dertec®

Designed to Perform

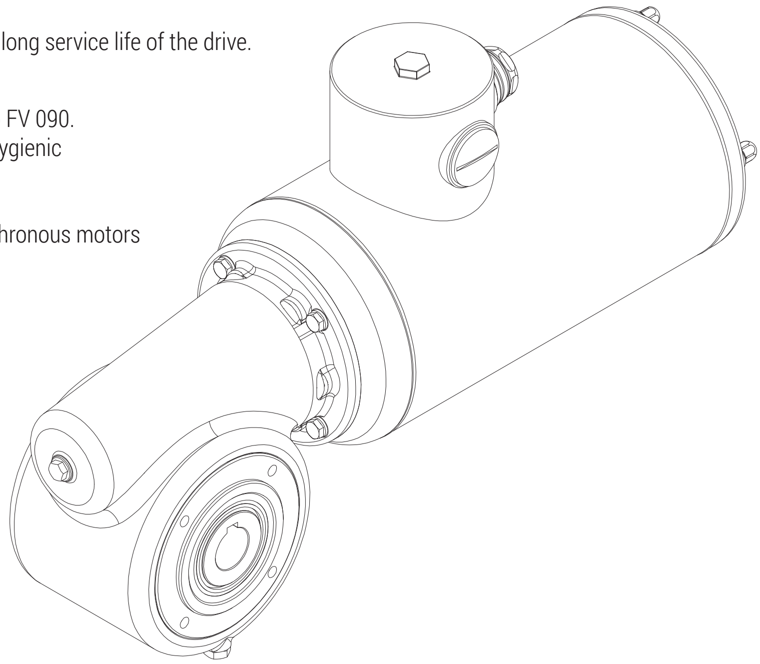
Stainless Steel **Worm Gearbox.**

FV

FV Worm gearbox

Dertec FV worm gearboxes have been developed with the aim of hygiene and cleanability.
The design aims to minimize build-up of dirt and the round shape contributes to less accumulation.
Adhesion of contaminants is minimized and therefore simplifies cleaning.
The use of electro polished stainless steel AISI 316 also contributes to the reduced use of strong chemical cleaning agents, which benefits the surface water quality.
Duplex stainless steel hollow shafts with PNS hardening contribute to a long service life of the drive.
The seals and lubrication used are suitable for use in the food industry.

Dertec FV series wormgears consists of 6 different sizes from FV 030 to FV 090.
Assembly with Dertec FP2SS stainless steel AC motors or with FP3SS hygienic stainless steel AC motors enable a completely hygienic drive.
For applications where speed and position control are important
Dertec offers signature line asynchronous motors or signature line synchronous motors with hygienic build in encoders.



Main Features

Made of high quality carefully electro polished stainless steel AISI 316 (mirror polished on request).
The smooth design gives the gearbox a nice appearance, ready to suit all kinds of stainless steel machinery for the food industry.

Hardened shaft
All hollow shafts are produced in duplex stainless steel AISI 2205. The special PNS surface treatment ensures enough hardness to collaborate with our special high temperature resistant blue shaft seals.
The PNS treatment increases the lifetime of shaft / seal cooperation and helps to reduce wear on the shaft surface.
By this, the gearbox obtains a longer drip free operation compared to standard shaft / seal combinations made of AISI 304 with NBR or FKM. The use of above combination offers all the positive characteristics of stainless steel and the surface hardness of a hardened shaft.

Blue shaft seals
Our high performance engineered shaft seals have a blue colour. It is a well overthought feature for food industry applications. It might be clear that the colour "blue" is a not existing organic colour.
In the context of food safety it is a common use to embed blue colours as these are very visible and easily to be recognised by vision scanning systems.

Foodgrade lubrication
All gearboxes are standard equipped with NSH H1 certified synthetic foodgrade lubrication.
On request it can be supplied with a halal, kosher or nut free certification.

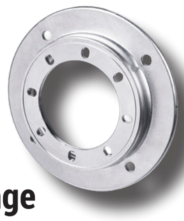
Laser engraved tag plate
To avoid dirt traps under the commonly used motor identification tag plate,
all our motors and gearboxes are being equipped with a laser engraved tag plate.
Besides for the food safety this also prevents against possible lost of information because of taking away the tag plate or loosing the tag plate from the driveparts.

As a part of our standard procedure every drive is tested in our production facility in the Netherlands to ensure correct functioning.

General specifications

- Standard ratio's 7,5 : 1 to 100 : 1
- 6 Gearbox sizes
- IEC motor adaption
- Standard hollow shafts 14, 18, 25, 28 and 35
- Extra hygienic optional shaft covers. (open and closed version)
- Easy clean torque arm with built in elastic element to reduce mis alignment.
- Optional output flanges available
- Stainless Steel AISI316
- Duplex stainless steel 2205 output shaft
- Designed and produced in the Netherlands
- Double wormgear reductions possible

Torque arms



Flange

Open &
Closed covers

Product Characteristics

FV 030	
Ratio's	From 7.5 : 1
	To 80 : 1
Standard shaft	14 mm
Max. Torque	Max. 20Nm
Max. Power	0.25 kW

FV 040	
Ratio's	From 7.5 : 1
	To 100 : 1
Standard shaft	18 mm
Max. Torque	Max. 40Nm
Max. Power	0.55 kW

FV 050	
Ratio's	From 7.5 : 1
	To 100 : 1
Standard shaft	25 mm
Max. Torque	Max. 86Nm
Max. Power	1.5 kW

FV 063	
Ratio's	From 7.5 : 1
	To 100 : 1
Standard shaft	25 mm
Max. Torque	Max. 159Nm
Max. Power	2.2 kW

FV 075	
Ratio's	From 7.5 : 1
	To 100 : 1
Standard shaft	28 mm
Max. Torque	Max. 230Nm
Max. Power	4 kW

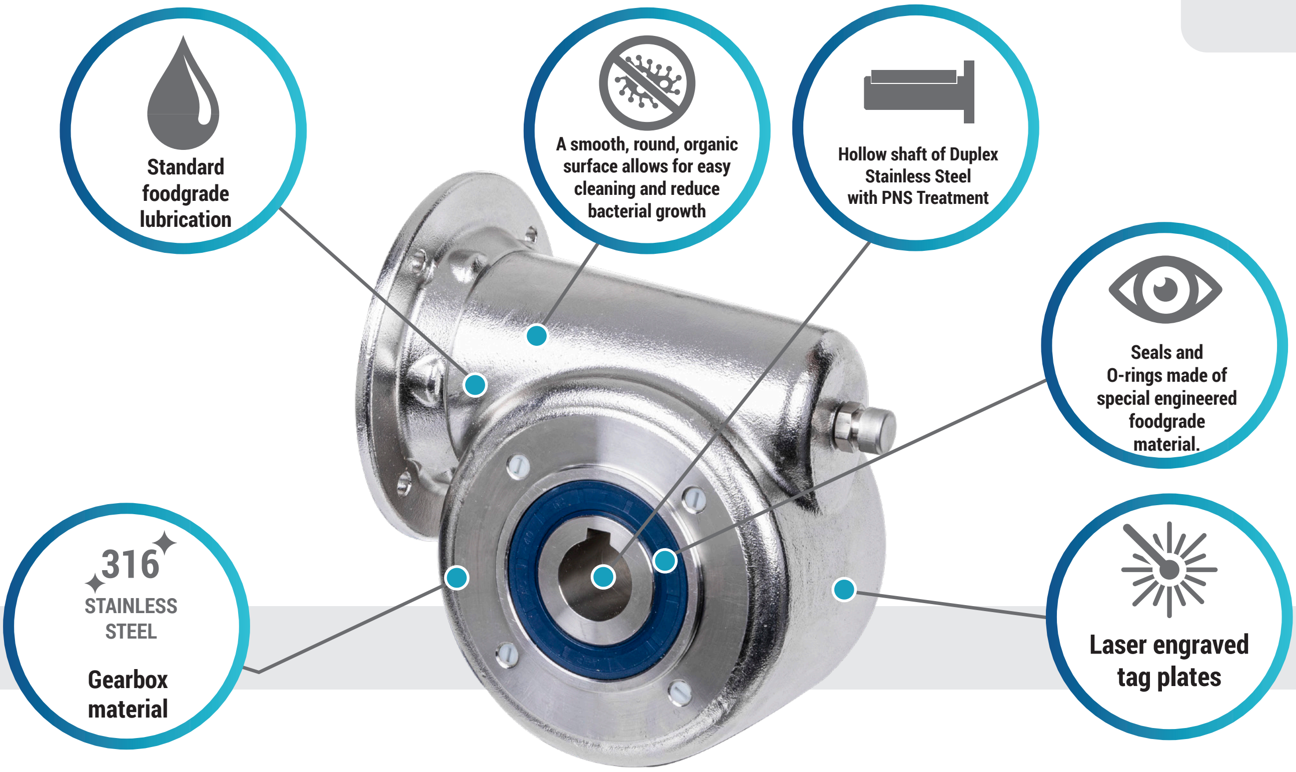
FV 090	
Ratio's	From 7.5 : 1
	To 100 : 1
Standard shaft	35 mm
Max. Torque	Max. 420Nm
Max. Power	4 kW

Torque Arms	
FV 030	SS 065 MS L85
FV 040	SS 075 MS L100
FV 050	SS 085 MS L100
	SS 085 MS L110S
FV 063	SS 095 MS L130S
	SS 095 MS L150
FV 075	SS 115 MS L160S
	SS 115 MS L200
FV 090	SS 130 MS L200

Easy clean closed cover	
FV 030	SS 065 CC
FV 040	SS 075 CC
FV 050	SS 085 CC
FV 063	SS 095 CC
FV 075	SS 115 CC
FV 090	SS 130 CC

Easy Clean Open Cover	
FV 030	SS 065 CO Ø14
FV 040	SS 075 CO Ø18
FV 050	SS 085 CO Ø25
FV 063	SS 095 CO Ø25
FV 075	SS 115 CO Ø28
FV 090	SS 130 CO Ø35

Output flanges	
FV030	SS 065 FL80
FV040	SS075 FL110
	SS075 FL140
FV050	SS085 FL120
	SS085 FL125
FV063	SS095 FL160
	SS095 FL180
FV075	SS115 FL200
FV090	SS130 FL250



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Project planning

Basic Parameters

Power P
The input power can be found in the **"Gearbox Selection Tables"** , it represents the amount of kilowatts [kW] that can be safely transmitted into the gearbox.

$$P_1 = \frac{P_2}{\eta}$$

P_1 = Input power (kW)
P_2 = Output power (kW)
η = Gearbox efficiency (%)

Rotation speed *n* and gear ratio *i*
The gear ratio can be calculated with the input and output speed

$$i = \frac{n_1}{n_2}$$

i = Gear ratio
n_1 = Input speed in (rpm)
n_2 = Output speed in (rpm)

Torque *M*
The output torque can be calculated with the input power, the efficiency and the output speed.

$$M_2 = \frac{9550 \cdot P_1 \cdot \eta}{n_2}$$

$$M_{2max} \geq M_2 \cdot fs_{gearbox}$$

M_2 = Output torque (Nm)
M_{2max} = Maximum output torque (Nm)
P_1 = Input power (kW)
n_2 = Output speed (rpm)
η = Gearbox efficiency (%)
$fs_{gearbox}$ = Service factor

Mass acceleration factor f_a
The mass acceleration factor is calculated with all the external mass moments of inertia and the mass moment of inertia from the motor.

$$f_a = \frac{J_c}{J_m}$$

f_a = Mass acceleration factor
J_c = All external mass moments of inertia [kg m^2]
J_m = Mass moment of inertia on the motor end [kg m^2]

If the mass acceleration factor $f_a \geq 10$, please contact us.

Efficiency of gearboxes η

The efficiency of gearboxes is mainly determined by the gear type, the gear ratio and the bearing friction. The efficiency of the gears at start-up and at sub-optimal operating speed is always lower than when the gears are running at the optimal operating speed. The gear shape of worm- and helical worm gearboxes causes more friction, thus a lower total efficiency. As a result of the higher friction, the temperature of worm gearboxes might also be higher than gearboxes with other gear types.

The efficiency of the different gear types can be found in the **"Possible Geometrical Combinations".**

For an approximate approach the following values can be used for the efficiency of gears at their (optimal) operational speed, beware these are generalized and can be different depending on the factors as discussed before.
For bevel-, helical- and parallel shaft gears the efficiency is in-between 94% (3-stage) and 96% (2-stage).
The efficiency of hypoid bevel gears is 90% (3-stage) and 92% (2-stage). For worm- and helical worm gears the efficiency depends on the gear ratio, incoming rotational speed and the temperature of the worm gearbox, the efficiency of the gears is between 40% and 90%.

