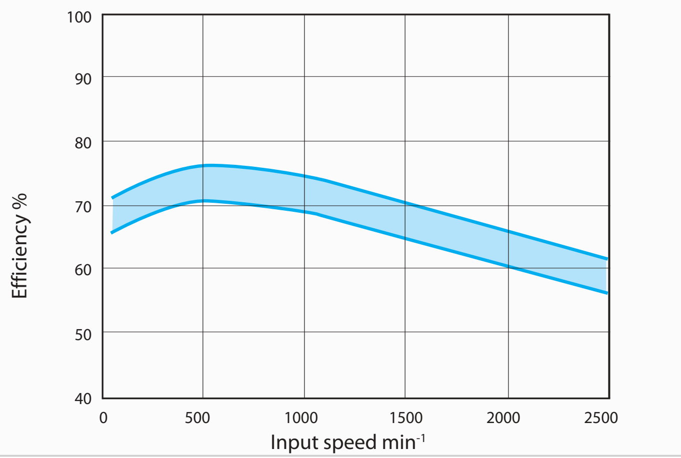


Fig. C2 a Efficiency curve (size C15-C45)

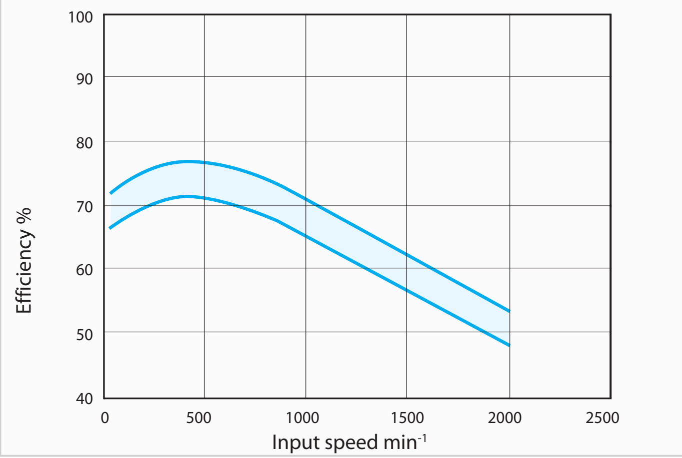


Fig. C2 b Efficiency curve (size C55-C65)

Fig. C2a and Fig. C2b show the correlation between efficiency and input speed. Further information see "4 Explaining the technical details" on page 18.

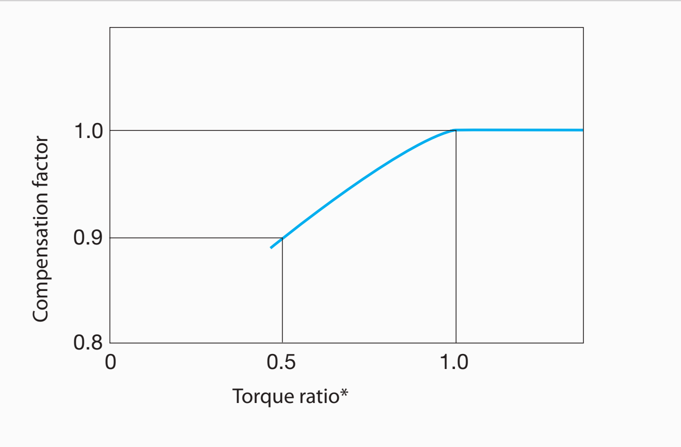


Fig. C3 Compensation curve for efficiency

*** Torque ratio = Load torque / Nominal output torque**

Compensation efficiency = efficiency · compensation factor

Note

1. The efficiency changes if the load torque does not match the nominal torque. Check the compensation factor in the diagram Fig. C3.
2. When the torque ratio is over 1.0, the compensation factor for efficiency is 1.0 (diagram Fig. C3).

7.7 Bearing loads

7.7.1 Maximum permissible radial and axial load on the input shaft

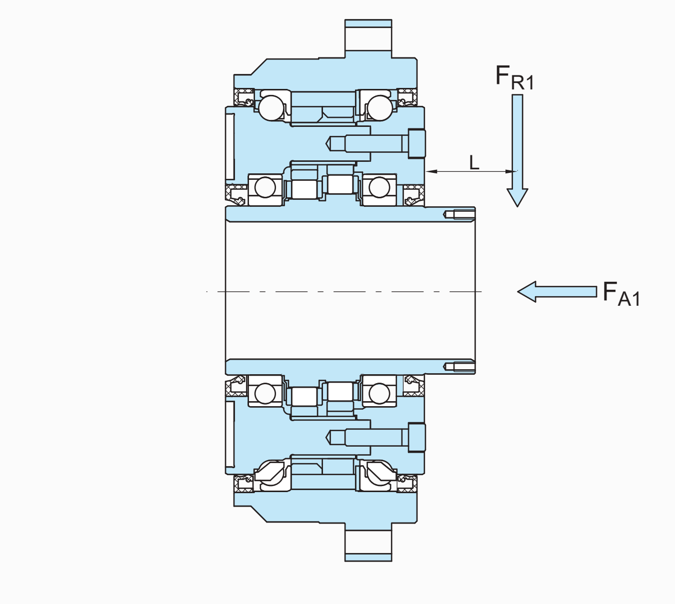


Fig. C4 Load position on input shaft

L [mm]	Load factor input L_{f1} Size C15	C25	C35	C45	C55	C65
5	0.79	0.8	0.76	0.75	0.73	0.73
10	0.86	0.86	0.81	0.79	0.77	0.77
15	0.93	0.92	0.86	0.83	0.8	0.8
20	1	0.98	0.9	0.87	0.84	0.84
25	1.25	1.14	0.95	0.91	0.88	0.87
30	1.5	1.36	1	0.95	0.91	0.9
35	1.75	1.59	1.17	0.99	0.95	0.94
40	2	1.82	1.33	1.11	0.99	0.97
45	2.25	2.05	1.5	1.25	1.07	1.02
50	2.5	2.27	1.67	1.39	1.19	1.14
60	3	2.73	2	1.67	1.43	1.36
70				1.94	1.67	1.59
80					1.9	1.82

Table C10 Load factor input L_{f1}
L = distance from input side carrier

If a gear or timing belt pulley instead of toothed belt pulley is mounted on the input shaft, the values for radial load and axial load should be equal to or less than the permissible values. The following equation is used to check whether the shaft load is permissible:

1. Input radial load F_{R1}

$$F_{R1} = 10^3 \cdot \frac{T_{2V}}{\eta \cdot i \cdot r_0} \leq \frac{F_{R1\,max}}{L_{f1} \cdot C_{f1} \cdot B_{f1}} \quad [N] \qquad \text{(Equation C-1)}$$

2. Input side axial load F_{A1}

$$F_{A1} \leq \frac{F_{A1\,max}}{C_{f1} \cdot B_{f1}} \; [N] \qquad \text{(Equation C-2)}$$

3. When radial and axial loads co-exist

$$\left(\frac{F_{R1} \cdot L_{f1}}{F_{R1\,max}} + \frac{F_{A1}}{F_{A1\,max}} \right) \cdot C_{f1} \cdot B_{f1} \leq 1 \qquad \text{(Equation C-3)}$$

F_{R1} = input side radial load [N]
T_{2V} = reference torque on output shaft [Nm]
r_0 = pitch circle radius of sprocket, pinion, or timing belt pulley [mm]
$F_{R1\,max}$ = maximum permissible input side radial load [N] (Table C11)
F_{A1} = input side axial load [N]
$F_{A1\,max}$ = maximum permissible input side axial load [N] (Table C12)
L_{f1} = load factor input (Table C10)
C_{f1} = correction factor input (Table C13)
B_{f1} = service factor input (Table C14)
L = distance of the radial load from the input side carrier (Table C10)
η = 0.7 (efficiency)

Size	Input speed n_{1m} [min^{-1}]						
	2500	2000	1750	1500	1000	750	600
C15	384	453	491	534	655	748	825
C25	523	563	589	620	709	781	841
C35			687	723	828	911	981
C45			785	826	946	1041	1121
C55				981	1123	1236	1332
C65					1419	1561	1682

Table C11 Max. permissible input side radial load $F_{R1\,max}$ [N]

Size	Input speed n_{1m} [min^{-1}]						
	2500	2000	1750	1500	1000	750	600
C15	432	479	509	546	658	751	832
C25	540	589	628	677	824	942	1040
C35		746	795	863	1040	1197	1334
C45			912	981	1197	1373	1530
C55				1481	1785	2050	2276
C65					2570	2953	3286

Table C12 Max. permissible input side axial load $F_{A1\,max}$ [N]

Calculation of the max. permissible radial load on the input shaft

Calculation of the max. permissible radial load using the following equation when the speed is not shown in the table above.

$$F_{R1\,max} = F_{R1,600}\left(\frac{600}{n_{1m}}\right)^{1/3}$$

$F_{R1\,max}$ = maximum permissible input side radial load at input speed n_{1m}

$F_{R1,600}$ = Radial load on input side at input speed n_{1m} = 600 min^{-1}

Calculation of the max. permissible axial load on the input shaft

Calculation of the max. permissible axial load using the following equation when the speed is not shown in the table above.

$$F_{A1\,max} = F_{A1,600}\left(\frac{600}{n_{1m}}\right)^{0.47}$$

$F_{A1\,max}$ = maximum permissible input side axial load at input speed n_{1m}

$F_{A1.600}$ = Axial load on input side at input speed n_{1m} = 600 min^{-1}

Correction factor input	C_{f1}
Chain	1
Gear or pinion *	1.25
Timing belt	1.25
V-Belt	1.5

Table C13 Correction factor input C_{f1}

* For helical pinions or bevel gears, please consult Sumitomo Drive Technologies.

Service factor input	B_{f1}
Uniform load	1
Light impacts	1.2
Severe impacts	1.6

Table C14 Service factor input B_{f1}

7.7.2 Main bearings

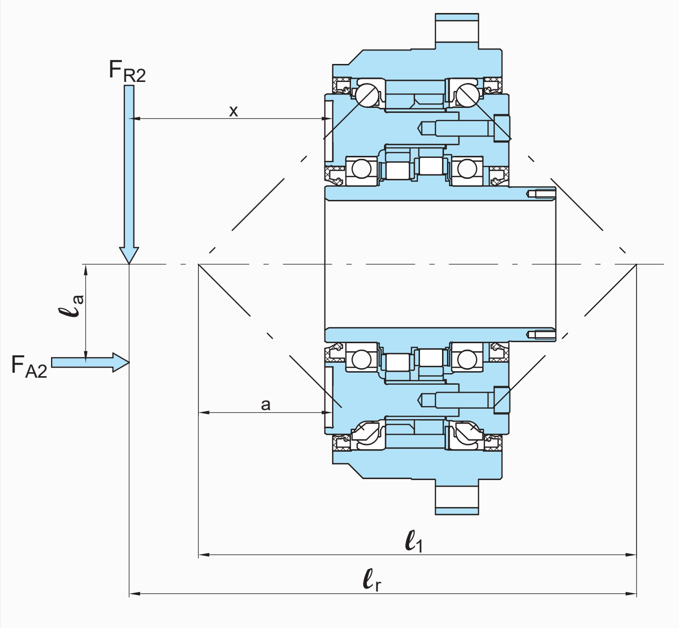


Fig. C5 Distance between the individual loading points

$$\ell_r = x - a + \ell_1 \quad \text{(Equation C-4)}$$

Size	Values of internal bearing distance	
	ℓ_1 [mm]	a [mm]
C15	130.6	33.2
C25	162	43.3
C35	196.2	54.9
C45	158.8	30.9
C55	191.8	41.9
C65	211.8	46.4

Table C15 Bearing spacing dimensions [mm]

Note If: $\ell_r > 4 \cdot \ell_1$, please contact Sumitomo Drive Technologies.

1. Moment stiffness

   The moment stiffness is the bending moment at which the output flange is tilted to the tilt angle.

   The tilt angle of the input flange is determined as follows:

$$\varphi_1 = \frac{T_k}{\Theta_1} \quad \text{(Equation C-5)}$$

External bending moment T_k

$$T_k = 10^{-3} \cdot (F_{R2} \cdot \ell_r + F_{A2} \cdot \ell_a) \quad \text{(Equation C-6)}$$

2. Max. permissible bending moment and max. permissible axial load.

   Check the external bending moment and the external axial load using equations C-6, C-7, and C-8.

Equivalent bending moment T_{ke}

$$T_{ke} = 10^{-3} \cdot (C_{f2} \cdot B_{f2} \cdot F_{R2} \cdot \ell_r + C_{f2} \cdot B_{f2} \cdot F_{A2} \cdot \ell_a) < T_{k\,max} \quad \text{(Equation C-7)}$$

Equivalent axial load F_{A2e} at the output shaft

$$F_{A2e} = F_{A2} \cdot C_{f2} \cdot B_{f2} < F_{A2\,max} \quad \text{(Equation C-8)}$$

F_{A2} = output side axial load [N]
$F_{A2\,max}$ = maximum permissible output side axial load [N]
F_{A2e} = equivalent output side axial load [N]
F_{R2} = output side radial load [N]
C_{f2} = correction factor output (Table C17)
B_{f2} = service factor output (Table C18)
ℓ_1 = bearing clearance [mm] (Table C15)
ℓ_r = calculated dimension for bending moment [mm]
ℓ_a = distance of axial load [mm]
x = distance from radial force to flange collar [mm]
a = correction factor [mm] (Table C15)
T_k = external bending moment [Nm]
$T_{k\,max}$ = maximum permissible bending moment [Nm] (Table C19)
T_{ke} = equivalent bending moment [Nm]
φ_1 = tilt angle [arcmin]
Θ_1 = moment stiffness main bearing [Nm/arcmin] (Table C16)

Size	Moment stiffness Θ_1
	[Nm/arcmin]
C15	548
C25	1150
C35	2400
C45	2649
C55	3924
C65	5690

Table C16 Average values for moment stiffness

Correction factor output	C_{f2}
Chain	1
Gear or pinion	1.25
Timing belt	1.25
V-Belt	1.5

Table C17 Correction factor output C_{f2}

Service factor output	B_{f2}
Uniform load (no shock)	1
Light impacts	1.2
Severe impacts	1.6

Table C18 Service factor output B_{f2}

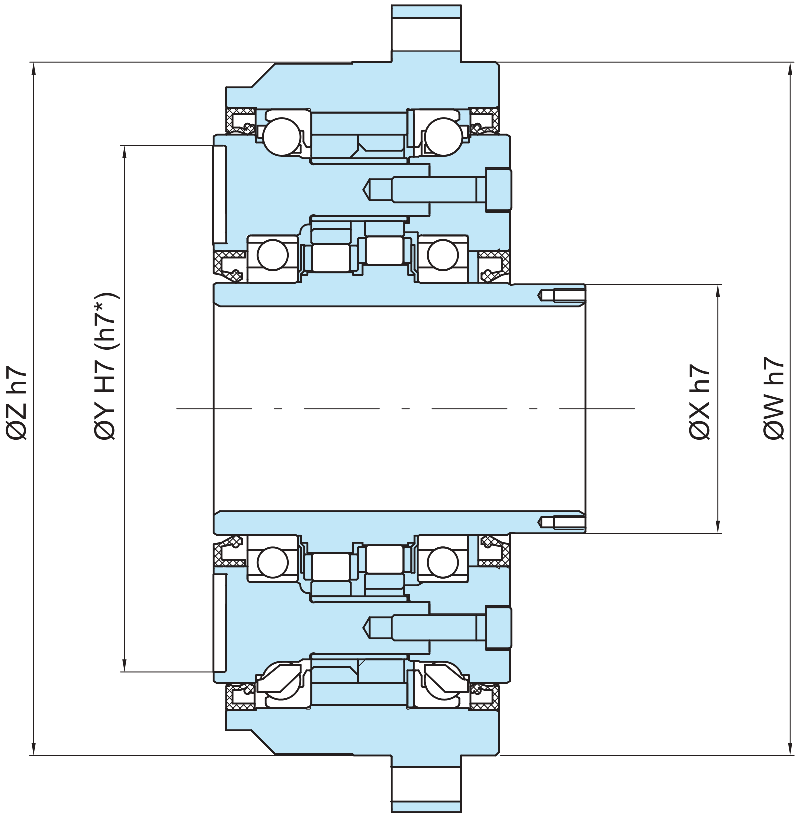
Size	Max. permissible bending moment $T_{k\,max}$	Max. permissible axial load $F_{A2\,max}$
	[Nm]	[N]
C15	1069	3924
C25	1850	7848
C35	2850	10790
C45	3924	8339
C55	6082	10791
C65	8829	13734

Table C19 Max. permissible bending moment and max. permissible axial load

7.8 Assembly specifications and tolerances

7.8.1 Assembly tolerances

Fits for assembly of input and output parts (timing belt, disc, gear, etc.) are shown schematically in the following figure. Use the diameters and tolerances shown in the table below.



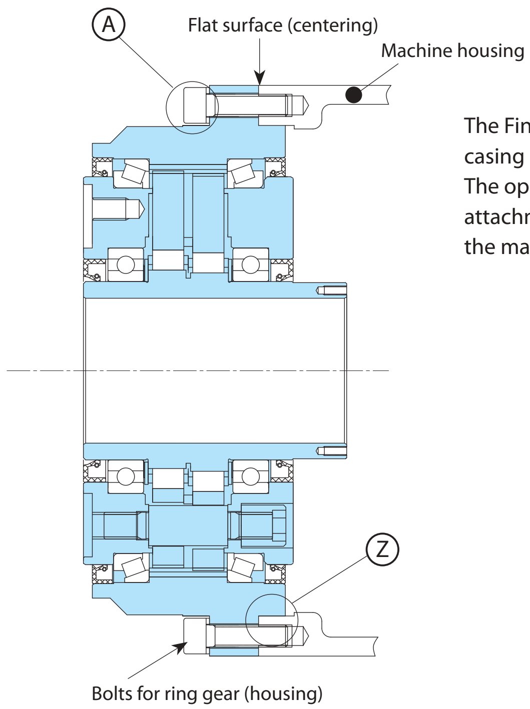
* valid for size C15

Size	Ø W	Ø X	Ø Y	Ø Z
C15	137	49.5	71 h7	137
C25	185	59	133 H7	185
C35	220	79	167 H7	220
C45	250	94	192 H7	250
C55	284	109	218 H7	284
C65	320	119	245 H7	320

Table C20 (Dimensions in mm)

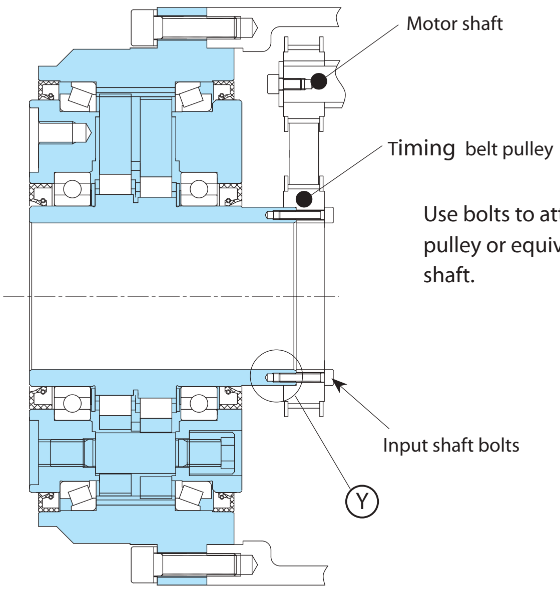
7.8.2 Assembly procedure

(1)



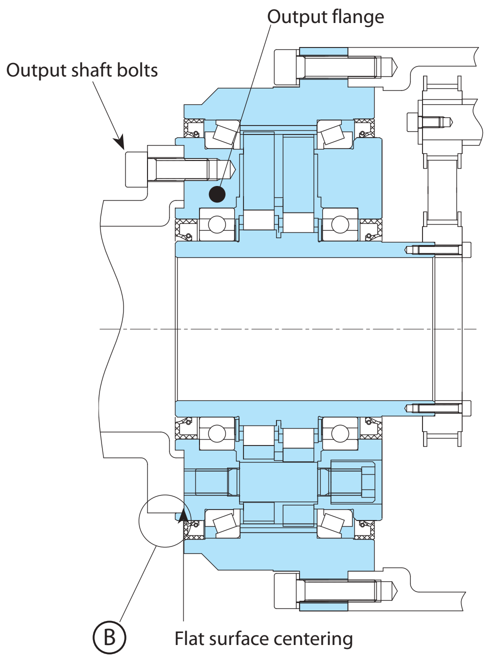
The Fine Cyclo C Series is attached to the machine casing by bolts. (spigot Z)
The opposite side (spigot A) can also be used for attachment to a machine housing when installed into the machine.

(2)



Use bolts to attach the timing belt pulley or equivalent parts to the input shaft.

(3)



Use bolts to attach output flange of Fine Cyclo to output shaft of machine.
(spigot B)

Note!
1. Make sure that you use the correct tightening torque for all fastening bolts when attaching the gearbox (see. Table C21).
2. Use bolts that are shorter than the depth of the threaded holes in the dimensioned drawing of the output flange.

7.8.3 Tightening torque and maximum permissible transmittable torque for bolts

The permissible transmitted torque for bolts and the number, size, and tightening torque for fastening the output side flange and the ring gear housing are listed in Table C21. In the event of an Emergency Stop with corresponding load peaks, the output flange and ring gear housing bolts must all be replaced.

Size	Output flange bolts			Bolts for ring gear (housing)		
	Number and size of bolts	Tightening torque [Nm]	Max. permissible transmittable torque for bolts [Nm]	Number and size of bolts	Tightening torque [Nm]	Max. permissible transmittable torque for bolts [Nm]
C15	16 × M6	13.6	1252	12 × M6	13.6	1520
C25	12 × M8	33.4	2080	12 × M8	33.4	3178
C35	12 × M10	65.7	4267	8 × M10	65.7	4670
C45	12 × M12	114	7191	8 × M12	114	7760
C55	12 × M14	181	10919	12 × M12	114	13008
C65	12 × M16	284	16893	16 × M12	114	19404

Size	Eccentric input shaft		
	Number and size of bolts	Tightening torque [Nm]	Max. permissible transmittable torque for bolts [Nm]
C15	6 × M3	1.67	57
C25	6 × M3	1.67	69
C35	6 × M4	3.92	157
C45	6 × M4	3.92	196
C55	8 × M5	8.04	481
C65	12 × M5	8.04	785

Table C21

- **Bolting:** Use metric hexagon socket head cap screws (DIN 4762, strength category 10.9).
- **Countermeasure for bolts loosening:** Use adhesives (Loctite 262, etc.) or spring washer (DIN 127A).
- **Use spring washers** (DIN 6796) when connecting the gearbox to the flange side, so that the bolt contact faces do not get damaged.

7.8.4 Lubrication

- The gearboxes of the Fine Cyclo C Series are filled with grease before delivery and are ready to use.
- Reconditioning is recommended after 20,000 operating hours, but at least every 3-5 years.
- The lifetime of the gearbox can be increased by returning it to the factory for overhauling and regreasing.

Specified grease	Manufacturer
Multemp FZ No. 00	Kyodo Yushi Co., Ltd.
Conditions for use: Ambient temperature -10 °C to +40 °C	

Table C22 Specified grease for the C Series

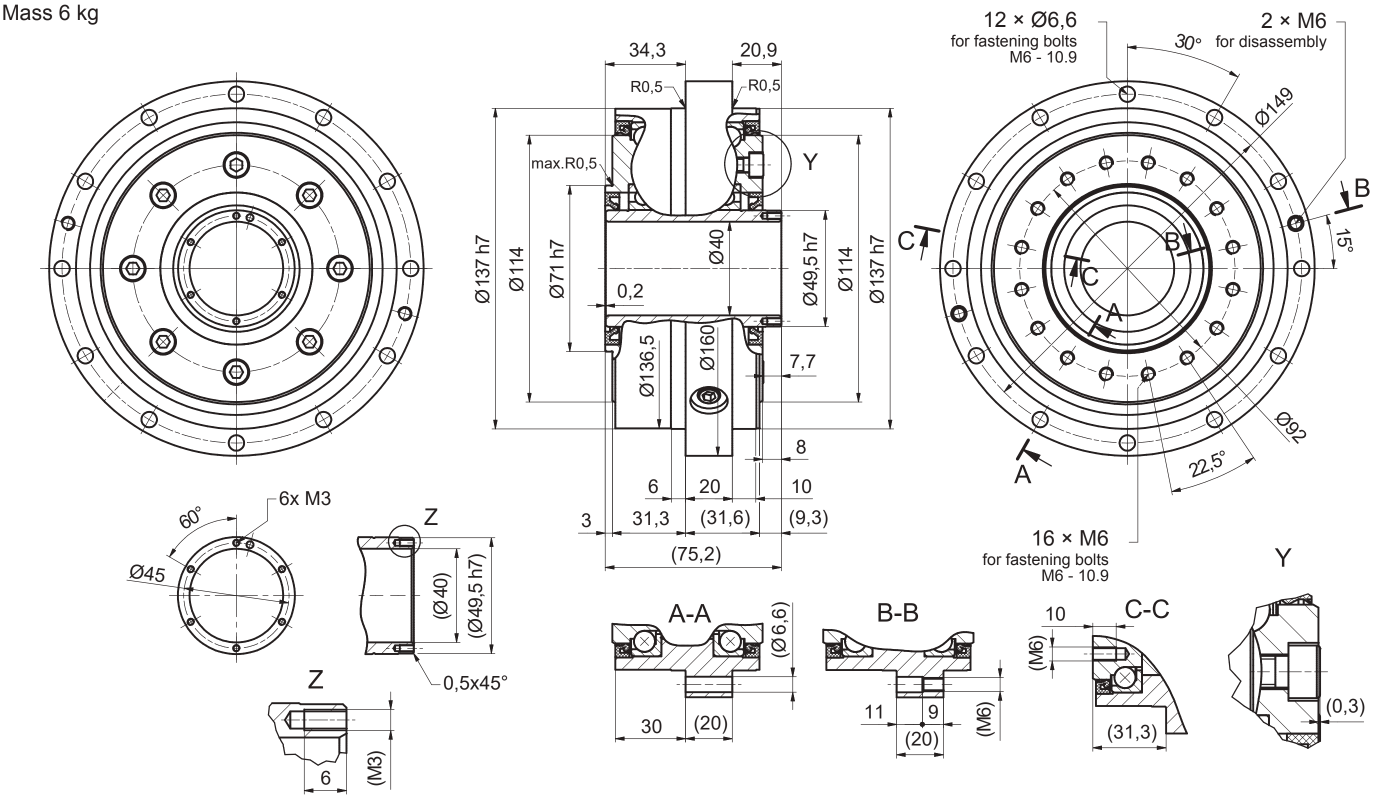
Size	Quantity of grease [g]
C15	45
C25	75
C35	110
C45	140
C55	200
C65	300

