



**SEW**  
EURODRIVE



# Servo Gearmotors (R, F, K and S Gear Units)

DB130000

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# Catalog





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# 1 The SEW-EURODRIVE Group of Companies

## Introduction

SEW-EURODRIVE is a leading company in the global market for electrical drive engineering. Its global presence, extensive product range and broad spectrum of services make SEW-EURODRIVE the ideal partner for the machinery and plant construction industry when it comes to providing drive systems for demanding applications.

SEW-EURODRIVE possesses many years of experience in drive engineering which it puts to good use when developing, producing and selling all its drives with components drawn from mechanical and electrical engineering and electronics.

The company headquarters are located in Bruchsal, Germany. Components for the SEW-EURODRIVE modular drive system are manufactured to the highest quality standards in production plants sited in Germany, France, Finland, the United States, Brazil and China. The individual drive systems are assembled with a consistently high quality standard and very short delivery times from stocked components in our assembly plants located in more than 30 industrialized countries all over the world. SEW-EURODRIVE sales, consulting, customer and spare parts services are available in more than 50 countries around the globe.

## The product range

- Gearmotors, gear units and motors.
  - Helical gear units/gearmotors
  - Parallel shaft helical gear units/gearmotors
  - Helical-bevel gear units/gearmotors
  - Helical-worm gear units/gearmotors
  - Spiroplan<sup>®</sup> right-angle gearmotors
  - Planetary gearmotors
  - Industrial gear units
  - Low backlash gear units/gearmotors
  - Energy efficient motors
  - Brake motors
  - Drives for overhead trolley systems
  - Geared torque motors
  - Pole-changing gearmotors
  - Helical-bevel servo gear units/gearmotors
  - Planetary servo gear units/gearmotors
  - ASEPTIC Gearmotors
  
- Electronically controlled drives
  - MOVITRAC<sup>®</sup> frequency inverters
  - MOVIDRIVE<sup>®</sup> drive inverters
  - MOVIDYN<sup>®</sup> servo controllers
  - Technology and communication options for the inverters
  - Asynchronous AC motors and AC gearmotors
  - Asynchronous and synchronous servomotors and geared servomotors
  - DC motors, brake motors and gearmotors
  - Asynchronous and synchronous linear motors



- Components for decentralized installation
  - MOVIMOT® gearmotors with integrated frequency inverter
  - MOVI-SWITCH® gearmotors with integrated switching and protection function
  - Field distributors, fieldbus interfaces
- Mechanical variable speed drives
  - VARIBLOC® wide V-belt variable speed gearmotors
  - VARIMOT® friction disc variable speed gearmotors
- Explosion-proof drives to EU directive 94/9/EC for categories 2 and 3
- Services
  - Technical consulting
  - Application software
  - Seminars and training
  - Extensive technical documentation
  - Worldwide customer service

### **Content of the catalog**

This catalog describes the following gear unit types:

- Helical gear units R-..
- Parallel shaft helical gear units F-..
- Helical-bevel gear units K-..
- Helical-worm gear units S-..

in combination with DFS/CFM synchronous servomotors and CT/CV asynchronous servomotors from SEW-EURODRIVE. The catalog contains project planning notes, mounting positions, technical data, selection tables and dimension drawings.

Please refer to separate catalogs for more information about gear units, gearmotors, pole-changing gearmotors, variable speed gearmotors.

### **Other catalogs**

- Low backlash servo gearmotors
- Gearmotors
- Gear units
- MOVIMOT® gearmotors.
- Pole-Changing gearmotors
- Variable speed gearmotors
- Drives for overhead trolley systems
- Explosion-proof drives
- Geared torque motors
- Planetary gearmotors
- Bucket elevator gear units
- Compact gear units
- ASEPTIC Gearmotors

### **Trademark**

HIPERFACE® is a registered trademark of Sick Stegmann GmbH.



## 2 Product Description and Overview of Types

### 2.1 General information

**Power and torque** The details on power and torque given in the catalog refer to mounting position M1 and similar mounting positions, where the input gear stage does not completely run under oil. In addition, the gearmotors are assumed to be standard versions with standard lubrication and under normal ambient conditions.