To ensure the efficiency of the gears is optimal it is recommended but not limited to: Regularly change oil, use the optimal mounting position and use the gearbox at the optimal operating speed.
Choosing the right size gearbox for the application is recommended to achieve a better efficiency, at speeds below- and over the optimal operating speed the efficiency is lower than at optimal speeds and conditions.

Service factor fs_{min} and $fs_{gearbox}$

The service factor is a method to determine the effects of the driven machine or other application on the gearbox, with a sufficient level of accuracy for most applications. The minimal service factor **(fs_{min})** for a machine can be determined using the **"Service factor graph"**. This minimum service factor is only an approximation, for the service factor for each gearbox, see the **"Gearbox Selection Tables"**.

⚠ **The minimal service factor (fs_{min}) should always be lower than or equal to the actual service factor of the gearbox ($fs_{gearbox}$).**

$$fs_{min} \leq fs_{gearbox}$$

fs_{min} = Minimal determined service factor **"Service factor graph"**
$fs_{gearbox}$ = Actual service factor for the gearbox **"Gearbox Selection Tables"**

⚠ **The service factor for each gearbox ($fs_{gearbox}$) is the critical service factor, and should always be equal to or higher than the minimum service factor (fs_{min}) !**

Switching frequency

The switching frequency determines how often an application switches per hour.
The switching consists of: **turning on/off, changing of speeds, changing of loads and braking**

z = Switching frequency [1/h]

Load classification

There are three load classifications to be considered, they depend on the mass acceleration factor.
The mass acceleration factor can be calculated, see **"Mass acceleration factor f_a"**

f_a = Mass acceleration factor

The load classifications are split in three groups with each examples of the common applications for each load classification.

A: Uniform load, a mass acceleration factor of **$f_a \leq 0,3$**
Examples of applications: Screw feeders for light materials, fans, assembly lines, conveyer belts for light materials, small mixers, light application elevators, cleaning machines, fillers, control machines.

B: Moderate shock load, mass acceleration of **$f_a \leq 3$**
Examples of applications: Winding devices, woodworking machine feeders, medium application elevators, balancers, medium mixers, conveyer belts for heavy materials, winches, sliding doors, fertilizer scrapers, packing machines, concrete mixers, crane mechanisms, milling cutters, folding machines, gear pumps.

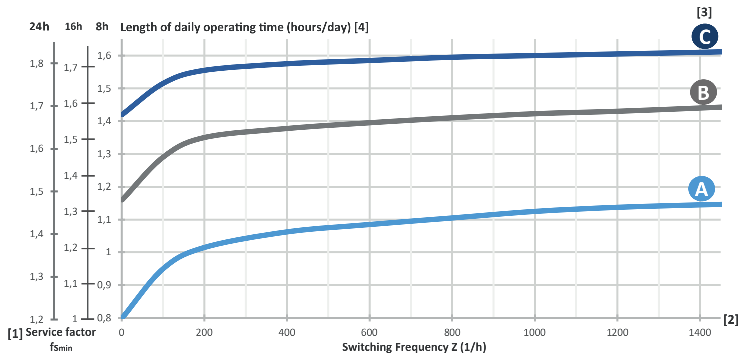
C: Heavy shock load, mass acceleration factor of **$f_a \leq 10$**.Examples of applications: Mixers for heavy materials, shears, presses, centrifuges, rotating supports, winches and lifts for heavy materials, heavy application elevators, grinding lathes, stone mills, bucket elevators, drilling machines, hammer mills, cam presses, folding machines, turntables, tumbling barrels, vibrators, shredders.

Service factor graph

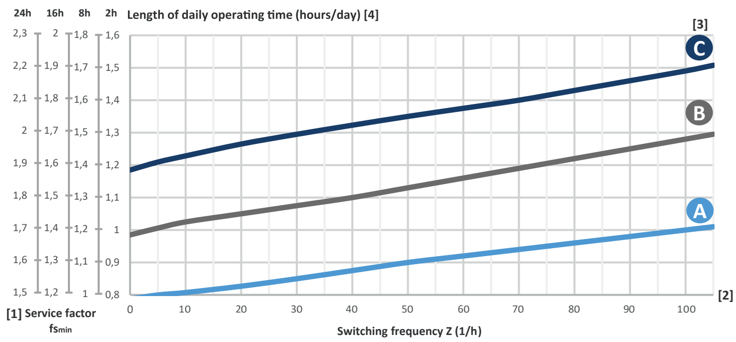
The determined Minimum **[1]** service factor is based on **[2]** switching frequency, **[3]** load classification and **[4]** length of daily operating time.

To get the expected service life from the gearbox, $fs_{min} \leq fs_{gearbox}$
see the "Gearbox Selection Tables" for the gearbox service factor

Service factor for a high Switching frequency [Z], used for all gearboxes:

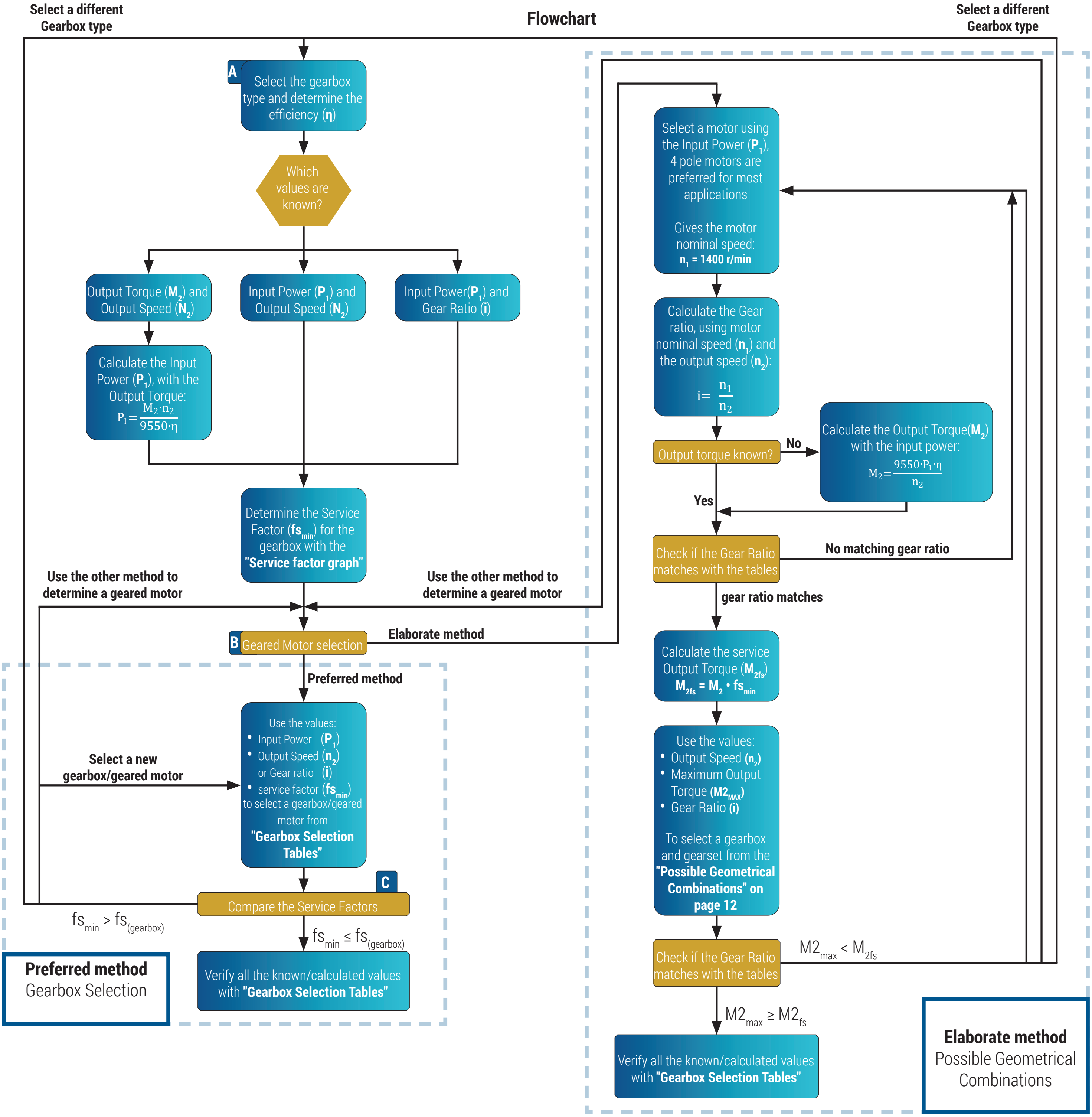


Service factor for low Switching frequency (Z), used mostly for worm- and helical worm gearboxes:



For worm gearboxes the ambient temperature has more influence on the service factor, the service factor should be adjusted as following:

Ambient temperature:
=30~40°C, f_s•1,1 ~ 1,2
=40~50°C, f_s•1,3 ~ 1,4
=50~60°C, f_s•1,5 ~ 1,6



A

Gearbox types by gear type:

- Worm gear
- Helical worm gear
- Helical bevel gear
- Hypoid bevel gear
- Parallel shaft gear
- (Compact) Helical gear

B

Geared motor selection, there are 2 methods of selecting a geared motor:

- The elaborate method is used to select a geared motor based on calculations.
- The preferred method is based on a quick and accurate decision with our tables.

C

The service factor, is a value to determine the effect of a driven machine on the gearbox. With **"Gearbox Selection Tables"** the minimum expected service factor (**fs_{min}**) can be determined.

The gearboxes themselves have a maximum service factor that varies per gearbox (**$fs_{gearbox}$**), always make sure that: **$fs_{min} \leq fs_{(gearbox)}$**

To get the expected service life from the gearbox.

Explanation of the flowchart

Gearbox selection type
To select a gearbox the values for efficiency and the service factor are needed. These can be predicted by choosing the type of gearbox, **"Possible Geometrical Combinations"**

Which values are known?
There are three sets of values that can be known and which can be used to select the right gearbox and geared motor.
These three sets of values are:

- **Output torque and speed**
- **Input power and speed**
- **Input power and gear ratio**

For only knowing the output torque- and speed it is necessary to determine the input power with the following equation:

$$P_1 = \frac{M_2 \cdot n_2}{9550 \cdot \eta}$$

P_1	Input power [kW]
M_2	Output torque [Nm]
η	Gearbox efficiency [%]
n_2	Rotational speed [rpm]

Determine the service factor
Use the **"Service factor graph"** to determine the service factor.

Select a geared motor
There are two methods to select a gearbox and a geared motor:

The preferred method: This method is accurate and quick, this method only needs a basic calculation in when the input power is unknown.

The elaborate method: This method gives more insight and a more hands on approach in the selection process for a gearbox and geared motor. There are a few calculations that have to be done in this method.

⚠ **If both methods don't give the correct results it can be possible that the gearbox and or motor are not correct for this application!**

Preferred method:

Use the "Gearbox Selection Tables"
Use the Input power, output speed or gear ratio and the service factor to select the gearbox/geared motor.

⚠ **Note: that the output torque is sufficiticated to your application**

Check the service factor
Check if the determined service factor fs_{min} is smaller or equal to the service factor from the **"Gearbox Selection Tables"** $fs_{min} \leq fs_{gearbox}$.

If $fs_{min} > fs_{gearbox}$ a different gearbox/geared motor should be selected if that is not possible then it is advised to check the other gearbox types..

If $fs_{min} \leq fs_{gearbox}$ go to the next step and verify the results.

Verify the results
If the service factor fs_{min} and $fs_{gearbox}$ gives a valid result, verify the rest of the results with the tables from **"Gearbox Selection Tables"**.

Elaborate method:

Select a motor
Select a motor from in the **(Motor documentation)**.
4-pole motors are preferred for most applications. The given nominal motor speed of a 4-pole motor is **n_1=1400 rpm**.

Calculate the gear ratio
If the gear ratio is known, the output speed **n_2** needs to be calculated.

$$n_2 = \frac{n_1}{i}$$

With the nominal speed from the selected motor and known output speed the gear ratio can be calculated.

$$i = \frac{n_1}{n_2}$$

i = Gear ratio [-]
n_1 = Gearbox input speed [rpm] (equal to motor speed)
n_2 = Gearbox output speed [rpm]

Check if the output torque is known
If the output torque is known go to the next step.
If the output torque is unknown use the following calculation to determine the output torque:

$$P_1 = \frac{M_2 \cdot n_2}{9550 \cdot \eta}$$

P_1 = Input power [kW]
M_2 = Output torque [Nm]
η = Gearbox efficiency [%]
n_2 = Rotational speed [rpm]

Check the gear ratio
With the known or calculated gear ratio and the **"Possible Geometrical Combinations"**, the gear ratio can be checked.
If the needed gear ratio is not in the list a different motor or gearbox should be selected.