Table C23 Lubrication

7.9 Dimensioned drawings

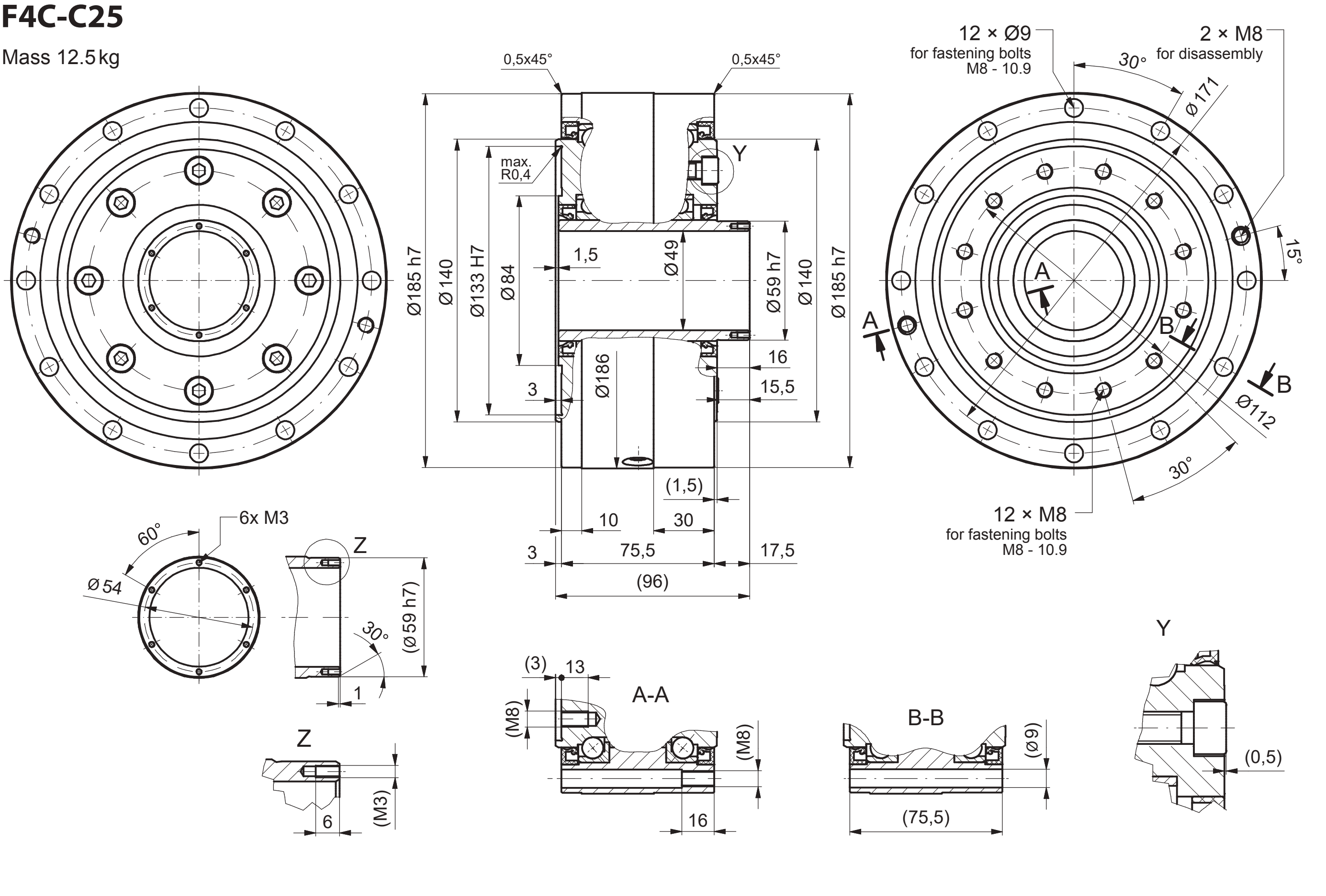
F4CF-C15

Mass 6 kg



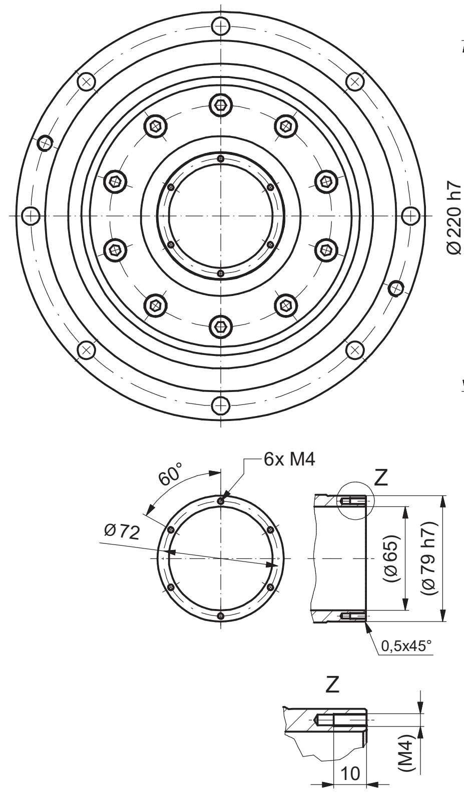
F4C-C25

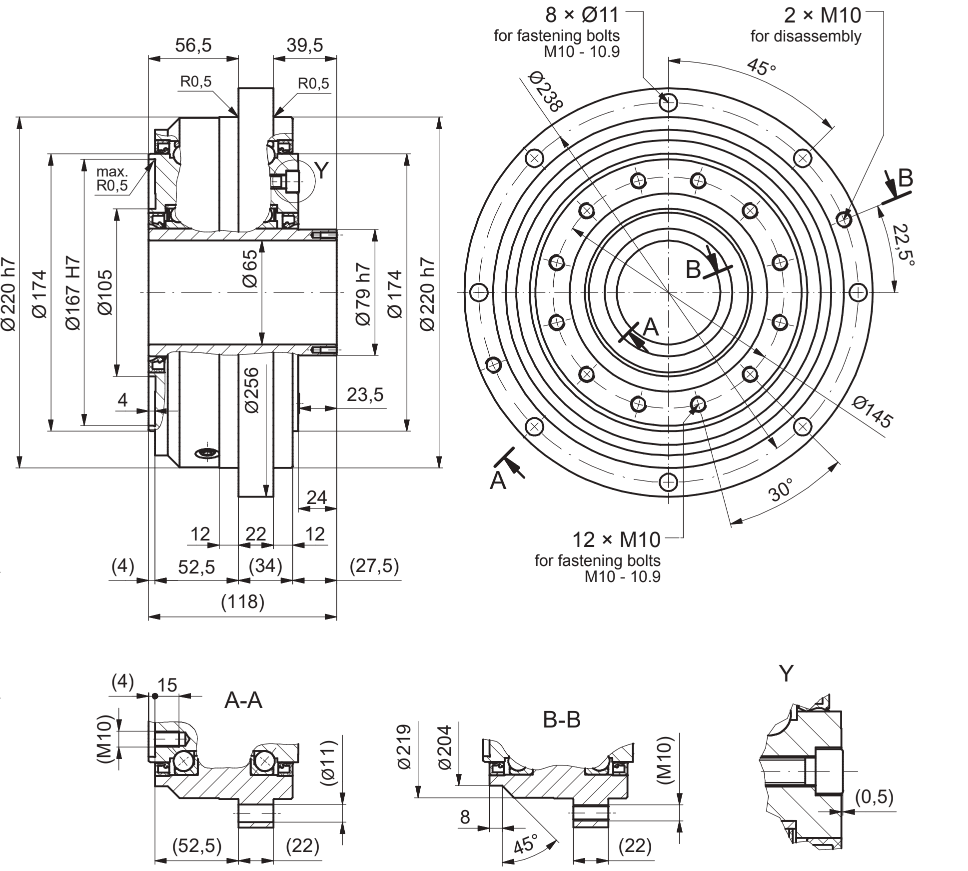
Mass 12.5kg



F4CF-C35

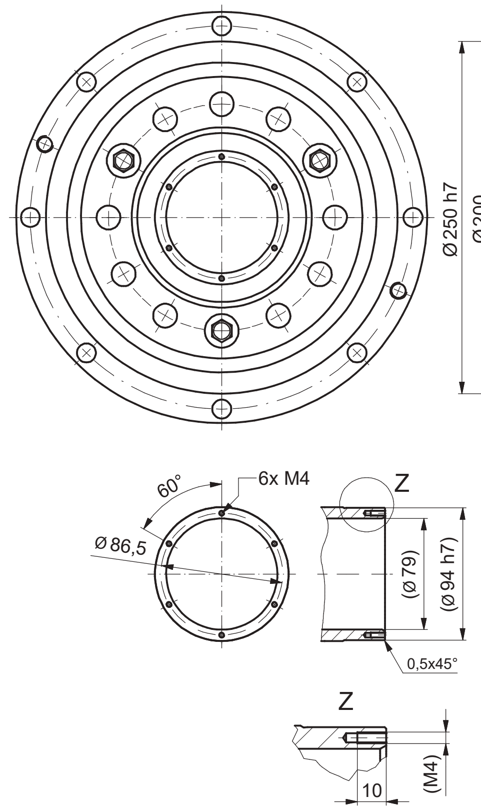
Mass 21 kg

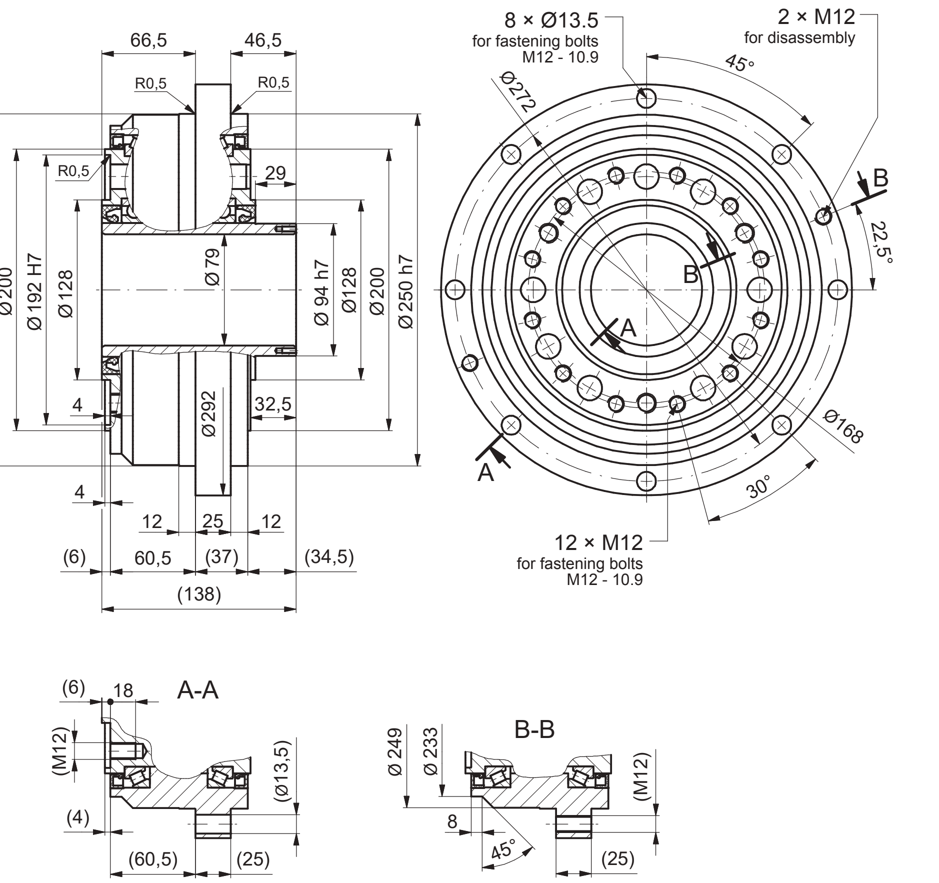




F2CF-C45

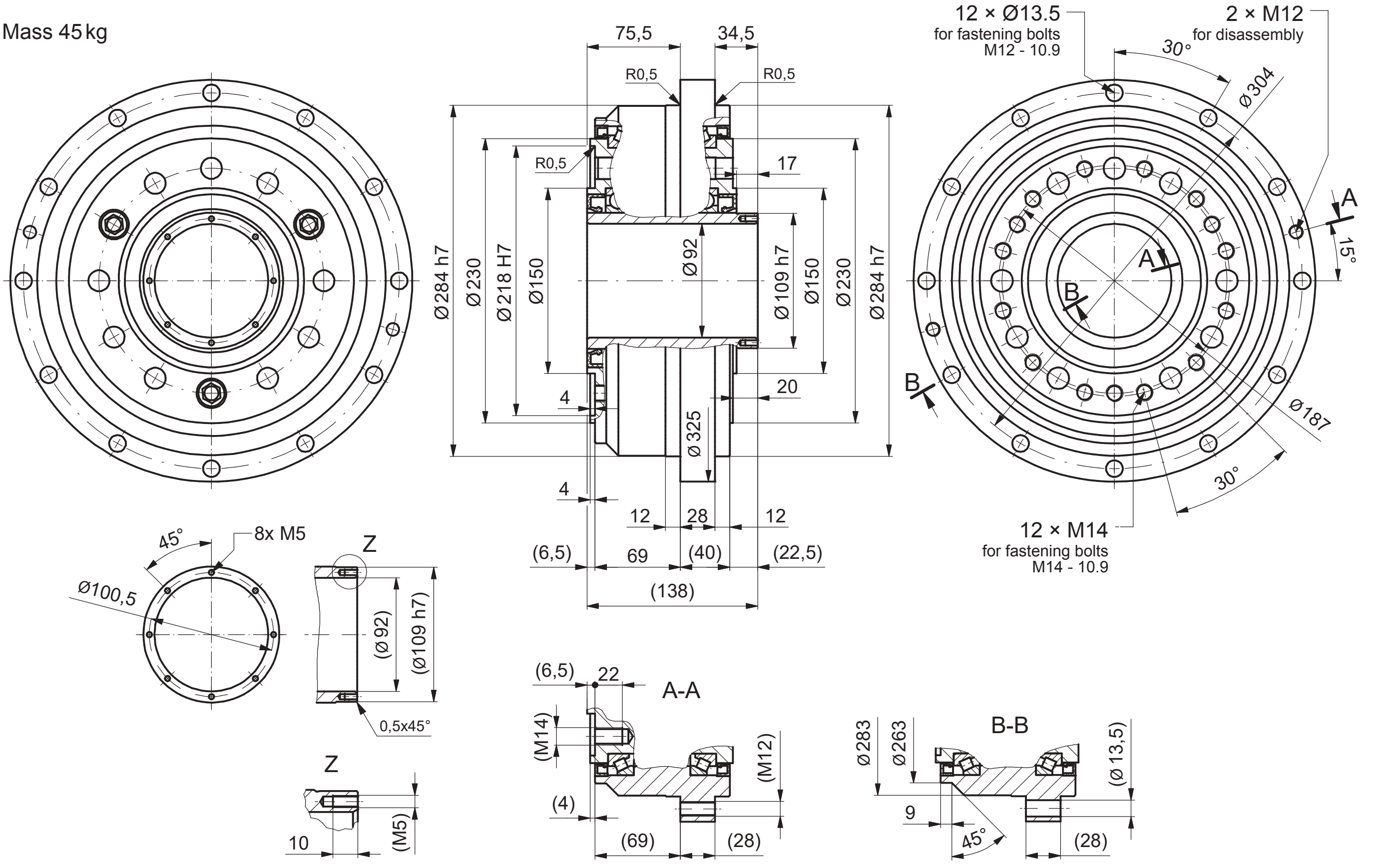
Mass 32 kg





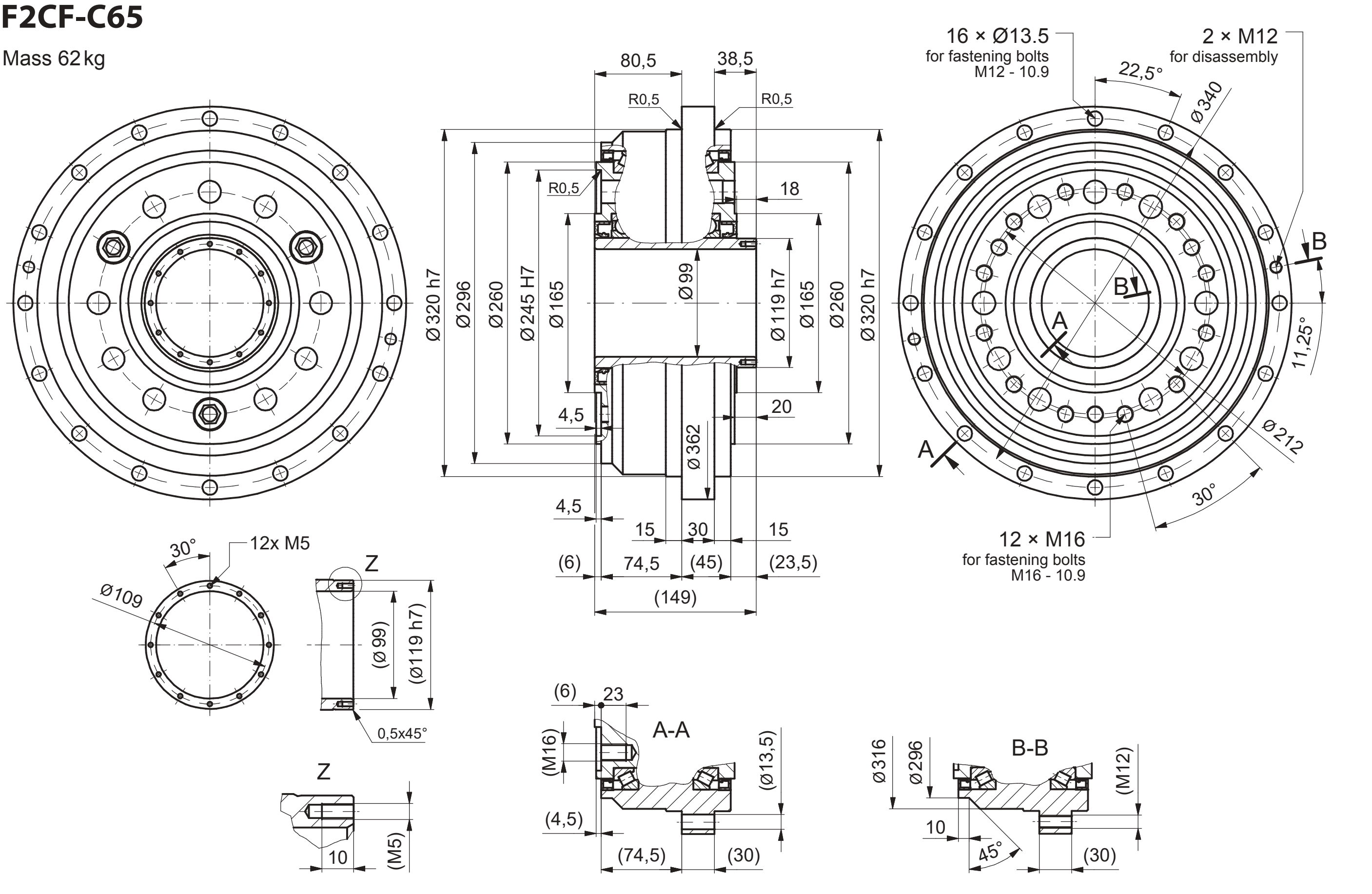
F2CF-C55

Mass 45 kg



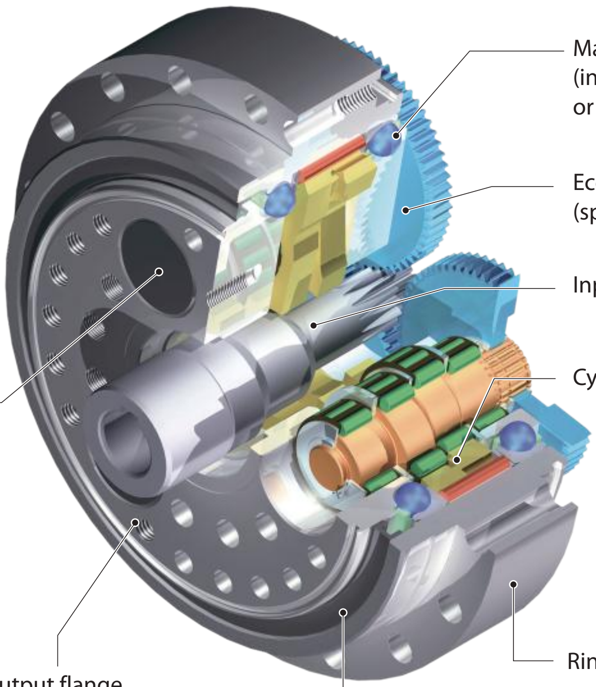
F2CF-C65

Mass 62 kg



8 UA Series

F4CF-UA
F2CF-UA



Special feature:

Upstream spur gear stage, gearbox with high positioning and path accuracy, even under changing dynamic conditions

- 7 sizes
- Low mass moments of inertia
- Double-stage ratios 66 to 283
- Nominal output torques up to 6952 Nm
- Acceleration torques up to 12500 Nm
- Input speeds up to 10271 min^{-1}
- Lost motion < 1 arcmin
- Improved moment stiffness
- High efficiency, even at low speeds
- Low vibration

8.1 Torques according to output speeds

Output speed n_{2m} [min^{-1}]				5			10			15			20		
Model	Size	Reduction ratio i nominal	Reduction ratio i real	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]
F4CF-	UA15	**60**	59.5	348	298	0.24	282	595	0.39	250	893	0.52	250	1190	0.70
		84	1603/19	348	422	0.24	282	844	0.39	250	1266	0.52	250	1687	0.70
		91	91	348	455	0.24	282	910	0.39	250	1365	0.52	250	1820	0.70
		127	127	348	635	0.24	282	1270	0.39	250	1905	0.52	250	2540	0.70
		139	1813/13	348	697	0.24	282	1395	0.39	250	2092	0.52	250	2789	0.70
		171	1883/11	348	856	0.24	282	1712	0.39	250	2568	0.52	250	3424	0.70
	UA25	**78**	77.5	695	388	0.49	565	775	0.79	500	1163	1.05	500	1550	1.40
		88	965/11	695	439	0.49	565	877	0.79	500	1316	1.05	500	1755	1.40
		115	115	695	575	0.49	565	1150	0.79	500	1725	1.05	500	2300	1.40
		124	2105/17	695	619	0.49	565	1238	0.79	500	1857	1.05	500	2476	1.40
		145	145	695	725	0.49	565	1450	0.79	500	2175	1.05	500	2900	1.40
		173	2245/13	695	863	0.49	565	1727	0.79	500	2590	1.05	500	3454	1.40
	UA35	**82**	82	1251	410	0.87	1016	820	1.42	900	1230	1.88	900	1640	2.51
		87	2003/23	1251	435	0.87	1016	871	1.42	900	1306	1.88	900	1742	2.51
		121	121	1251	605	0.87	1016	1210	1.42	900	1815	1.88	900	2420	2.51
		152	152.2	1251	761	0.87	1016	1522	1.42	900	2283	1.88	900	3044	2.51
		166	1159/7	1251	828	0.87	1016	1656	1.42	900	2484	1.88	900	3311	2.51
	UA45	**82**	82	1835	410	1.28	1491	820	2.08	1320	1230	2.76	1320	1640	3.69
		99	691/7	1835	494	1.28	1491	987	2.08	1320	1481	2.76	1320	1974	3.69
		121	121	1835	605	1.28	1491	1210	2.08	1320	1815	2.76	1320	2420	3.69
		130	2213/17	1835	651	1.28	1491	1302	2.08	1320	1953	2.76	1321	2604	3.69
		152	152.2	1835	761	1.28	1491	1522	2.08	1320	2283	2.76	1320	3044	3.69
		166	1159/7	1835	828	1.28	1491	1656	2.08	1320	2484	2.76	1320	3311	3.69
	UA55	**81**	81	2781	405	1.94	2259	810	3.15	2000	1215	4.19	1321	1620	3.69
		97	97	2781	485	1.94	2259	970	3.15	2000	1455	4.19	1322	1940	3.69
		126	125.8	2781	629	1.94	2259	1258	3.15	2000	1887	4.19	1323	2516	3.69
		145	145	2781	725	1.94	2259	1450	3.15	2000	2175	4.19	1324	2900	3.70
		169	169	2781	845	1.94	2259	1690	3.15	2000	2535	4.19	1325	3380	3.70
		241	241	2781	1205	1.94	2259	2410	3.15	2000	3615	4.19	1326	4820	3.70

Continued on Page 98

Table UA1a Rating values (reference value output speed n_{2m})

Size	Max. acceleration and deceleration torque T_{2A}	Peak torque for Emergency Stop T_{2max}
	[Nm]	[Nm]
UA15	625	1250
UA25	1250	2500
UA35	2250	4500
UA45	3300	6600
UA55	5000	10000

Table UA2a Maximum acceleration and peak torque

25			30			40			50			60			Max. permissible output speed $n_{2\,max}$ short term [min^{-1}]	Moment of inertia j related to the input shaft [$\times 10^{-4}$ kgm^2]	Mass [kg]
Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]			
250	1488	0.87	250	1785	1.05	250	2380	1.40	250	2975	1.75	250	3570	2.09	60	CF	4
250	2109	0.87	250	2531	1.05	250	3375	1.40	250	4218	1.75	250	5062	2.09		CF	
250	2275	0.87	250	2730	1.05	250	3640	1.40	250	4550	1.75	250	5460	2.09		CF	
250	3175	0.87	250	3810	1.05	250	5080	1.40	250	6350	1.75	250	7620	2.09		CF	
250	3487	0.87	250	4184	1.05	250	5578	1.40	250	6973	1.75	250	8368	2.09		CF	
250	4280	0.87	250	5135	1.05	250	6847	1.40	250	8559	1.75	250	10271	2.09		CF	
500	1938	1.75	500	2325	2.09	500	3100	2.79	500	3875	3.49				50	CF	6
500	2193	1.75	500	2632	2.09	500	3509	2.79	500	4386	3.49					CF	
500	2875	1.75	500	3450	2.09	500	4600	2.79	500	5750	3.49					CF	
500	3096	1.75	500	3715	2.09	500	4953	2.79	500	6191	3.49					CF	
500	3625	1.75	500	4350	2.09	500	5800	2.79	500	7250	3.49					CF	
500	4317	1.75	500	5181	2.09	500	6908	2.79	500	8635	3.49					CF	
900	2050	3.14	900	2460	3.77	900	3280	5.03							40	CF	11
900	2177	3.14	900	2613	3.77	900	3483	5.03								CF	
900	3025	3.14	900	3630	3.77	900	4840	5.03								CF	
900	3805	3.14	900	4566	3.77	900	6088	5.03								CF	
900	4139	3.14	900	4967	3.77	900	6623	5.03								CF	
1320	2050	4.61	1320	2460	5.53										30	CF	17
1320	2468	4.61	1320	2961	5.53											CF	
1320	3025	4.61	1320	3630	5.53											CF	
1321	3254	4.61	1321	3905	5.53												
1320	3805	4.61	1320	4566	5.53											CF	
1320	4139	4.61	1320	4967	5.53											CF	
1321	2025	4.61	1321	2430	5.53										30	CF	22
1322	2425	4.61	1322	2910	5.54											CF	
1323	3145	4.62	1323	3774	5.54											CF	
1324	3625	4.62	1324	4350	5.55											CF	
1325	4225	4.63	1325	5070	5.55											CF	
1326	6025	4.63	1326	7230	5.55											CF	

Continued on Page 99

1. T_{2N} = nominal output torque
   Nominal output torque corresponds to the max. permissible average load torque at all output speeds.
   The nominal output torque for speeds less than 5 min^{-1} is equal to the value at 5 min^{-1}.
   The value for the maximum permissible input power is calculated from the nominal output torque at 100%.
   This value takes the efficiency of Fine Cyclo into consideration.
2. n_{1max} = maximum permissible input speed
   Gearbox can be used in the maximum input speed range specified in the table.
3. T_{2A} = max. Acceleration and braking torque (for fatigue strength at $2 \cdot 10^7$ load cycles)
   Permissible peak torque for normal start and stop procedures.
4. T_{2max} = max. permissible torque for Emergency Stop situations or in the event of heavy shocks (limited by the mechanical strength).
   (permissible 1000 x over the entire lifetime)
5. The rated torque T_{2N} is calculated using the following equation when the speed is not shown in the table above:

$$T_{2N} = T_{2N,\,15} \left(\frac{15}{n_{2m}} \right)^{0.3}$$

T_{2N} : Rated torque at output speed n_{2m}

$T_{2N,\,15}$: Rated torque at output speed n_{2m} is 15 min^{-1}

Output speed n_{2m} [min⁻¹]				5			10			15			20		
Model	Size	Reduction ratio i nominal	Reduction ratio i real	Nominal output torque [Nm]	Input speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min⁻¹]	Max. permissible input power [kW]
Continuation of Page 96															
F2CF-	UA65	**89**	88.75	4769	444	3.33	3874	888	5.41	3430	1331	7.18	3430	1775	9.58
		121	1579/13	4769	607	3.33	3874	1215	5.41	3430	1822	7.18	3430	2429	9.58
		136	136	4769	680	3.33	3874	1360	5.41	3430	2040	7.18	3430	2720	9.58
		144	3317/23	4769	721	3.33	3874	1442	5.41	3430	2163	7.18	3430	2884	9.58
		163	163	4769	815	3.33	3874	1630	5.41	3430	2445	7.18	3430	3260	9.58
		171	2227/13	4769	857	3.33	3874	1713	5.41	3430	2570	7.18	3430	3426	9.58
		199	199	4769	995	3.33	3874	1990	5.41	3430	2985	7.18	3430	3980	9.58
		249	249.4	4769	1247	3.33	3874	2494	5.41	3430	3741	7.18	3430	4988	9.58
	UA80	**93**	92.8	6952	464	4.85	5647	928	7.88	5000	1392	10.47	5000	1856	13.96
		103	1445/14	6952	516	4.85	5647	1032	7.88	5000	1548	10.47	5000	2064	13.96
		122	121.96	6952	610	4.85	5647	1220	7.88	5000	1829	10.47	5000	2439	13.96
		155	1087/7	6952	776	4.85	5647	1553	7.88	5000	2329	10.47	5000	3106	13.96
		166	165.7	6952	829	4.85	5647	1657	7.88	5000	2486	10.47	5000	3314	13.96
		190	190	6952	950	4.85	5647	1900	7.88	5000	2850	10.47	5000	3800	13.96
		239	1193/5	6952	1193	4.85	5647	2386	7.88	5000	3579	10.47	5000	4772	13.96
		283	3685/13	6952	1417	4.85	5647	2835	7.88	5000	4252	10.47	5000	5669	13.96

Table UA1 b Rating values (reference value output speed n_{2m})

Size	Max. acceleration and deceleration torque T_{2A}	Peak torque for Emergency Stop T_{2max}
	[Nm]	[Nm]
UA65	8575	17150
UA80	12500	25000

Table UA2 b Maximum acceleration and peak torque

25			30			40			50			60			Max. permissible output speed $n_{2\,max}$ short term [min⁻¹]	Moment of inertia j related to the input shaft [×10⁻⁴ kgm²]	Mass [kg]
Nominal output torque [Nm]	Input speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min⁻¹]	Max. permissible input power [kW]			
Continuation of Page 97																	
3430	2219	11.97	3430	2663	14.37										30	CF	38
3430	3037	11.97	3430	3644	14.37											CF	
3430	3400	11.97	3430	4080	14.37											CF	
3430	3605	11.97	3430	4327	14.37											CF	
3430	4075	11.97	3430	4890	14.37											CF	
3430	4283	11.97	3430	5139	14.37											CF	
3430	4975	11.97	3430	5970	14.37											CF	
3430	6235	11.97	3430	7482	14.37											CF	
5000	2320	17.45													25	CF	56
5000	2580	17.45														CF	
5000	3049	17.45														CF	
5000	3882	17.45														CF	
5000	4143	17.45														CF	
5000	4750	17.45														CF	
5000	5965	17.45														CF	
5001	7087	17.46														CF	

1. T_{2N} = nominal output torque
   Nominal output torque corresponds to the max. permissible average load torque at all output speeds.
   The nominal output torque for speeds less than 5 min^{-1} is equal to the value at 5 min^{-1}.
   The value for the maximum permissible input power is calculated from the nominal output torque at 100%.
   This value takes the efficiency of Fine Cyclo into consideration.
2. n_{1max} = maximum permissible input speed
   Gearbox can be used in the maximum input speed range specified in the table.
3. T_{2A} = max. Acceleration and braking torque (for fatigue strength at $2 \cdot 10^7$ load cycles)
   Permissible peak torque for normal start and stop procedures.
4. T_{2max} = max. permissible torque for Emergency Stop situations or in the event of heavy shocks (limited by the mechanical strength).
   (permissible 1000 x over the entire lifetime)
5. The rated torque T_{2N} is calculated using the following equation when the speed is not shown in the table above:

$$T_{2N} = T_{2N,\,15}\left(\frac{15}{n_{2m}}\right)^{0.3}$$

T_{2N} : Rated torque at output speed n_{2m}

$T_{2N,\,15}$: Rated torque at output speed n_{2m} is 15 min^{-1}

8.2 Torques according to input speeds

Input speed n_{1m} [min⁻¹]				5000			4000			3000			2500			2000		
Model	Size	Reduction ratio i nominal	Reduction ratio i real	Nominal output torque [Nm]	Output speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min⁻¹]	Max. permissible input power [kW]
F4CF-	UA15	60	59.5							174	50	1.22	184	42	1.08	196	34	0.92
		84	1603/19					47	-	193	36	0.96	204	30	0.84	218	24	0.72
		91	91	169	55	1.30	181	44	1.11	197	33	0.91	208	27	0.80	223	22	0.68
		127	127	187	39	1.03	200	31	0.88	218	24	0.72	230	20	0.63	246	16	0.54
		139	1813/13	192	36	0.96	206	29	0.82	224	22	0.67	237	18	0.59	253	14	0.51
		171	1883/11	205	29	0.83	219	23	0.71	239	18	0.58	252	15	0.51	269	12	0.44
	UA25	78	77.5							376	39	2.03	397	32	1.79	425	26	1.53
		88	965/11				358	46	2.28	390	34	1.86	412	28	1.64	441	23	1.40
		115	115	363	43	2.21	388	35	1.89	424	26	1.54	447	22	1.36	478	17	1.16
		124	2105/17	371	40	2.09	397	32	1.79	433	24	1.46	457	20	1.29	489	16	1.10
		145	145	390	34	1.88	416	28	1.60	454	21	1.31	480	17	1.15	513	14	0.99
		173	2245/13	410	29	1.66	439	23	1.42	478	17	1.16	505	14	1.02	540	12	0.87
	UA35	82	82							689	37	3.52	727	30	3.10	778	24	2.65
		87	2003/23							701	34	3.37	741	29	2.97	792	23	2.54
		121	121				710	33	3.28	774	25	2.68	818	21	2.36	874	17	2.02
		152	152.2	711	33	3.26	761	26	2.79	829	20	2.28	876	16	2.01	936	13	1.72
		166	1159/7	730	30	3.08	780	24	2.63	850	18	2.15	898	15	1.89	960	12	1.62
	UA45	82	82										1067	30	4.54	1141	24	3.89
		99	691/7							1068	30	4.53	1128	25	3.99	1206	20	3.41
		121	121							1135	25	3.93	1199	21	3.46	1282	17	2.96
		130	2213/17							1160	23	3.73	1226	19	3.29	1311	15	2.81
		152	152.2				1116	26	4.09	1216	20	3.35	1285	16	2.95	1373	13	2.52
		166	1159/7	1070	30	4.51	1144	24	3.86	1247	18	3.16	1317	15	2.78	1409	12	2.38
	UA55	81	81													1722	25	5.94
		97	97										1700	26	6.12	1818	21	5.23
		126	125.8				1596	32	7.09	1740	24	5.79	1838	20	5.10	1965	16	4.36
		145	145				1666	28	6.42	1816	21	5.25	1918	17	4.62	2051	14	3.95
		169	169				1744	24	5.76	1901	18	4.71	2008	15	4.15	2147	12	3.55
		241	241				1940	17	4.50	2115	12	3.68	2234	10	3.24	2389	8	2.77

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Table UA3a Rating values (reference value input speed n_{2m})

Size	Max. acceleration and deceleration torque T_{2A}	Peak torque for Emergency Stop T_{2max}
	[Nm]	[Nm]
UA15	625	1250
UA25	1250	2500
UA35	2250	4500
UA45	3300	6600
UA55	5000	10000