**Input speeds** The torque data in this catalog are based on the following input speed:

- $n_e = 1500$  1/min with DFS/CFM synchronous servomotors.
- $n_e = 1400$  1/min with CT/CV asynchronous servomotors.

**Noise levels** The noise levels of all SEW servo gearmotors and servomotors are well within the maximum permitted noise levels laid down by the VDI guideline 2159 for gear units and EN 60034 for motors.

**Coating** The servo gear units, synchronous and asynchronous servomotors and servo gearmotors from SEW-EURODRIVE will be coated as follows:

Type	DFS/CFM synchronous servomotor	CT/CV asynchronous servomotor
Servomotor without gear unit	RAL 9005 black	RAL 7031 blue gray
R / F / K / S servo gearmotor	RAL 7031 blue gray	RAL 7031 blue gray

Special coatings are available on request.

**Weights** Please note that all weights shown in the catalog exclude the oil fill for the gearmotors. The weight varies according to gear unit design and gear unit size. The lubricant fill is dependent on the mounting position, and consequently it is impossible to make any generally valid statements. Refer to "Lubricants" in the "Design and Operating Notes" section for recommended lubricant fill quantities depending on the mounting position. The exact weight is given in the order confirmation.

**Air admission and accessibility** The gearmotors/brake motors must be mounted on the driven machine in such a way that both axially and radially there is enough space left for unimpeded air admission and for the purposes of maintenance of the brake. Please also refer to the notes on the motor dimension sheets in this regard.



***NOCO® fluid for protection against contact corrosion***

As standard, all shaft-mounted gearmotors are supplied with NOCO® fluid, a paste that prevents contact corrosion. Use this paste in accordance with the instructions in the gear unit operating instructions. It facilitates service and stripping down jobs.

NOCO® fluid is food grade according to USDA-H1. You can tell that NOCO® fluid is a food grade oil by the USDA-H1 identification label on its packaging.

***Brake motors***

On request, motors and gearmotors can be supplied with an integrated mechanical brake. The SEW-EURODRIVE brake is an electromagnetic disk brake with a DC coil that releases electrically and brakes using spring force. The design principle means the brake is applied if the power fails. This means it complies with fundamental safety requirements.

The brake can also be released mechanically if equipped with manual brake release. A hand lever that springs back automatically is supplied with the brake. Manual brake release is not available with DFS servomotors. The brake is activated by a brake control system accommodated either in the wiring space of the motor or in the control cabinet.

A significant feature of the brakes is their very short length. The integrated construction of the SEW-EURODRIVE brake motor permits particularly compact and sturdy solutions.

***Reduced backlash version***

Gear units with reduced backlash in helical, parallel shaft helical and helical-bevel design are available as of gear unit size 37. The circumferential backlash of these gear units is considerably less than that of the standard versions so that positioning tasks can be solved with great precision. The circumferential backlash is specified in angular minutes in the [ ' ] combination overviews. The dimension drawings for the standard versions are applicable.

***International markets***

SEW-EURODRIVE is a member of the AGMA (American Gear Manufacturers' Association), and as such, all its gear units and geared motors conform to AGMA specifications.

We supply motors for connection conditions according to CSA and NEMA standards on request (registered with UL).

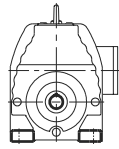
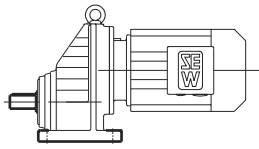


## 2.2 Gearmotor versions

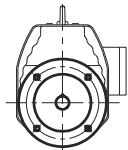
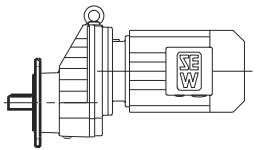
### Helical gearmotors

The following helical gearmotor types can be supplied:

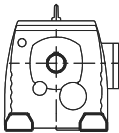
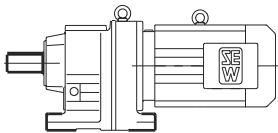
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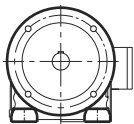
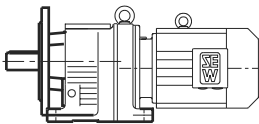
**RX..DS/CM..**  
**RX..CT/CV..**  
Single-stage foot-mounted helical gearmotor



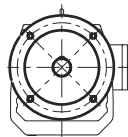
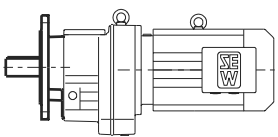
**RXF..DS/CM..**  
**RXF..CT/CV..**  
Single-stage flange-mounted helical gearmotor



**R..DS/CM..**  
**R..CT/CV..**  
Foot-mounted helical gearmotor



**R..F DS/CM**  
**R..F CT/CV..**  
Foot and flange-mounted helical gearmotor



**RF..DS/CM**  
**RF..CT/CV..**  
Flange-mounted helical gearmotor

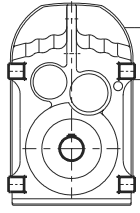
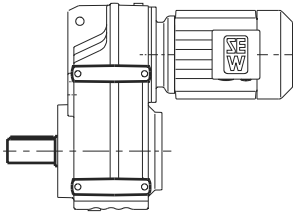
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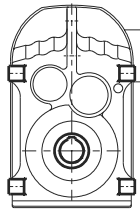
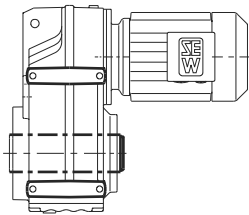
## Product Description and Overview of Types

### Gearmotor versions

**Parallel shaft helical gearmotors** The following parallel shaft helical gearmotor types can be supplied:

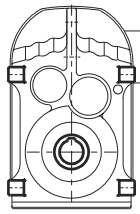
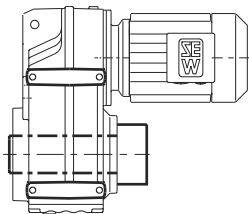


**F..DS/CM..**  
**F..CT/CV..**  
Foot-mounted parallel shaft helical gearmotor

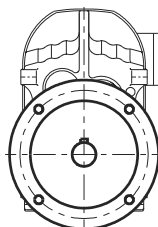
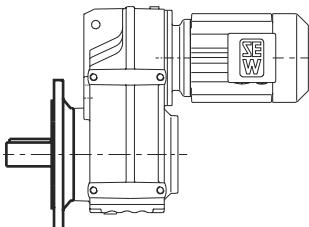


**FA..B DS/CM..**  
**FA..B CT/CV..**  
Foot-mounted parallel shaft helical gearmotor with hollow shaft

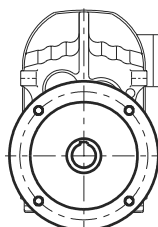
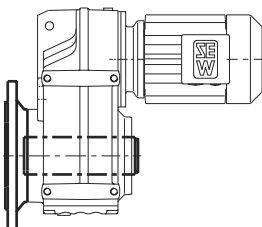
**FV..B DS/CM..**  
**FV..B CT/CV..**  
Foot-mounted parallel shaft helical gearmotor with hollow shaft and splined hollow shaft to DIN 5480



**FH..B DS/CM..**  
**FH..B CT/CV..**  
Foot-mounted parallel shaft helical gearmotor with hollow shaft and shrink disc



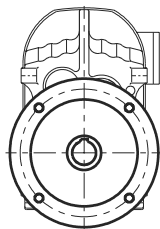
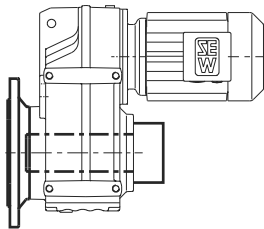
**FF..DS/CM..**  
**FF..CT/CV..**  
Parallel shaft helical gearmotor in B5 flange-mounted version