Calculate the service output torque
With the determined service factor and the output torque, calculate the service output torque.

$$M_{2fs} = M_2 \cdot fs_{min}$$

M_{2fs} = Service output torque [Nm]
M_2 = Output torque [Nm]
fs_{min} = Service Factor

Use the Possible Geometrical Combinations tables
Use the Output speed, Service output torque and gear ratio to determine a gearbox and gearset with the tables from the **"Possible Geometrical Combinations"**.

Check the maximum output torque
Check if the maximum output torque in these tables matches the calculated service output torque. If the maximum torque is lower than the calculated service torque: **$M_{2max} < M_{2fs}$** it is advised to select a different motor or gearbox.

If **$M_{2max} \geq M_{2fs}$** go to the next step and verify the results.

Verify the results
If the maximum output torque matches the tables and gives a valid result, then verify the values from the tables with the calculated values and make a selection for the gearbox/geared motor.

Example 1: Preferred method

Known parameters:

This example uses a different gearbox type but is generally applicable

M_2	Nominal output torque [Nm]	= **110 Nm**
n_2	Rotational speed [rpm]	= **29 rpm**

Moderate shock load, operational **16 hours a day**, Switching frequency of **200 times per hour.**

Gearbox selection type

A hypoid bevel gearbox is selected. The estimated efficiency ***η≈90% to 94%***. For a more accurate efficiency look it up in the **"Possible Geometrical Combinations"**.

When in doubt use the lowest estimated efficiency.

Which values are known?

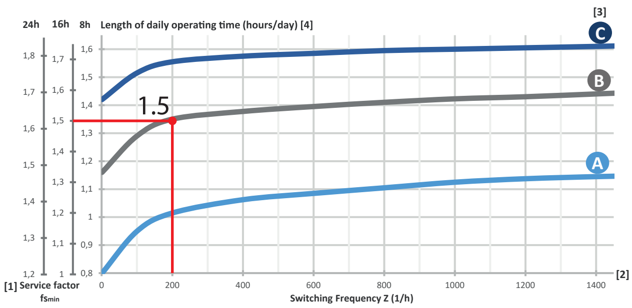
- Output torque- and speed
- ~~Input power- and speed~~
- ~~Input power and gear ratio~~

M_2 = **110Nm**
n_2 = **29 rpm**

Looking up the output speed and output torque in the **"Possible Geometrical Combinations" on page 15** tables gives an efficiency of: **η≈92%**
With the output torque- and speed it is necessary to determine the input power with the following equation:

$$P_1 = \frac{M_2 \cdot n_2}{9550 \cdot \eta} = \frac{110 \cdot 29}{9550 \cdot 0{,}92} = 0{,}363 \text{ kW}$$

Determine the safety factor



Select the *'Elaborate method'* or the *'Preferred method'*

Preferred method is chosen.

P_{1n} [kW]	n_2 min^{-1}	M_{2n} [Nm]	i	F_{r2} [N]	fs		
0.37	23	140	60.50	3430	1.40	FK38B IEC71	712-4 B14a
	29	113	48.71	3190	1.80		
	36	91	39.29	2970	2.00		
	46	70	30.31	2720	2.80		
	57	57	24.44	2530	3.20		
	69	47	20.25	2380	3.20		
	95	34	14.67	2130	3.20		

Check the service factor

fs_{min}=**1,5**
$fs_{(gearbox)}$=**1,8**

Check if the following is true

$fs_{min} \le fs_{gearbox}$
Yes, because **1,5 < 1,8**

Verify the results

Needed Torque: **110 Nm**, available torque in selected gearbox: **113 Nm**
Needed output speed: **29 rpm**, available output speed in selected gearbox: **29 rpm**
Calculated Input power: **0,363 kW**, available input power in selected gearbox: **0.37 kW**

Service factor: $fs_{min} \le$ fs(gearbox) = **1,5<1,8**
So the choice of gearbox/geared motor is: **FK38B IEC71 / 712-4 B14a.**

It is recommended to select a gearbox or geared motor that fits the application. Choosing a gearbox or geared motor that is too light or too heavy can cause damage (to the machine) and shorten the expected service life of the gearbox/geared motor!

This example uses a different gearbox type but is generally applicable

Example 2: Eleborate method

Known parameters:

P1 Input power [kW] = **0.55kW** **i** gear ratio = **30:1**
Heavy shock load, operational **24 hours a day**, switching frequency of **800 times per hour.**

Gearbox selection type
A hypoid bevel gearbox is selected. The estimated efficiency ***η≈90% to 94%***. For a more accurate efficiency look it up in the **"Possible Geometrical Combinations"**

When in doubt use the lowest estimated efficiency.

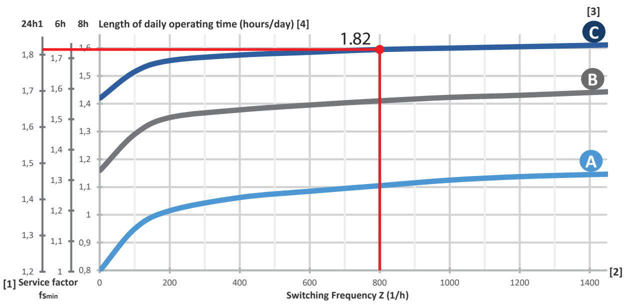
Which values are known?

- ~~Output torque- and speed~~
- ~~Input power- and speed~~
- Input power and gear ratio

P_1 = **0.55 kW**
i = **30:1**

Looking up the output speed and output torque in the **"Possible Geometrical Combinations"** tables gives an efficiency of: **η≈94%**

Determine the safety factor



Select the elaborate or the Simple method
Elaborate method is chosen

Select a motor
Check the **"Possible Geometrical Combinations"**, which motor is preferred. In this example an IEC80 B14a motor is preferred.

The choice of motor is based on a 4-pole motor, which means an input speed of 1400 rpm.
However it is possible to choose from a wide range of motors.

Calculate the output speed

i = 30:1
n_1 = 1400 rpm

$$i = \frac{n_1}{n_2} \rightarrow n_2 = \frac{n_1}{i} \rightarrow \frac{1400\ rpm}{30} = 46{,}67\ rpm$$

Check of the output torque is known
The output torque is not known yet, so it needs to be calculated with the known values.

$$M = \frac{9550 \cdot P \cdot \eta}{2} = \frac{9550 \cdot 0{,}55 \cdot 0{,}90}{46{,}67\ rpm} \quad 101{,}3\ Nm$$

Check the gear ratio
To check the gear ratio, look in the **"Possible Geometrical Combinations"** tables for the preferred gearbox. As seen below, the gear ratio and output speed match with this gearbox. The preferred motor is also possible with this gearbox type.

FK 28 B

Maximum torque = 130 Nm @ N1= 1400 rpm

n_2 [min⁻¹]	M_{2max} [Nm]	F_{r2} [N]	i		η%	IEC 63 B5	IEC 71 B14a	IEC 80 B14a	IEC 90 B14a
35	130	2610	40	40.09	94	✓	✓	✓	
48	130	2350	30	29.33	94	✓	✓	✓	
59	130	2200	25	24.07	94	✓	✓	✓	✓

Calculate the service output torque

Use the determined service factor and the calculated output torque.

$M_{2fs} = M_2 \cdot fs_{min} \rightarrow 101{,}3\ \text{Nm} \cdot 1{,}82 = 184{,}37\ \text{Nm}$

Use the Possible Geometrical Combinations tables

FK 28 B

*Maximum torque = **130 Nm** @ N1= 1400 rpm*

n_2 [Min⁻¹]	M_{2max} [Nm]	F_{r2} [N]	i		η%	IEC 63 B5	IEC 71 B14a	IEC 80 B14a	IEC 90 B14a
35	130	2610	40	40.09	94	✓	✓	✓	
48	130	2350	30	29.33	94	✓	✓	✓	
59	130	2200	25	24.07	94	✓	✓	✓	✓

Check the maximum output torque

With the known values and the selected gearbox, we can determine that the following values apply:

n_2 = 48 rpm ≈ 46.67 rpm [calculated]
I = 30 = 30 [known]
M2fs = 101,3 Nm [calculated]

So the determined gearbox has enough output torque for the application 130 Nm, but when we look at the service output torque, it is not recommended to choose this gearbox with this service factor and service output torque.

M_{2fs} = 184,37 Nm [calculated]
$M_{2max} < M_{2fs} \rightarrow$ 130 Nm < 184,37 Nm

It is recommended to choose another gearbox, the easiest way to do this is to look for a bigger gearbox within the same gearbox type.

Selecting a new gearbox

It is recommended to match the calculated results as before, but look for a higher maximum torque. Try to select a maximum torque that still matches the application, it is not recommended to select a gearbox with more maximum torque than the application needs.

FK 38 B

*Maximum torque = **200 Nm** @ N1= 1400 rpm*

n_2 [Min⁻¹]	M_{2max} [Nm]	F_{r2} [N]	i		η%	IEC 63 B5	IEC 71 B14a	IEC 80 B14a	IEC 90 B14a
36	200	2970	40	39.29	94	✓	✓	✓	✓
47	200	2720	30	30.31	94	✓	✓	✓	✓
58	200	25030	25	24.44	94		✓	✓	✓

Verify the results

With the table for the FK38B gearbox, we can determine the following.

n_2 = 47 rpm ≈ 46.67 rpm [calculated]
i = 30 = 30 = [known]
M_2 = 101,3 Nm [calculated]
M_{2fs} = 184,37 Nm [calculated]

Check if the maximum output torque is higher than the service output torque.

$M_{2max} > M_{2fs} \rightarrow$ 200 Nm > 184,37 Nm

So this gearbox can be used for the application, because the service output torque is lower than the maximum output torque.

The recommended gearbox with motor is:

For a gearbox, a **FK38B** with a true gear ratio of **30,31** and for a motor, the **IEC80 B14a** is possible.

It is recommended to select a gearbox or geared motor that fits the application. Choosing a gearbox or geared motor that is too light or too heavy can cause damage (to the machine) and shorten the expected service life of the gearbox/geared motor

Overhung and axial loads

Determing overhung loads

Each transmission element has a transmission element factor f_z , this factor is different for each element.

In order to properly use transmission elements, always make sure that they are aligned properly on the shaft of the gearbox and or the shaft of the machine or other application. It is important to check that the transmission element is mounted properly before use, the element might cause problems in dynamic situations if this isn't checked

$$F_r = \frac{M \cdot 2000}{d_0} \cdot fz$$

F_r = overhung load [N]
M = Torque [Nm]
d_0 = Mean diameter of the mounted element [mm]
F_z = Element factor [see table above]

Transmission elements	Transmission elements Factor Fz	Comments
Gears	1.00	≥ 17 Teeth
	1.15	< 17 Teeth
Chain sprockets	1.00	≥ 20 Teeth
	1.25	< 20 Teeth
	1.40	< 13 Teeth
Narrow V-belt Pulleys	1.75	Influence of the tensile force
Flat Belt Pulleys	2.50	Influence of the tensile force
Toothed Belt Pulleys	2.50	Influence of the tensile force

Rated bearing service life

The rated bearing service life L_{10h} (in hours, according to **ISO 281**) is used to calculate the estimated bearing life in hours. For special operating conditions the modified service life should be used.

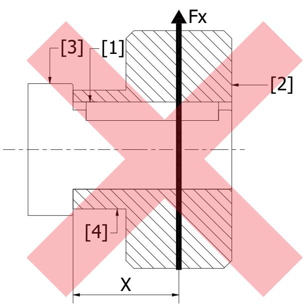
$$L_{10h} = \frac{10^6}{60 \cdot n_2} \cdot \left(\frac{C}{F_r}\right)$$

L_{10h} = Rated service life [hour]
C = Basic dynamic load rating, bearing [kN]
F_r = Equivalent dynamic load, bearing [kN]
ρ = Exponent for the life equation, ρ=3 for ball bearings, ρ=10/3 for roller bearings
n_2 = Gearbox output speed [rpm]

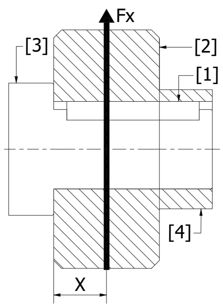
Preferred mounting for overhung loads

The preferred way of mounting the overhung load for sprockets, gears and other transmissions is with the hub **[4]** at the end of the shaft **[3]** and the sprocket/gear **[2]** against the shoulder, see **[B]** in the figure below. This method ensures a better load distribution on the end of the shaft.