Table UA4a Maximum acceleration and peak torque

1750			1500			1000			750			600					
Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]	Max. permissible output speed $n_{2\,max}$ short term [min^{-1}]	Moment of inertia j related to the input shaft [$\times 10^{-4}$ kgm^2]	Mass [kg]
204	29	0.84	214	25	0.75	242	17	0.57	263	13	0.46	282	10	0.40	60	CF	4
227	21	0.66	238	18	0.59	268	12	0.44	292	9	0.36	313	7	0.31		CF	
232	19	0.62	243	16	0.56	274	11	0.42	299	8	0.34	320	7	0.29		CF	
256	14	0.49	269	12	0.44	303	8	0.33	331	6	0.27	348	5	0.23		CF	
264	13	0.46	276	11	0.41	312	7	0.31	340	5	0.26	348	4	0.21		CF	
280	10	0.40	294	9	0.36	332	6	0.27	348	4	0.21	348	4	0.17		CF	
442	23	1.39	463	19	1.25	523	13	0.94	570	10	0.77	610	8	0.66	50	CF	6
459	20	1.28	481	17	1.15	543	11	0.86	592	9	0.71	633	7	0.60		CF	
498	15	1.06	521	13	0.95	589	9	0.71	642	7	0.58	686	5	0.50		CF	
509	14	1.00	533	12	0.90	602	8	0.68	656	6	0.56	695	5	0.47		CF	
534	12	0.90	559	10	0.81	631	7	0.61	688	5	0.50	695	4	0.40		CF	
562	10	0.80	589	9	0.71	665	6	0.54	695	4	0.42	695	3	0.34		CF	
810	21	2.41	848	18	2.17	958	12	1.63	1044	9	1.33	1116	7	1.14	40	CF	11
824	20	2.31	863	17	2.08	975	11	1.56	1063	9	1.28	1137	7	1.09		CF	
910	14	1.84	953	12	1.65	1076	8	1.24	1173	6	1.02	1251	5	0.87		CF	
975	11	1.56	1021	10	1.40	1153	7	1.06	1251	5	0.86	1251	4	0.69		CF	
1000	11	1.48	1047	9	1.32	1182	6	1.00	1251	5	0.79	1251	4	0.63		CF	
1188	21	3.54	1244	18	3.18	1405	12	2.39	1531	9	1.96	1637	7	1.67	30	CF	17
1255	18	3.11	1315	15	2.79	1485	10	2.10	1619	8	1.72	1731	6	1.47		CF	
1335	14	2.69	1398	12	2.42	1578	8	1.82	1721	6	1.49	1835	5	1.27		CF	
1364	13	2.56	1429	12	2.30	1613	8	1.73	1759	6	1.41	1835	5	1.18			
1430	11	2.30	1497	10	2.06	1691	7	1.55	1835	5	1.26	1835	4	1.01		CF	
1466	11	2.16	1536	9	1.94	1734	6	1.46	1835	5	1.16	1835	4	0.93		CF	
1793	22	5.41	1877	19	4.85	2120	12	3.65	2311	9	2.99	2471	7	2.56	30	CF	22
1892	18	4.77	1982	15	4.28	2238	10	3.22	2440	8	2.63	2609	6	2.25		CF	
2046	14	3.97	2143	12	3.57	2420	8	2.69	2638	6	2.20	2781	5	1.85		CF	
2135	12	3.60	2236	10	3.23	2525	7	2.43	2753	5	1.99	2781	4	1.61		CF	
2235	10	3.23	2341	9	2.90	2644	6	2.18	2781	4	1.72	2781	4	1.38		CF	
2486	7	2.52	2604	6	2.26	2781	4	1.61	2781	3	1.21	2781	2	0.97		CF	

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1. T_{2N} = nominal output torque
   Nominal output torque corresponds to the max. permissible average load torque at all input speeds.
   The nominal output torque for speeds n_2 less than 5 min^{-1} is equal to the value at 5 min^{-1}.
   The value for the maximum permissible input power is calculated from the nominal output torque at 100%.
   This value takes the efficiency of Fine Cyclo into consideration.
2. n_{1max} = maximum permissible input speed
   Gearbox can be used in the maximum input speed range specified in the table.
3. T_{2A} = max. Acceleration and braking torque (for fatigue strength at $2 \cdot 10^7$ load cycles)
   Permissible peak torque for normal start and stop procedures.
4. T_{2max} = max. permissible torque for Emergency Stop situations or in the event of heavy shocks (limited by the mechanical strength). (permissible 1000 x over the entire lifetime)
5. The rated torque T_{2N} is calculated using the following equation when the speed is not shown in the table above:

$$T_{2N} = T_{2N,\,15} \left(\frac{15}{n_{2m}} \right)^{0.3}$$

T_{2N} : Rated torque at output speed n_{2m}
$T_{2N,\,15}$: Rated torque at output speed n_{2m} is 15 min^{-1}

Input speed n_{1m} [min^{-1}]				5000			4000			3000			2500			2000		
Model	**Size**	**Reduction ratio i nominal**	**Reduction ratio i real**	**Nominal output torque [Nm]**	**Output speed [min^{-1}]**	**Max. permissible input power [kW]**	**Nominal output torque [Nm]**	**Output speed [min^{-1}]**	**Max. permissible input power [kW]**	**Nominal output torque [Nm]**	**Output speed [min^{-1}]**	**Max. permissible input power [kW]**	**Nominal output torque [Nm]**	**Output speed [min^{-1}]**	**Max. permissible input power [kW]**	**Nominal output torque [Nm]**	**Output speed [min^{-1}]**	**Max. permissible input power [kW]**
Continuation of Page 100																		
F2CF-	UA65	**89**	88.75	2306	56	18.14							2839	28	11.17	3036	23	9.55
		121	1579/13							2953	25	10.19	3119	21	8.96	3335	16	7.67
		136	136				2803	29	11.51	3055	22	9.41	3227	18	8.28	3450	15	7.08
		144	3317/23				2852	28	11.05	3109	21	9.03	3284	17	7.95	3512	14	6.80
		163	163	2767	31	11.85	2959	25	10.14	3226	18	8.29	3407	15	7.30	3643	12	6.24
		171	2227/13	2809	29	11.45	3004	23	9.79	3274	18	8.01	3458	15	7.05	3698	12	6.03
		199	199	2938	25	10.31	3142	20	8.82	3425	15	7.21	3617	13	6.35	3868	10	5.43
		249	249.4	3144	20	8.80	3362	16	7.53	3665	12	6.16	3871	10	5.42	4139	8	4.63
	UA80	**93**	92.8													4485	22	13.50
		103	1445/14										4330	24	14.65	4630	19	12.53
		122	121.96							4310	25	14.80	4553	20	13.03	4868	16	11.15
		155	1087/7							4634	19	12.50	4895	16	11.00	5234	13	9.41
		166	165.7				4335	24	14.61	4726	18	11.95	4991	15	10.51	5337	12	8.99
		190	190				4517	21	13.28	4924	16	10.85	5200	13	9.55	5561	11	8.17
		239	1193/5	4523	21	13.23	4836	17	11.32	5272	13	9.26	5568	10	8.15	5954	8	6.97
		283	3685/13	4763	18	11.73	5092	14	10.03	5551	11	8.20	5864	9	7.22	6270	7	6.18

Table UA3 b **Rating values (reference value output speed n_{2m})**

Size	**Max. acceleration and deceleration torque T_{2A}**	**Peak torque for Emergency Stop T_{2max}**
	[Nm]	**[Nm]**
UA65	8575	17150
UA80	12500	25000

Table UA4 b **Maximum acceleration and peak torque**

1750			1500			1000			750			600			Max. permissible output speed $n_{2\,max}$ short term [min^{-1}]	Moment of inertia j related to the input shaft [$\times 10^{-4}$ kgm^2]	Mass [kg]
Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]			
Continuation of Page 100																	
3160	20	8.70	3309	17	7.81	3737	11	5.88	4074	8	4.81	4356	7	4.11	30	CF	38
3472	14	6.98	3636	12	6.27	4106	8	4.72	4476	6	3.86	4769	5	3.29		CF	
3591	13	6.45	3761	11	5.79	4248	7	4.36	4631	6	3.57	4769	4	2.94		CF	
3655	12	6.19	3828	10	5.56	4323	7	4.19	4713	5	3.42	4769	4	2.77		CF	
3792	11	5.68	3971	9	5.10	4485	6	3.84	4769	5	3.06	4769	4	2.45		CF	
3849	10	5.49	4031	9	4.93	4553	6	3.71	4769	4	2.92	4769	4	2.33		CF	
4026	9	4.94	4216	8	4.44	4762	5	3.34	4769	4	2.51	4769	3	2.01		CF	
4308	7	4.22	4512	6	3.79	4769	4	2.67	4769	3	2.00	4769	2	1.60		CF	
4668	19	12.29	4889	16	11.03	5522	11	8.31	6019	8	6.79	6436	6	5.81	25	CF	56
4820	17	11.41	5048	15	10.24	5701	10	7.71	6214	7	6.31	6645	6	5.39		CF	
5067	14	10.15	5307	12	9.11	5993	8	6.86	6533	6	5.61	6952	5	4.78		CF	
5448	11	8.57	5706	10	7.70	6444	6	5.79	6952	5	4.69	6952	4	3.75		CF	
5555	11	8.19	5818	9	7.35	6570	6	5.54	6952	5	4.39	6952	4	3.51		CF	
5788	9	7.44	6062	8	6.68	6846	5	5.03	6952	4	3.83	6952	3	3.07		CF	
6197	7	6.35	6490	6	5.70	6952	4	4.07	6952	3	3.05	6952	3	2.44		CF	
6526	6	5.63	6835	5	5.05	6952	4	3.42	6952	3	2.57	6952	2	2.05		CF	

1. T_{2N} = nominal output torque
   Nominal output torque corresponds to the max. permissible average load torque at all input speeds.
   The nominal output torque for speeds n_2 less than 5 min^{-1} is equal to the value at 5 min^{-1}.
   The value for the maximum permissible input power is calculated from the nominal output torque at 100%.
   This value takes the efficiency of Fine Cyclo into consideration.
2. n_{1max} = maximum permissible input speed
   Gearbox can be used in the maximum input speed range specified in the table.
3. T_{2A} = max. Acceleration and braking torque (for fatigue strength at $2 \cdot 10^7$ load cycles)
   Permissible peak torque for normal start and stop procedures.
4. T_{2max} = max. permissible torque for Emergency Stop situations or in the event of heavy shocks (limited by the mechanical strength).
   (permissible 1000 x over the entire lifetime)
5. The rated torque T_{2N} is calculated using the following equation when the speed is not shown in the table above:

$$T_{2N} = T_{2N,\,15}\left(\frac{15}{n_{2m}}\right)^{0.3}$$

T_{2N} : Rated torque at output speed n_{2m}

$T_{2N,\,15}$: Rated torque at output speed n_{2m} is 15 min^{-1}

8.3 Stiffness and Lost Motion

Size	i	Test torque T_p [Nm]	Lost Motion		Torsional stiffness 50% - 100% T_p [Nm/arcmin]
			Lost Motion [arcmin]	Domain of definition [Nm]	
UA15	60 / 84 / 91 / 127 / 139 / 171	250	< 0.75	±7.5	63
UA25	78 / 88 / 115 / 124 / 145 / 173	500	< 0.5	±15	112
UA35	82 / 87 / 121 / 152 / 166	900		±27	196
UA45	82 / 99 / 121 / 130 / 152 / 166	1320		±40	343
UA55	81 / 97 / 126 / 145 / 169 / 241	2000		±60	530
UA65	89 / 121 / 136 / 144 / 163 / 171 / 199 / 249	3430		±103	933
UA80	93 / 103 / 122 / 155 / 166 / 190 / 239 / 283	5000		±150	1300

Table UA5 Torsional stiffness

T_p: Test torque at input speed $n_1 = 1500\ min^{-1}$

Note arcmin means "angular minute".
Table values for stiffness are average values.

Calculation of the twist angle:

1) At a load torque less than 3% T_p

$$\varphi = \frac{\text{Lost Motion}}{2} \cdot \frac{\text{Load torque}}{0.03 \cdot T_p}$$

2) At a load torque greater than 3% T_p (standard case)

$$\varphi = \frac{\text{Lost Motion}}{2} + \frac{\text{Load torque} - (0.03 \cdot T_p)}{\text{Torsional stiffness}}$$

8.4 No-load running torque NLRT

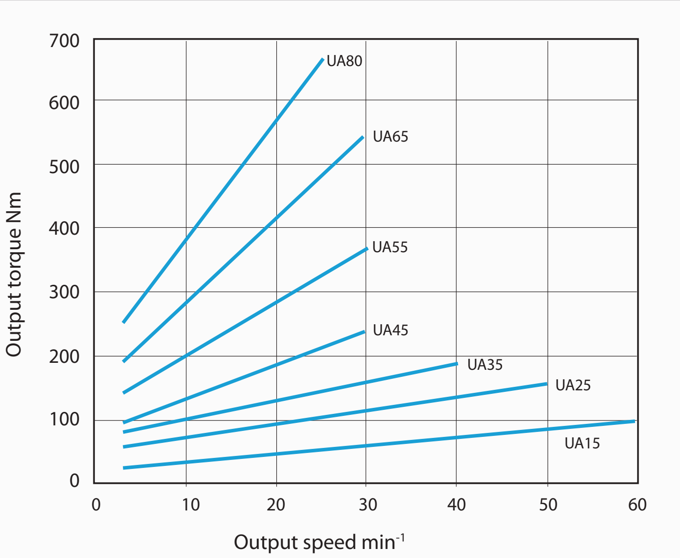


Fig. UA1 Output side no-load running torque

Note
1. Fig. UA1 shows the average no-load running torque after gearbox is run in (not factory-new condition).
2. Table UA6 shows the measuring conditions

Ring gear housing temperature	approx. 30 °C
Precision during assembly	as per 8.8.1
Lubrication	Standard lubrication

Table UA6 Measurement conditions

8.5 Breakaway torque

Indicates the necessary torque for breakaway of the gearbox on the input or output side, after stop without output side load.

Breakaway torque on output side (BTO)

Note
1. Table UA8 shows the max. breakaway torque on the output side BTO. Fine Cyclo gearboxes are not self-locking. The BTO is defined as the maximum value (factory-new condition), which steadily decreases during the lifetime.
2. Table UA7 shows the measuring conditions

Size	Breakaway torque BTO [Nm]
UA15	< 20
UA25	< 49
UA35	< 88
UA45	< 108
UA55	< 137
UA65	< 167
UA80	< 196

Table UA8 Value of the breakaway torque on the output side (BTO)

Breakaway torque on input side (BTI)

Note
1. Table UA9 shows the max. breakaway torque BTI on the input side. BTI is defined as the maximum value (factory-new condition) which steadily decreases during the lifetime.
2. The following equation is to be used to calculate the input torques of the idle time losses:

$$\textbf{Input torque} = \frac{\textbf{Output torque}}{\textbf{Ratio}}$$

3. Table UA7 shows the measuring conditions

Precision during assembly	as per 8.8.1
Lubrication	Standard lubrication

Table UA7 Measurement conditions

Size	i	Breakaway torque BTI [Nm]
UA15	60	< 0.3
	84	< 0.3
	91	< 0.2
	127	< 0.1
	139	< 0.1
	171	< 0.1
UA25	78	< 0.6
	88	< 0.6
	115	< 0.4
	124	< 0.4
	145	< 0.3
	173	< 0.3
UA35	82	< 1.1
	87	< 1.0
	121	< 0.7
	152	< 0.6
	166	< 0.5
UA45	82	< 1.3
	99	< 1.1
	121	< 0.9
	130	< 0.8
	152	< 0.7
	166	< 0.7
UA55	81	< 1.7
	97	< 1.4
	126	< 1.1
	145	< 0.9
	169	< 0.8
	241	< 0.6
UA65	89	< 1.9
	121	< 1.4
	136	< 1.2
	144	< 1.2
	163	< 1.0
	171	< 1.0
	199	< 0.8
	249	< 0.7
UA80	93	< 2.1
	103	< 1.9
	122	< 1.6
	155	< 1.3
	166	< 1.2
	190	< 1.0
	239	< 0.8
	283	< 0.7

Table UA9 Value of the breakaway torque on the input side (BTI)

8.6 Efficiency

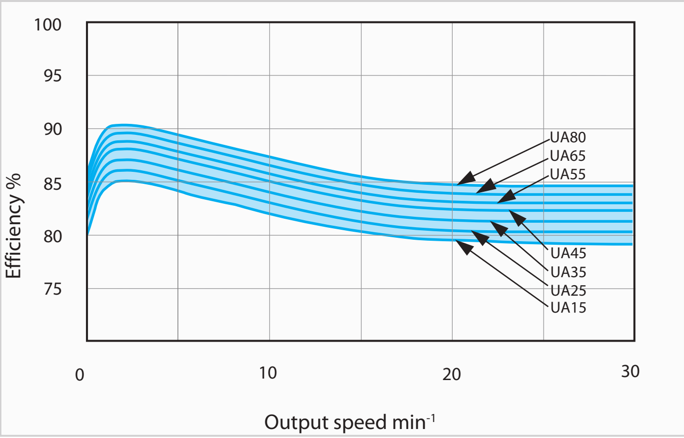


Fig. UA2 Efficiency curve

Fig. UA2 shows the efficiency of a run-in gearbox under nominal load at an ambient temperature of 20 °C.
For further information, see "4 Explaining the technical details" on page 18.

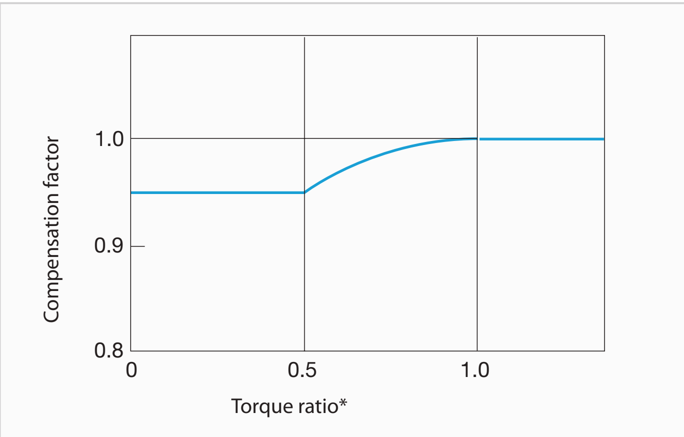


Fig. UA3 Compensation curve for efficiency

$$\textbf{* Torque ratio} = \frac{\textbf{Load torque}}{\textbf{Nominal output torque}}$$

Compensation efficiency =
efficiency · compensation factor

Note

1. The efficiency changes if the load torque does not match the nominal torque. Check the compensation factor in the diagram Fig. UA3.
2. When the torque ratio is over 1.0, the compensation factor for efficiency is 1.0 (diagram Fig. UA3).

8.7 Main bearings

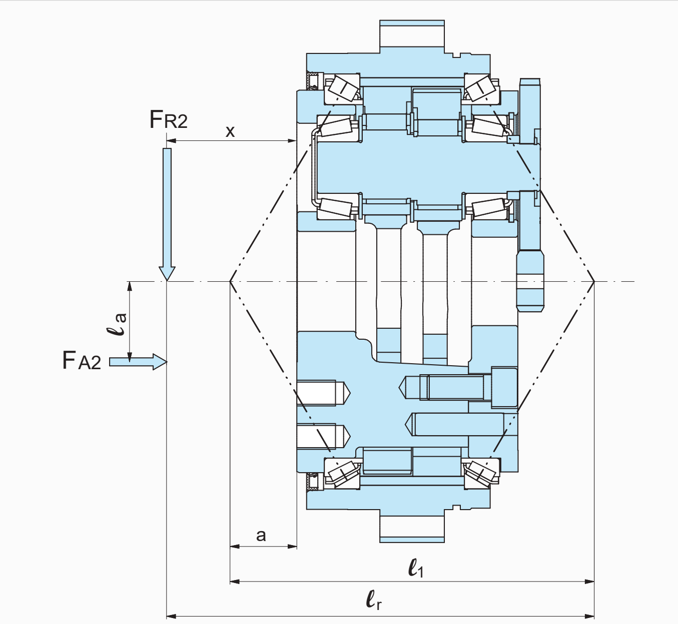


Fig. UA4 Distance between the individual loading points

$$\ell_r = x - a + \ell_1 \quad \text{(Equation UA-4)}$$

1. Moment stiffness

   The moment stiffness is the bending moment at which the output flange is tilted to the tilt angle.

   The tilt angle of the input flange is determined as follows:

$$\varphi_1 = \frac{T_k}{\Theta_1} \quad \text{(Equation UA-5)}$$

External bending moment T_k

$$T_k = 10^{-3} \cdot (F_{R2} \cdot \ell_r + F_{A2} \cdot \ell_a) \quad \text{(Equation UA-6)}$$

2. Max. permissible bending moment and max. permissible axial load.

   Check the external bending moment and the external axial load using equations UA-6, UA-7, UA-8 and Table UA14.

Equivalent bending moment T_{ke}

$$T_{ke} = 10^{-3} \cdot (C_{f2} \cdot B_{f2} \cdot F_{R2} \cdot \ell_r + C_{f2} \cdot B_{f2} \cdot F_{A2} \cdot \ell_a) < T_{k\,max} \quad \text{(Equation UA-7)}$$

Equivalent axial load F_{A2e} at the output shaft

$$F_{A2e} = F_{A2} \cdot C_{f2} \cdot B_{f2} < F_{A2\,max} \quad \text{(Equation UA-8)}$$

Size	Values of internal bearing distance	
	ℓ_1 [mm]	a [mm]
UA15	114.2	20.4
UA25	131.9	26
UA35	154.5	34.8
UA45	177.5	38.7
UA55	205.7	50.9
UA65	183.4	32.7
UA80	215.1	35.9

Table UA10 Bearing spacing dimensions [mm]

Note If: $\ell_r > 4 \cdot \ell_1$, please contact Sumitomo Drive Technologies.

Size	Moment stiffness Θ_1
	[Nm/arcmin]
UA15	550
UA25	833
UA35	1127
UA45	1500
UA55	2500
UA65	6000
UA80	9000

Table UA11 Average values for moment stiffness

F_{A2} = output side axial load [N]
$F_{A2\,max}$ = maximum permissible output side axial load [N]
F_{A2e} = equivalent output side axial load [N]
F_{R2} = output side radial load [N]
C_{f2} = correction factor output (Table UA12)
B_{f2} = service factor output (Table UA13)
ℓ_1 = bearing clearance [mm] (Table UA10)
ℓ_r = calculated dimension for bending moment [mm]
ℓ_a = distance of axial load [mm]
x = distance from radial force to flange collar [mm]
a = correction factor [mm] (Table UA10)
T_k = external bending moment [Nm]
$T_{k\,max}$ = maximum permissible bending moment [Nm] (Table UA14)
T_{ke} = equivalent bending moment [Nm]
φ_1 = tilt angle [arcmin]
Θ_1 = moment stiffness main bearing [Nm/arcmin] (Table UA11)

Correction factor output	C_{f2}
Chain	1
Gear or pinion	1.25
Timing belt	1.25
V-Belt	1.5

Table UA12 Correction factor output C_{f2}

Service factor output	B_{f2}
Uniform load (no shock)	1
Light impacts	1 – 1.2
Severe impacts	1.4 – 1.6

Table UA13Service factor output B_{f2}

Size	Max. permissible bending moment $T_{k\,max}$	Max. permissible axial load $F_{A2\,max}$
	[Nm]	[N]
UA15	883	3924
UA25	1666	5194
UA35	2156	7840
UA45	3430	8820
UA55	4000	10780
UA65	7056	11000
UA80	10000	13734

Table UA14 Max. permissible bending moment and max. permissible axial load

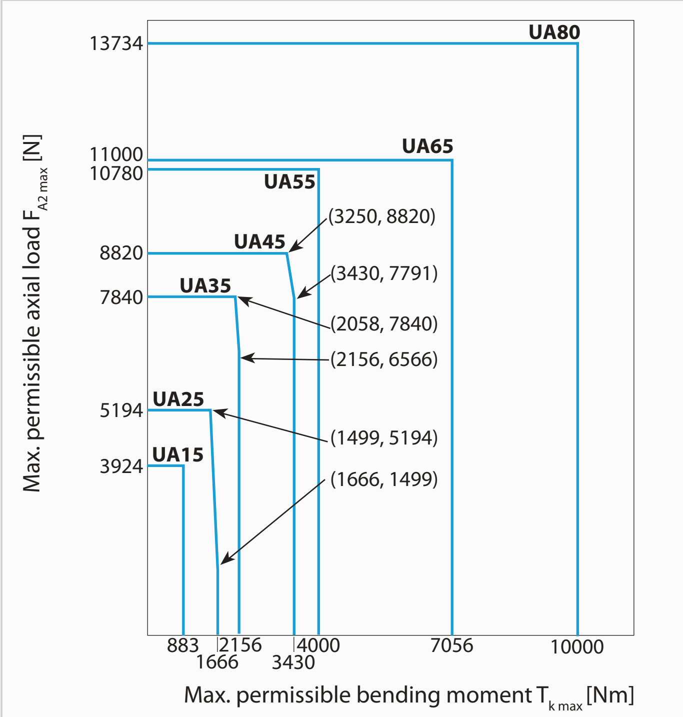
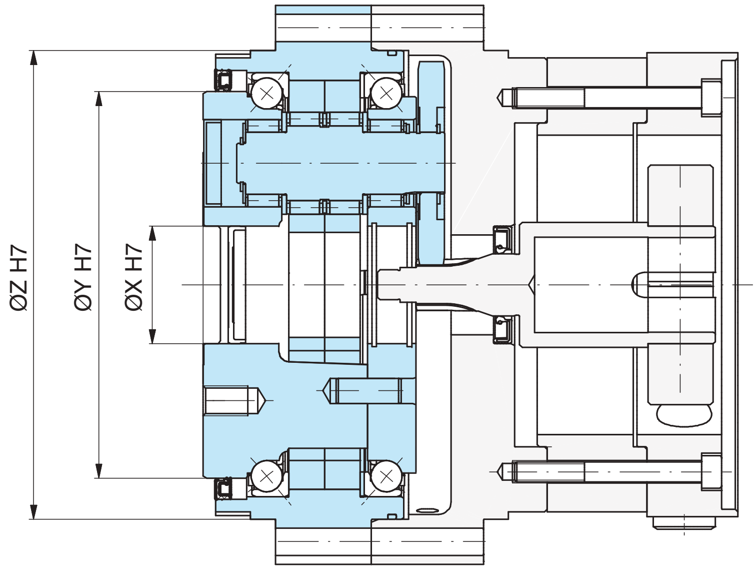


Fig. UA5 Max. permissible bending moment and axial load

8.8 Assembly specifications and tolerances

8.8.1 Assembly tolerances

To ensure the function, lifetime, and characteristics of the gearbox, the radial run-out of the shaft ends, the coaxiality and the axial run-out of the fastening surface as per EN 50347:2001 are sufficient. When used in high-precision applications, the tolerance according to EN 50347:2001 should be reduced by 50%, which has additional advantages.



Size	Ø X	Ø Y	Ø Z
UA15	28	90	113
UA25	32	110	137
UA35	35	130	160
UA45	47	155	188
UA55	42	174	208
UA65	55	210	255
UA80	62	238	284

Table UA15 (Dimensions in mm)

Tightening torque and maximum permissible transmittable torque for bolts

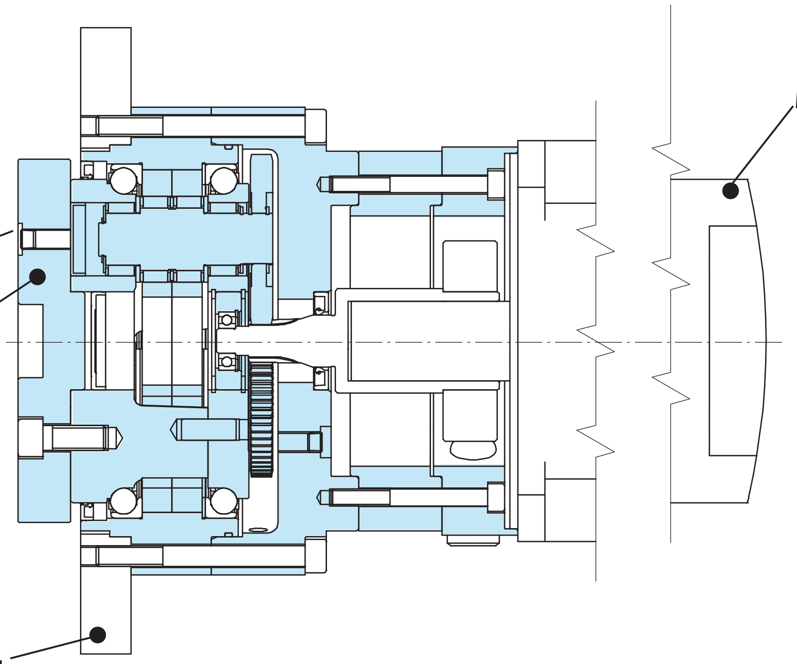
The permissible transmitted torque for bolts and the number, size, and tightening torque for fastening the output side flange and the ring gear housing are listed in Table UA16. In the event of an Emergency Stop with corresponding load peaks, the output flange and ring gear housing bolts must all be replaced. Liquid sealing material must be applied between all fittings of the gearbox with the customer's applications.

Size	Output flange bolts				Bolts for ring gear (housing)		
	Number and size of bolts	Pitch circle-ø	Tightening torque [Nm]	Max. permissible transmittable torque for bolts [Nm]	Number and size of bolts	Tightening torque [Nm]	Max. permissible transmittable torque for bolts [Nm]
UA15	15 × M6 9 × M6	72 48	15.7	1505	16 × M5	9.1	1389
UA25	9 × M10 6 × M0	86 50	76.5	3083	12 × M8	38.3	3283
UA35	15 × M10 6 × M10	107 72	76.5	5848	18 × M8	38.3	5707
UA45	18 × M10 9 × M12	131 93	76.5 133	10262	18 × M10	76.5	10646
UA55	15 × M12 9 × M12	140 97	133	12406	20 × M10	76.5	12977
UA65	21 × M12 12 × M12	177 136	133	22321	18 × M12	133	20656
UA80	15 × M16 9 × M16	193 139	331	32221	24 × M12	133	30545

Table UA16 Bolt tightening torque and permissible torque values

- **Bolting:** Use metric hexagon socket head cap screws (DIN 4762, strength category 12.9).
- **Countermeasure for bolts loosening:** Use adhesives (Loctite 262, etc.) or spring washer (DIN 127A).
- **Use spring washers** (DIN 6796) when connecting the gearbox to the flange side, so that the bolt contact faces do not get damaged.

8.8.2 Installation example



The customer's output shaft is bolted to the output flange of the gearbox.

The motor shaft must have a key.

The correct penetration depth of the gearing (shaft distance from output) must be observed as per the Fine Cyclo catalogue (see the dimension sheets).

8.8.3 Lubrication

- F2/4CF-UA Fine Cyclo gearboxes are delivered without grease and must be filled with Multemp FZ No.00 grease as per Table UA178 and sealed before being used for the first time (for the grease filling port, see Figure).
  These greases are suitable for ambient temperatures from -10 °C to +40 °C.
- Reconditioning is recommended after 20,000 operating hours, but at least every 3-5 years.