**FAF..DS/CM..**  
**FAF..CT/CV..**  
Parallel shaft helical gearmotor in B5 flange-mounted version with hollow shaft

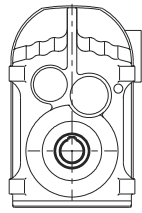
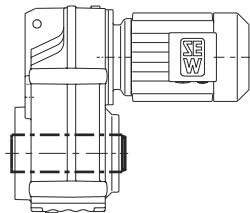
**FVF..DS/CM..**  
**FVF..CT/CV..**  
Parallel shaft helical gearmotor in B5 flange-mounted version with hollow shaft and splined hollow shaft to DIN 5480

03165AXX



**FHF..DS/CM..**  
**FHF..CT/CV..**

Parallel shaft helical gearmotor in B5 flange-mounted version with hollow shaft and shrink disc

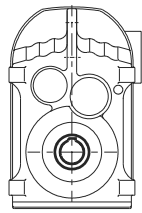
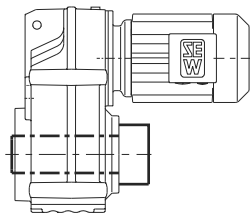


**FA..DS/CM..**  
**FA..CT/CV..**

Parallel shaft helical gearmotor with hollow shaft

**FV..DS/CM..**  
**FV..CT/CV..**

Parallel shaft helical gearmotor with hollow shaft and splined hollow shaft to DIN 5480

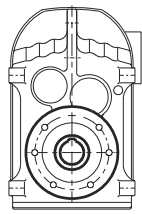
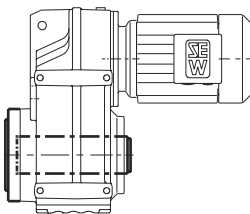


**FH..DS/CM..**  
**FH..CT/CV..**

Parallel shaft helical gearmotor with hollow shaft and shrink disc

**FT..DS/CM..**  
**FT..CT/CV..**

Parallel shaft helical gearmotor with hollow shaft and TorqLOC<sup>®</sup> hollow shaft mounting system

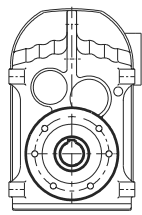
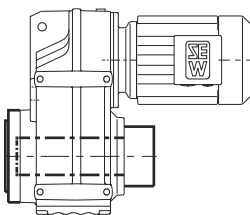


**FAZ..DS/CM..**  
**FAZ..CT/CV..**

Parallel shaft helical gearmotor in B14 flange-mounted version with hollow shaft

**FVZ..DS/CM..**  
**FVZ..CT/CV..**

Parallel shaft helical gearmotor in B14 flange-mounted version with hollow shaft and splined hollow shaft to DIN 5480



**FHZ..DS/CM..**  
**FHZ..CT/CV..**

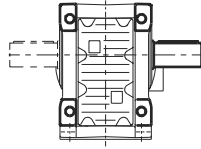
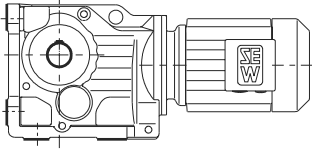
Parallel shaft helical gearmotor in B14 flange-mounted version with hollow shaft and shrink disc

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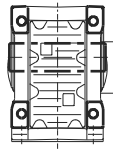
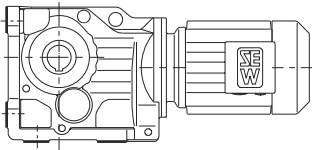


#### Helical-bevel gearmotors

The following helical-bevel gearmotor types can be supplied:

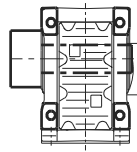
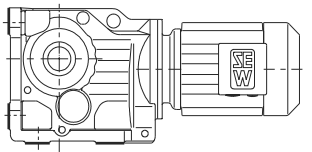


**K..DS/CM..**  
**K..CT/CV..**  
 Foot-mounted helical-bevel gearmotor

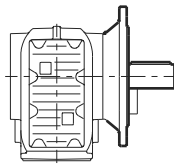
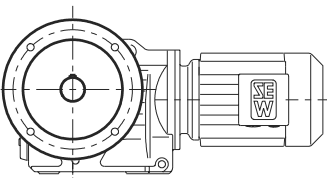