[A] NOT Preferred



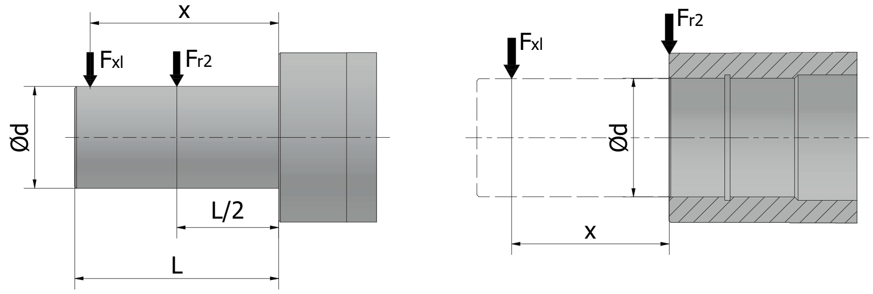
[B] Preferred



nr.	Part Name
[1]	Key
[2]	Sprocket / Gear
[3]	Solid shaft
[4]	Hub
[Fx]	Radial Force on the Sprocket / Gear
[X]	Distance to center of mass and force

Overhung load conversion for off-centre force applications

The rated bearing life is the basis for determining the permissible overhung load. The permissible overhung loads for foot mounted gearboxes with solid shafts can be calculated with the following calculation.



$$F_{xL} = F_{r2} \cdot \frac{a}{b+x}$$

F_{xL} = Permitted overhung load based on bearing service life[N]
F_{r2} = Permitted overhung load (x=L/2) for foot mounted gearboxes according to the selection tables [N]
F_{r2max} = Maximum permitted overhung load (x=L/2) for foot mounted gearboxes according to the sellection tables [N]
x = Distance from the shaft shoulder to the applied force [mm]
a,b ød, L = Gear unit constant for overhung load conversions [mm]

The values in table are for the foot mounted gearboxes with solid shaft only, the measurements are for the standard shafts.

FV	a [mm]	b [mm]	Ød [mm]	L [mm]	Fr2 max [N]
FV 030	65	50	14	30	1830
FV 040	84	64	18	40	3490
FV 050	101	76	25	50	4840
FV 063	120	95	25	50	6270
FV 075	131	101	28	60	7380
FV 090	162	122	35	80	8180

FKA	a [mm]	b [mm]	Ød [mm]	L [mm]
FKA 38	123,5	98,5	25	50
FKA 48	153,5	123,5	30	60
FKA 68	181,3	141,3	40	80
FKA 78	215,8	165,8	50	100
FKA 88	252	192	60	120

FFA	a [mm]	b [mm]	Ød [mm]	L [mm]
FFA 38	123,5	98,5	25	50
FFA 48	153,5	123,5	30	60
FFA 68	181,3	141,3	40	80
FFA 78	215,8	165,8	50	100

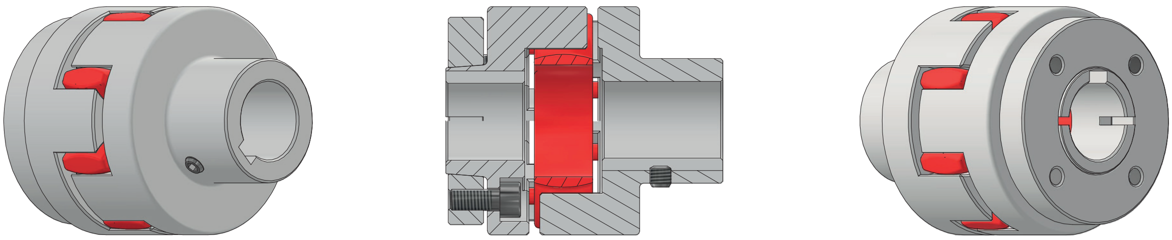
FRC	a [mm]	b [mm]	Ød [mm]	L [mm]
FRC 01	103	83	20	40
FRC 02	116,5	91,5	25	50

FK	a [mm]	b [mm]	Ød [mm]	L [mm]
FK 28 B/C	104	78	25	50
FK 38 B/C	118	93	25	50
FK 48 B/C	131	101	28	60
FK 58 B/C	159	119	35	80

FS(A)	a [mm]	b [mm]	Ød [mm]	L [mm]
FS(A) 38	118,5	98,5	20	40
FS(A) 48	130	105	25	50
FS(A) 58	150	120	30	60
FS(A) 68	184	149	35	70

FR	a [mm]	b [mm]	Ød [mm]	L [mm]
FR 38	118	93	25	50
FR 48	137	107	30	60
FR 68	168,5	133,5	35	70

The use of couplings



Example of a flexible coupling

Couplings are usually needed when a gearbox is rigidly mounted to a machine or other application. A coupling offers some room for misalignment that may be present or develop during use of the gearbox.

Not all misalignments can be statically determined, some may develop during dynamic processes are only present during use of the gearbox

Couplings give room for these misalignments and ensure the service life of the bearings inside of the gearbox, by offering a bit more room for error when there are misalignments.

There are different types of couplings that can be used in such applications, one example is a flexible coupling ***,see: example of a flexible coupling***.
Flexible couplings often have three parts, one for the shaft of the machine or application,
one for the shaft of the gearbox and a part that gives flexibility. The flexible part is often made of rubber or another kind of polymer.

Note: A coupling slightly increases the temperature of the shafts, due to friction and slightly decreases the efficiency of the gearbox.

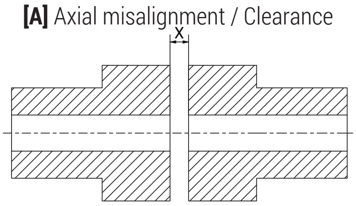
Mounting of couplings

To properly mount the couplings and prevent excessive wear on the gearbox, it is necessary to mount the couplings correctly.
To mount a coupling properly please pay attention to the following types of misalignment.

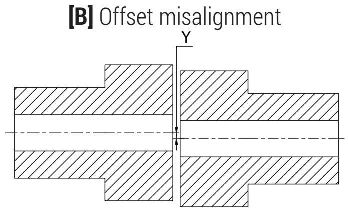
Note: The amount of allowable misalignment is often specified in the coupling datasheet, from the coupling manufacturer

Never mount couplings onto the shaft by hitting them with a hammer, this can cause damage to the gearbox bearings and can reduce the gearbox service life

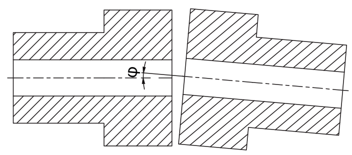
[A] Axial misalignment / Clearance



[B] Offset misalignment



[C] Angular misalignment



[A] Horizontal misalignment/Clearance:
Make sure that the horizontal misalignment/clearance [X] does not exceed the minimum and maximum clearance. This value is dependant on the type of coupling, material of the coupling and bore/shaft diameter and length. $X_{min} \leq X \leq X_{max}$, where $X_{min} > 0$.

Note: For the allowable clearance see the coupling manufacturers data sheet.

[B] Axial misalignment:
Make sure that the axial misalignment [Y] is as close to 0 as possible, in general axial misalignment will cause wear when the misalignment is too big.

[C] Angular misalignment:
Make sure the angular misalignment [φ] is as close to 0 (degrees) as possible, excessive angular misalignment will cause damage.

Couplings allow small misalignments, but excessive misalignment and couplings that aren't mounted properly can still cause damage to the gearbox and or machine or other applications.

Dynamic irreversibility

Dynamic irreversibility is achieved when the output shaft stops instantly as the transmitted power through the worm gear is stopped. To achieve this condition the dynamic efficiency should be **η_d<0,4** see the figure below. The full range of the dynamic irreversibility for each gearbox is documented in the **"Mesh Data".**

η_d	>0.6	0.5 ~ 0.6	0.4 ~ 0.5	<0.4
Dynamic irreversibility	Dynamic reversibility	Low Dynamic reversibility	Good Dynamic irreversibility	Dynamic reversibility

Static irreversibility

Static irreversibility is achieved when the worm gears cannot be driven at standstill by the shaft. To achieve this condition the static efficiency has to be **η_s<0,5** see the figure below. The full range of the static irreversibility for each gearbox is documented in the **"Mesh Data".**

η_s	>0.55	0.5 ~ 0.55	<0.5
Static irreversibility	Static reversibility	Low Static reversibility	Static irreversibility

The shown irreversibility classes are approximate, vibrations and shock can affect the gears and cause these kinds of behaviour to happen at higher dynamic and static efficiencies. Because it is virtually impossible to guarantee non-reversing, it is recommended to use an external brake with sufficient capabilities to prevent vibrations induced starting. For the irreversibility conditions of combined gear units, the product can be calculated with this equation: $\eta_{tot} = \eta_1 \cdot \eta_2$

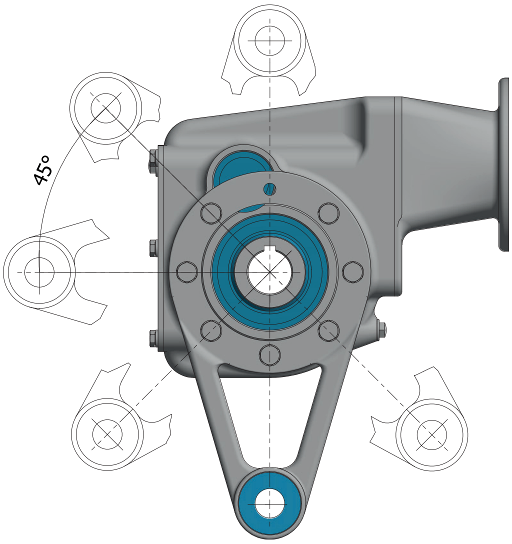
Gear mesh data

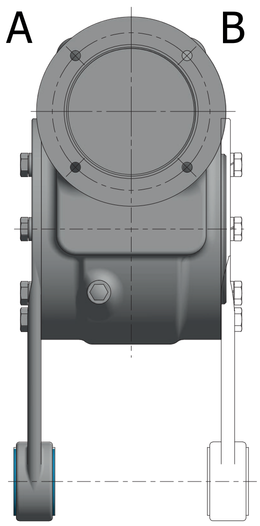
	i	7,5	10	15	20	25	30	40	50	60	80	100
FV030	z1	4	3	2	2	1	1	1	1	1	1	X
	Mn	1,36	1,39	1,42	1,09	1,69	1,43	1,10	0,89	0,74	0,56	X
	Y	18°55′	14°25′	9°44′	7°50′	5°53′	4°54′	3°56′	3°17′	2°43′	2°7′	X
	ηd	0,84	0,81	0,76	0,72	0,66	0,64	0,59	0,54	0,50	0,44	X
	ηs	0,66	0,62	0,54	0,49	0,41	0,38	0,33	0,29	0,26	0,21	X
FV040	z1	4	3	2	2	2	1	1	1	1	1	1
	Mn	1,87	1,95	2,00	1,54	1,26	2,04	1,55	1,27	1,06	0,80	0,65
	Y	23°54′	18°23′	12°30′	10°3′	8°45′	6°19′	5°4′	4°24′	3°42′	2°52′	2°29′
	ηd	0,86	0,84	0,80	0,77	0,74	0,69	0,65	0,61	0,57	0,51	0,47
	ηs	0,7	0,66	0,59	0,54	0,51	0,44	0,39	0,36	0,32	0,27	0,24
FV050	z1	4	3	2	2	2	1	1	1	1	1	1
	Mn	2,34	2,43	2,50	1,92	1,56	2,54	1,94	1,58	1,32	1,00	0,80
	Y	23°49′	18°19′	12°27′	10°3′	8°33′	6°18′	5°4′	4°18′	3°38′	2°52′	2°17′
	ηd	0,87	0,85	0,81	0,78	0,75	0,71	0,67	0,63	0,59	0,53	0,48
	ηs	0,70	0,66	0,59	0,54	0,51	0,44	0,93	0,36	0,32	0,27	0,24
FV063	z1	4	3	2	2	2	1	1	1	1	1	1
	Mn	2,96	3,08	3,17	2,44	1,98	3,23	2,47	1,99	1,68	1,27	1,02
	Y	23°31′	18°53′	12°51′	10°29′	8°45′	6°30′	5°17′	4°24′	3°49′	2°59′	2°26′
	ηd	0,88	0,86	0,82	0,80	0,77	0,73	0,69	0,65	0,62	0,56	0,51
	ηs	0,70	0,66	0,59	0,55	0,51	0,44	0,40	0,36	0,33	0,28	0,24
FV075	z1	4	3	2	2	2	1	1	1	1	1	1
	Mn	3,53	3,70	3,83	2,94	2,39	3,92	2,99	2,41	2,02	1,54	1,24
	Y	26°38′	20°37′	14°5′	11°19′	9°29′	7°9′	5°43′	4°46′	4°1′	3°17′	2°44′
	ηd	0,88	0,87	0,84	0,81	0,79	0,76	0,72	0,68	0,64	0,59	0,55
	ηs	0,71	0,68	0,61	0,57	0,53	0,47	0,41	0,37	0,34	0,29	0,26
FV090	z1	4	3	2	2	2	1	1	1	1	1	1
	Mn	4,23	4,47	4,66	3,60	2,93	4,79	3,67	2,97	2,49	1,89	1,52
	Y	29°5′	22°39′	15°33′	14°42′	12°33′	10°53′	7°55′	6°30′	5°29′	3°45′	3°6′
	ηd	0,89	0,88	0,85	0,83	0,81	0,78	0,74	0,71	0,68	0,63	0,59
	ηs	0,72	0,69	0,63	0,59	0,56	0,49	0,44	0,41	0,37	0,32	0,28

Torque arm

A torque arm is an attachment for a gearbox that prevents the gearbox from spinning with the driven shaft. When a gearbox is mounted directly on the output shaft without any external support it is always necessary to use a torque arm.