Specified grease	Manufacturer
Multemp FZ No. 00	Kyodo Yushi Co., Ltd.
Conditions for use: Ambient temperature -10°C to +40°C	

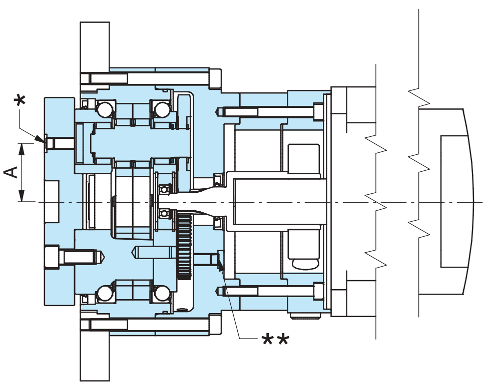
Table UA17Specified grease for the UA Series

Size	Quantity of grease [g]			A [mm]	B [mm]
	Horizontal	Vertical 1	Vertical 2		
UA15	122	152	143	29	33
UA25	209	261	227	34	34
UA35	313	400	361	39	45
UA45	383	487	417	49	50
UA55	679	818	748	54	65
UA65	940	1180	1090	63	74
UA80	1700	2140	1995	71	75

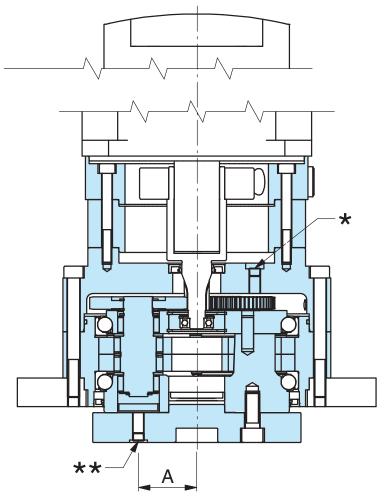
Table UA18 Lubrication

The grease quantity above relates to the gearbox.
The cavity between the gearbox and the motor (motor adapter) must also be taken into account.

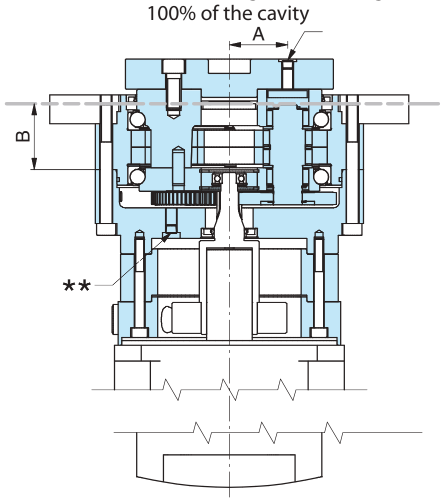
Mounting position
Horizontal
Additional amount of grease for flange:
50% of the cavity



Mounting position
Vertical 1
Downward output
additional amount of grease for flange:
0% of the cavity

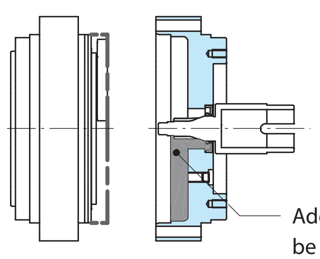


Mounting position
Vertical 2
Upward output
additional amount of grease for flange:
100% of the cavity

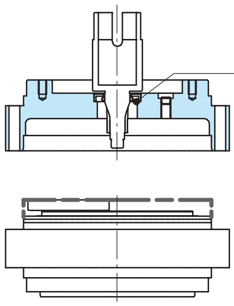


* Filling port for grease
** Grease drain port for grease change

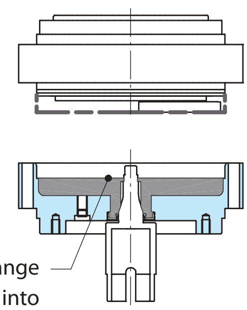
Determination of the cavity
The additional amount of grease is necessary for the functioning of the gearbox



Additional motor flange cavity must be taken into account when grease filling (50% of the volume)



Additional cavity on the motor flange need not be taken into account.
(However, the oil seal must be moistened with grease).

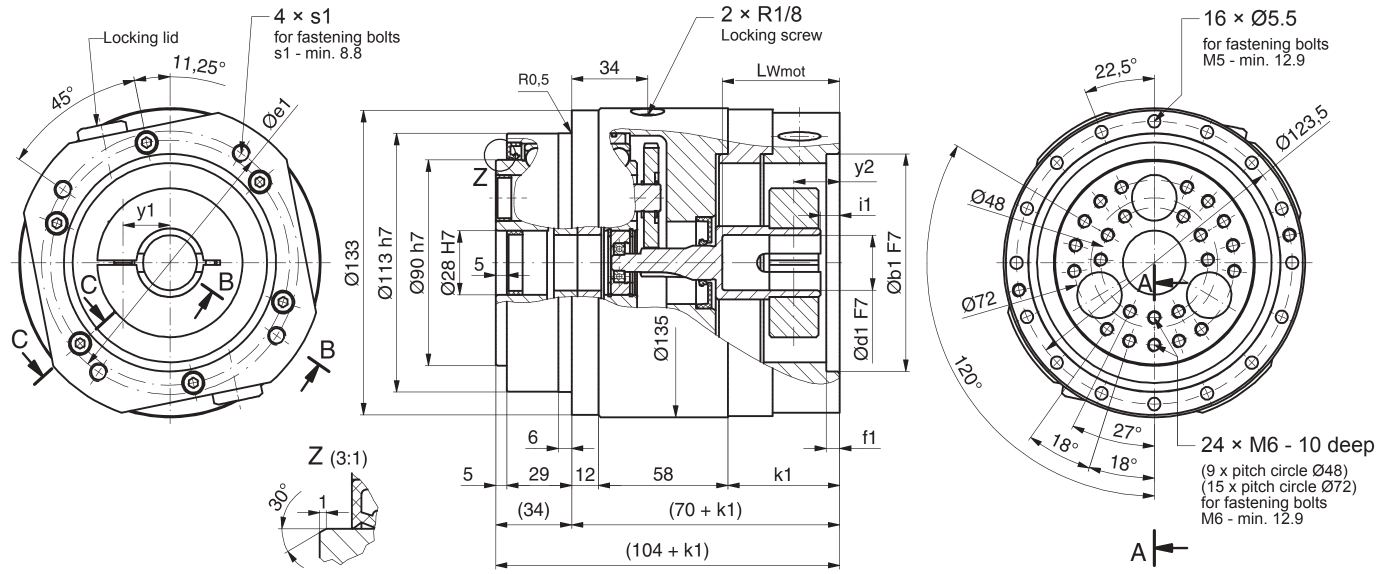


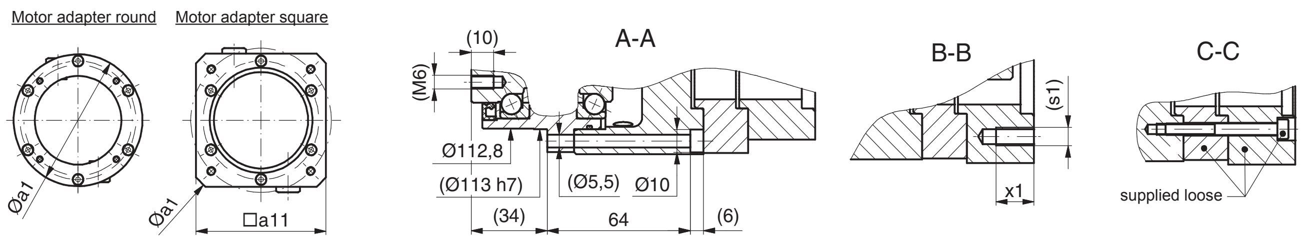
Additional motor flange cavity must be taken into account when filling with grease (100% of the volume)

8.9 Dimensioned drawings

F4CF-UA15

Mass basic gear + adaptor 7.26 kg





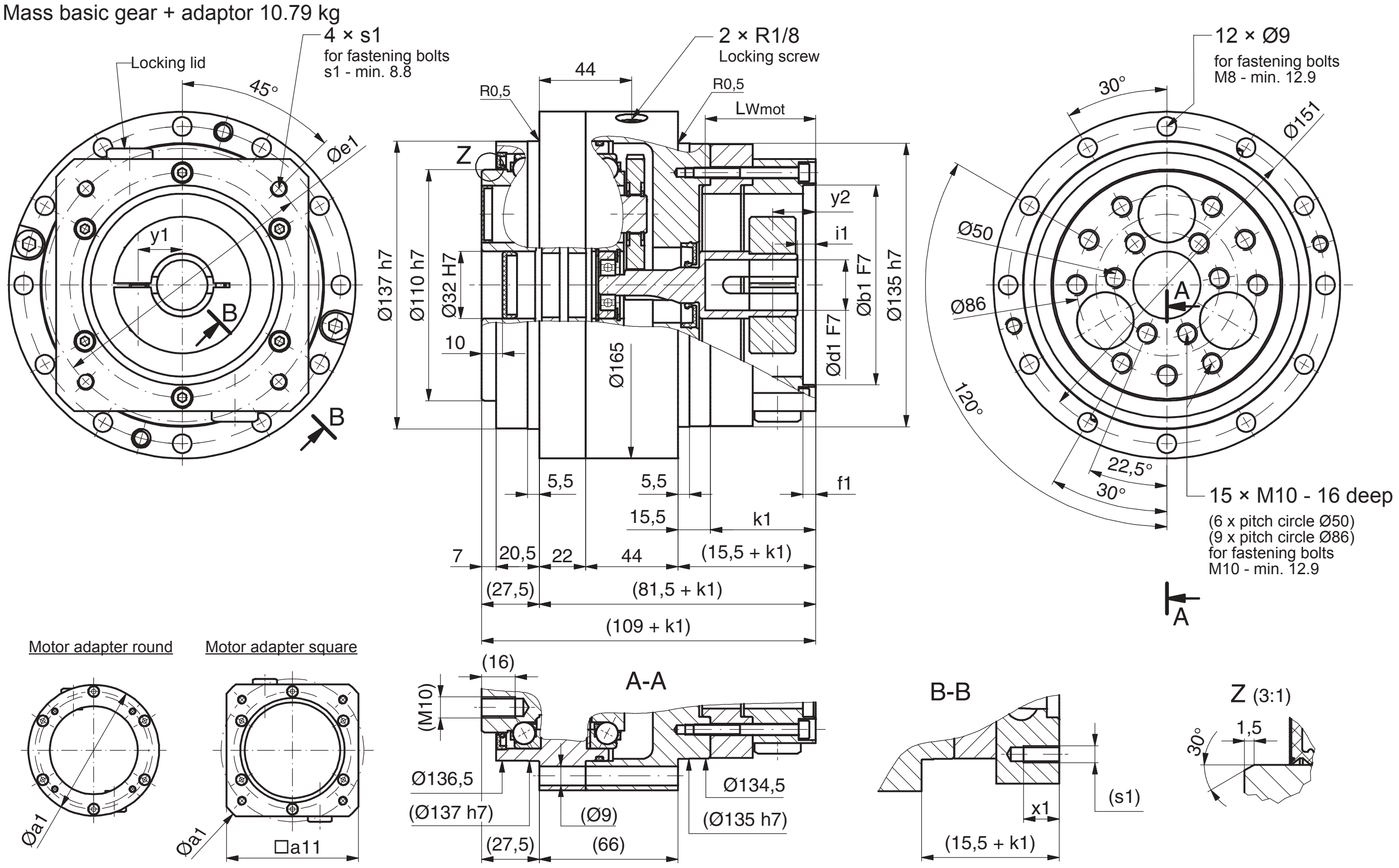
Motor mounting dimensions F4CF- UA15

Motor code	Hole for shaft	Min./Max. Length of motor shaft	Centering F7	Spigot seat depth	Pitch circle Ø	Thread in gearbox flange	Thread depth	Flange diameter	Flange square dimension	Flange width	Shaft recess	Positional dimensions locking lid	
	Ød1	$L_{w\,Mot\ min/max}$	Øb1	f1	Øe1	4x s1	x1	Øa1	□a11	k1	i1	y1	y2
	mm												
C06G	9	24.0 / 30.5	40	5.5	63	M4	7.5	119	-	29	7.5	17	16.5
C08G	9	24.0 / 30.5	40	5.5	63	M5	7.5	119	-	29	7.5	17	16.5
C11G	9	24.0 / 30.5	60	5.5	75	M5	7.5	119	-	29	7.5	18.5	16.5
D30G	10	25.0 / 31.5	80	6	100	M6	14	119	-	30	8.5	18.5	16.5
E10G	11	24.0 / 30.5	50	5.5	70	M4	7.5	119	-	29	7.5	17	16.5
E11G	11	24.0 / 30.5	60	5.5	75	M5	7.5	119	-	29	7.5	18.5	16.5
F25G	12	24.0 / 30.5	50	5.5	70	M5	7.5	119	-	29	7.5	17	16.5
F17G	12	25.5 / 32.0	70	6	90	M5	12	119	-	30.5	9	18.5	17
H10G	14	24.0 / 30.5	50	5.5	70	M4	7.5	119	-	29	7.5	17	16.5
H25G	14	24.0 / 30.5	50	5.5	70	M5	7.5	119	-	29	7.5	17	16.5
H20G	14	24.0 / 30.5	50	6	95	M6	14	119	-	29	7.5	17	16.5
H30G	14	25.0 / 31.5	80	6	100	M6	14	119	-	30	8.5	18.5	16.5
H50G	14	25.0 / 31.5	110	6	130	M8	17	158	120	30	8.5	25	18
H60L	14	36.5 / 43.0	110	8	145	M8	17	158	120	41.5	20	25	29.5
J30G	16	29.5 / 31.5	80	6	100	M6	14	119	-	30	8.5	18.5	16.5
J60G	16	29.5 / 31.5	110	6.5	145	M8	17	158	120	30	8.5	25	18
M17G	19	30.0 / 42.0	70	6	90	M5	12	119	-	40.5	9	18.5	17
M18G	19	30.0 / 42.0	70	6	90	M5	12	119	-	40.5	9	18.5	17
M30G	19	29.5 / 41.5	80	6	100	M6	14	119	-	40	8.5	18.5	16.5
M50G	19	29.5 / 41.5	110	6	130	M8	17	158	120	40	8.5	25	18
M70G	19	29.5 / 41.5	130	6	165	M10	20	188	144	40	8.5	25	18
N30G	22	31.5 / 41.5	80	6	100	M6	14	119	-	40	8.5	18.5	16.5
N60G	22	31.5 / 41.5	110	6.5	145	M8	17	158	120	40	8.5	25	18
N70G	22	31.5 / 41.5	130	6	165	M10	20	188	144	40	8.5	25	18
Z30G	24	31.5 / 51.5	80	6	100	M6	14	119	-	50	8.5	18.5	16.5
Z45G	24	31.5 / 51.5	95	6	115	M8	17	158	120	50	8.5	18.5	18
Z70G	24	31.5 / 51.5	130	6	165	M10	20	188	144	50	8.5	25	18

Note Other motor mounting dimensions available on request.

F4CF-UA25

Mass basic gear + adaptor 10.79 kg



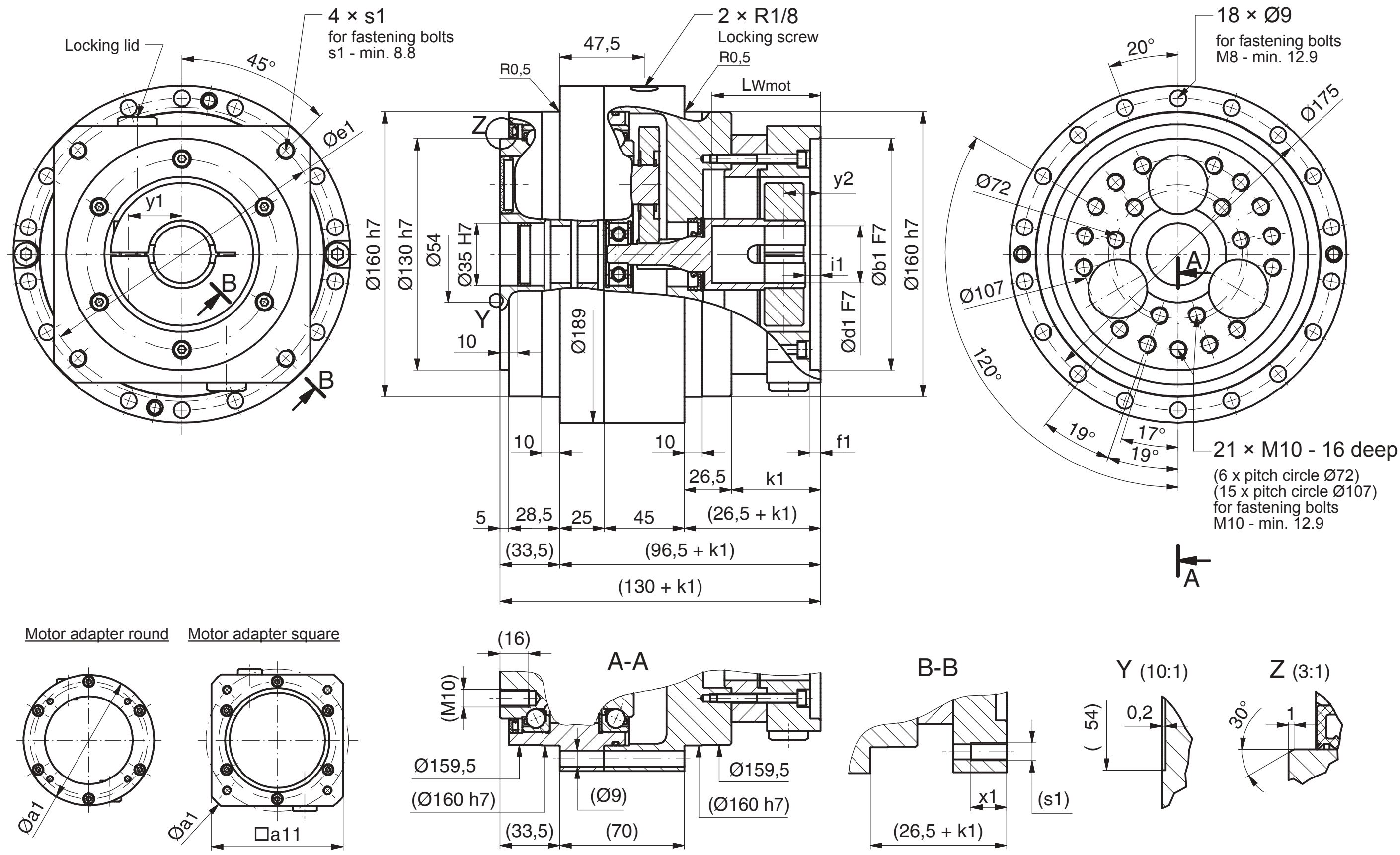
Motor mounting dimensions F4CF- UA25

Motor code	Hole for shaft	Min./Max. Length of motor shaft	Centering F7	Spigot seat depth	Pitch circle Ø	Thread in gearbox flange	Thread depth	Flange diameter	Flange square dimen-sion	Flange width	Shaft recess	Positional dimen-sions locking lid	
	Ød1	$L_{w\ Mot\ min/max}$	Øb1	f1	Øe1	4x s1	x1	Øa1	□a11	k1	i1	y1	y2
	mm												
D30G	10	25.0 / 31.5	80	6	100	M6	14	119	-	30	8.5	18.5	16.5
E10G	11	24.0 / 30.5	50	5.5	70	M4	7.5	119	-	29	7.5	17	16.5
E11G		24.0 / 30.5	60	5.5	75	M5	7.5	119	-	29	7.5	18.5	16.5
F25G	12	24.0 / 30.5	50	5.5	70	M5	7.5	119	-	29	7.5	17	16.5
F17G		25.5 / 32.0	70	6	90	M5	12	119	-	30.5	9	18.5	17
H10G	14	24.0 / 30.5	50	5.5	70	M4	7.5	119	-	29	7.5	17	16.5
H25G		24.0 / 30.5	50	5.5	70	M5	7.5	119	-	29	7.5	17	16.5
H20G		24.0 / 30.5	50	6	95	M6	14	119	-	29	7.5	17	16.5
H30G		25.0 / 31.5	80	6	100	M6	14	119	-	30	8.5	18.5	16.5
H50G		25.0 / 31.5	110	6	130	M8	17	158	120	30	8.5	25	18
H60L		36.5 / 43.0	110	8	145	M8	17	158	120	41.5	20	25	29.5
J30G	16	29.5 / 31.5	80	6	100	M6	14	119	-	30	8.5	18.5	16.5
J60G		29.5 / 31.5	110	6.5	145	M8	17	158	120	30	8.5	25	18
M17G	19	30.0 / 42.0	70	6	90	M5	12	119	-	40.5	9	18.5	17
M18G		30.0 / 42.0	70	6	90	M5	12	119	-	40.5	9	18.5	17
M30G		29.5 / 41.5	80	6	100	M6	14	119	-	40	8.5	18.5	16.5
M35G		29.5 / 41.5	95	6	115	M8	17	138	120	40	8.5	18.5	18
M50G		29.5 / 41.5	110	6	130	M8	17	158	120	40	8.5	25	18
M70G		29.5 / 41.5	130	6	165	M10	20	188	144	40	8.5	25	18
N30G	22	31.5 / 41.5	80	6	100	M6	14	119	-	40	8.5	18.5	16.5
N60G		31.5 / 41.5	110	6.5	145	M8	17	158	120	40	8.5	25	18
N70G		31.5 / 41.5	130	6	165	M10	20	188	144	40	8.5	25	18
Z30G	24	31.5 / 51.5	80	6	100	M6	14	119	-	50	8.5	18.5	16.5
Z45G		31.5 / 51.5	95	6	115	M8	17	158	120	50	8.5	18.5	18
Z70G		31.5 / 51.5	130	6	165	M10	20	188	144	50	8.5	25	18

Note Other motor mounting dimensions available on request.

F4CF-UA35

Mass basic gear + adaptor 18.03 kg



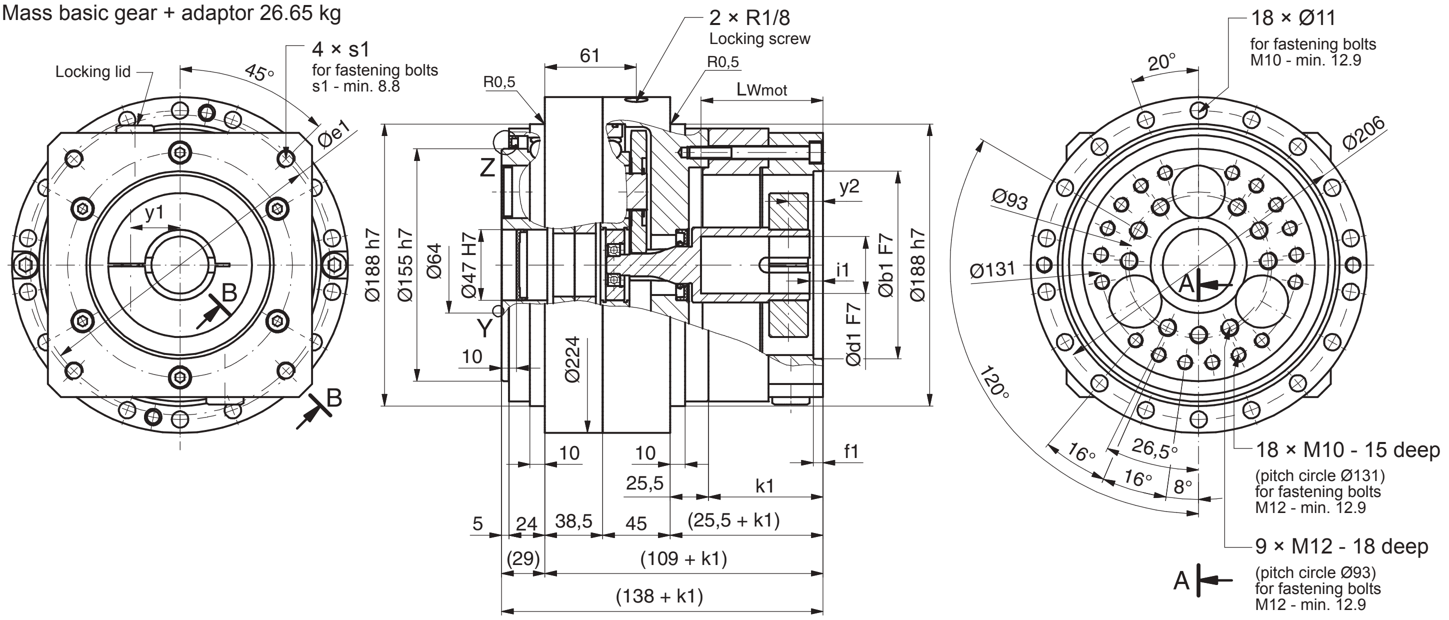
Motor mounting dimensions F4CF- UA35

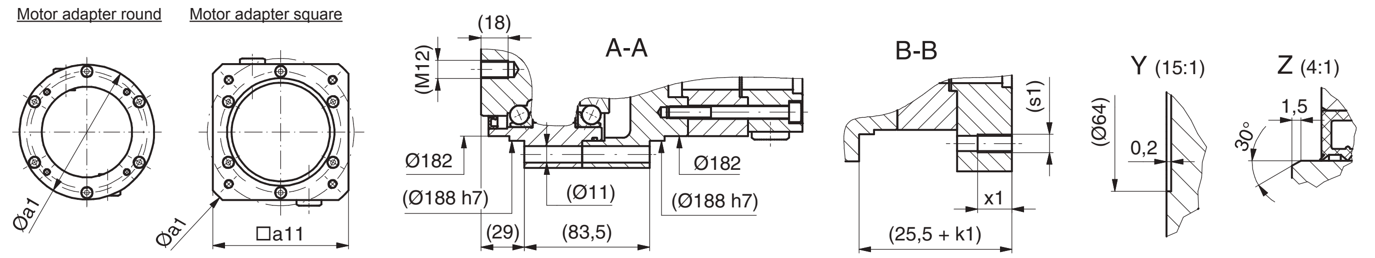
Motor code	Hole for shaft	Min./Max. Length of motor shaft	Centering F7	Spigot seat depth	Pitch circle Ø	Thread in gearbox flange	Thread depth	Flange diameter	Flange square dimension	Flange width	Shaft recess	Positional dimensions locking lid	
	Ød1	$L_{w\,Mot\ min/max}$	Øb1	f1	Øe1	4x s1	x1	Øa1	□a11	k1	i1	y1	y2
	mm												
D30G	10	25.0 / 41.0	80	6	100	M6	14	119	-	30	8.5	18.5	16.5
E10G	11	24.0 / 40.0	50	5.5	70	M4	7.5	119	-	29	7.5	17	16.5
E11G		24.0 / 40.0	60	5.5	75	M5	7.5	119	-	29	7.5	18.5	16.5
F25G	12	24.0 / 40.0	50	5.5	70	M5	7.5	119	-	29	7.5	17	16.5
F17G		25.5 / 41.5	70	6	90	M5	12	119	-	30.5	9	18.5	17
H10G	14	24.0 / 40.0	50	5.5	70	M4	7.5	119	-	29	7.5	17	16.5
H25G		24.0 / 40.0	50	5.5	70	M5	7.5	119	-	29	7.5	17	16.5
H20G		24.0 / 40.0	50	6	95	M6	14	119	-	29	7.5	17	16.5
H30G		25.0 / 41.0	80	6	100	M6	14	119	-	30	8.5	18.5	16.5
H50G		25.0 / 41.0	110	6	130	M8	17	158	120	30	8.5	25	18
H60L		36.5 / 52.5	110	8	145	M8	17	158	120	41.5	20	25	29.5
J30G	16	29.5 / 41.0	80	6	100	M6	14	119	-	30	8.5	18.5	16.5
J60G		29.5 / 41.0	110	6.5	145	M8	17	158	120	30	8.5	25	18
M17G	19	30.0 / 41.5	70	6	90	M5	12	119	-	30.5	9	18.5	17
M18G		30.0 / 41.5	70	6	90	M5	12	119	-	30.5	9	18.5	17
M30G		29.5 / 41.0	80	6	100	M6	14	119	-	30	8.5	18.5	16.5
M35G		29.5 / 41.0	95	6	115	M8	17	138	120	30	8.5	18.5	18
M50G		29.5 / 41.0	110	6	130	M8	17	158	120	30	8.5	25	18
M70G		29.5 / 41.0	130	6	165	M10	20	188	144	30	8.5	25	18
N30G	22	31.5 / 41.0	80	6	100	M6	14	119	-	30	8.5	18.5	16.5
N60G		31.5 / 41.0	110	6.5	145	M8	17	158	120	30	8.5	25	18
N70G		31.5 / 41.0	130	6	165	M10	20	188	144	30	8.5	25	18
Z30G	24	31.5 / 51.0	80	6	100	M6	14	119	-	40	8.5	18.5	16.5
Z45G		31.5 / 51.0	95	6	115	M8	17	158	120	40	8.5	18.5	18
Z70G		31.5 / 51.0	130	6	165	M10	20	188	144	40	8.5	25	18
U80G	38	31.5 / 81.5	180	6.5	215	M12	23	237	186	70	9.0	30	21.5

Note Other motor mounting dimensions available on request.