**KA..B DS/CM..**  
**KA..B CT/CV..**  
 Foot-mounted helical-bevel gearmotor with hollow shaft

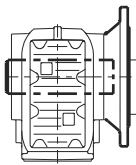
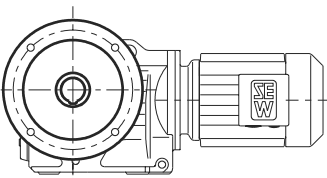
**KV..B DS/CM..**  
**KV..B CT/CV..**  
 Foot-mounted helical-bevel gearmotor with hollow shaft and splined hollow shaft to DIN 5480



**KH..B DS/CM..**  
**KH..B CT/CV..**  
 Foot-mounted helical-bevel gearmotor with hollow shaft and shrink disc



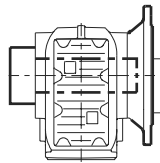
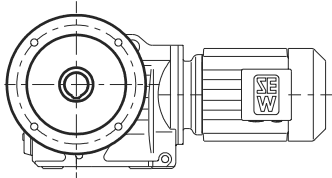
**KF..DS/CM..**  
**KF..CT/CV..**  
 Helical-bevel gearmotor in B5 flange-mounted version



**KAF..DS/CM..**  
**KAF..CT/CV..**  
 Helical-bevel gearmotor in B5 flange-mounted version with hollow shaft

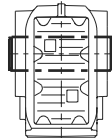
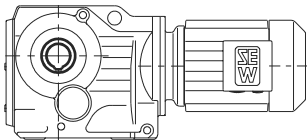
**KVF..DS/CM**  
**KVF..CT/CV..**  
 Helical-bevel gearmotor in B5 flange-mounted version with hollow shaft and splined hollow shaft to DIN 5480

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**KHF..DS/CM..**  
**KHF..CT/CV..**

Helical-bevel gearmotor in B5 flange-mounted version with hollow shaft and shrink disc

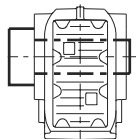
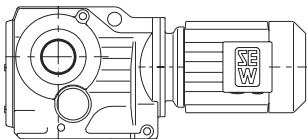


**KA..DS/CM..**  
**KA..CT/CV..**

Helical-bevel gearmotor with hollow shaft

**KV..DS/CM..**  
**KV..CT/CV..**

Helical-bevel gearmotor with hollow shaft and splined hollow shaft to DIN 5480

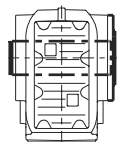
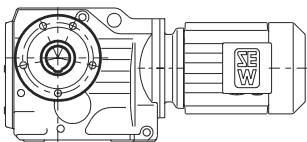


**KH..DS/CM..**  
**KH..CT/CV..**

Helical-bevel gearmotor with hollow shaft and shrink disc

**KT..DS/CM..**  
**KT..CT/CV..**

Helical-bevel gearmotor with hollow shaft and TorqLOC® hollow shaft mounting system

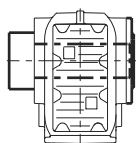
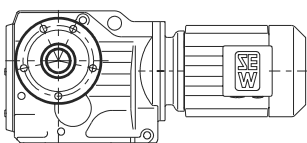


**KAZ..DS/CM..**  
**KAZ..CT/CV..**

Helical-bevel gearmotor in B14 flange-mounted version with hollow shaft

**KVZ..DS/CM..**  
**KVZ..CT/CV..**

Helical-bevel gearmotor in B14 flange-mounted version with hollow shaft and splined hollow shaft to DIN 5480



**KHZ..DS/CM..**  
**KHZ..CT/CV..**

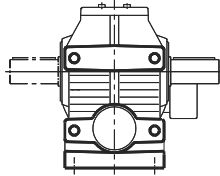
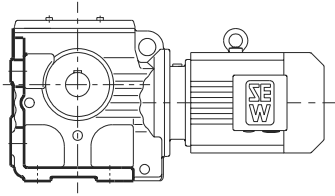
Helical-bevel gearmotor in B14 flange-mounted version with hollow shaft and shrink disc