Depending on the gearbox type and size, torque arms can be mounted in a multitude of different positions on the output sides of the gearbox, see the figure below for an example of the different positions.

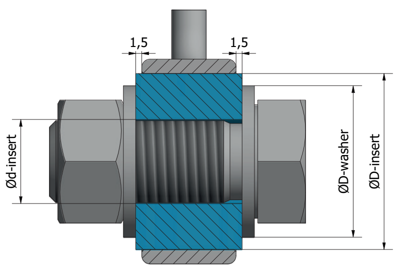


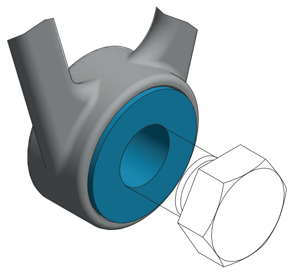


When mounting the torque arm pay attention to the following:

- A torque arm is used to prevent the gearbox from turning with the driven shaft, the torque arm does not prevent movement.
- It is important that the gearbox is allowed some movement when using a torque arm, to ensure that the gearbox bearings don't wear excessively.
- Make sure that the gearbox has enough clearance around it, so it is not in direct contact with the surroundings.
- It is always recommended to mount the torque arm on the gearbox side closest to the machine, this lowers the probability and the effect of misalignment.
- Avoid mounting the torque arm to a separate frame, this could cause misalignment. Mounting to the machine/application is always preferred.
- Always make sure the torque arm is properly mounted to the gearbox, and all available mounting holes are used.
- When using a torque arm, pay attention when mounting the torque arm to a "fixed" position. The torque arm should have enough room to move freely and should not be mounted too tight.
- When attaching the torque arm to a "fixed" position with a bolt, make sure that the bolt is hand tightened and that the rubber insert is not tightened too firm.
- Make sure when using a bolt to hold the torque arm in place, that the washer is smaller than the rubber insert (see figure below).
- If the rubber insert moves out of place, the alignment is not done properly. This does not mean that the torque arm is not tightened properly.

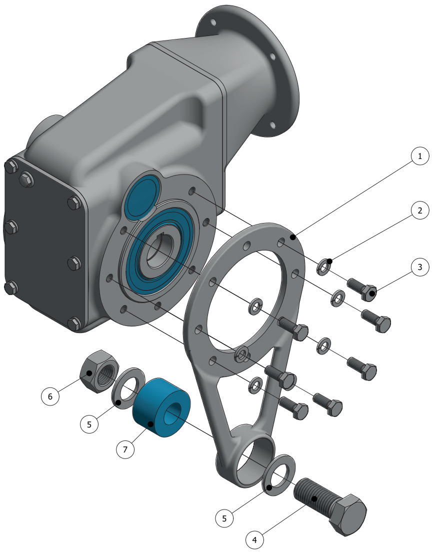
	ø D-ring [mm]	ø D-insert [mm]	ø d-insert
MSB 2510	<25	25	10
MSB 4320	<43	43	20





Mounting the torque arm

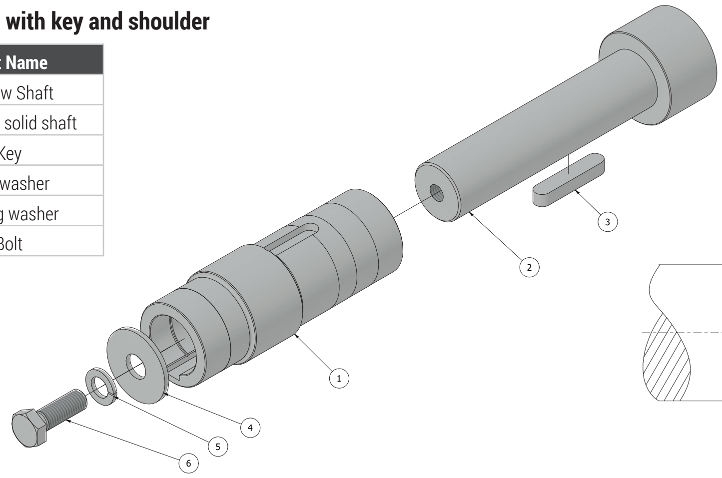
To mount the torque arm, mount the **[1]**torque arm to the gearbox and bolt it down with **[2]** spring washer and **[3]** bolts of the right size. Attach the holding **[4]**bolt with a **[5]** washer, through the hole of the **[7]**rubber insert. Add another **[5]**washer on the opposite side of the **[7]**rubber insert and attach the **[6]** nut hand tight to the holding **[4]**bolt.



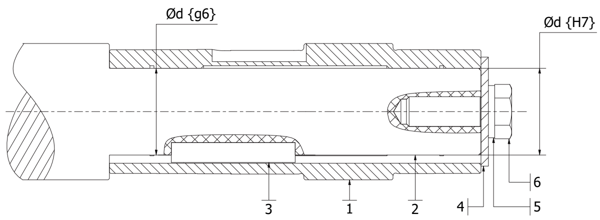
nr.	Part Name
1	Torque arm
2	Spring washer
3	Bolt
4	Bolt
5	Washer
6	Nut
7	Rubber insert

Hollow shaft with key and shoulder

nr.	Part Name
1	Hollow Shaft
2	Machine solid shaft
3	Key
4	Flat washer
5	Spring washer
6	Bolt

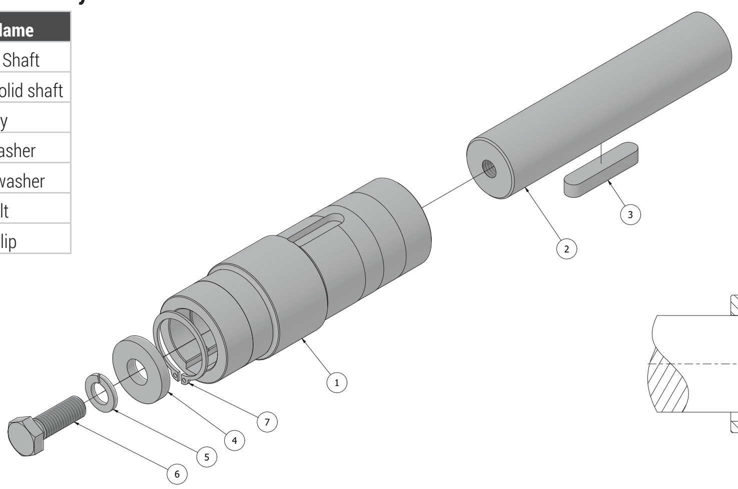


A machine shaft with a key and shoulder is usually held in place with a bolt, a lock washer and a flat washer on the outside of the hollow shaft.

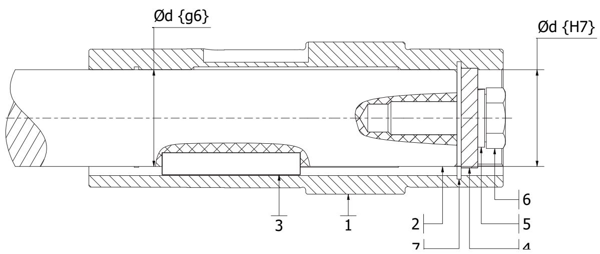


Hollow shaft with key without shoulder

nr.	Part Name
1	Hollow Shaft
2	Machine solid shaft
3	Key
4	Flat washer
5	Spring washer
6	Bolt
7	Circlip



A machine shaft with a key and without shoulder is usually held in place with a bolt, lock washer, a thick flat washer and a circlip on the inside of the hollow shaft.

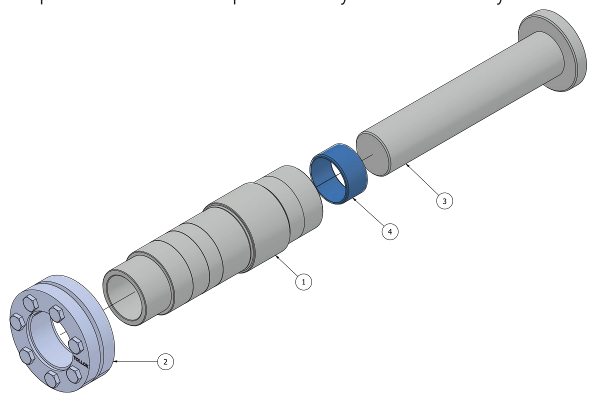


Hollow shaft with a shrink disk

For some applications a shrink disk is preferred, this is a disk that is installed on a longer hollow shaft, which clamps down onto is shaft. This friction holds the machine shaft inside the hollow shaft in place. Because of the friction fit, the machine shaft does not need to have a key in it.

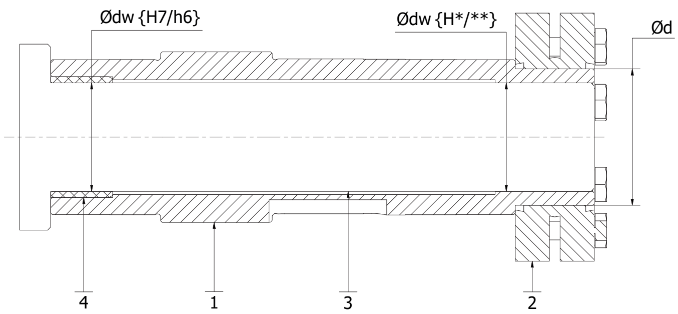
The benefit of a shrink disk is that it provides a way for easy removal of the shaft. Because it is a friction fit, no contact corrosion forms between the shafts, Also it provides an extra fail safe when the machine locks up. The gearbox will not be damaged because the shrink disk will slip when to much torque is applied. A shrink disk provides fast and simple assembly and disassembly. The downside to a shrink disk is that it takes up more space.

nr.	Part Name
1	Hollow Shaft SD
2	Shrinkdisk
3	Machine solid shaft
4	Spacer tube



Shrink disk specifications and installation

The measurements for the machine shaft diameter and the tolerances are shown in the table below. Here the amount of screws and screw type with the tightening torque are also shown.

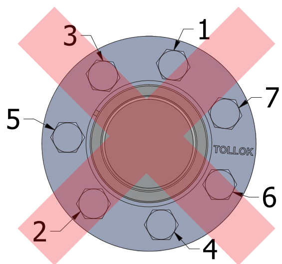


Ød [mm]	Ødw size [mm]	Ødw {H*/**} tolerance	Tightening screws [N° X Type]	Tightening torque [Nm]
14	11-12	H6/j6	4 x M5	4
16	13-14		5 x M5	
24	19-21		6 x M5	
30	24-26		7 x M5	
>30	24-26	H6/h6		
36	28-31		5 x M6	12
44	32-36		7 x M6	
50	38-42		8 x M6	
>50	38-42	H6/g6		
55	42-48			
62	48-52		10 x M6	
68	50-55			
75	55-65		7 x M8	30
80	60-75			
>80	60-75	H7/g9		

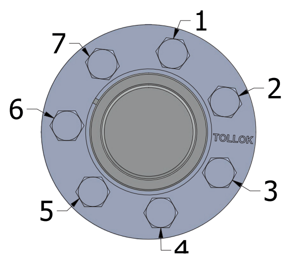
In order to ensure the shrinkdisk is used correctly the following has to be taken into account:

- When the shrink disk is untightened, make sure the screws don't get loosened all the way, this could cause them to fall out.
- When tightening the shrink disk do this in the correct order according to **[B]** with the right amount of torque as shown in the table. If tightening is not done properly situation **[E]** unequally tightening can occur.