F4CF-UA45

Mass basic gear + adaptor 26.65 kg





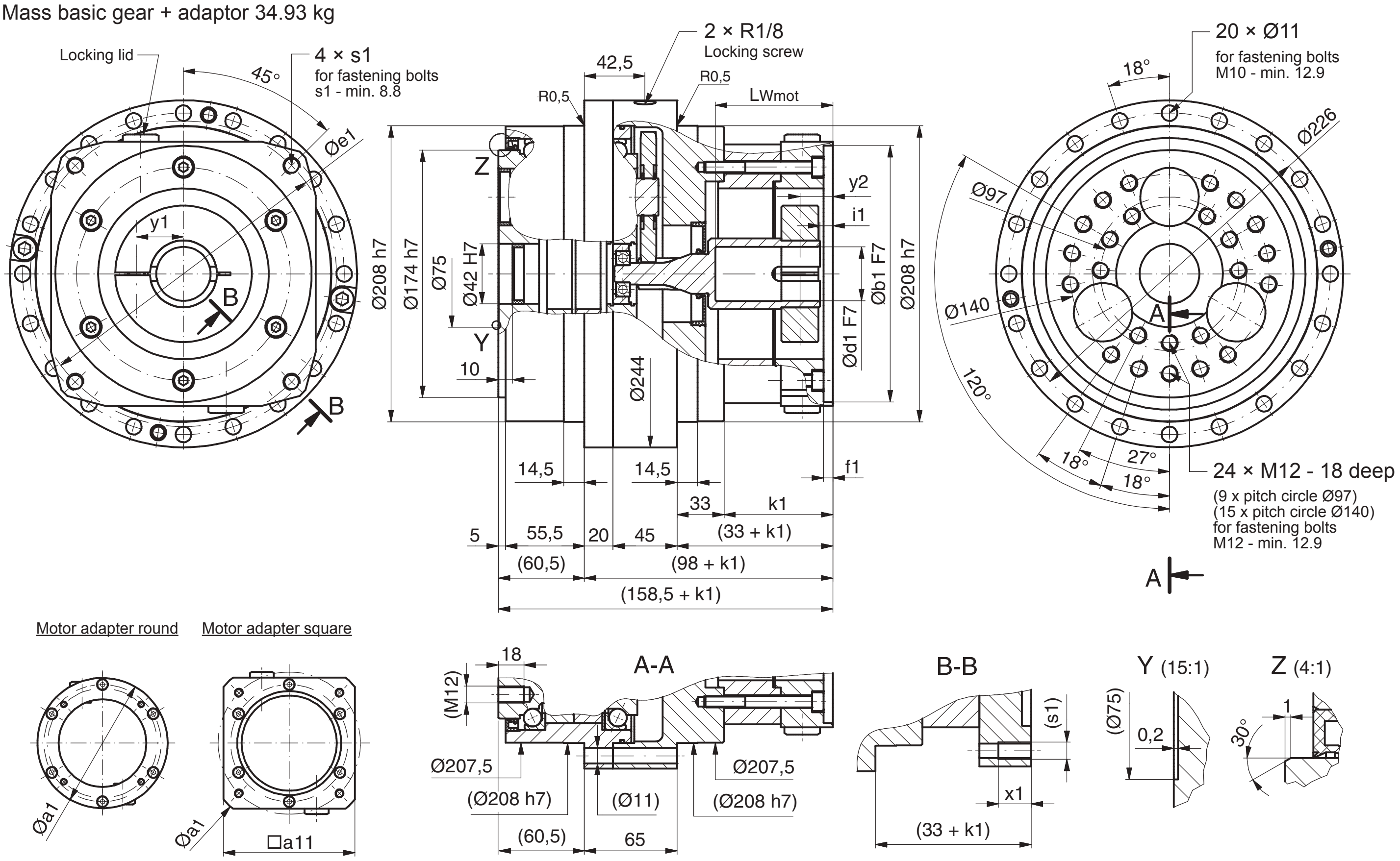
Motor mounting dimensions F4CF- UA45

Motor code	Hole for shaft	Min./Max. Length of motor shaft	Centering F7	Spigot seat depth	Pitch circle Ø	Thread in gearbox flange	Thread depth	Flange diameter	Flange square dimension	Flange width	Shaft recess	Positional dimensions locking lid	
	Ød1	$L_{w\ Mot\ min/max}$	Øb1	f1	Øe1	4x s1	x1	Øa1	□a11	k1	i1	y1	y2
							mm						
H17G	14	30.0 / 41.5	70	9	90	M5	12	169	-	36.5	9	18.5	20
H30G		29.5 / 41.0	80	6	100	M6	14	169	-	36	8.5	24	20.5
H50G		29.5 / 41.0	110	6	130	M8	17	169	-	36	8.5	24	20.5
H60L		41.0 / 52.5	110	6	145	M8	17	169	-	47.5	20	25	32
J30G	16	29.5 / 41.0	80	6	100	M6	14	169	-	36	8.5	24	20.5
J60G		29.5 / 41.0	110	6	145	M8	17	169	-	36	8.5	25	20.5
M17G	19	30.0 / 41.5	70	9	90	M5	12	169	-	36.5	9	18.5	20
M18G		30.0 / 41.5	70	9	90	M5	12	169	-	36.5	9	18.5	20
M30G		29.5 / 41.0	80	6	100	M6	14	169	-	36	8.5	24	20.5
M35G		29.5 / 41.0	95	6	115	M8	17	169	-	36	8.5	24	20.5
M50G		29.5 / 41.0	110	6	130	M8	17	169	-	36	8.5	24	20.5
M70G		29.5 / 41.0	130	8	165	M10	20	188	-	36	8.5	25	20.5
N30G	22	29.5 / 51.0	80	6	100	M6	14	169	-	46	8.5	24	20.5
N60G		29.5 / 51.0	110	6	145	M8	17	169	-	46	8.5	25	20.5
N70G		29.5 / 51.0	130	8	165	M10	20	188	-	46	8.5	25	20.5
Z30G	24	29.5 / 51.0	80	6	100	M6	14	169	-	46	8.5	24	20.5
Z35G		29.5 / 51.0	95	6	115	M8	17	169	-	46	8.5	24	20.5
Z50G		29.5 / 51.0	110	6	130	M8	17	169	-	46	8.5	24	20.5
Z70G		29.5 / 51.0	130	8	165	M10	20	188	-	46	8.5	25	20.5
Q50G	28	31.5 / 61.0	110	6	130	M8	17	169	-	56	8.5	24	20.5
Q70G		31.5 / 61.0	130	8	165	M10	20	188	-	56	8.5	25	20.5
Q76G		37.0 / 66.5	114.3	6	200	M12	23	223	176	61.5	14	33	26.5
S70G	32	31.5 / 61.0	130	8	165	M10	20	188	-	56	8.5	25	20.5
S88G		32.0 / 61.5	130	8	215	M12	23	237	186	56.5	9	30	21.5
T76G	35	37.0 / 86.5	114.3	6	200	M12	23	223	176	81.5	14	33	26.5
U80G	38	32.0 / 81.5	180	6.5	215	M12	23	237	168	76.5	9	30	21.5

Note Other motor mounting dimensions available on request.

F4CF-UA55

Mass basic gear + adaptor 34.93 kg



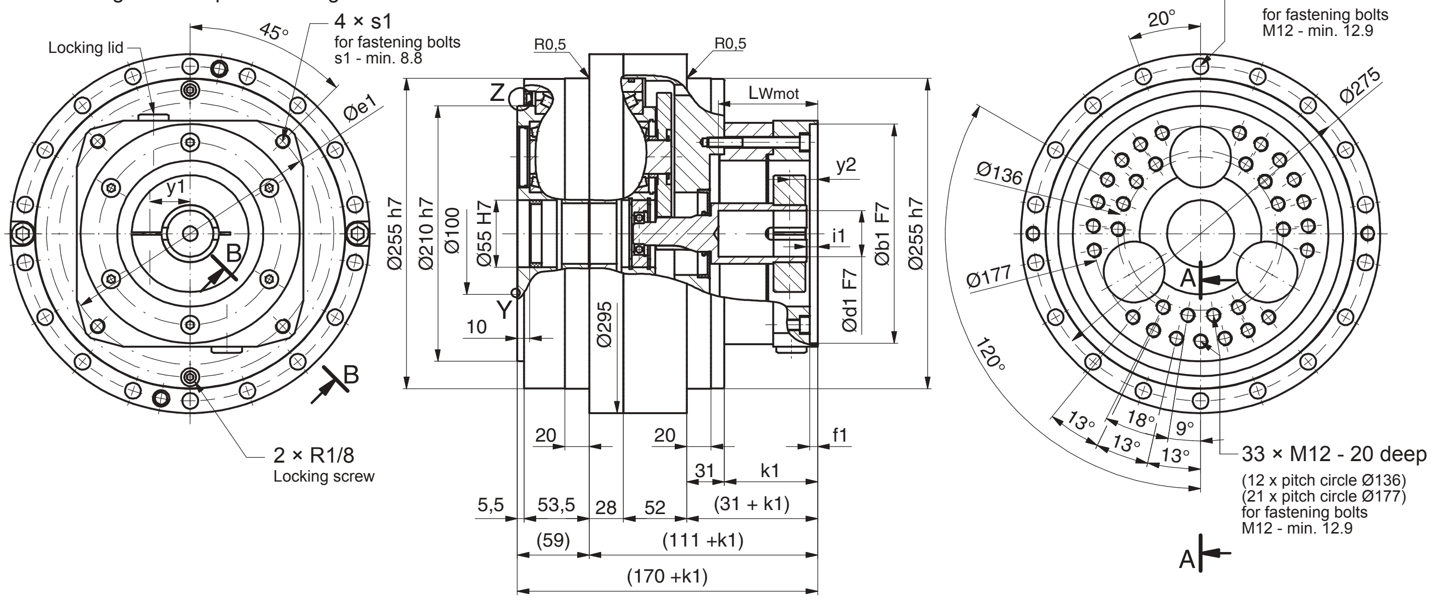
Motor mounting dimensions F4CF- UA55

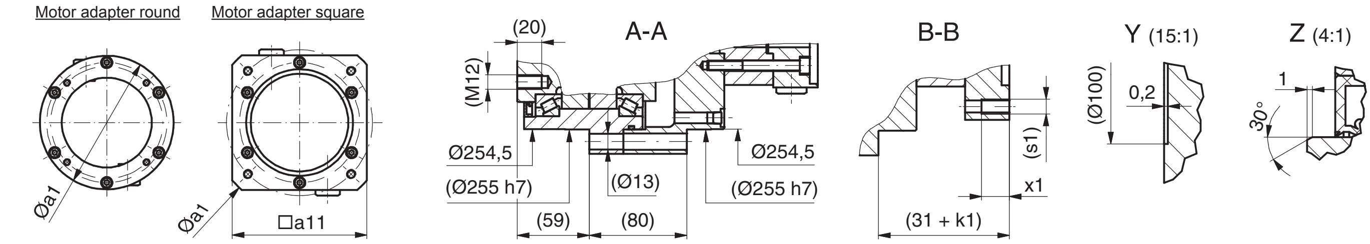
Motor code	Hole for shaft	Min./Max. Length of motor shaft	Centering F7	Spigot seat depth	Pitch circle Ø	Thread in gearbox flange	Thread depth	Flange diameter	Flange square dimension	Flange width	Shaft recess	Positional dimensions locking lid	
	Ød1	$L_{w\,Mot\ min/max}$	Øb1	f1	Øe1	4x s1	x1	Øa1	□a11	k1	i1	y1	y2
	mm												
H17G	14	30.0 / 41.5	70	9	90	M5	12	169	-	36.5	9	18.5	20
H30G		29.5 / 41.0	80	6	100	M6	14	169	-	36	8.5	24	20.5
H50G		29.5 / 41.0	110	6	130	M8	17	169	-	36	8.5	24	20.5
H60L		41.0 / 52.5	110	6	145	M8	17	169	-	47.5	20	25	32
J30G	16	29.5 / 41.0	80	6	100	M6	14	169	-	36	8.5	24	20.5
J60G		29.5 / 41.0	110	6	145	M8	17	169	-	36	8.5	25	20.5
M17G	19	30.0 / 41.5	70	9	90	M5	12	169	-	36.5	9	18.5	20
M18G		30.0 / 41.5	70	9	90	M5	12	169	-	36.5	9	18.5	20
M30G		29.5 / 41.0	80	6	100	M6	14	169	-	36	8.5	24	20.5
M35G		29.5 / 41.0	95	6	115	M8	17	169	-	36	8.5	24	20.5
M50G		29.5 / 41.0	110	6	130	M8	17	169	-	36	8.5	24	20.5
M70G		29.5 / 41.0	130	8	165	M10	20	188	-	36	8.5	25	20.5
N30G	22	29.5 / 51.0	80	6	100	M6	14	169	-	46	8.5	24	20.5
N60G		29.5 / 51.0	110	6	145	M8	17	169	-	46	8.5	25	20.5
N70G		29.5 / 51.0	130	8	165	M10	20	188	-	46	8.5	25	20.5
Z30G	24	29.5 / 51.0	80	6	100	M6	14	169	-	46	8.5	24	20.5
Z35G		29.5 / 51.0	95	6	115	M8	17	169	-	46	8.5	24	20.5
Z50G		29.5 / 51.0	110	6	130	M8	17	169	-	46	8.5	24	20.5
Z70G		29.5 / 51.0	130	8	165	M10	20	188	-	46	8.5	25	20.5
Q50G	28	31.5 / 61.0	110	6	130	M8	17	169	-	56	8.5	24	20.5
Q70G		31.5 / 61.0	130	8	165	M10	20	188	-	56	8.5	25	20.5
Q76G		37.0 / 66.5	114.3	6	200	M12	23	223	176	61.5	14	33	26.5
S70G	32	31.5 / 61.0	130	8	165	M10	20	188	-	56	8.5	25	20.5
S88G		32.0 / 61.5	130	8	215	M12	23	237	186	56.5	9	30	21.5
T76G	35	37.0 / 86.5	114.3	6	200	M12	23	223	176	81.5	14	33	26.5
U80G	38	32.0 / 81.5	180	6.5	215	M12	23	237	168	76.5	9	30	21.5

Note Other motor mounting dimensions available on request.

F2CF-UA65

Mass basic gear + adaptor 58.27 kg





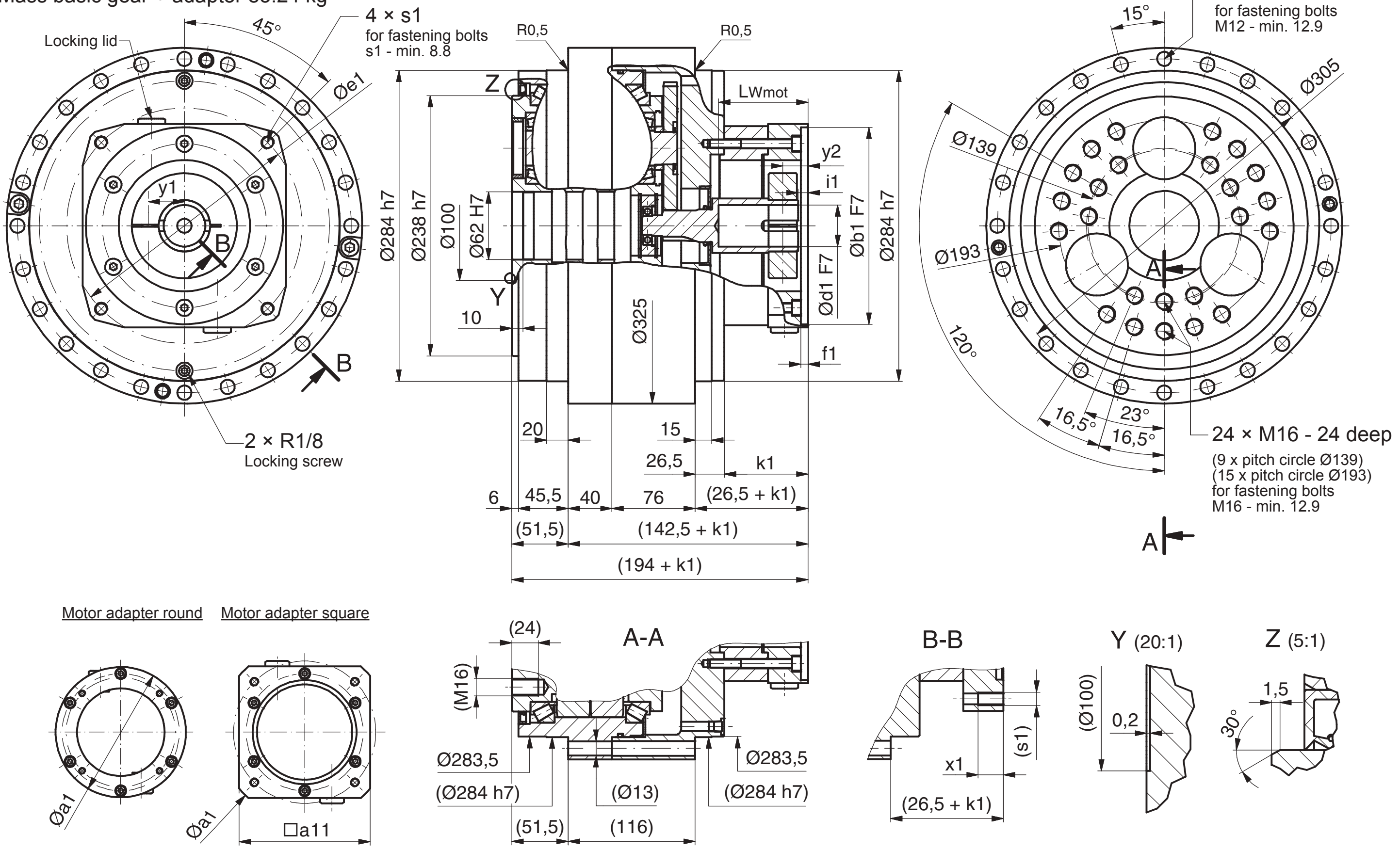
Motor mounting dimensions F2CF- UA65

Motor code	Hole for shaft	Min./Max. Length of motor shaft	Centering F7	Spigot seat depth	Pitch circle Ø	Thread in gearbox flange	Thread depth	Flange diameter	Flange square dimension	Flange width	Shaft recess	Positional dimensions locking lid	
	Ød1	$L_{w\,Mot\ min/max}$	Øb1	f1	Øe1	4x s1	x1	Øa1	□a11	k1	i1	y1	y2
	mm												
H17G	14	30.0 / 41.5	70	9	90	M5	12	169	-	36.5	9	18.5	20
H30G		29.5 / 41.0	80	6	100	M6	14	169	-	36	8.5	24	20.5
H50G		29.5 / 41.0	110	6	130	M8	17	169	-	36	8.5	24	20.5
H60L		41.0 / 52.5	110	6	145	M8	17	169	-	47.5	20	25	32
J30G	16	29.5 / 41.0	80	6	100	M6	14	169	-	36	8.5	24	20.5
J60G		29.5 / 41.0	110	6	145	M8	17	169	-	36	8.5	25	20.5
M17G	19	30.0 / 41.5	70	9	90	M5	12	169	-	36.5	9	18.5	20
M18G		30.0 / 41.5	70	9	90	M5	12	169	-	36.5	9	18.5	20
M30G		29.5 / 41.0	80	6	100	M6	14	169	-	36	8.5	24	20.5
M35G		29.5 / 41.0	95	6	115	M8	17	169	-	36	8.5	24	20.5
M50G		29.5 / 41.0	110	6	130	M8	17	169	-	36	8.5	24	20.5
M70G		29.5 / 41.0	130	8	165	M10	20	188	-	36	8.5	25	20.5
N30G	22	29.5 / 51.0	80	6	100	M6	14	169	-	46	8.5	24	20.5
N60G		29.5 / 51.0	110	6	145	M8	17	169	-	46	8.5	25	20.5
N70G		29.5 / 51.0	130	8	165	M10	20	188	-	46	8.5	25	20.5
Z30G	24	29.5 / 51.0	80	6	100	M6	14	169	-	46	8.5	24	20.5
Z35G		29.5 / 51.0	95	6	115	M8	17	169	-	46	8.5	24	20.5
Z50G		29.5 / 51.0	110	6	130	M8	17	169	-	46	8.5	24	20.5
Z70G		29.5 / 51.0	130	8	165	M10	20	188	-	46	8.5	25	20.5
Q50G	28	31.5 / 61.0	110	6	130	M8	17	169	-	56	8.5	24	20.5
Q70G		31.5 / 61.0	130	8	165	M10	20	188	-	56	8.5	25	20.5
Q76G		37.0 / 66.5	114.3	6	200	M12	23	223	176	61.5	14	33	26.5
S70G	32	31.5 / 61.0	130	8	165	M10	20	188	-	56	8.5	25	20.5
S88G		32.0 / 61.5	130	8	215	M12	23	237	186	56.5	9	30	21.5
T76G	35	37.0 / 86.5	114.3	6	200	M12	23	223	176	81.5	14	33	26.5
U80G	38	32.0 / 81.5	180	6.5	215	M12	23	237	168	76.5	9	30	21.5

Note Other motor mounting dimensions available on request.

F2CF-UA80

Mass basic gear + adaptor 83.24 kg



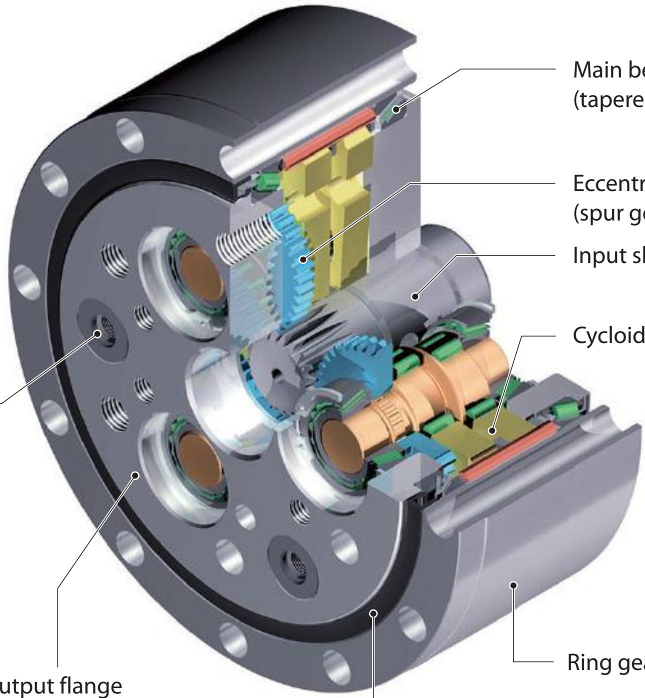
Motor mounting dimensions F2CF- UA80

Motor code	Hole for shaft	Min./Max. Length of motor shaft	Centering F7	Spigot seat depth	Pitch circle Ø	Thread in gearbox flange	Thread depth	Flange diameter	Flange square di-mension	Flange width	Shaft recess	Positional dimensions locking lid	
	Ød1	$L_{w\,Mot\ min/max}$	Øb1	f1	Øe1	4x s1	x1	Øa1	□a11	k1	i1	y1	y2
							mm						
H30G	14	29.5 / 41.0	80	6	100	M6	14	169	-	36	8.5	24	20.5
H50G		29.5 / 41.0	110	6	130	M8	17	169	-	36	8.5	24	20.5
H60L		41.0 / 52.5	110	6	145	M8	17	169	-	47.5	20	25	32
J30G	16	29.5 / 41.0	80	6	100	M6	14	169	-	36	8.5	24	20.5
J60G		29.5 / 41.0	110	6	145	M8	17	169	-	36	8.5	25	20.5
M17G	19	30.0 / 41.5	70	9	90	M5	12	169	-	36.5	9	18.5	20
M18G		30.0 / 41.5	70	9	90	M5	12	169	-	36.5	9	18.5	20
M30G		29.5 / 41.0	80	6	100	M6	14	169	-	36	8.5	24	20.5
M50G		29.5 / 41.0	110	6	130	M8	17	169	-	36	8.5	24	20.5
M70G		29.5 / 41.0	130	8	165	M10	20	188	-	36	8.5	25	20.5
N30G	22	29.5 / 51.0	80	6	100	M6	14	169	-	46	8.5	24	20.5
N60G		29.5 / 51.0	110	6	145	M8	17	169	-	46	8.5	25	20.5
N70G		29.5 / 51.0	130	8	165	M10	20	188	-	46	8.5	25	20.5
Z30G	24	29.5 / 51.0	80	6	100	M6	14	169	-	46	8.5	24	20.5
Z35G		29.5 / 51.0	95	6	115	M8	17	169	-	46	8.5	24	20.5
Z50G		29.5 / 51.0	110	6	130	M8	17	169	-	46	8.5	24	20.5
Z70G		29.5 / 51.0	130	8	165	M10	20	188	-	46	8.5	25	20.5
Q50G	28	31.5 / 61.0	110	6	130	M8	17	169	-	56	8.5	24	20.5
Q70G		31.5 / 61.0	130	8	165	M10	20	188	-	56	8.5	25	20.5
Q76G		37.0 / 66.5	114.3	6	200	M12	23	223	176	61.5	14	33	26.5
S70G	32	31.5 / 61.0	130	8	165	M10	20	188	-	56	8.5	25	20.5
S88G		32.0 / 61.5	130	8	215	M12	23	237	186	56.5	9	30	21.5
T76G	35	37.0 / 86.5	114.3	6	200	M12	23	223	176	81.5	14	33	26.5
U80G	38	32.0 / 81.5	180	6.5	215	M12	23	237	168	76.5	9	30	21.5
W87G	48	75.0 / 112.5	230	6.5	265	M12	23	297	240	107.5	40	45	58.5
W90G		32.0 / 83.5	250	6.5	300	M16	31	337	260	78.5	11	33	22.5

Note Other motor mounting dimensions available on request.

9 T Series

F2C(F)-T



Special feature:

Gearboxes with high positioning and path accuracy, even under highly fluctuating dynamic conditions

- 7 sizes
- Integral spur gear prestage
- Low mass moments of inertia
- Reduction ratios (double-stage) 81/118.5/141/171
- Nominal output torques up to 6140 Nm
- Acceleration torques up to 11000 Nm
- Input speeds up to 8460 min^{-1}
- Lost motion < 0.5 arcmin
- Very smooth running
- High efficiency, even at low speeds
- Low vibration

9.1 Torques according to output speeds

Output speed n_{2m} [min^{-1}]			5			10			15			20			25		
Model	Size	Reduction ratio i	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]
F2C(F)-	**T155**	**81**	232	405	0.16	188	810	0.26	167	1215	0.35	153	1620	0.43	143	2025	0.5
		118.5	232	593	0.16	188	1185	0.26	167	1778	0.35	153	2370	0.43	143	2963	0.5
		141	232	705	0.16	188	1410	0.26	167	2115	0.35	153	2820	0.43	143	3525	0.5
	T255	**81**	573	405	0.4	465	810	0.65	412	1215	0.86	378	1620	1.05	353	2025	1.23
		118.5	573	593	0.4	465	1185	0.65	412	1778	0.86	378	2370	1.05	353	2963	1.23
		141	573	705	0.4	465	1410	0.65	412	2115	0.86	378	2820	1.05	353	3525	1.23
	T355	**81**	1091	405	0.76	886	810	1.24	785	1215	1.64	720	1620	20.1	673	2025	2.35
		118.5	1091	593	0.76	886	1185	1.24	785	1778	1.64	720	2370	20.1	673	2963	2.35
		141	1091	705	0.76	886	1410	1.24	785	2115	1.64	720	2820	20.1	673	3525	2.35
	T455	**81**	1770	405	1.24	1440	810	2.01	1280	1215	2.76	1170	1620	3.26	1090	2025	3.81
		118.5	1770	593	1.24	1440	1185	2.01	1280	1778	2.76	1170	2370	3.26	1090	2963	3.81
		141	1770	705	1.24	1440	1410	2.01	1280	2115	2.76	1170	2820	3.26	1090	3525	3.81
		171	1770	855	1.24	1440	1710	2.01	1280	2565	2.76	1170	3420	3.26	1090	4275	3.81
	T555	**81**	2730	405	1.9	2220	810	3.09	1960	1215	4.1	1800	1620	5.02	1680	2025	5.87
		118.5	2730	593	1.9	2220	1185	3.09	1960	1778	4.1	1800	2370	5.02	1680	2963	5.87
		141	2730	705	1.9	2220	1410	3.09	1960	2115	4.1	1800	2820	5.02	1680	3525	5.87
		171	2730	855	1.9	2220	1710	3.09	1960	2565	4.1	1800	3420	5.02	1680	4275	5.87
	T655	**81**	4360	405	3.04	3550	810	4.94	3140	1215	6.56	2880	1620	8.03	2690	2025	9.39
		118.5	4360	593	3.04	3550	1185	4.94	3140	1778	6.56	2880	2370	8.03	2690	2963	9.39
		141	4360	705	3.04	3550	1410	4.94	3140	2115	6.56	2880	2820	8.03	2690	3525	9.39
		171	4360	855	3.04	3550	1710	4.94	3140	2565	6.56	2880	3420	8.03	2690	4275	9.39
	T755	**81**	6140	405	4.28	4990	810	6.95	4410	1215	9.23	4050	1620	11.3	3790	2025	13.2
		118.5	6140	593	4.28	4990	1185	6.95	4410	1778	9.23	4050	2370	11.3	3790	2963	13.2
		141	6140	705	4.28	4990	1410	6.95	4410	2115	9.23	4050	2820	11.3	3790	3525	13.2
		171	6140	855	4.28	4990	1710	6.95	4410	2565	9.23	4050	3420	11.3	3790	4275	13.2

Table T1 **Rating values (reference value output speed n_{2m})**

Size	Max. acceleration and deceleration torque T_{2A}	Peak torque for Emergency Stop T_{2max}
	[Nm]	[Nm]
T155	417	834
T255	1030	2060
T355	1960	3920
T455	3190	6380
T555	4910	9820
T655	7850	15700
T755	11000	22000

Table T2 **Maximum acceleration and peak torque**

30			40			50			60			Max. permissible input speed $n_{1\,max}$ short term [min^{-1}]	Moment of inertia j related to the input shaft [×10^{-4} kgm^2]	Mass [kg]
Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Input speed [min^{-1}]	Max. permissible input power [kW]			
135	2430	0.57	124	3240	0.67	116	4050	0.81	110	4860	0.92	4860	0.138	
135	3555	0.57	124	4740	0.67	116	5925	0.81	110	7110	0.92	7110	0.103	4.8
135	4230	0.57	124	5640	0.67	116	7050	0.81	110	8460	0.92	8460	0.092	
335	2430	1.40	307	3240	1.71	287	4050	2.0				4050	0.373	
335	3555	1.40	307	4740	1.71	287	5925	2.0				5925	0.263	8.4
335	4230	1.40	307	5640	1.71	287	7050	2.0				7050	0.23	
637	2430	2.67	585	3240	3.26							3240	1.05	
637	3555	2.67	585	4740	3.26							4740	0.733	14
637	4230	2.67	585	5640	3.26							5640	0.638	
1040	2430	4.33										2430	2.55	
1040	3555	4.33										3555	1.92	24
1040	4230	4.33										4230	1.72	
1040	5130	4.33										5130	1.54	
1590	2430	6.66										2430	4.98	
1590	3555	6.66										3555	3.65	34
1590	4230	6.66										4230	3.23	
1590	5130	6.66										5130	2.88	
												2025	9.65	
												2963	7.13	48
												3525	6.35	
												4275	5.68	
												2025	16.7	
												2963	12.2	71
												3525	10.8	
												4275	9.6	

1. T_{2N} = nominal output torque
   Nominal output torque corresponds to the max. permissible average load torque at all output speeds.
   The nominal output torque for speeds less than 5 min^{-1} is equal to the value at 5 min^{-1}.
   The value for the maximum permissible input power is calculated from the nominal output torque at 100%.
   This value takes the efficiency of Fine Cyclo into consideration.
2. n_{1max} = maximum permissible input speed
   Gearbox can be used in the maximum input speed range specified in the table.
3. T_{2A} = max. Acceleration and braking torque (for fatigue strength at $2 \cdot 10^7$ load cycles)
   Permissible peak torque for normal start and stop procedures.
4. T_{2max} = max. permissible torque for Emergency Stop situations or in the event of heavy shocks (limited by the mechanical strength).
   (permissible 1000 x over the entire lifetime)
5. The rated torque T_{2N} is calculated using the following equation when the speed is not shown in the table above:

$$T_{2N} = T_{2N,\,15}\left(\frac{15}{n_{2m}}\right)^{0.3}$$

T_{2N} : Rated torque at output speed n_{2m}

$T_{2N,\,15}$: Rated torque at output speed n_{2m} is 15 min^{-1}

9.2 Torques according to input speeds

Input speed n_{1m} [min^{-1}]			5000			4000			3000			2500			2000		
Model	Size	Reduction ratio i	Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min^{-1}]	Max. permissible input power [kW]
F2C(F)-	T155	81				117	49	0.81	127	37	0.66	134	31	0.58	144	25	0.50
		118.5	122	42	0.72	131	34	0.62	143	25	0.50	151	21	0.44	161	17	0.38
		141	129	35	0.64	138	28	0.55	150	21	0.45	159	18	0.39	170	14	0.34
	T255	81				288	49	1.99	314	37	1.62	332	31	1.43	355	25	1.22
		118.5	302	42	1.78	323	34	1.52	352	25	1.24	372	21	1.10	398	17	0.94
		141	318	35	1.58	340	28	1.35	371	21	1.10	392	18	0.97	419	14	0.83
	T355	81							599	37	3.10	632	31	2.72	676	25	2.33
		119				615	34	2.90	671	25	2.37	709	21	2.09	758	17	1.79
		141	606	35	3.00	648	28	2.57	707	21	2.10	747	18	1.85	798	14	1.58
	T455	81										1031	31	4.44	1102	25	3.80
		118.5							1094	25	3.87	1156	21	3.40	1236	17	2.91
		141				1057	28	4.19	1153	21	3.42	1217	18	3.01	1302	14	2.58
		171	1048	29	4.28	1120	23	3.66	1221	18	2.99	1290	15	2.63	1379	12	2.25
	T555	81										1579	31	6.80	1688	25	5.82
		118.5							1675	25	5.92	1769	21	5.21	1892	17	4.46
		141				1619	28	6.41	1765	21	5.24	1864	18	4.61	1993	14	3.95
		171	1604	29	6.55	1715	23	5.60	1870	18	4.58	1975	15	4.03	2112	12	3.45
	T655	81													2704	25	9.32
		118.5							2684	25	9.49	2835	21	8.35	3031	17	7.14
		141							2827	21	8.40	2986	18	7.39	3193	14	6.32
		171				2748	23	8.98	2996	18	7.34	3164	15	6.46	3383	12	5.53
	T755	81													3798	25	13.09
		118.5							3769	25	13.32	3981	21	11.73	4257	17	10.03
		141							3971	21	11.80	4194	18	10.38	4485	14	8.88
		171				3860	23	12.61	4208	18	10.31	4444	15	9.07	4752	12	7.76