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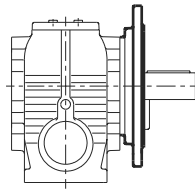
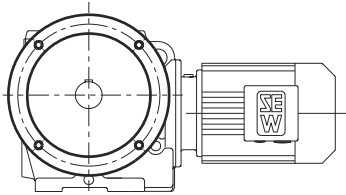


#### Helical-worm gearmotors

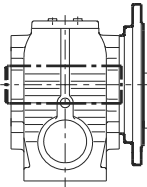
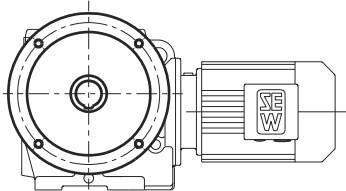
The following helical-worm gearmotor types can be supplied:



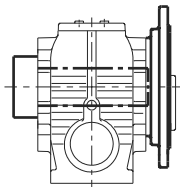
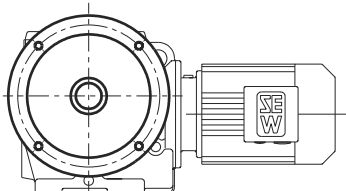
**S..DS/CM..**  
**S..CT/CV..**  
Foot-mounted helical-worm gearmotor



**SF..DS/CM..**  
**SF..CT/CV..**  
Helical-worm gearmotor in B5 flange-mounted version

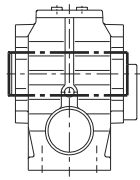
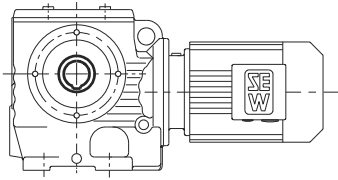


**SAF..DS/CM..**  
**SAF..CT/CV..**  
Helical-worm gearmotor in B5 flange-mounted version with hollow shaft

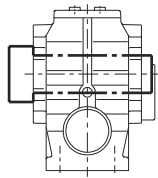
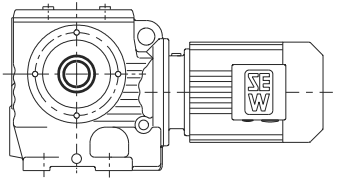


**SHF..DS/CM..**  
**SHF..CT/CV..**  
Helical-worm gearmotor in B5 flange-mounted version with hollow shaft and shrink disc

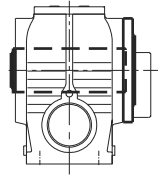
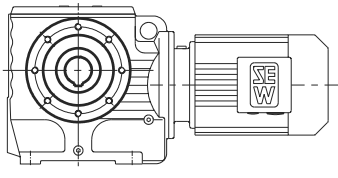
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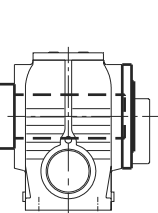
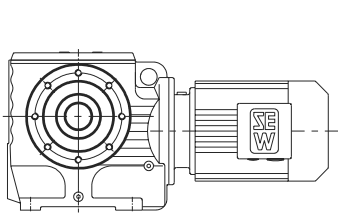
**SA..DS/CM..**  
**SA..CT/CV..**  
Helical-worm gearmotor with hollow shaft



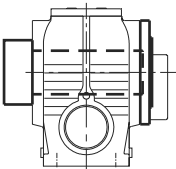
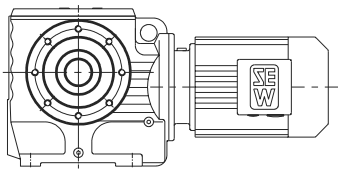
**SH..DS/CM..**  
**SH..CT/CV..**  
Helical-worm gearmotor with hollow shaft and shrink disc