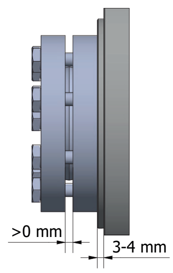
[A] Incorrect tightening order



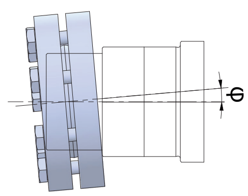
[B] Correct tightening order



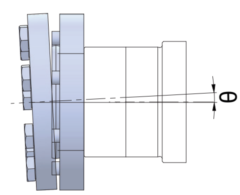
[C] Minumum and maximum clearance



[D] Angular misalignment



[E] Unequally tightened



Possible Geometrical Combinations

Possible Geometrical Combinations

FV 030
Maximum Torque = 21 Nm @ N1 = 1400 r/min

n2 [Min-1]	M2max [Nm]			Fr2 [N]	i	η%			IEC56 B14a	IEC63 B14a
	2 pole	4 pole	6 pole			2 pole	4 pole	6 pole		
186,7	13	18	21	683	7,5	87%	84%	81%	V	V
140	13	18	21	752	10	85%	81%	77%	V	V
93,3	13	18	21	861	15	80%	76%	72%	V	V
70	12	18	21	948	20	77%	73%	69%	V	V
56	15	21	25	1021	25	71%	66%	61%	V	V
46,6	15	20	23	1085	30	70%	65%	60%	V	V
35	14	17	20	1194	40	65%	58%	51%	V	V
28	13	17	20	1286	50	61%	54%	47%	V	V
23,3	11	16	19	1367	60	54%	49%	44%	V	
17,5	9	13	15	1504	80	45%	43%	40%	V	

FV 040
Maximum Torque = 46 Nm @ N1 = 1400 r/min

n2 [Min-1]	M2max [Nm]			Fr2 [N]	i	η%			IEC63 B14a	IEC71 B14a
	2 pole	4 pole	6 pole			2 pole	4 pole	6 pole		
186,7	28	40	44	1315	7,5	86%	85%	85%	V	V
140	29	40	44	1447	10	86%	83%	83%	V	V
93,3	31	40	43	1657	15	85%	79%	78%	V	V
70	29	39	44	1824	20	80%	77%	73%	V	V
56	29	38	44	1964	25	79%	75%	72%	V	V
46,6	35	46	49	2087	30	76%	69%	66%	V	V
35	31	40	47	2298	40	69%	65%	62%	V	V
28	29	39	45	2475	50	68%	61%	57%	V	
23,3	28	37	43	2630	60	64%	57%	53%	V	
17,5	25	33	38	2895	80	58%	51%	45%	V	
14	23	30	34	3118	100	53%	47%	41%	V	

FV 050
Maximum Torque = 86 Nm @ N1 = 1400 r/min

n2 [Min-1]	M2max [Nm]			Fr2 [N]	i	η%			IEC63 B14a	IEC71 B14a	IEC80 B14a
	2 pole	4 pole	6 pole			2 pole	4 pole	6 pole			
186,7	52	69	85	1805	7,5	89%	86%	85%		V	V
140	54	73	84	1987	10	87%	84%	83%		V	V
93,3	56	74	84	2274	15	84%	81%	79%		V	V
70	54	72	77	2503	20	82%	78%	75%		V	V
56	51	70	72	2696	25	79%	75%	73%		V	V
46,6	63	86	90	2865	30	75%	71%	68%		V	V
35	60	76	80	3153	40	73%	67%	63%	V	V	
28	52	74	78	3397	50	70%	63%	59%	V	V	
23,3	51	68	70	3610	60	66%	59%	55%	V	V	
17,5	45	65	68	3973	80	61%	53%	49%	V	V	
14	40	54	60	4280	100	56%	48%	44%	V		

FV 063
Maximum Torque = 159 Nm @ N1 = 1400 r/min

n2 [Min-1]	M2max [Nm]			Fr2 [N]	i	η%			IEC71 B14a	IEC80 B14a	IEC90 B14a
	2 pole	4 pole	6 pole			2 pole	4 pole	6 pole			
186,7	93	130	149	2359	7,5	91%	89%	86%		V	V
140	99	131	155	2597	10	88%	86%	84%		V	V
93,3	103	138	154	2973	15	85%	82%	80%		V	V
70	99	132	145	3272	20	83%	80%	77%		V	V
56	92	129	137	3524	25	80%	77%	74%		V	V
46,6	118	159	170	3745	30	76%	73%	70%		V	V
35	106	145	165	4122	40	73%	69%	65%	V	V	V
28	102	132	145	4440	50	72%	65%	61%	V	V	
23,3	95	128	138	4719	60	69%	62%	58%	V	V	
17,5	86	123	129	5193	80	64%	56%	52%	V	V	
14	78	119	126	5595	100	59%	51%	47%	V		

FV 075
Maximum Torque = 230 Nm @ N1 = 1400 r/min

n2 [Min-1]	M2max [Nm]			Fr2 [N]	i	η%			IEC80 B14a	IEC90 B14a	IEC100 B14a	IEC112 B14a
	2 pole	4 pole	6 pole			2 pole	4 pole	6 pole				
186,7	129	186	216	2785	7,5	89%	88%	86%		V	V	V
140	144	194	227	3065	10	88%	87%	84%		V	V	V
93,3	149	205	235	3509	15	86%	84%	81%		V	V	V
70	164	212	236	3862	20	84%	81%	78%	V	V		
56	152	199	214	4160	25	82%	79%	75%	V	V		
46,7	172	230	255	4421	30	79%	76%	71%	V	V		
35	166	218	234	4865	40	76%	72%	67%	V	V		
28	197	207	222	5241	50	73%	68%	63%	V			
23,3	173	200	211	5569	60	70%	64%	60%	V			
17,5	132	192	203	6130	80	66%	59%	55%	V			
14	122	182	191	6603	100	62%	55%	50%	V			

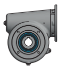
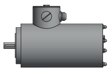
FV 090
Maximum Torque = 420 Nm @ N1 = 1400 r/min

n2 [Min-1]	M2max [Nm]			Fr2 [N]	i	η%			IEC80 B14a	IEC90 B14a	IEC100 B14a	IEC112 B14a
	2 pole	4 pole	6 pole			2 pole	4 pole	6 pole				
186,7	212	290	339	3081	7,5	91%	89%	88%		V	V	V
140	236	307	366	3391	10	90%	88%	86%		V	V	V
93,3	261	359	412	3882	15	0%	85%	83%		V	V	V
70	258	352	383	4273	20	86%	83%	81%		V	V	V
56	254	332	368	4603	25	85%	81%	78%		V	V	V
46,7	315	420	468	4891	30	82%	78%	75%		V	V	V
35	284	359	402	5383	40	79%	74%	71%	V	V		
28	258	339	395	5799	50	77%	71%	67%	V	V		
23,3	250	318	351	6163	60	74%	68%	64%	V	V		
17,5	230	284	309	6783	80	70%	63%	59%	V			
14	201	269	280	7306	100	66%	59%	54%	V			

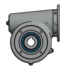
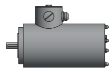
Gearbox Selection Tables

Gearbox Selection Tables

0,06 - 0,18 kW

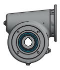
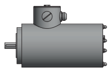
P1 [kW]	n2 [Min-1]	M2 [Nm]	i	Fr2 [N]	fs (gear-box)		
0,06	186,7	2,6	7,5	683	7,0	FV 030 IEC56	561-4 B14A
	140	3,3	10	752	5,4		
	93,3	4,7	15	861	3,9		
	70	5,9	20	948	3,1		
	56	6,8	25	1021	3,1		
	46,7	7,9	30	1085	2,5		
	35	9,7	40	1194	1,9		
	28	11	50	1286	1,5		
	23,3	12	60	1367	1,3		
0,09	186,7	3,9	7,5	683	4,7	FV 030 IEC56	562-4 B14A
	140	5	10	752	3,6		
	93,3	7	15	861	2,6		
	70	8,8	20	948	2,0		
	56	10	25	1021	2,1		
	46,7	12	30	1085	1,7		
	35	14	40	1194	1,2		
	28	17	50	1286	1,0		
0,12	186,7	5,2	7,5	683	3,5	FV030 IEC63	631-4 B14A
	140	6,6	10	752	2,7		
	93,3	9,3	15	861	1,9		
	70	12	20	948	1,5		
	56	14	25	1021	1,6		
	46,7	16	30	1085	1,3		
	46,7	17	30	2087	2,7	FV 040 IEC63	631-4 B14A
	35	21	40	2298	1,9		
	28	25	50	2475	1,6		
	23,3	28	60	2630	1,3		
	17,5	33	80	2895	1,0		
	23,3	29	60	3610	2,3	FV 050 IEC63	631-4 B14A
	17,5	35	80	3973	1,9		
	14	39	100	4280	1,4		
0,18	186,7	7,7	7,5	683	2,3	FV 030 IEC63	632-4 B14A
	140	10	10	752	1,8		
	93,3	14	15	861	1,3		
	70	18	20	948	1,0		
	56	20	25	1021	1,0		
	70	19	20	1824	2,1	FV 040 IEC63	632-4 B14A
	56	23	25	1964	1,7		
	46,7	25	30	2087	1,8		
	35	32	40	2298	1,3		
	28	37	50	2475	1,0		

0,18kW - 0,25 kW

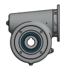
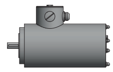
P1 [kW]	n2 [Min-1]	M2 [Nm]	i	Fr2 [N]	fs (gear-box)		
0,18	45	28	20	2113	1,6	FV 040 IEC71	711-6 B14A
	36	34	25	2276	1,3		
	30	38	30	2419	1,3		
	22,5	47	40	2662	1,0		
	35	33	40	3153	2,3	FV 050 IEC63	632-4B 14A
	28	39	50	3397	1,9		
	23,3	43	60	3610	1,6		
	17,5	52	80	3973	1,2		
	18	56	50	3936	1,4	FV 050 IEC71	711-6 B14A
	15	63	60	4183	1,1		
	15	66	60	5467	2,1	FV 063 IEC71	711-6 B14A
	11,3	79	80	6018	1,6		
	9	90	100	6270	1,4		
0,25	186,7	11	7,5	1315	3,6	FV 040 IEC71	711-4 B14A
	140	14	10	1447	2,8		
	93,3	20	15	1657	2,0		
	70	26	20	1824	1,5		
	56	32	25	1964	1,2		
	46,7	35	30	2087	1,3		
	120	17	7,5	1524	2,6	FV 040 IEC71	712-6 B14A
	90	22	10	1677	2,0		
	60	31	15	1920	1,4		
	45	39	20	2113	1,1		
	70	27	20	2503	2,7	FV 050 IEC71	711-4 B14A
	56	32	25	2696	2,2		
	46,7	36	30	2865	2,3		
	35	46	40	3153	1,7		
	28	54	50	3397	1,4		
	23,3	60	60	3610	1,1		
	45	40	20	2900	1,9	FV 050 IEC71	712-6 B14A
	36	48	25	3124	1,5		
	30	54	30	3320	1,7		
	22,5	67	40	3654	1,2		
	18	78	50	3936	1,0		
	28	55	50	4440	2,4	FV 063 IEC71	711-4 B14A
	23,3	63	60	4719	2,0		
	17,5	76	80	5193	1,6		
	14	87	100	5595	1,4		
	18	81	50	5145	1,8	FV063 IEC71	712-6 B14A
	15	92	60	5467	1,5		
	11,3	110	80	6018	1,2		
	9	125	100	6270	1,0		
	17,5	80	80	6130	2,4	FV075 IEC71	711-4 B14A
	14	94	100	6603	1,9		
	11,3	117	80	7103	1,7	FV075 IEC71	712-6 B14A
	9	133	100	7380	1,4		

P_{1n} = Rated Motor Power [kW]
n_2 = Output Speed [Min^{-1}]
M_{2n} = Rated Output torque [Nm]
M_{2max} = Maximum permissible output torque [Nm]
F_{r2} = Permitted Overhung Load Output Side [N]
i = Gear unit Ratio
η% = Transmission Efficiency %
fs = Service Factor