Table T3 **Rating values (reference value input speed n_{1m})**

Size	Max. acceleration and deceleration torque T_{2A}	Peak torque for Emergency Stop T_{2max}
	[Nm]	[Nm]
T155	417	834
T255	1030	2060
T355	1960	3920
T455	3190	6380
T555	4910	9820
T655	7850	15700
T755	11000	22000

Table T4 **Maximum acceleration and peak torque**

1750			1500			1000			750			600					
Nominal output torque [Nm]	Output speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min⁻¹]	Max. permissible input power [kW]	Nominal output torque [Nm]	Output speed [min⁻¹]	Max. permissible input power [kW]	Max. permissible input speed $n_{1\,max}$ short term [min⁻¹]	Moment of inertia j related to the input shaft [×10⁻⁴ kgm²]	Mass [kg]
150	22	0.45	157	19	0.41	177	12	0.31	193	9	0.25	206	7	0.21	4860	0.138	4.8
168	15	0.35	176	13	0.31	198	8	0.23	216	6	0.19	231	5	0.16	7110	0.103	
177	12	0.31	185	11	0.27	209	7	0.21	228	5	0.17	244	4	0.14	8460	0.092	
369	22	1.11	387	19	1.00	437	12	0.75	476	9	0.62	509	7	0.53	4050	0.373	8.4
414	15	0.85	434	13	0.77	490	8	0.58	534	6	0.47	571	5	0.40	5925	0.263	
436	12	0.76	457	11	0.68	516	7	0.51	562	5	0.42	601	4	0.36	7050	0.23	
704	22	2.12	737	19	1.91	832	12	1.43	907	9	1.17	970	7	1.00	3240	1.05	14
789	15	1.63	826	13	1.46	933	8	1.10	1017	6	0.90	1087	5	0.77	4740	0.733	
831	12	1.44	870	11	1.29	983	7	0.97	1071	5	0.80	1146	4	0.68	5640	0.638	
1147	22	3.46	1202	19	3.11	1357	12	2.34	1479	9	1.91	1582	7	1.64	2430	2.55	24
1286	15	2.65	1347	13	2.38	1521	8	1.79	1658	6	1.47	1773	5	1.25	3555	1.92	
1355	12	2.35	1419	11	2.11	1603	7	1.59	1747	5	1.30	1868	4	1.11	4230	1.72	
1436	10	2.05	1504	9	1.84	1698	6	1.39	1851	4	1.13	1979	4	0.97	5130	1.54	
1757	22	5.30	1840	19	4.76	2078	12	3.58	2265	9	2.93	2422	7	2.51	2430	4.98	34
1969	15	4.06	2062	13	3.65	2329	8	2.74	2539	6	2.24	2715	5	1.92	3555	3.65	
2075	12	3.60	2173	11	3.23	2454	7	2.43	2675	5	1.99	2860	4	1.70	4230	3.23	
2198	10	3.14	2302	9	2.82	2600	6	2.12	2834	4	1.74	3031	4	1.48	5130	2.88	
2814	22	8.49	2948	19	7.62	3329	12	5.74	3629	9	4.69	3880	7	4.01	2025	9.65	48
3155	15	6.51	3304	13	5.84	3731	8	4.40	4068	6	3.59	4349	5	3.07	2963	7.13	
3324	12	5.76	3481	11	5.17	3931	7	3.89	4286	5	3.18	4582	4	2.72	3525	6.35	
3522	10	5.03	3688	9	4.52	4165	6	3.40	4541	4	2.78	4855	4	2.38	4275	5.68	
3953	22	11.92	4140	19	10.70	4675	12	8.06	5097	9	6.59	5450	7	5.64	2025	16.7	71
4431	15	9.14	4640	13	8.20	5241	8	6.17	5713	6	5.05	6109	5	4.32	2963	12.2	
4668	12	8.09	4889	11	7.26	5521	7	5.47	6019	5	4.47	6436	4	3.82	3525	10.8	
4946	10	7.07	5180	9	6.34	5850	6	4.78	6377	4	3.91	6819	4	3.34	4275	9.6	

1. T_{2N} = nominal output torque
   Nominal output torque corresponds to the max. permissible average load torque at all input speeds.
   The nominal output torque for speeds n_2 less than 5 min^{-1} is equal to the value at 5 min^{-1}.
   The value for the maximum permissible input power is calculated from the nominal output torque at 100%.
   This value takes the efficiency of Fine Cyclo into consideration.
2. n_{1max} = maximum permissible input speed
   Gearbox can be used in the maximum input speed range specified in the table.
3. T_{2A} = max. Acceleration and braking torque (for fatigue strength at $2 \cdot 10^7$ load cycles)
   Permissible peak torque for normal start and stop procedures.
4. T_{2max} = max. permissible torque for Emergency Stop situations or in the event of heavy shocks (limited by the mechanical strength).
   (permissible 1000 x over the entire lifetime)
5. The rated torque T_{2N} is calculated using the following equation when the speed is not shown in the table above:

$$T_{2N} = T_{2N,15} \left(\frac{15}{n_{2m}}\right)^{0.3}$$

T_{2N} : Rated torque at output speed n_{2m}
$T_{2N,15}$: Nominal torque at output speed n_{2m} is 15 min^{-1}

9.3 Stiffness and Lost Motion

Size	i	Test torque T_p [Nm]	Lost Motion		Torsional stiffness 3% - 50% T_p [Nm/arcmin]	Torsional stiffness 3% - 100% T_p [Nm/arcmin]	Torsional stiffness 50% - 100% T_p [Nm/arcmin]
			Lost Motion [arcmin]	Domain of definition [Nm]			
T155	81 118.5 141	±167	< 0.75	±5	25	36	41
T255	81 118.5 141	±412	< 0.5	±12.4	72	103	118
T355	81 118.5 141	±785		±23.6	130	186	206
T455	81 118.5 141 171	±1280		±38.4	213	304	343
T555	81 118.5 141 171	±1960		±58.8	371	530	589
T655	81 118.5 141 171	±3140		±94.2	584	834	981
T755	81 118.5 141 171	±4410		±132	804	1148	1280

Table T5 Torsional stiffness

T_p: Test torque at input speed $n_1 = 1500\ \text{min}^{-1}$

Note arcmin means "angular minute".
Table values for stiffness are average values.

Calculation of the twist angle:

1) At a load torque less than 3% T_p

$$\varphi = \frac{\text{Lost Motion}}{2} \cdot \frac{\text{Load torque}}{0.03 \cdot T_p}$$

2) At a load torque greater than 3% T_p (standard case)

$$\varphi = \frac{\text{Lost Motion}}{2} + \frac{\text{Load torque} - (0.03 \cdot T_p)}{\text{Torsional stiffness}}$$

9.4 No-load running torque NLRT

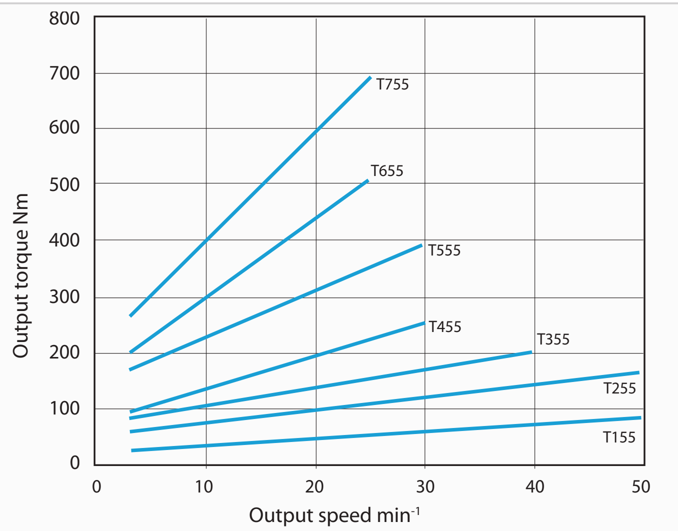


Fig. T1 Input side no-load running torque

Note
1. Fig. T1 shows the average no-load running torque after gearbox is run in (not factory-new condition).
2. Table T6 shows the measuring conditions

Ring gear housing temperature	approx. 30 °C
Precision during assembly	as per 9.8.1
Lubrication	Standard lubrication

Table T6 Measurement conditions

9.5 Breakaway torque

Indicates the necessary torque for breakaway of the gearbox on the input or output side, after stop without output side load.

Breakaway torque on output side (BTO)

Note 1. Table T8 shows the max. breakaway torque on the output side BTO. Fine Cyclo gearboxes are not self-locking. The BTO is defined as the maximum value (factory-new condition), which steadily decreases during the lifetime.
2. Table T7 shows the measuring conditions

Size	Breakaway torque BTO [Nm]
T155	< 40
T255	< 90
T355	< 150
T455	< 190
T555	< 270
T655	< 380
T755	< 500

Table T8 Value of the breakaway torque on the output side (BTO)

Precision during assembly	according to 9.8.1
Lubrication	Standard lubrication

Table T7 Measurement conditions

Breakaway torque on input side (BTI)

Note 1. Table T9 shows the max. breakaway torque BTI on the input side. BTI is defined as the maximum value (factory-new condition) which steadily decreases during the lifetime.
2. Table T7 shows the measuring conditions

Size	i	Breakaway torque BTI [Nm]
T155	81	< 0.5
	118.5	< 0.3
	141	< 0.3
T255	81	< 1.1
	118.5	< 0.7
	141	< 0.6
T355	81	< 1.8
	118.5	< 1.2
	141	< 1
T455	81	< 2.3
	118.5	< 1.6
	141	< 1.3
	171	< 1.1
T555	81	< 3.3
	118.5	< 2.2
	141	< 1.9
	171	< 1.5
T655	81	< 4.6
	118.5	< 3.1
	141	< 2.6
	171	< 2.2
T755	81	< 6
	118.5	< 4.1
	141	< 3.5
	171	< 2.9

Table T9 Value of the breakaway torque on the input side (BTI)

9.6 Efficiency

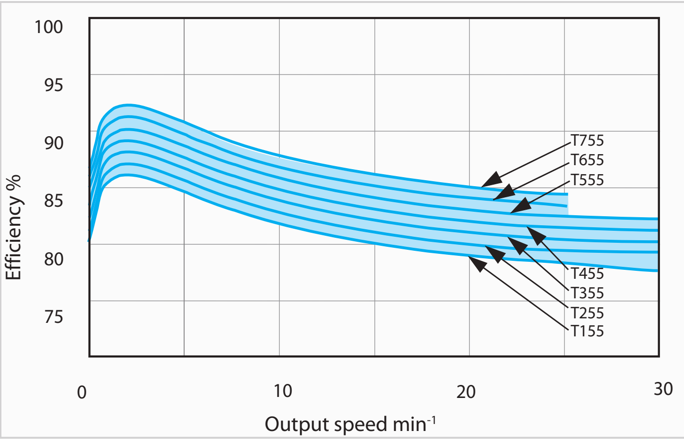


Fig. T2a Efficiency curve

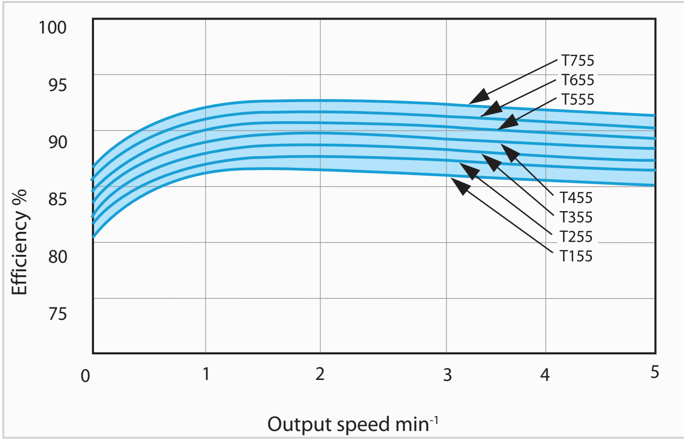


Fig. T2b Efficiency curve at low speeds

Fig. T2a and Fig. T2b show the efficiency of a run-in gearbox under nominal load at an ambient temperature of 20 °C. Further information may be obtained from "4 Explaining the technical details" on page 18.

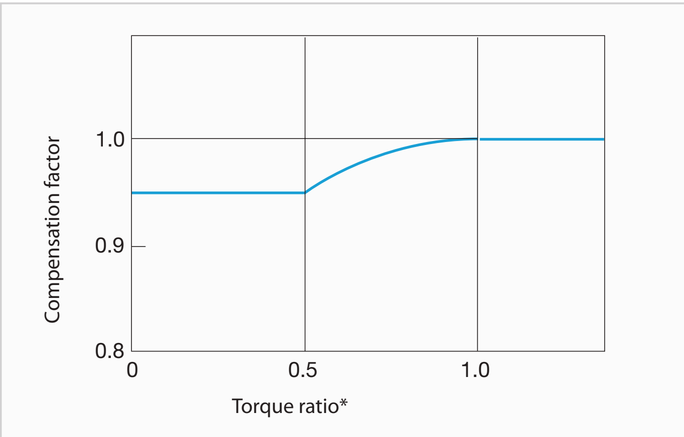


Fig. T3 Compensation curve for efficiency

Compensation efficiency =
efficiency · compensation factor

Note

1. The efficiency changes if the load torque does not match the nominal torque. Check the compensation factor in the diagram Fig. T3.
2. When the torque ratio is over 1.0, the compensation factor for efficiency is 1.0 (diagram Fig. T3).

$$\text{* Torque ratio} = \frac{\text{Load torque}}{\text{Nominal output torque}}$$

9.7 Main bearings

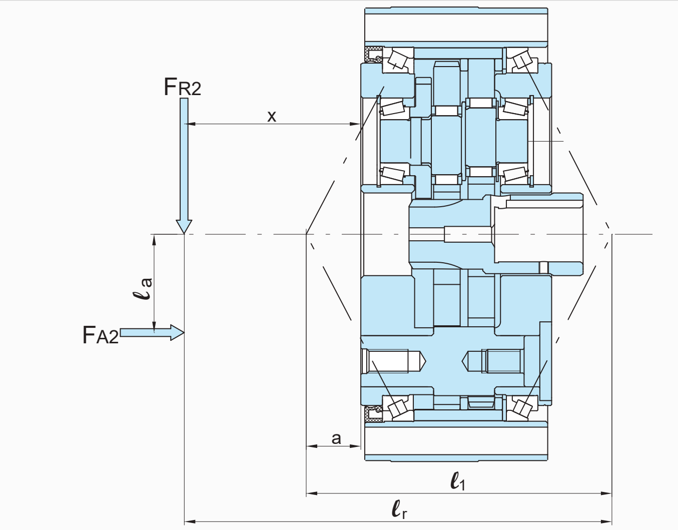


Fig. T4 Distance between the individual loading points

$\ell_r = x - a + \ell_1$ (Equation T-4)

1. Moment stiffness

   The moment stiffness is the bending moment at which the output flange is tilted by the tilt angle.

   The tilt angle of the input flange is determined as follows:

$$\varphi_1 = \frac{T_k}{\Theta_1}$$ (Equation T-5)

External bending moment T_k

$$T_k = 10^{-3} \cdot (F_{R2} \cdot \ell_r + F_{A2} \cdot \ell_a)$$ (Equation T-6)

2. Max. permissible bending moment and max. permissible axial load

   Check the external bending moment and the external axial load using equations T-6, T-7, T-8 and Table T14.

Equivalent bending moment T_{ke}

$$T_{ke} = 10^{-3} \cdot (C_{f2} \cdot B_{f2} \cdot F_{R2} \cdot \ell_r + C_{f2} \cdot B_{f2} \cdot F_{A2} \cdot \ell_a) < T_{k\,max}$$ (Equation T-7)

Equivalent axial load F_{A2e} at the output shaft

$$F_{A2e} = F_{A2} \cdot C_{f2} \cdot B_{f2} < F_{A2\,max}$$ (Equation T-8)

Size	Values of internal bearing distance	
	ℓ_1 [mm]	a [mm]
T155	80.9	5.2
T255	92.4	5.7
T355	120.0	12.0
T455	147.2	22.6
T555	169.8	28.9
T655	205.8	39.4
T755	227.8	43.9

Table T10 Bearing spacing dimensions [mm]

Note If: $\ell_r > 4 \cdot \ell_1$, please contact Sumitomo Drive Technologies.

Size	Moment stiffness Θ_1
	[Nm/arcmin]
T155	390
T255	835
T355	1370
T455	1860
T555	2940
T655	4420
T755	6380

Table T11 Average values for moment stiffness

F_{A2} = output side axial load [N]
$F_{A2\,max}$ = maximum permissible output side axial load [N]
F_{A2e} = equivalent output side axial load [N]
F_{R2} = output side radial load [N]
C_{f2} = correction factor output (Table T12)
B_{f2} = service factor output (Table T13)
ℓ_1 = bearing clearance [mm] (Table T10)
ℓ_r = calculated dimension for bending moment [mm]
ℓ_a = distance of axial load [mm]
x = distance from radial force to flange collar [mm]
a = correction factor [mm] (Table T10)
T_k = external bending moment [Nm]
$T_{k\,max}$ = maximum permissible bending moment [Nm] (Table T14)
T_{ke} = equivalent bending moment [Nm]
φ_1 = tilt angle [arcmin]
Θ_1 = moment stiffness main bearing [Nm/arcmin] (Table T11)

Correction factor output	C_{f2}
Chain	1
Gear or pinion	1.25
Timing belt	1.25
V-Belt	1.5

Table T12 Correction factor output C_{f2}

Service factor output	B_{f2}
Uniform load (no shock)	1
Light impacts	1.2
Severe impacts	1.6

Table T13 Service factor output B_{f2}

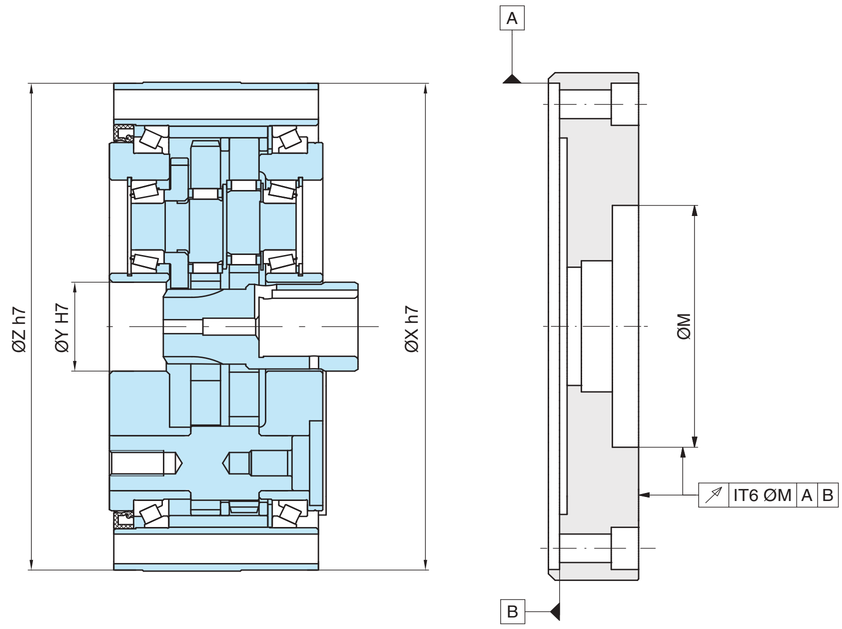
Size	Max. permissible bending moment $T_{k\,max}$	Max. permissible axial load $F_{A2\,max}$	
		Tension	Compression
	[Nm]	[N]	[N]
T155	883	3920	3920
T255	1180	3920	5400
T355	1820	5400	7850
T455	2750	6870	11800
T555	4170	8340	15700
T655	6380	10800	19600
T755	9570	13700	24500

Table T14 Max. permissible bending moment and max. permissible axial load

9.8 Assembly specifications and tolerances

9.8.1 Assembly tolerances

To ensure the function, lifetime, and characteristics of the gearbox, the radial run-out of the shaft ends, the coaxiality and the axial run-out of the fastening surface as per EN 50347:2001 are sufficient. When used in high-precision applications, the tolerance according to EN 50347:2001 should be reduced by 50%, which has additional advantages.



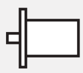
Size	Ø X	Ø Y	Ø Z	Ø M
T155	125	23.5	125	 Motor centering
T255	155	28	155	
T355	185	35	185	
T455	230	42	230	
T555	260	47	260	
T655	295	58	295	
T755	330	62	330	

Table T15 (Dimensions in mm)

Tightening torque and maximum permissible transmittable torque for bolts

The permissible transmitted torque for bolts and the number, size, and tightening torque for fastening the output side flange and the ring gear housing are listed in Table T16. In the event of an Emergency Stop with corresponding load peaks, the output flange and ring gear housing bolts must all be replaced. Liquid sealing material must be applied between all fittings of the gearbox with the customer's applications.

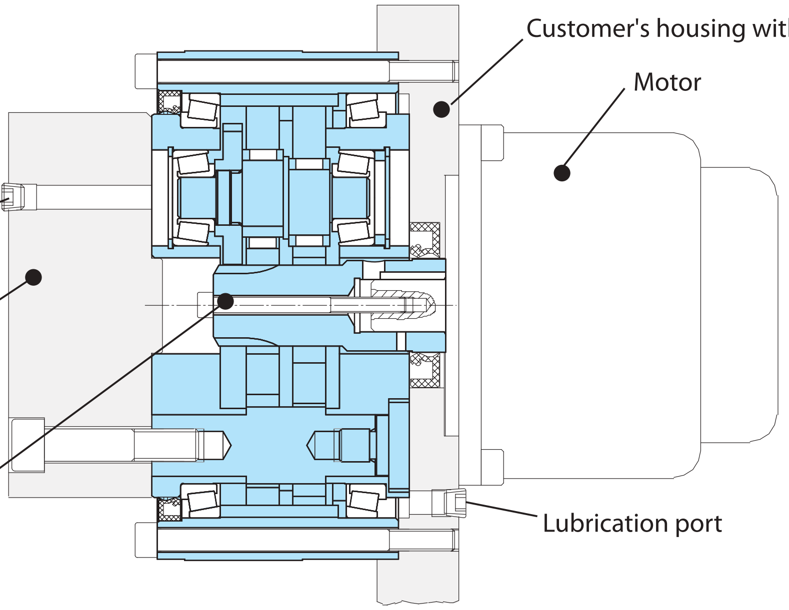
Size	Output flange bolts				Bolts for ring gear (housing)		
	Number and size of bolts	Pitch circle-ø	Tightening torque [Nm]	Max. permissible transmittable torque for bolts [Nm]	Number and size of bolts	Tightening torque [Nm]	Max. permissible transmittable torque for bolts [Nm]
T155	6 × M6 3 × M8 6 × M8	45 66 72	14 33 33	970	16 × M6	14	1250 (1480)*
T255	6 × M12 3 × M8 6 × M8	84 82 50	115 33 33	2160	12 × M8 (16 × M8)*	33	2150 (3500)*
T355	6 × M14 3 × M12 6 × M12	104 102 63	180 115 115	4500	16 × M8	33	3450 (4150)*
T455	6 × M16 3 × M12 6 × M12	135 129 63	280 115 115	7250	12 × M12 (16 × M10)*	115 (66)*	7350 (7650)*
T555	6 × M18 3 × M14 6 × M14	165 150 115	390 180 180	11200	16 × M12	115	11200 (14300)*
T655	6 × M22 3 × M16 6 × M16	180 170 115	750 280 280	18200	16 × M14 (16 × M12)*	180 (115)*	17300 (14300)*
T755	6 × M24 3 × M18 6 × M18	200 190 130	950 390 390	24000	16 × M16 (24 × M12)*	280 (115)*	27000 (24300)*

Table T16
* Values in brackets apply only for type F2C**F**-T

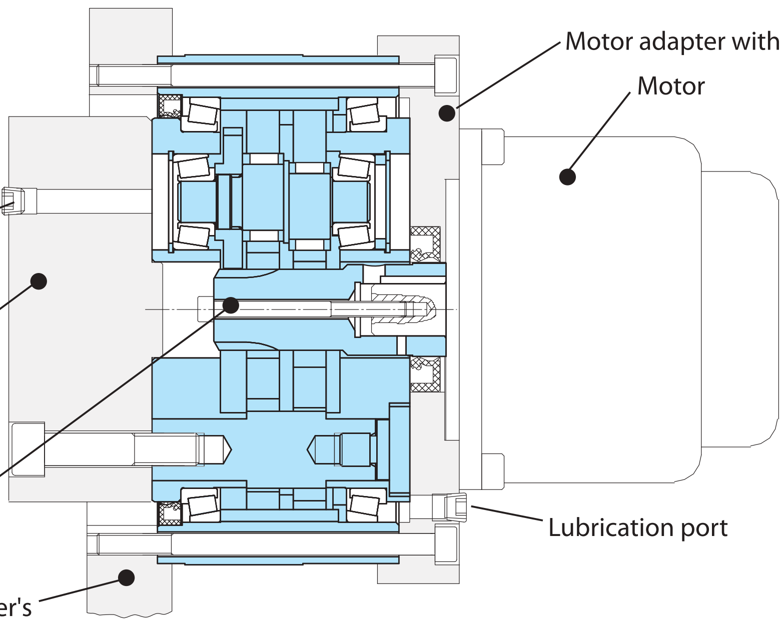
- **Bolting:** Use metric hexagon socket head cap screws (DIN 4762, strength category 10.9).
- **Countermeasure for bolts loosening:** Use adhesives (Loctite 262, etc.) or spring washer (DIN 127A).
- **Use spring washers** (DIN 6796) when connecting the gearbox to the flange side, so that the bolt contact faces do not get damaged.

9.8.2 Installation example

(1)



(2)



An adapter is required for the installation of the motor on the input side flange. This can be supplied. An oil seal is enclosed beside the gear and needs to be mounted by the customer. The input shaft of the gearbox is not mounted in the gearbox.

The customer's output shaft is bolted to the output flange of the gearbox.

In the case of standard installations with a hollow shaft and keyway, the input shaft of the gearbox must be screwed to the front threaded hole of the motor shaft. The motor shaft must have a key. The correct insertion depth of the gearing (shaft distance from output) must be observed as per the Fine Cyclo catalogue (see the dimension sheets).

9.8.3 Lubrication

- F2C(F)-T Fine Cyclo gearboxes are delivered without grease and must be filled with Multemp FZ No.00 grease as per Table T178 and sealed before being used for the first time (for the grease filling port, see Figure).
  These greases are suitable for ambient temperatures from -10 °C to +40 °C.
- Reconditioning is recommended after 20,000 operating hours, but at least every 3-5 years.

Specified grease	Manufacturer
Multemp FZ No. 00	Kyodo Yushi Co., Ltd.
Conditions for use: Ambient temperature -10 °C to +40 °C	

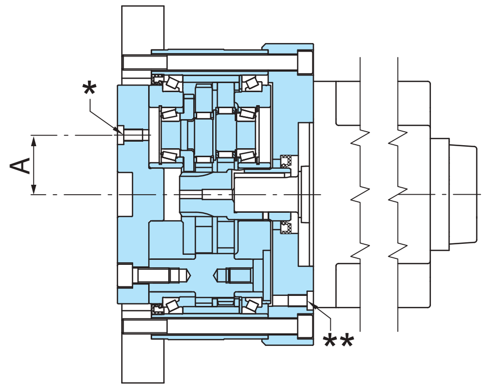
Table T17 Specified grease for the T Series

Size	Quantity of grease [g]		A [mm]
	Vertical	Horizontal	
T155	80	60	25
T255	120	100	31
T355	230	180	39
T455	300	240	47
T555	400	320	55
T655	700	560	63
T755	800	640	73

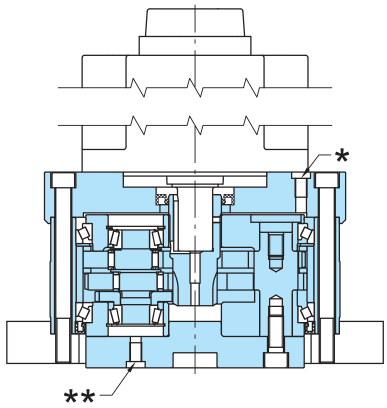
Table T18 Lubrication

The grease quantity above relates to the gearbox. The cavity between the gearbox and the motor (intermediate flange) must also be taken into account.

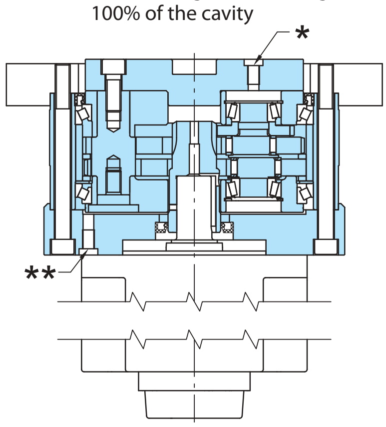
Mounting position
Horizontal
Additional amount of grease for flange:
50% of the cavity



Mounting position
Vertical 1
Downward output
additional amount of grease for flange:
0% of the cavity



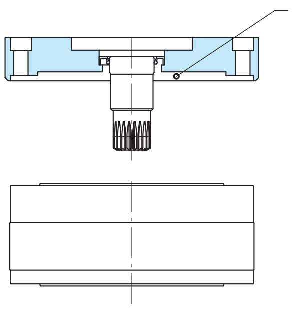
Mounting position
Vertical 2
Upward output
additional amount of grease for flange:
100% of the cavity



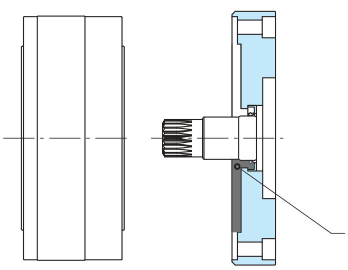
* Filling port for grease
** Grease drain port for grease change

Determination of the cavity

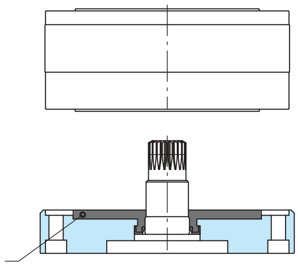
The additional amount of grease is necessary for the functioning of the gearbox



Additional cavity on the motor flange need not be taken into account. (However, the oil seal must be moistened with grease).