**ST..DS/CM..**  
**ST..CT/CV..**  
Helical-worm gearmotor with hollow shaft and TorqLOC® hollow shaft mounting system



**SAZ..DS/CM..**  
**SAZ..CT/CV..**  
Helical-worm gearmotor in B14 flange-mounted version with hollow shaft



**SHZ..DS/CM..**  
**SHZ..CT/CV..**  
Helical-worm gearmotor in B14 flange-mounted version with hollow shaft and shrink disc

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### **2.3 Unit designations for gear units and options**

#### **Helical gear units**

<i>RX..</i>	Single-stage foot-mounted
<i>RXF..</i>	Single-stage flange-mounted
<i>R..</i>	Foot-mounted
<i>R..F</i>	Foot and flange-mounted
<i>RF..</i>	Flange-mounted

#### **Parallel shaft helical gear unit**

<i>F..</i>	Foot-mounted version
<i>FA..B</i>	Foot-mounted and hollow shaft
<i>FH..B</i>	Foot-mounted and hollow shaft with shrink disc
<i>FV..B</i>	Foot-mounted and splined hollow shaft to DIN 5480
<i>FF..</i>	B5 flange-mounted
<i>FAF..</i>	B5 flange-mounted and hollow shaft
<i>FHF..</i>	B5 flange-mounted and hollow shaft with shrink disc
<i>FVF..</i>	B5 flange-mounted and splined hollow shaft to DIN 5480
<i>FA..</i>	Hollow shaft
<i>FH..</i>	Hollow shaft with shrink disc
<i>FT..</i>	Hollow shaft with TorqLOC® hollow shaft mounting system
<i>FV..</i>	Splined hollow shaft to DIN 5480
<i>FAZ..</i>	B14 flange-mounted and hollow shaft
<i>FHZ..</i>	B14 flange-mounted and hollow shaft with shrink disc
<i>FVZ..</i>	B14 flange-mounted and splined hollow shaft to DIN 5480



**Helical-bevel gear units**

K..	Foot-mounted version
KA..B	Foot-mounted and hollow shaft
KH..B	Foot-mounted and hollow shaft with shrink disc
KV..B	Foot-mounted and splined hollow shaft to DIN 5480
KF..	B5 flange-mounted
KAF..	B5 flange-mounted and hollow shaft
KHF..	B5 flange-mounted and hollow shaft with shrink disc
KVF..	B5 flange-mounted and splined hollow shaft to DIN 5480
KA..	Hollow shaft
KH..	Hollow shaft with shrink disc
KT..	Hollow shaft with TorqLOC® hollow shaft mounting system
KV..	Splined hollow shaft to DIN 5480
KAZ..	B14 flange-mounted and hollow shaft
KHZ..	B14 flange-mounted and hollow shaft with shrink disc
KVZ..	B14 flange-mounted and splined hollow shaft to DIN 5480

**Helical-worm gear unit**

S..	Foot-mounted version
SF..	B5 flange-mounted
SAF..	B5 flange-mounted and hollow shaft
SHF..	B5 flange-mounted and hollow shaft with shrink disc
SA..	Hollow shaft
SH..	Hollow shaft with shrink disc
ST..	Hollow shaft with TorqLOC® hollow shaft mounting system
SAZ..	B14 flange-mounted and hollow shaft
SHZ..	B14 flange-mounted and hollow shaft with shrink disc

**R, F, K gear unit option**

/R Reduced backlash

**K and S gear unit option**

/T with torque arm

**F gear unit option**

/G with rubber buffer



## 2.4 Unit designations for servomotors and options

### **Synchronous servomotors**

<i>DS...</i>	Motor for mounting to size 56 gear units
<i>DFS...</i>	Size 56 in flange-mounted version
<i>CM...</i>	Motor for mounting to gear units of sizes 71 / 90 / 112
<i>CFM...</i>	Sizes 71 / 90 / 112 in flange-mounted version