0,37 - 0,55 kW

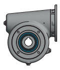
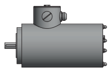
P1 [kW]	n2 [Min-1]	M2 [Nm]	i	Fr2 [N]	fs (gear-box)		
0,37	186,7	16	7,5	1315	2,5	FV040 IEC71	712-4 B14a
	140	21	10	1447	1,9		
	93,3	30	15	1657	1,3		
	70	39	20	1824	1,0		
	140	21	10	1987	3,4	FV050 IEC71	712-4 B14a
	93,3	31	15	2274	2,4		
	70	39	20	2503	1,9		
	56	47	25	2696	1,5		
	46,7	54	30	2865	1,6		
	35	68	40	3153	1,1		
	120	25	7,5	2091	3,4	FV050 IEC80	801-6 B14a
	90	33	10	2302	2,6		
	60	47	15	2635	1,8		
	45	59	20	2900	1,3		
	36	72	25	3124	1,0		
	30	80	30	3320	1,1		
	35	70	40	4122	2,1	FV063 IEC71	712-4 B14a
	28	82	50	4440	1,6		
	23,3	94	60	4719	1,4		
	17,5	113	80	5193	1,1		
	45	60	20	3791	2,4	FV 063 IEC80	801-6 B14A
	36	73	25	4084	1,9		
	30	82	30	4339	2,1		
	22,5	102	40	4776	1,6		
	18	120	50	5145	1,2		
	15	137	60	5467	1,0		
	23,3	97	60	5569	2,1	FV 075 IEC 71	712-4 B14A
	17,5	119	80	6130	1,6		
	14	139	100	6603	1,3		
	18	124	50	6073	1,8	FV 075 IEC80	801-6 B14A
	15	141	60	6453	1,5		
	11,3	173	80	7103	1,2		
	9	196	100	7380	1,0		
	11,3	185	80	7859	1,7	FV 090 IEC80	801-6 B14A
	9	212	100	8180	1,3		
0,55	186,7	24	7,5	1805	2,9	FV050 IEC80	801-4 B14a
	140	32	10	1987	2,3		
	93,3	46	15	2274	1,6		
	70	59	20	2503	1,2		
	56	70	25	2696	1,0		
	46,7	80	30	2865	1,1		
	120	37	7,5	2091	2,3	FV050 IEC80	802-6 B14a
	90	48	10	2302	1,7		
	60	69	15	2635	1,2		

0,55 kW - 0,75 kW

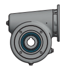
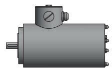
P1 [kW]	n2 [Min-1]	M2 [Nm]	i	Fr2 [N]	fs (gear-box)		
0,55	70	60	20	3272	2,2	FV063 IEC80	801-4 B14a
	56	72	25	3524	1,8		
	46,7	82	30	3745	1,9		
	35	104	40	4122	1,4		
	28	122	50	4440	1,1		
	60	70	15	3444	2,2	FV063 IEC80	802-6 B14a
	45	90	20	3791	1,6		
	36	108	25	4084	1,3		
	30	123	30	4339	1,4		
	22,5	152	40	4776	1,1		
	35	108	40	4865	2,0	FV 075 IEC80	801-4 B14A
	28	128	50	5241	1,6		
	23,3	144	60	5569	1,4		
	17,5	177	80	6130	1,1		
	30	124	30	5122	2,1	FV 075 IEC80	802-6 B14a
	22,5	156	40	5637	1,5		
	18	184	50	6073	1,2		
	15	210	60	6453	1,0		
	17,5	189	80	6783	1,5	FV 090 IEC80	801-4 B14A
	14	221	100	7306	1,2		
	18	196	50	6719	2,0	FV 090 IEC80	802-6 B14A
	15	224	60	7140	1,6		
	11,3	275	80	7859	1,1		
0,75	186,7	33	7,5	1805	2,1	FV050 IEC80	802-4 B14a
	140	43	10	1987	1,7		
	93,3	62	15	2274	1,2		
	93,3	63	15	2973	2,2	FV063 IEC80	802-4 B14a
	70	82	20	3272	1,6		
	56	98	25	3524	1,3		
	46,7	112	30	3745	1,4		
	35	141	40	4122	1,0		
	120	51	7,5	2734	2,9	FV063 IEC90	90S-6 B14a
	90	67	10	3009	2,3		
	60	96	15	3444	1,6		
	45	123	20	3791	1,2		
	56	101	25	4160	2,0	FV 075 IEC80	802-4 B14A
	46,7	117	30	4421	2,0		
	35	147	40	4865	1,5		
	28	174	50	5241	1,2		
	23,3	196	60	5569	1,0		
	60	97	15	4065	2,4	FV 075 IEC90	90S-6 B14A
	45	124	20	4474	1,9		
	36	149	25	4820	1,4		
	30	170	30	5122	1,5		
	22,5	213	40	5637	1,1		

P_{1n} = Rated Motor Power [kW]
n_2 = Output Speed [Min^{-1}]
M_{2n} = Rated Output torque [Nm]
M_{2max} = Maximum permissible output torque [Nm]
F_{r2} = Permitted Overhung Load Output Side [N]
i = Gear unit Ratio
η% = Transmission Efficiency %
fs = Service Factor

0,75 - 1,5 kW

P1 [kW]	n2 [Min-1]	M2 [Nm]	i	Fr2 [N]	fs (gear-box)		
0,75	28	182	50	5799	1,9	FV 090 IEC80	802-4 B14A
	23,3	209	60	6163	1,5		
	17,5	258	80	6783	1,1		
	30	179	30	5667	2,6	FV 090 IEC90	90S-6 B14A
	22,5	226	40	6238	1,8		
	18	267	50	6719	1,5		
	15	306	60	7140	1,1		
1,1	120	75	7,5	2734	2,0	FV 063 IEC90	90L-6 B14A
	90	98	10	3009	1,6		
	60	140	15	3444	1,1		
	186,7	50	7,5	2359	2,6	FV 063 IEC90	90S-4 B14A
	140	65	10	2597	2,0		
	93,3	92	15	2973	1,5		
	70	120	20	3272	1,1		
	56	144	25	3524	0,9		
	46,7	164	30	3745	1,0		
	90	98	10	3551	2,3	FV 075 IEC90	90L-6 B14A
	60	142	15	4065	1,7		
	45	182	20	4474	1,3		
	36	219	25	4820	1,0		
	30	249	30	5122	1,0		
	93,3	95	15	3509	2,1	FV 075 IEC90	90S-4 B14A
	70	122	20	3862	1,7		
	56	148	25	4160	1,3		
	46,7	171	30	4421	1,3		
	35	216	40	4865	1,0		
	36	228	25	5333	1,6	FV 090 IEC90	90L-6 B14A
	30	263	30	5667	1,8		
	22,5	331	40	6238	1,2		
	18	391	50	6719	1,0		
	35	222	40	5383	1,6	FV 090 IEC90	90S-4 B14A
	28	266	50	5799	1,3		
	23,3	306	60	6163	1,0		
1,5	186,7	68	7,5	2359	1,9	FV 063 IEC90	90L-4 B14A
	140	88	10	2597	1,5		
	93,3	126	15	2973	1,1		
	120	103	7,5	3227	2,1	FV 075 IEC100	100L1-6 B14A
	90	134	10	3551	1,7		
	60	193	15	4065	1,2		
	140	89	10	3065	2,2	FV 075 IEC90	90L-4 B14A
	93,3	129	15	3509	1,6		
	70	166	20	3862	1,3		
	56	202	25	4160	1,0		
	46,7	233	30	4421	1,0		

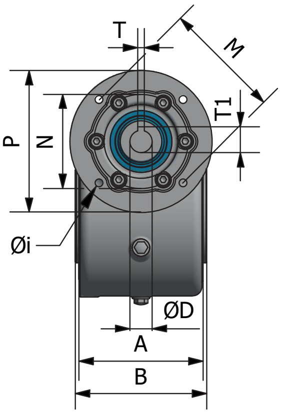
1,5 - 4 kW

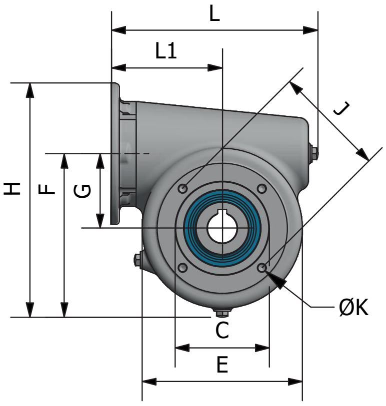
P1 [kW]	n2 [Min-1]	M2 [Nm]	i	Fr2 [N]	fs (gear-box)		
1,5	90	137	10	3929	2,7	FV 090 IEC100	100L1-6 B14A
	60	198	15	4498	2,1		
	45	258	20	4951	1,5		
	36	310	25	5333	1,2		
	30	358	30	5667	1,3		
	70	170	20	4273	2,1	FV 090 IEC90	90L-4 B14A
	56	207	25	4603	1,6		
	46,7	239	30	4891	1,7		
	35	303	40	5383	1,2		
2,2	186,7	99	7,5	2785	1,9	FV 075 IEC100	100L1-4 B14A
	140	131	10	3065	1,5		
	93,3	189	15	3509	1,1		
	186,7	100	7,5	3081	2,9	FV 090 IEC100	100L1-4 B14A
	140	132	10	3391	2,3		
	93,3	191	15	3882	1,9		
	70	249	20	4273	1,4		
	56	304	25	4603	1,1		
	46,7	351	30	4891	1,2		
	120	154	7,5	3570	2,2	FV 090 IEC112	112M-6 B14A
	90	201	10	3929	1,8		
	60	291	15	4498	1,4		
	45	378	20	4951	1,0		
3	186,7	135	7,5	2785	1,4	FV 075 IEC100	100L2-4 B14A
	140	178	10	3065	1,1		
	186,7	137	7,5	3081	2,1	FV 090 IEC100	100L2-4 B14A
	140	180	10	3391	1,7		
	93,3	261	15	3882	1,4		
	70	340	20	4273	1,0		
4	186,7	180	7,5	2785	1,0	FV 075 IEC112	112M-4 B14A
	186,7	182	7,5	3081	1,6	FV 090 IEC112	112M-4 B14A

P_{1n} = Rated Motor Power [kW]
n_2 = Output Speed [Min^{-1}]
M_{2n} = Rated Output torque [Nm]
M_{2max} = Maximum permissible output torque [Nm]
F_{r2} = Permitted Overhung Load Output Side [N]
i = Gear unit Ratio
η% = Transmission Efficiency %
fs = Service Factor

General Dimensions

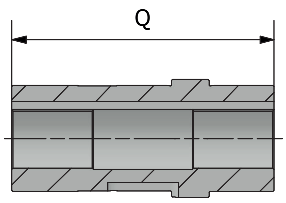
General dimensions

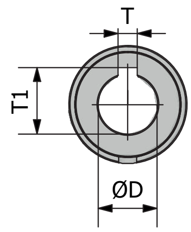


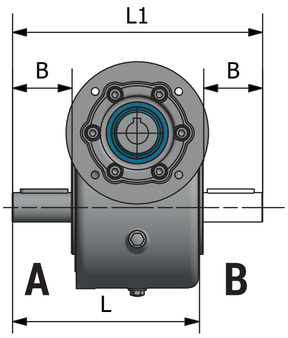


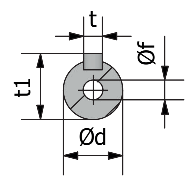
Gearbox	Motor Type	A	B	C	ØD	E	F	G	H	Øi	J	ØK	L	L1	M	N	P	T	T1
FV 030	IEC 56B14A	58	63	55	9	75	75	30	115	5,5	65	4xM6	104	54,5	65	50	80	3	10,2
	IEC 63B14A				11				120						75	60	90	4	12,8
FV 040	IEC 63B14A	73	78	60	11	90	97	40	142	5,5	75	4xM6	128	69,5	75	60	90	4	12,8
	IEC 71B14A				14				150	6,5					85	70	105	5	16,3
FV 050	IEC 63B14A	87	92	70	11	100	118	50	163	5,5	85	4xM8	144	79,5	75	60	90	4	12,8
	IEC 71B14A				14				171	6,5					85	70	105	5	16,3
	IEC 80B14A				19				178	7					100	80	120	6	21,8
FV 063	IEC 71B14A	105	111	80	14	110	139	63	184	6,5	95	4xM8	176	95	85	70	105	5	16,3
	IEC 80B14A				19				192				175	94	100	80	120	6	21,8
	IEC 90B14A				24				199	8,5					115	95	140	8	27,3
FV 075	IEC 80B14A	124	130	95	19	140	168	75	228	7	115	8xM8	207	112,5	100	80	120	6	21,8
	IEC 90B14A				24				238	9					115	95	140	8	27,3
	IEC 100B14A				28				248						130	110	160		31,3
	IEC 112B14A															110			
FV 090	IEC 80B14A	134	140	110	19	160	198	90	258	7	130	8xM10	241	129,5	100	80	120	6	21,8
	IEC 90B14A				24				268	9					115	95	140	8	27,3
	IEC 100B14A				28				278						130	110	160		31,3
	IEC 112B14A																		

Hollow shaft & Solid shaft









Hollow shaft

Gearbox	Ø D [H7/h6]	T	T1	Q
FV 030	14	5	16,3	63
FV 040	18	6	20,8	78
FV 050	25	8	28,3	92
FV 063	25	8	28,3	111
FV 075	28	8	31,3	130
FV 090	35	10	38,3	140