Additional motor flange cavity must be taken into account when grease filling (50% of the volume)

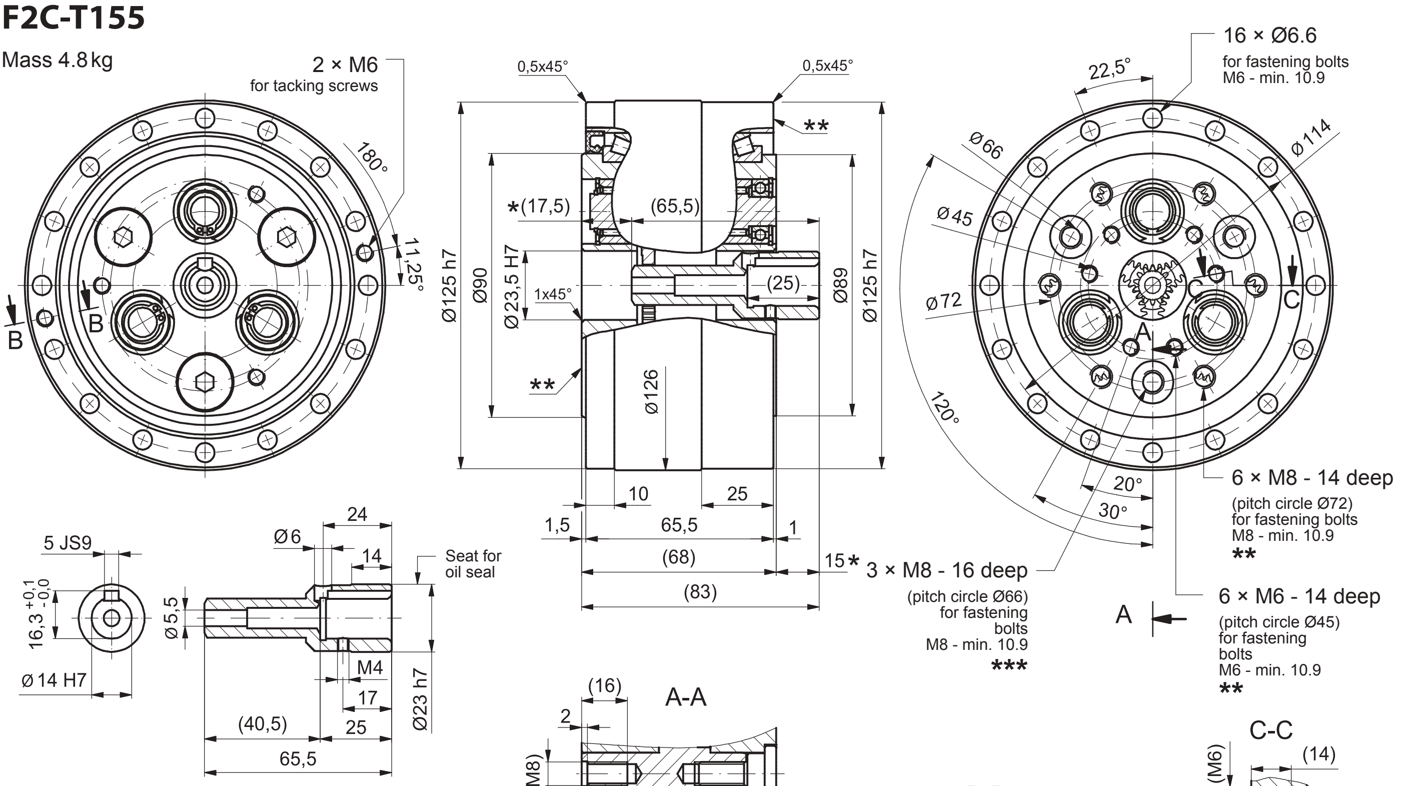


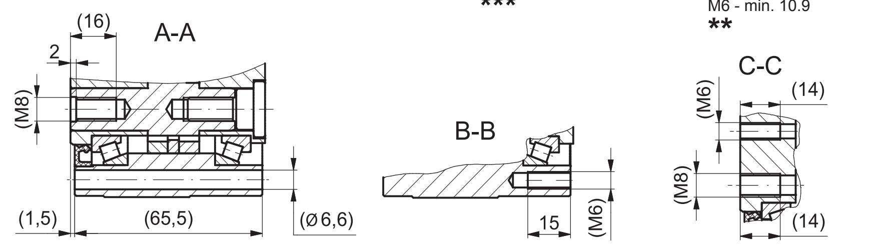
Additional motor flange cavity must be taken into account when filling with grease (100% of the volume)

9.9 Dimensioned drawings

F2C-T155

Mass 4.8 kg

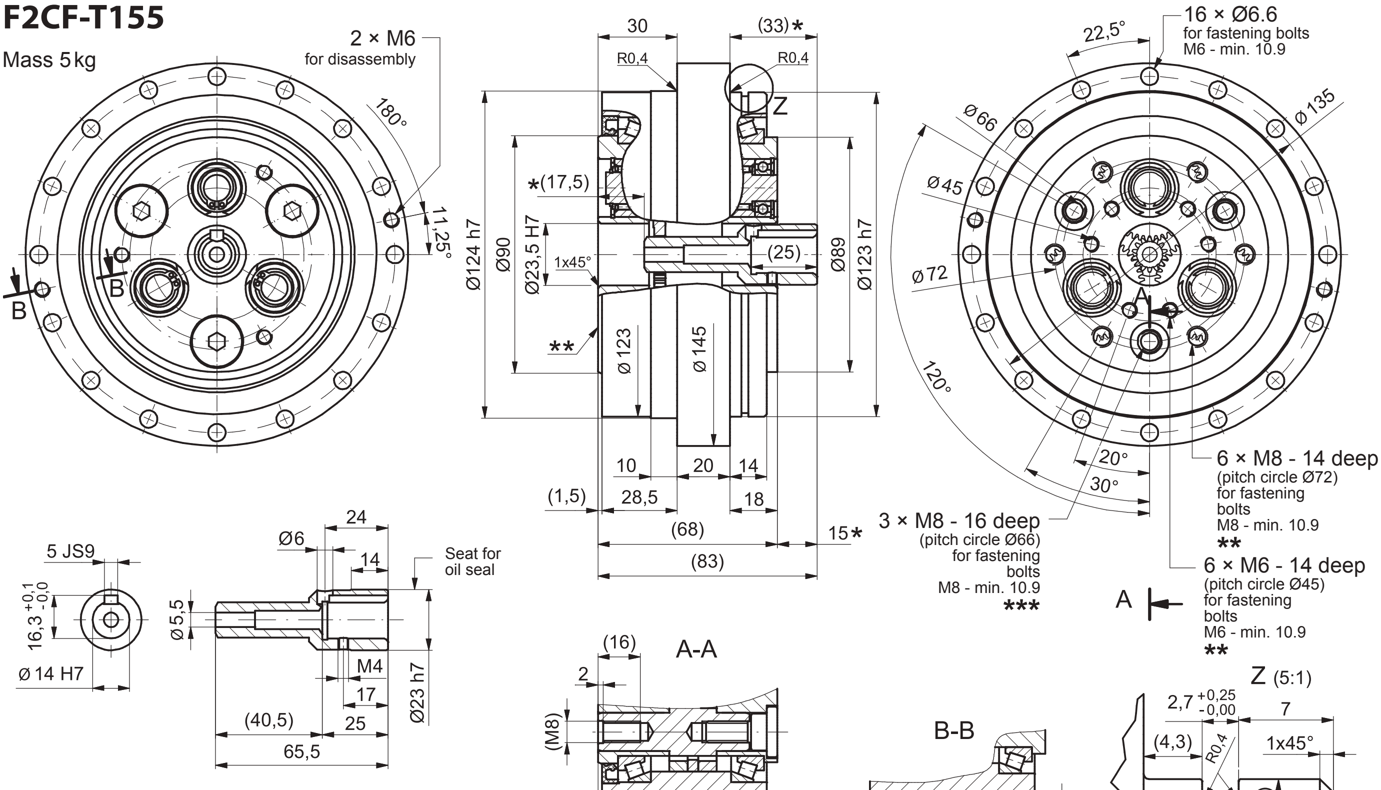


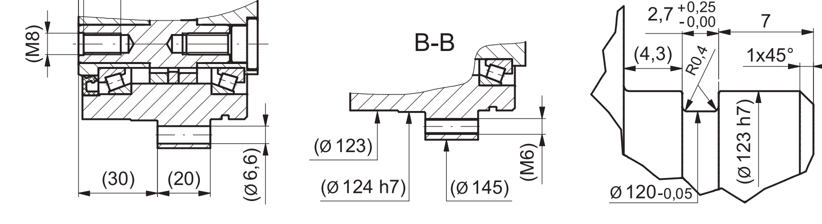


* Distance must be adhered to during installation.
** Seal with liquid gasket.
*** Bolts required for gearbox function.

F2CF-T155

Mass 5 kg

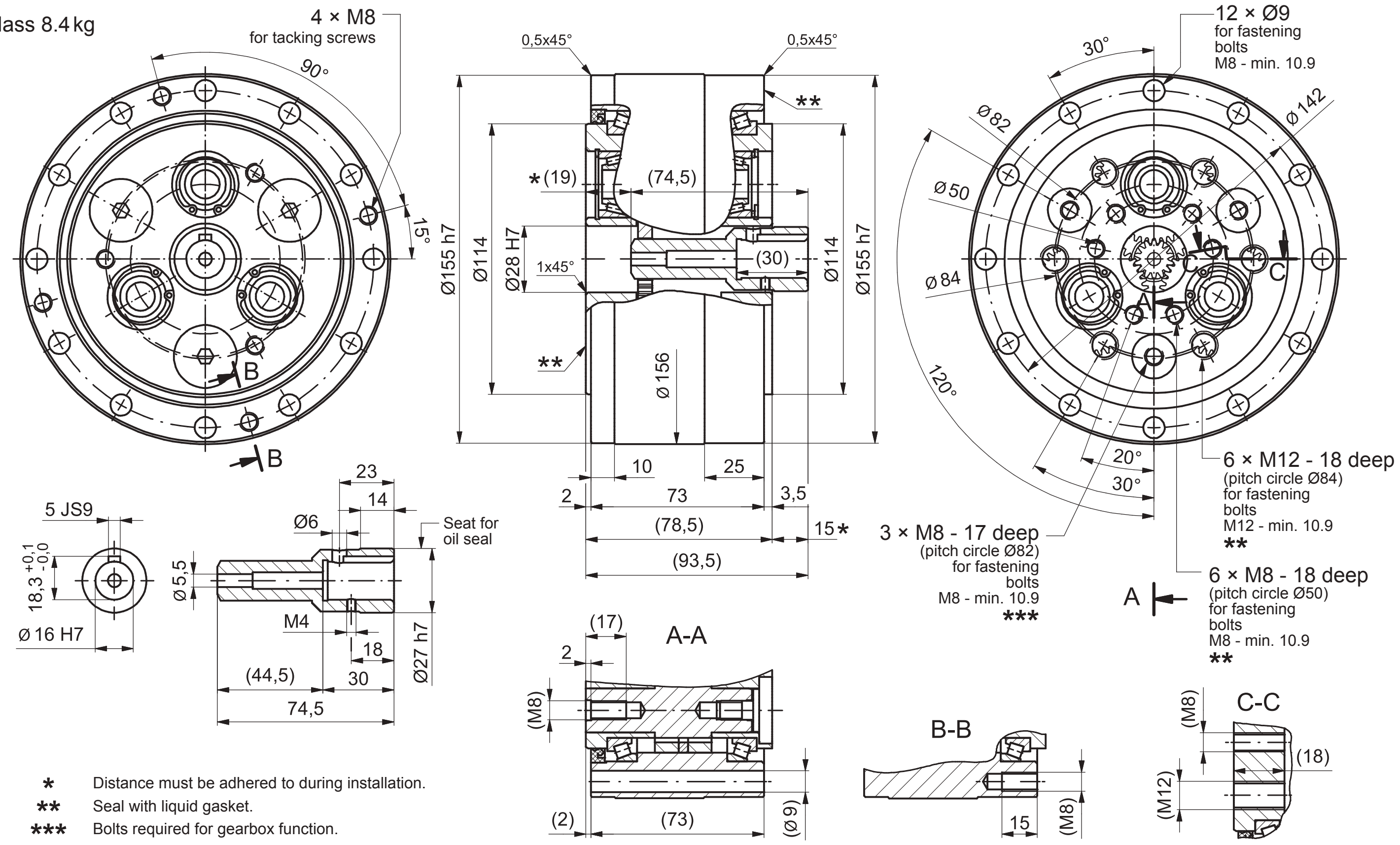




* Distance must be adhered to during installation.
** Seal with liquid gasket.
*** Bolts required for gearbox function.

F2C-T255

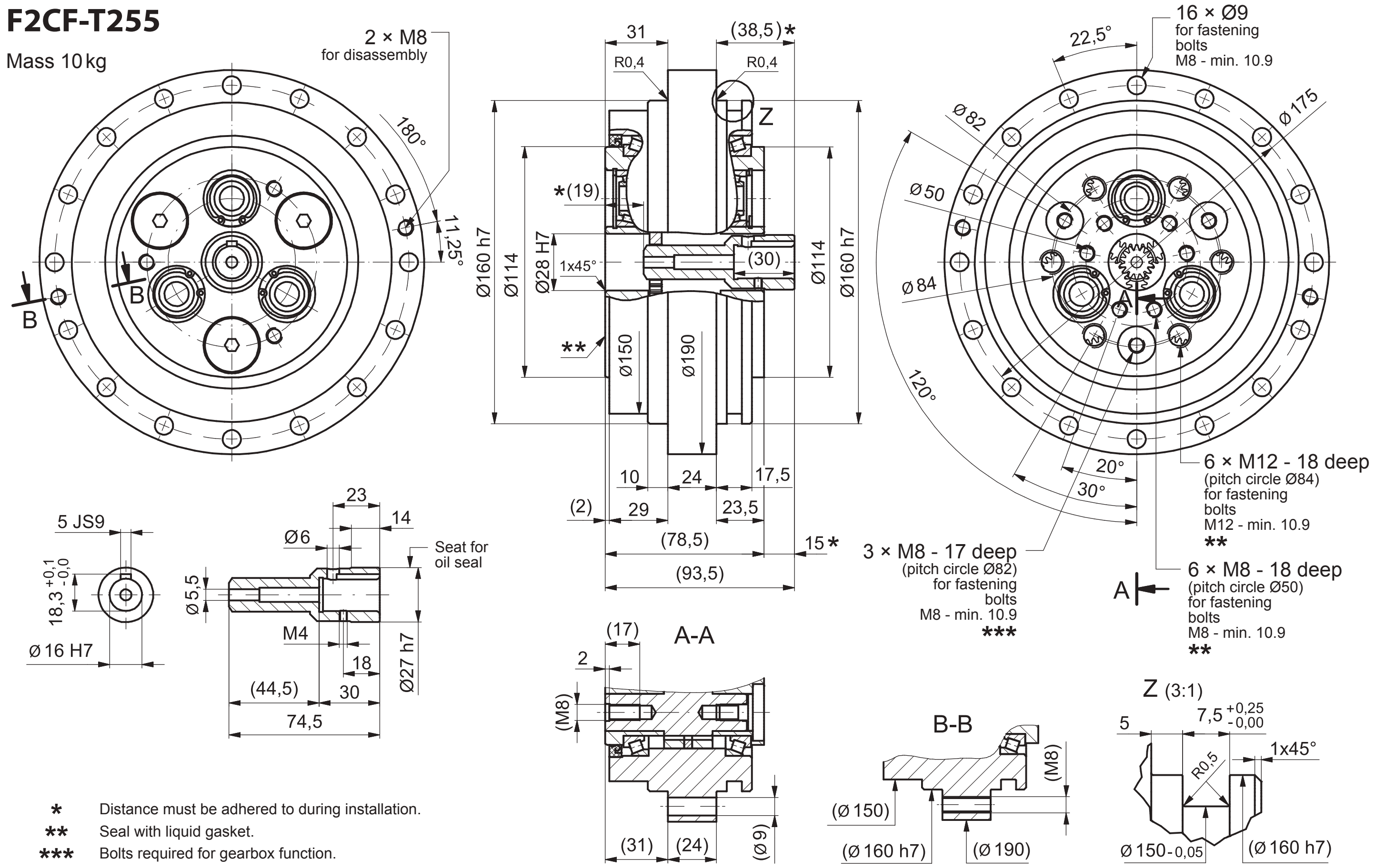
Mass 8.4 kg



* Distance must be adhered to during installation.
** Seal with liquid gasket.
*** Bolts required for gearbox function.

F2CF-T255

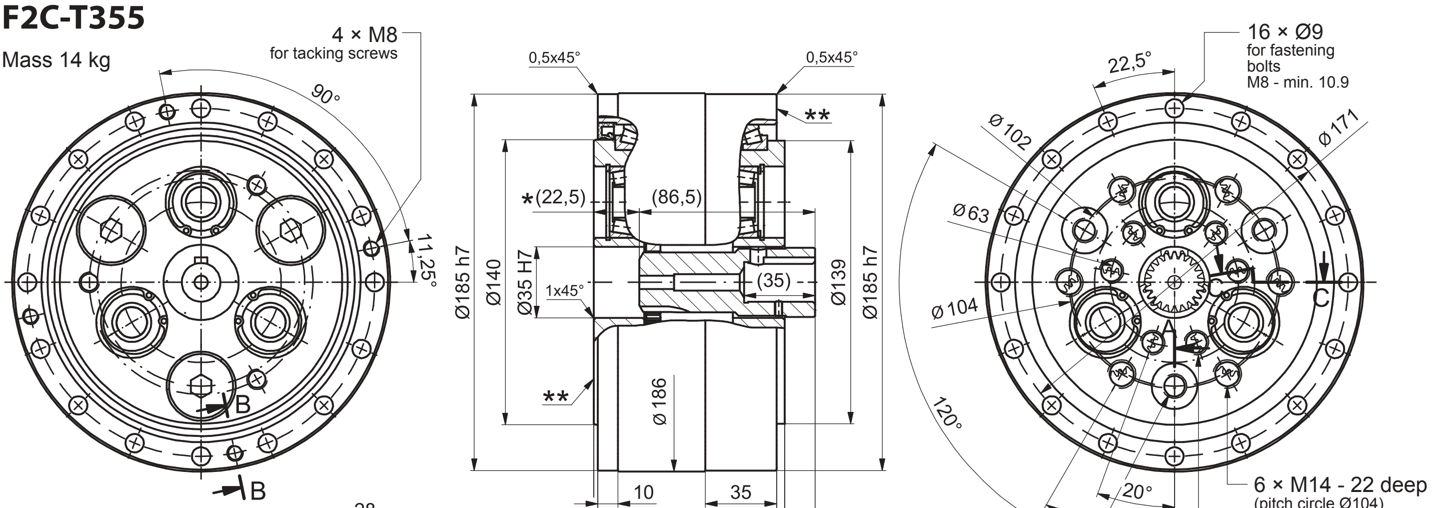
Mass 10 kg

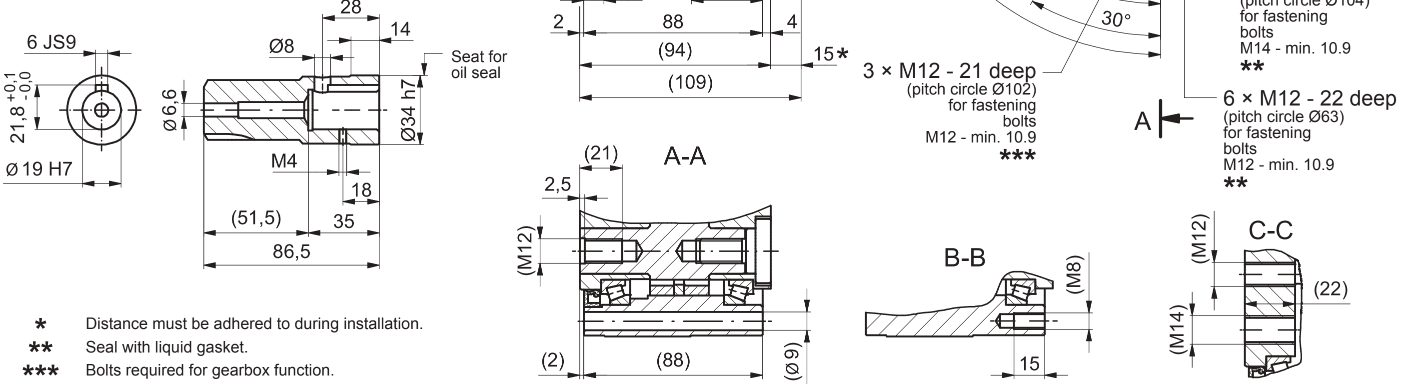


* Distance must be adhered to during installation.
** Seal with liquid gasket.
*** Bolts required for gearbox function.

F2C-T355

Mass 14 kg

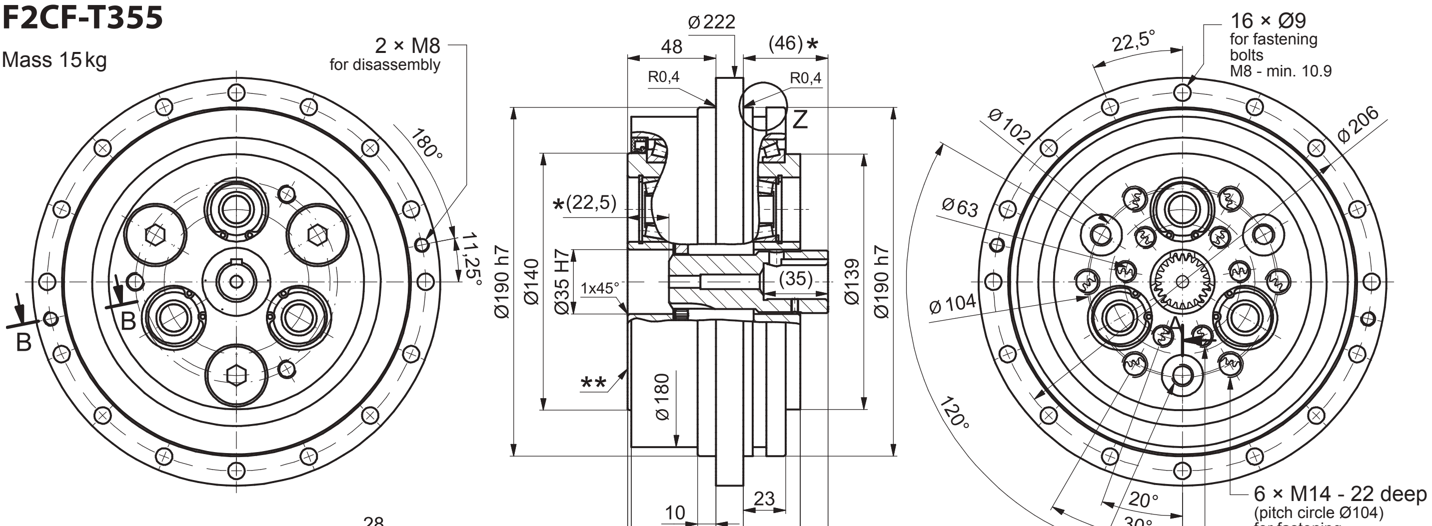


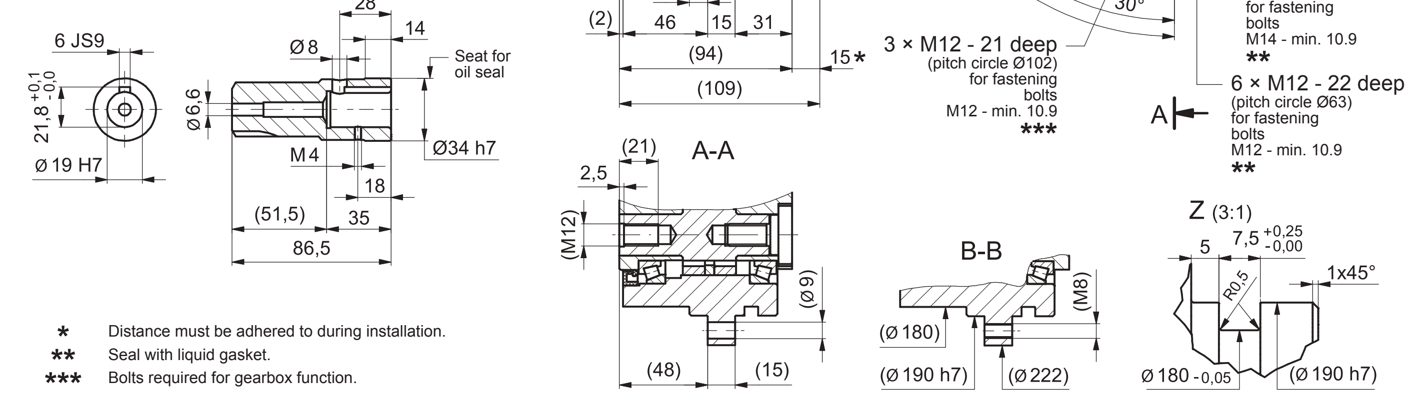


* Distance must be adhered to during installation.
** Seal with liquid gasket.
*** Bolts required for gearbox function.

F2CF-T355

Mass 15 kg

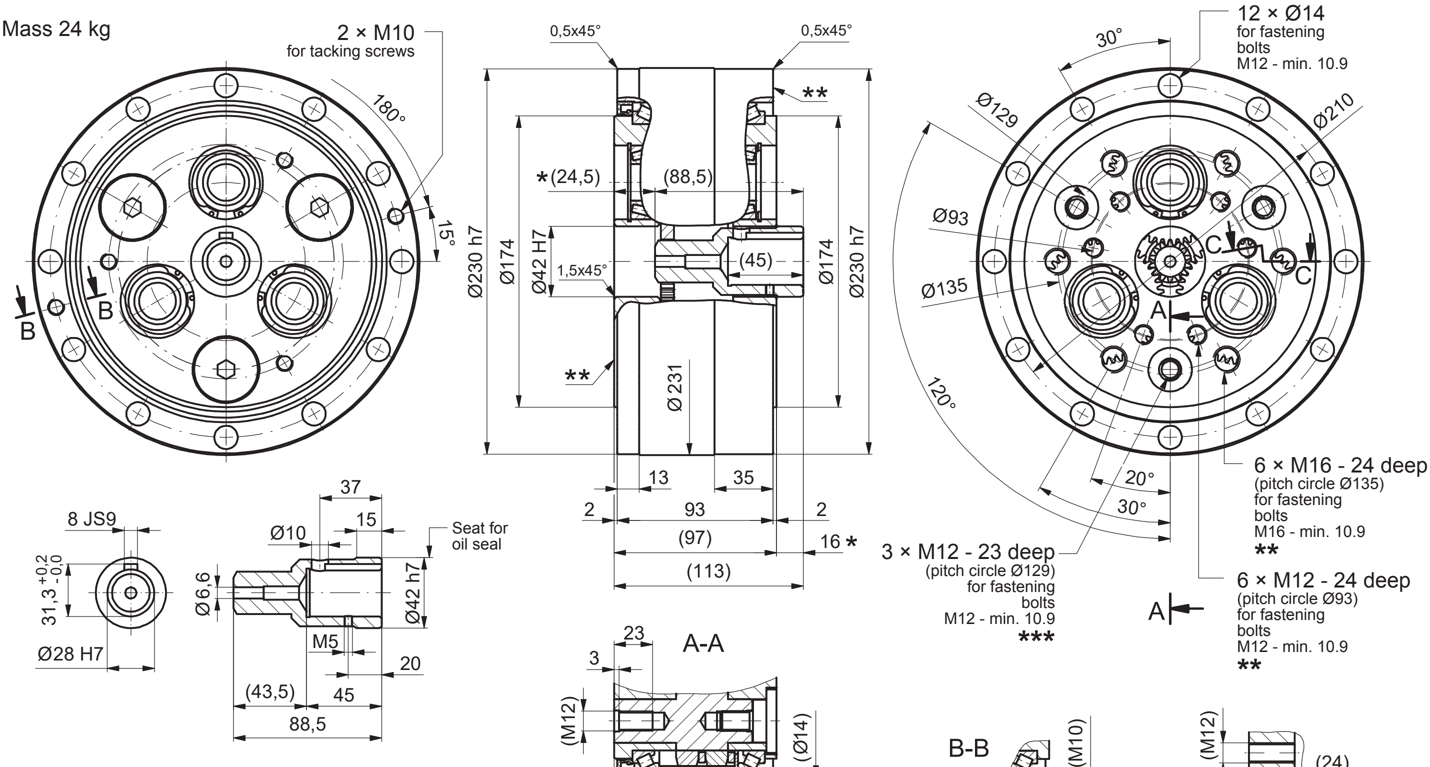


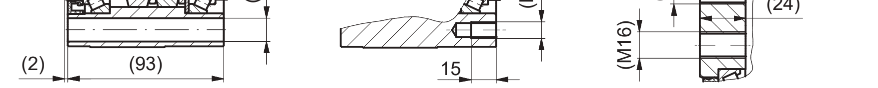


* Distance must be adhered to during installation.
** Seal with liquid gasket.
*** Bolts required for gearbox function.

F2C-T455

Mass 24 kg

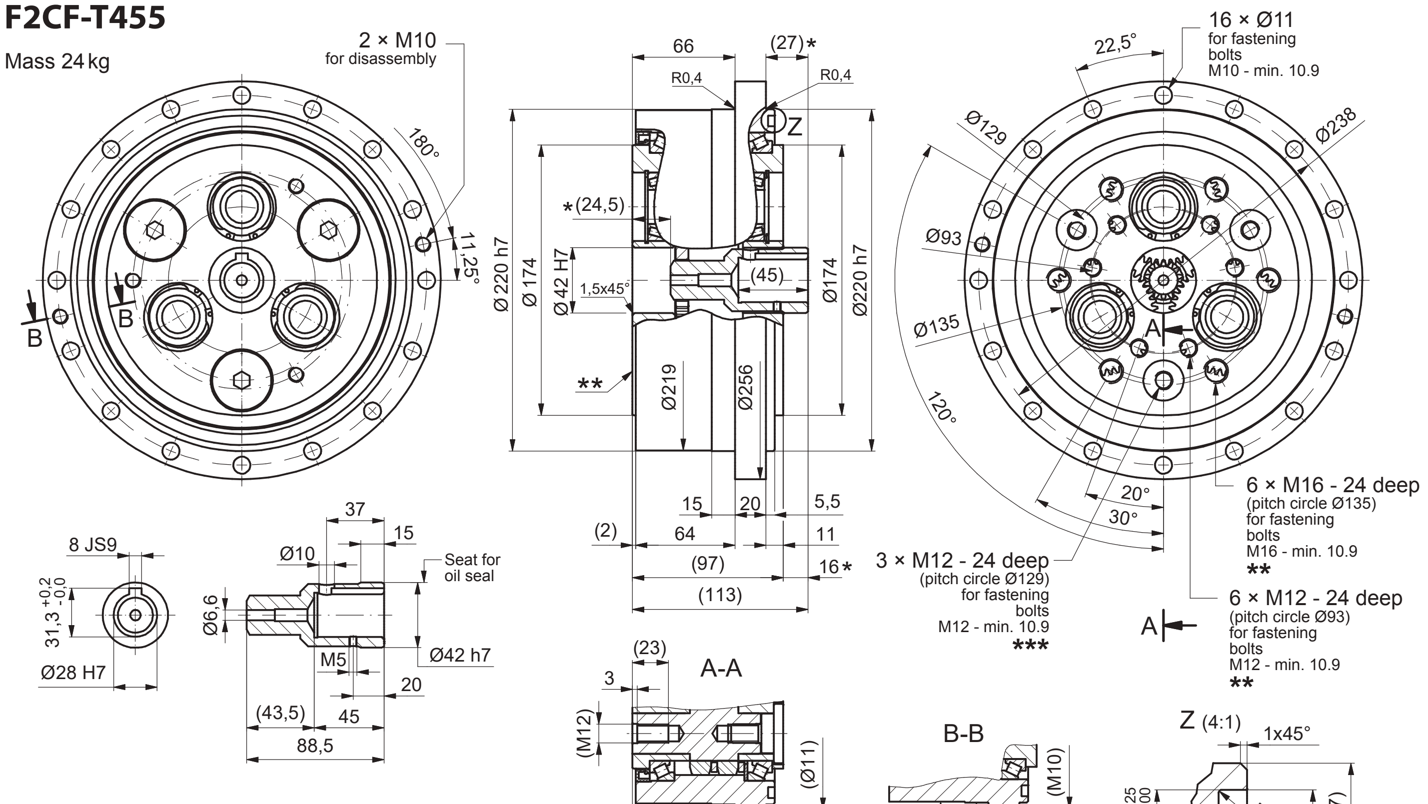


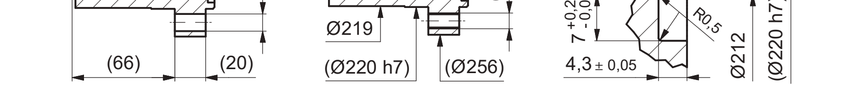


* Distance must be adhered to during installation.
** Seal with liquid gasket.
*** Bolts required for gearbox function.