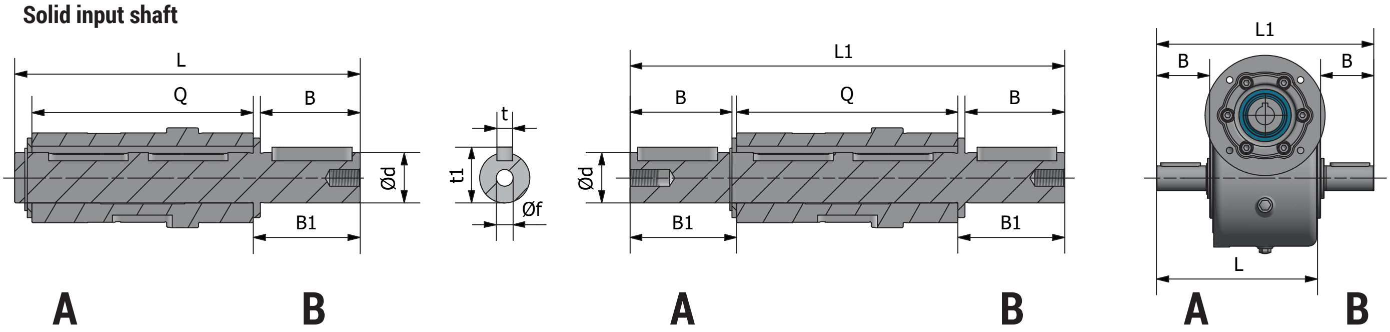
Different solid shaft dimensions possible on request

Solid shaft

Gearbox	Ød[g7]	Øf	t	t1	L	L1	B
FV 030	14	M6	5	16	93	123	30
FV 040	18	M6	6	20,5	118	158	40
FV 050	25	M10	8	28	142	192	50
FV 063	25	M10	8	28	162	212	50
FV 075	28	M10	8	31	180	240	60
FV 090	35	M12	10	38	220	300	80

Different solid shaft dimensions possible on request

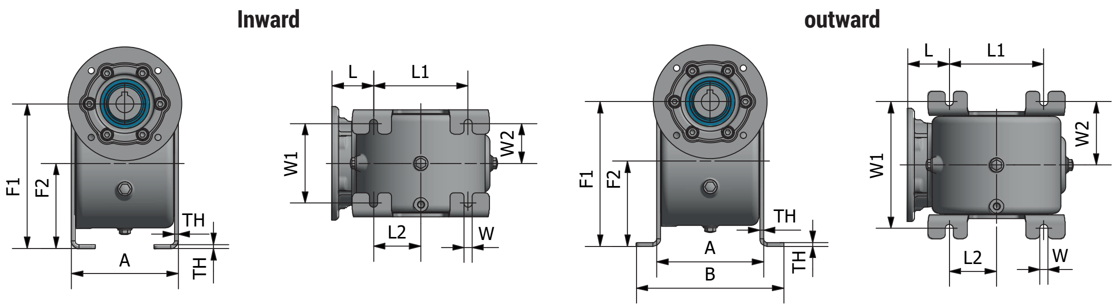
Solid input shaft



Gearbox	Ød[g7]	Øf	t	t1	L	L1	Q	B	B1
FV 030	14	M6	5	16	102	128	63	30	32,5
FV 040	18	M6	6	20,5	128	164	78	40	43
FV 050	25	M10	8	28	153	199	92	50	53,5
FV 063	25	M10	8	28	173	218	111	50	53,5
FV 075	28	M10	8	31	192	257	130	60	63,5
FV 090	35	M12	10	38	234	309	140	80	84,5

Different solid input shaft dimensions possible on request

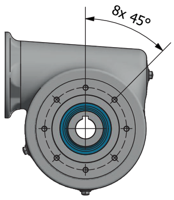
Feet



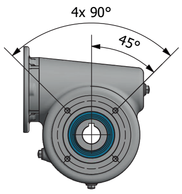
Gearbox	Foot	Position	A	B	F1	F2	L	L (IEC71)	L1	L2	TH	W	W1	W2
FV 030	SS 06 VP60	Inward	64	X	90	60	21,5	22,5	66	33	3	8	20,5	41
		Outward		100									40,5	81
FV 040	SS 075 VP70	Inward	79	X	110	70	34,5	35,5	77	35	3	6,5	30	60
		Outward		109									46	92
FV 050	SS 085 VP80	Inward	93	X	130	80	39,5	40,5	80	40	3	8,5	35	70
		Outward		129									55	110
FV 063	SS 095 VP90	Inward	113	X	153	100	44	45,0	100	50	4	8,5	42	84
		Outward		156									67	134
FV 075	SS 115 VP95	Inward	134	X	170	95	52,5	53,5	120	60	5	11,5	50	100
		Outward		180									79	158
FV 090	SS 130 VP110	Inward	144	X	200	110	59,5	60,5	140	70	5	13	50	100
		Outward		204									89	178

General Dimensions

Hole overview

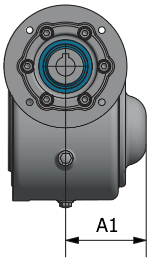


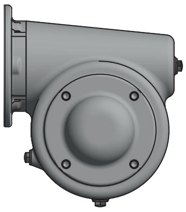
FV 075 & FV 090

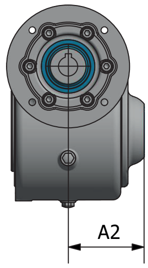


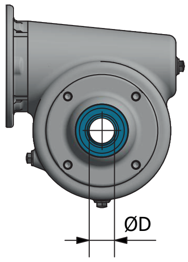
FV 030, 040, 050, 063

Open & Closed cover





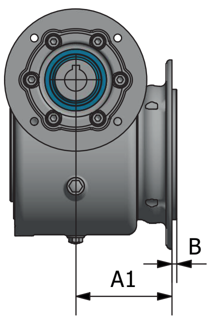


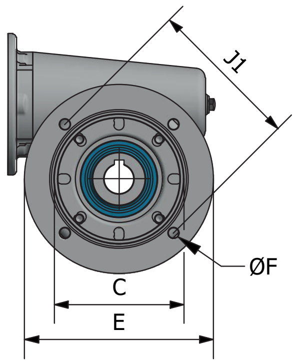


Gearbox	Closed cover	A1
FV 030	SS 065 CC	43
FV 040	SS 075 CC	56,5
FV 050	SS 085 CC	64
FV 063	SS 095 CC	78,5
FV 075	SS 115 CC	90
FV 090	SS 130 CC	95

Gearbox	Open cover	A2	ØD
FV 030	SS 065 CO	43	14
FV 040	SS 075 CO	56,5	18
FV 050	SS 085 CO	64	25
FV 063	SS 095 CO	78,5	25
FV 075	SS 115 CO	90	28
FV 090	SS 130 CO	95	35

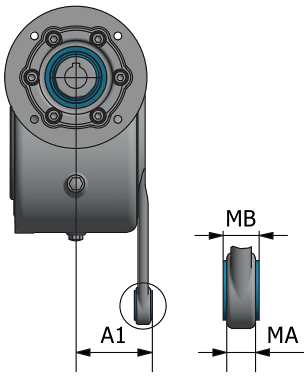
Output flanges

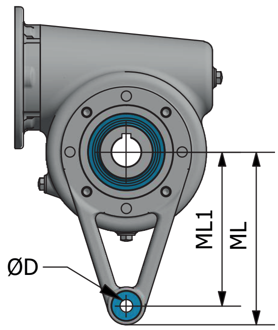




Gearbox	Flange type	A1	B	C	E	ØF	J1
FV 030	SS 065 FL80	62	2	50	80	6,6	68
FV 040	SS 075 FL110	70	2	60	110	8,5	85
	SS 075 FL140			95	140	9,5	115
FV 050	SS 085 FL120	90	2,5	80	120	7	100
	SS 085 FL125		2	70	125	11	85
FV 063	SS 095 FL160	81,5	4	110	160	9	130
	SS 095 FL180	115,5	2	115	180	11	150
FV 075	SS 115 FL200	90	3,5	130	200	11	165
FV 090	SS 130 FL250	93,5	4	180	250	13,5	215

Torque arm

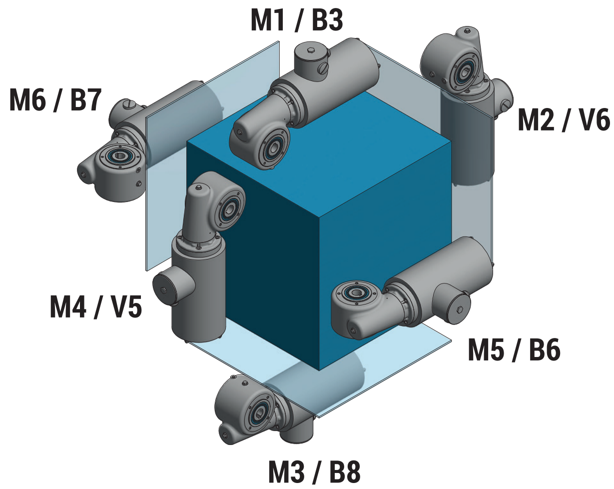




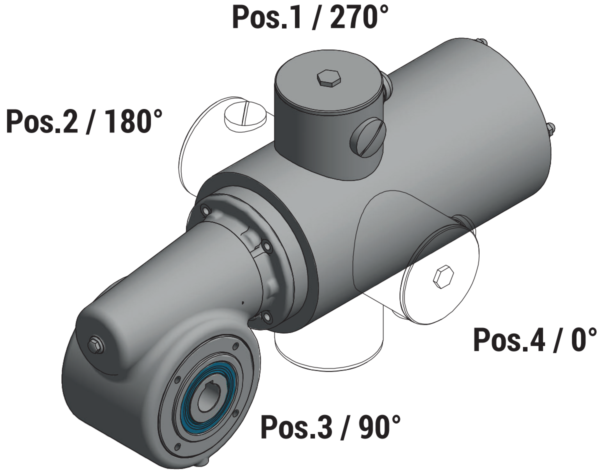
Gearbox	Torque arm	A1	MA	MB	ØD	ML	ML1
FV 030	SS 065 MS L85	40	12	15	10,5	100	85
FV 040	SS 075 MS L100	47,3	12	15	10,5	116	100
FV 050	SS 085 MS L100	55,3	12	15	10,5	116	100
	SS 085 MS L110	55,35	12	15	10,5	126	110
FV 063	SS 095 MS L130	64,35	12	15	10,5	146	130
	SS 095 MS L150	64,3	12	15	10,5	166	150
FV 075	SS 115 MS L160	79,35	23	26	20,5	185	160
	SS 115 MS L200	79,3	23	26	20,5	225	200
FV 090	SS 130 MS L200	85,55	23	26	20,5	225	200

Extra information

Mounting Positions



Terminal Box Positions



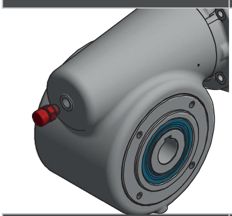
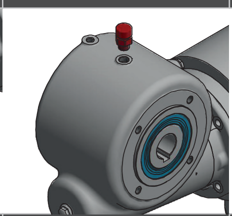
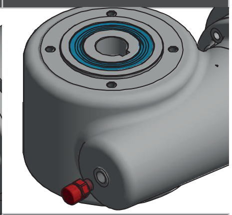
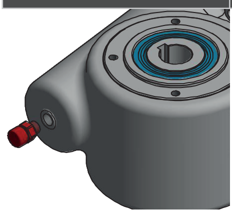
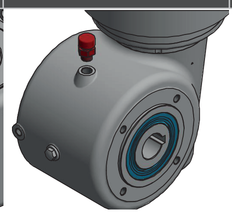
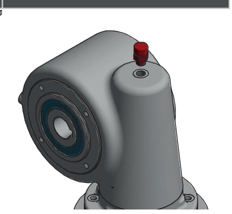
Lubrication Quantity

Oil Quantity	Mounting position					
Gearbox	M1 (B3)	M3 (B8)	M6 (B7)	M5 (B6)	M4 (V5)	M2 (V6)
FV 030	40	40	40	40	40	40
FV 040	75	75	75	75	75	75
FV 050	190	190	190	190	190	190
FV 063	340	340	340	340	340	340
FV 075	440	440	440	440	440	440
FV 090	1200	1200	1200	1200	1200	1200

Lubrication Type

Lubrication brand	Lubrication type	
Matrix	Foodmax 460	Standard
Castrol	Optileb GT 460	Alternative
Bechem	Berusynth 460H1	Alternative
Shell	Casida Fluid GL460	Alternative
Mobil	SHC Cibus 460	Alternative

Debreather Positions

M1 / B3	M3 / B8	M5 / B6
		
M6 / B7	**M4 / V5**	**M2 / V6**
		

Weight

Gearbox	Weight
FV 030	2,1 kg
FV 040	3,7 kg
FV 050	5,7 kg
FV 063	8,9 kg
FV 075	16,4 kg
FV 090	22,0kg

Given values are an average and may vary depending on oil quantity.

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FV Documentation - 1.0
3/3/2022

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Note: Unless otherwise stated all sizes are in millimeters