F2CF-T455

Mass 24 kg

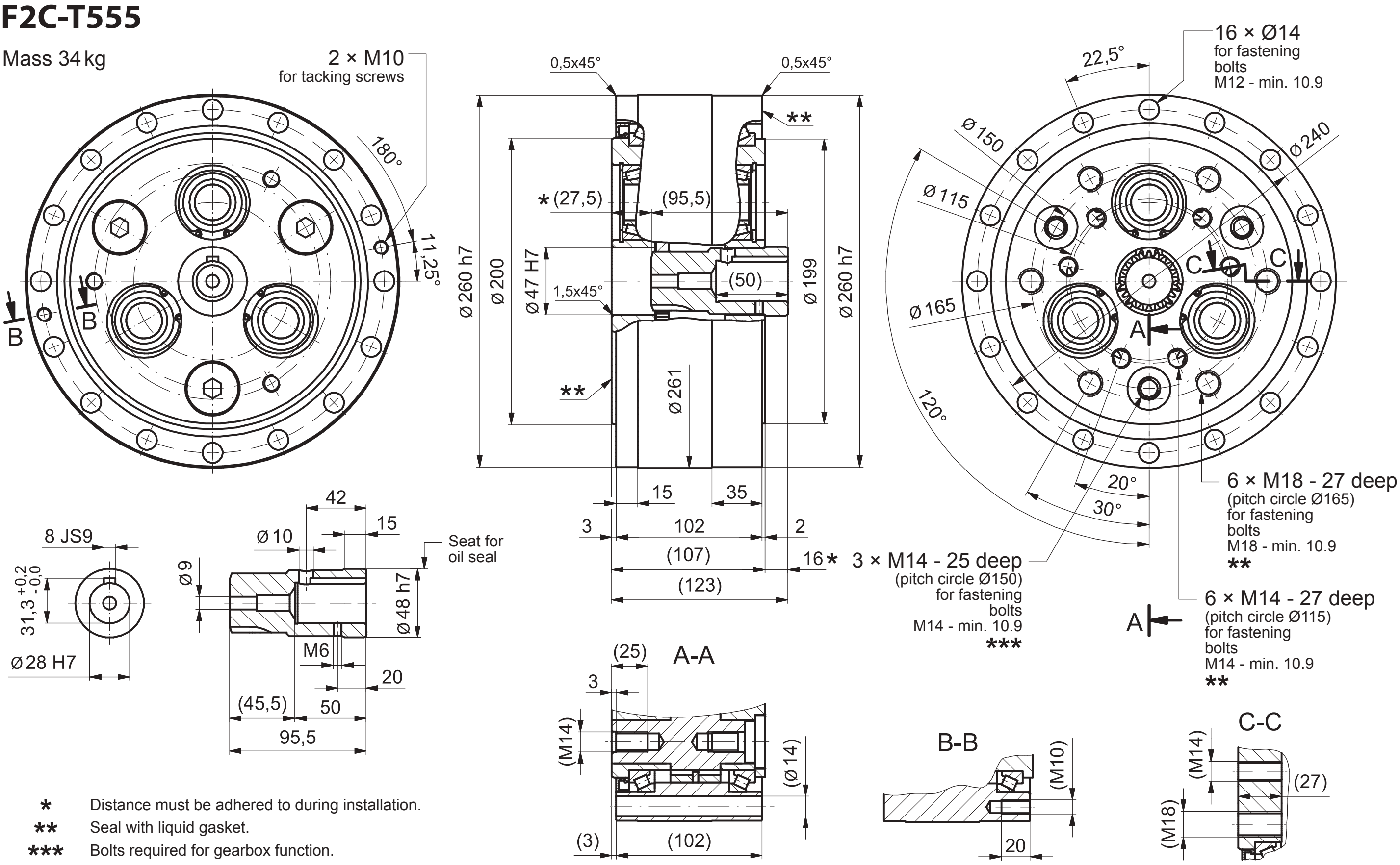




* Distance must be adhered to during installation.
** Seal with liquid gasket.
*** Bolts required for gearbox function.

F2C-T555

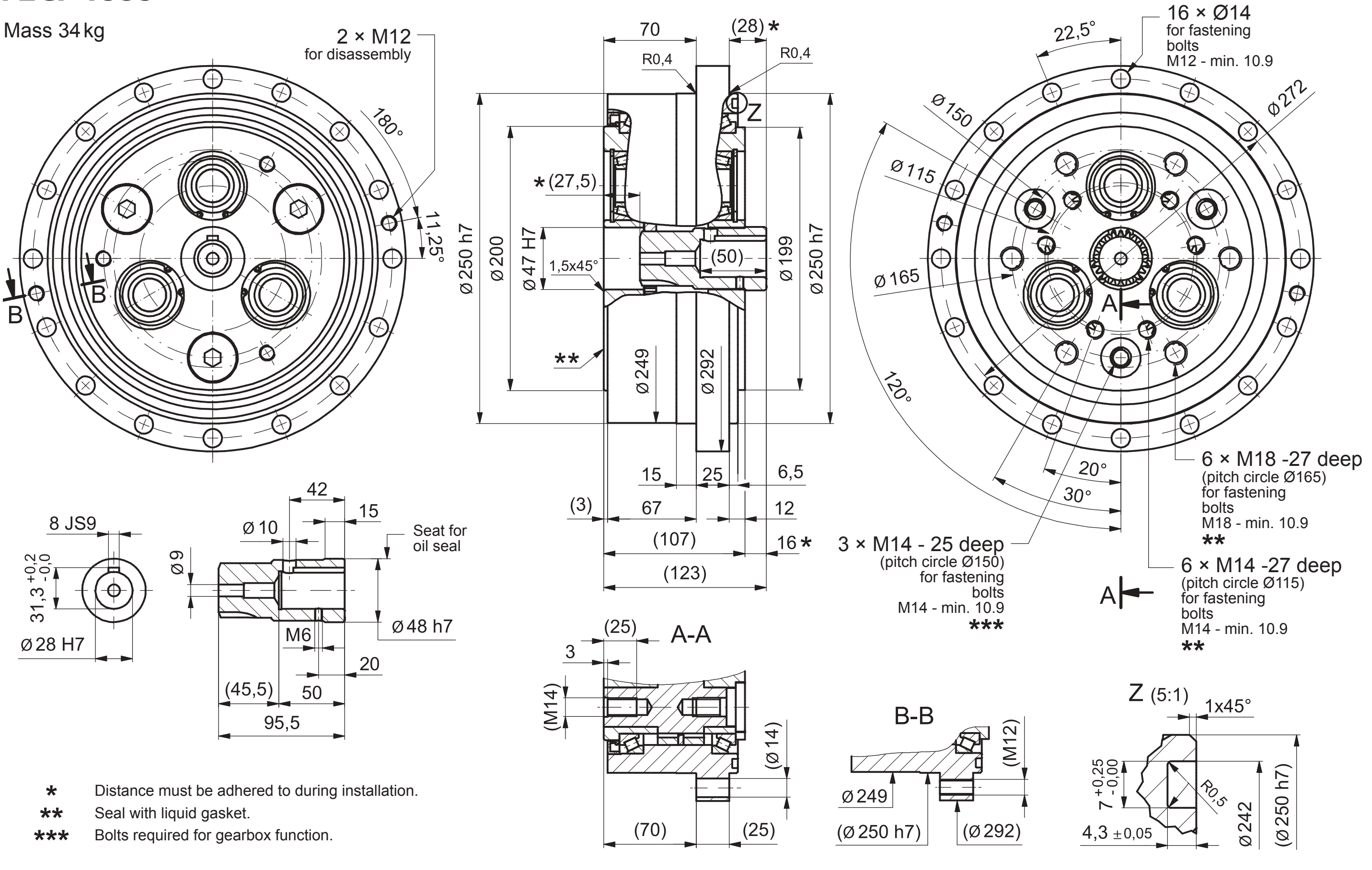
Mass 34 kg



* Distance must be adhered to during installation.
** Seal with liquid gasket.
*** Bolts required for gearbox function.

F2CF-T555

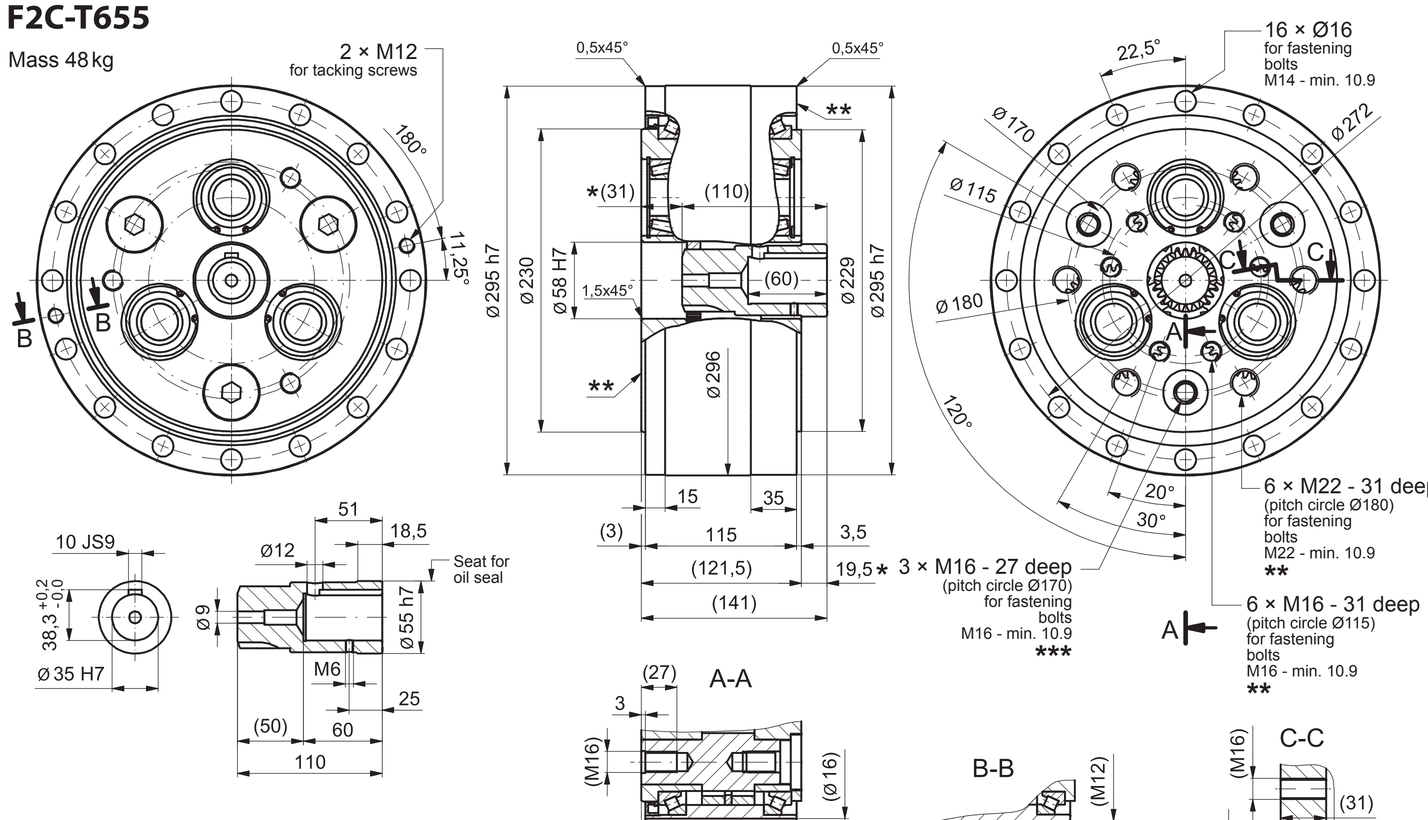
Mass 34 kg



* Distance must be adhered to during installation.
** Seal with liquid gasket.
*** Bolts required for gearbox function.

F2C-T655

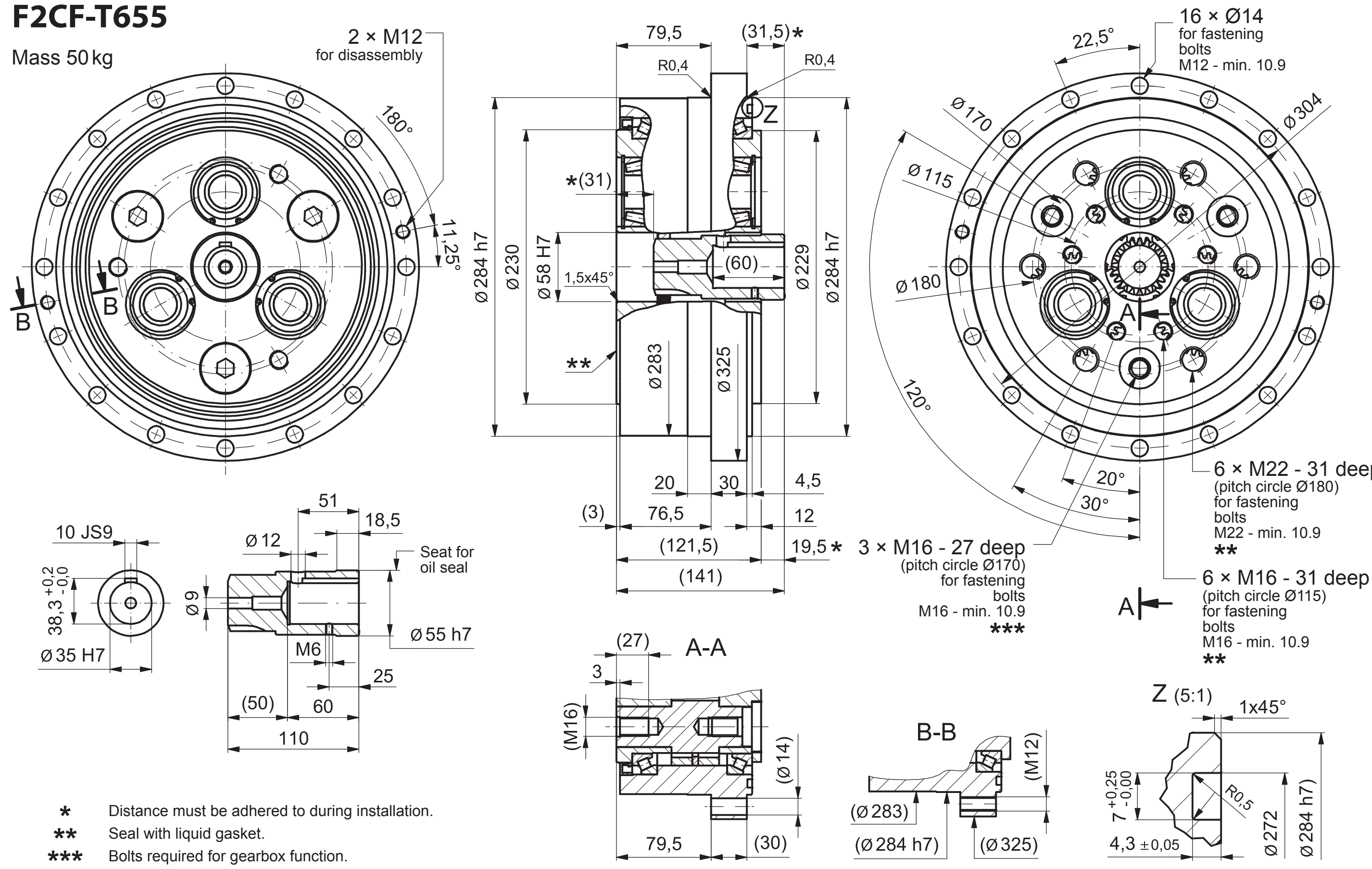
Mass 48 kg



* Distance must be adhered to during installation.
** Seal with liquid gasket.
*** Bolts required for gearbox function.

F2CF-T655

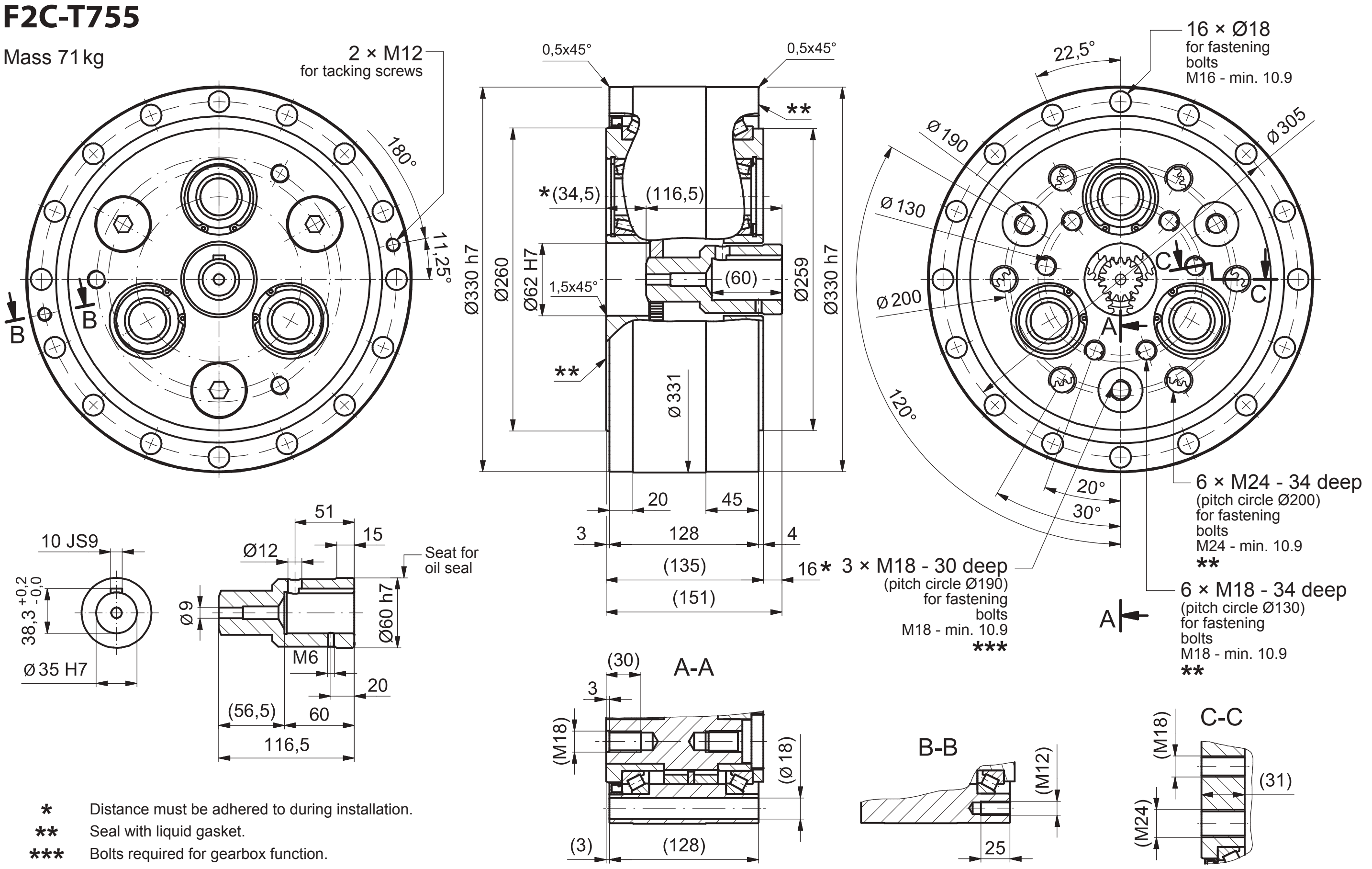
Mass 50 kg



* Distance must be adhered to during installation.
** Seal with liquid gasket.
*** Bolts required for gearbox function.

F2C-T755

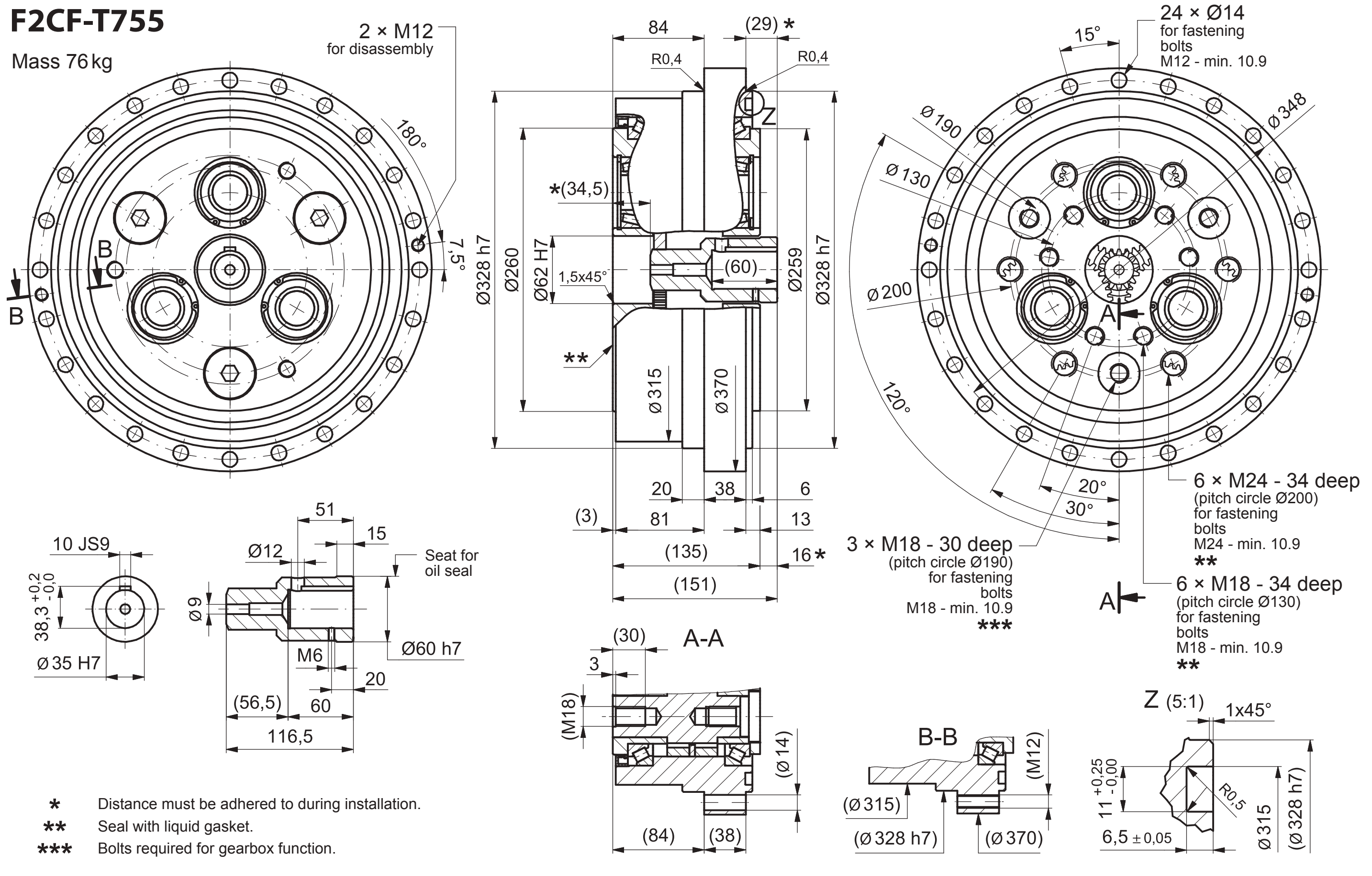
Mass 71 kg



* Distance must be adhered to during installation.
** Seal with liquid gasket.
*** Bolts required for gearbox function.

F2CF-T755

Mass 76 kg



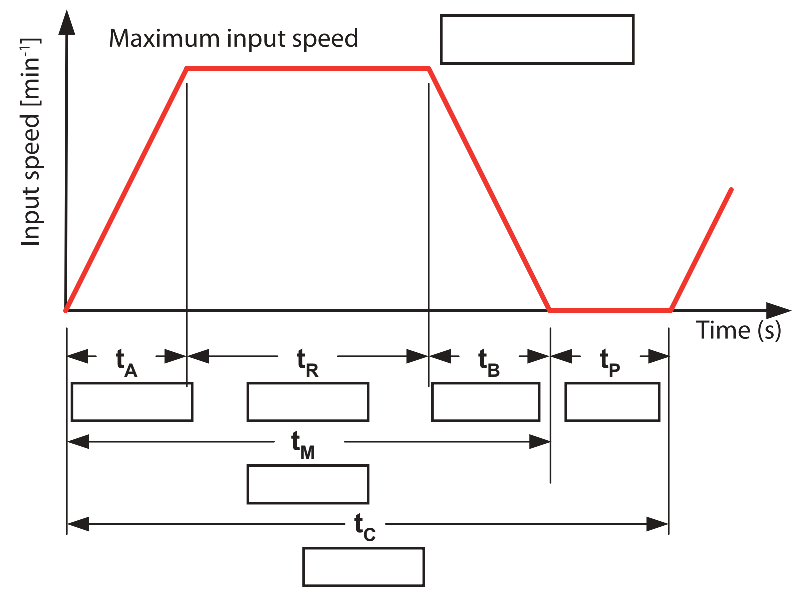
* Distance must be adhered to during installation.
** Seal with liquid gasket.
*** Bolts required for gearbox function.

10 Appendix

Precision gearbox - application data sheet

Specific application data is required for the selection of a suitable precision gearbox.
Please complete the following data sheet to enable us to respond quickly. Thank you.

1. Load cycle:



t_A = starting time

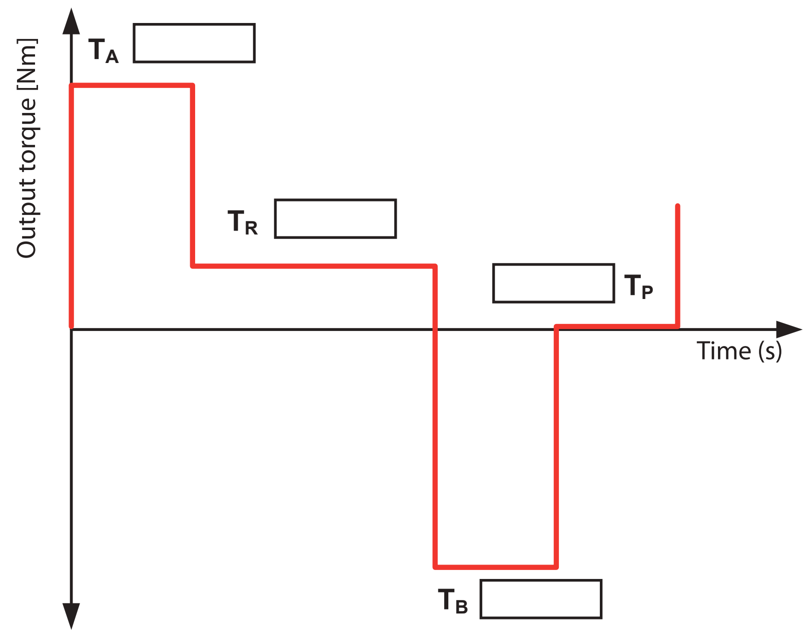
t_R = duration of uniform movement

t_B = braking time (delay time)

t_P = pause time (time between movements)

t_M = duration of the movement phase of a working cycle ($t_A + t_R + t_B$)

t_C = duration of the entire working cycle ($t_M + t_P$)



T_A = torque when starting (acceleration torque)

T_R = torque at constant speed

T_B = brake torque (delay torque)

T_P = pause torque (to hold the position between the movements if necessary)

Precision gearbox - application data sheet

2. What is the required reduction ratio? __________: 1

3. Please specify the following input power data (motor):

1. Nominal speed: __________________ [min^{-1}]

2. Continuous static torque: __________________ [Nm]

3. Peak torque: __________________ [Nm]

4. Manufacturer: ____

5. Model number: ____________________________________

4. Is a hollow shaft required?

☐ yes If applicable, what size? ______________
☐ no

5. Should Sumitomo provide an input adapter?

☐ yes
☐ no

If you have selected "Yes", please specify the dimensions of the input or submit a copy of the dimensioned drawing.

Is it a motor shaft with or without a key?
☐ With key
☐ Without key

6. How is the gearbox connected to the motor?

☐ Direct coupling
☐ Timing belt or chain drive (continue with No. 6a)
☐ V-belt (continue with No. 6a)
☐ Spur gear (continue with No. 6a)
☐ Other (continue with No. 6a)

6a. Definition of prestage

Inertia		kg·m^2
Ratio		

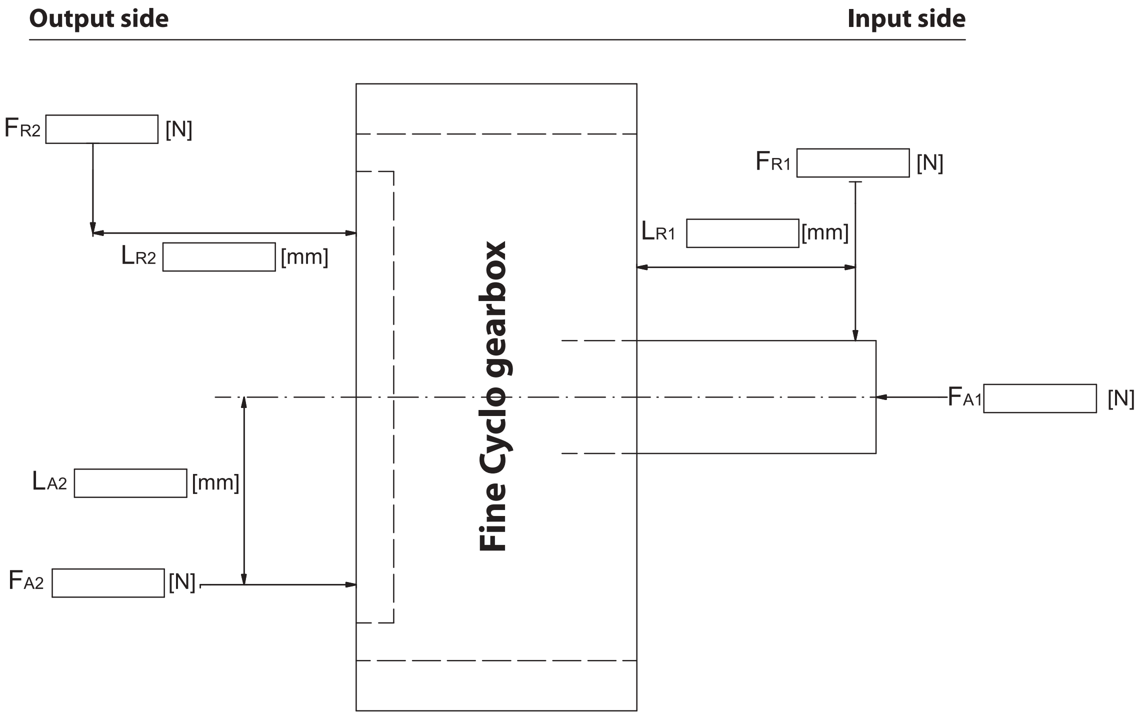
7. How is the gearbox connected to the final load?

☐ Direct coupling
☐ Toothed belt or chain drive
☐ Spur gear
☐ Other

8. Please select one of the following load properties:

☐ Uniform load
☐ Moderate impact load
☐ Heavy impact load

9. Radial and axial load



F_R = radial load
L_R = distance from radial force to flange collar
F_A = axial load
L_A = distance of the axial load from the centre line
1: Input side
2: Output side

10. Please describe your application in as much detail as possible (if possible, please enclose drawing).

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