### **Standard equipment for synchronous servomotors**

<i>/SM.0</i>	Motor plug connector (socket on motor end only)
<i>/SB.0</i>	Plug connector motor + brake (socket on motor end only)
<i>/RH1M</i>	Resolver
<i>/RH1L</i>	Resolver for brake motors
<i>/TF</i>	Thermistor (PTC resistor)
<i>/KTY</i>	Temperature sensor

### **Synchronous servomotor options**

<i>/B</i>	Size 56 disc brake
<i>/BR</i>	Size 71 / 90 / 112 disc brake
<i>../HR</i>	.. with automatic manual brake release sizes 71 / 90 / 112
<i>/SM..</i>	Motor plug connector with code number for size and connection cross section
<i>/SB..</i>	Plug connector for motor + brake with code number for size and connection cross section
<i>/ES1H</i>	Single-turn HIPERFACE® encoder, spread shaft, size 56 / 71 / 90 / 112
<i>/AS1H</i>	Multi-turn HIPERFACE® encoder, spread shaft, size 56 / 71 / 90 / 112
<i>/AV1H</i>	Multi-turn HIPERFACE® encoder, solid shaft, size 56 / 71 / 90 / 112
<i>/AV1Y</i>	Multi-turn SSI encoder, solid shaft, size 56
<i>/VR</i>	Forced cooling fan
<i>/KK</i>	Terminal box
<i>/KK5</i>	Terminal box for radial encoder
<i>/KK6</i>	Terminal box for axial encoder



**Asynchronous servomotors**

CT...	Foot-mounted / attached motor sizes 71 ... 90
CFT...	Flange mounted sizes 71 ... 90
CV...	Foot-mounted / attached motor sizes 100 ... 200
CFV...	Flange mounted sizes 100 ... 200

**Standard equipment for asynchronous servomotors**

/TF	Thermistor (PTC resistor)
/ES1S	Encoder with spread shaft, sin/cos signals, sizes 71 ... 100
/ES2S	Encoder with spread shaft, sin/cos signals, sizes 112M ... 132S
/EV1S	Encoder with solid shaft, sin/cos signals, sizes 132M ... 200

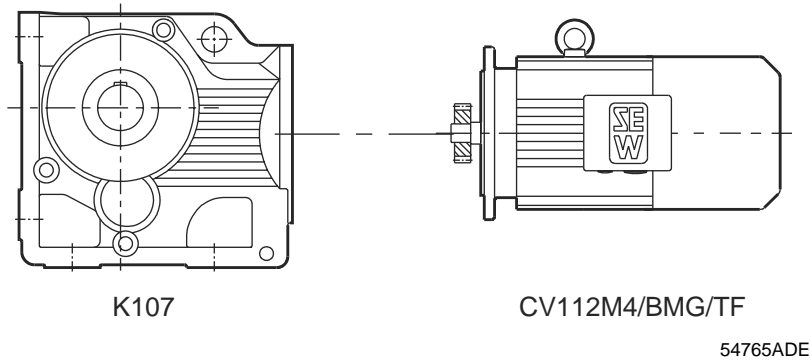
**Asynchronous servomotor options**

/BM(G)	Disk brake
../HF	.. with lockable manual brake release
../HR	.. with automatic manual brake release
/TH	Thermostat (bimetallic switch)
/V	Forced cooling fan, three-phase current, sizes 132M ... 200
/VR	Forced cooling fan, direct current, sizes 71 ... 132S
/VS	Forced cooling fan, single-phase alternating current, sizes 71 ... 132S
/C	Protection canopy for the fan guard
/ES1R	Encoder with spread shaft, TTL (RS-422), sizes 71 ... 100
/ES2R	Encoder with spread shaft, TTL (RS-422), sizes 112 .. 132S
/EV1R	Encoder with solid shaft, TTL (RS-422), sizes 71 ... 200
/EV1S	Encoder with solid shaft, sin/cos signals, sizes 71 ... 132S
/AV1Y	Multi-turn SSI encoder, solid shaft
/AV1A	Multi-turn HIPERFACE® encoder, solid shaft
/EV1A	Mounting device for encoders with solid shaft
/IS	Integrated plug connector
A..7	HAN.. plug connector (Harting)

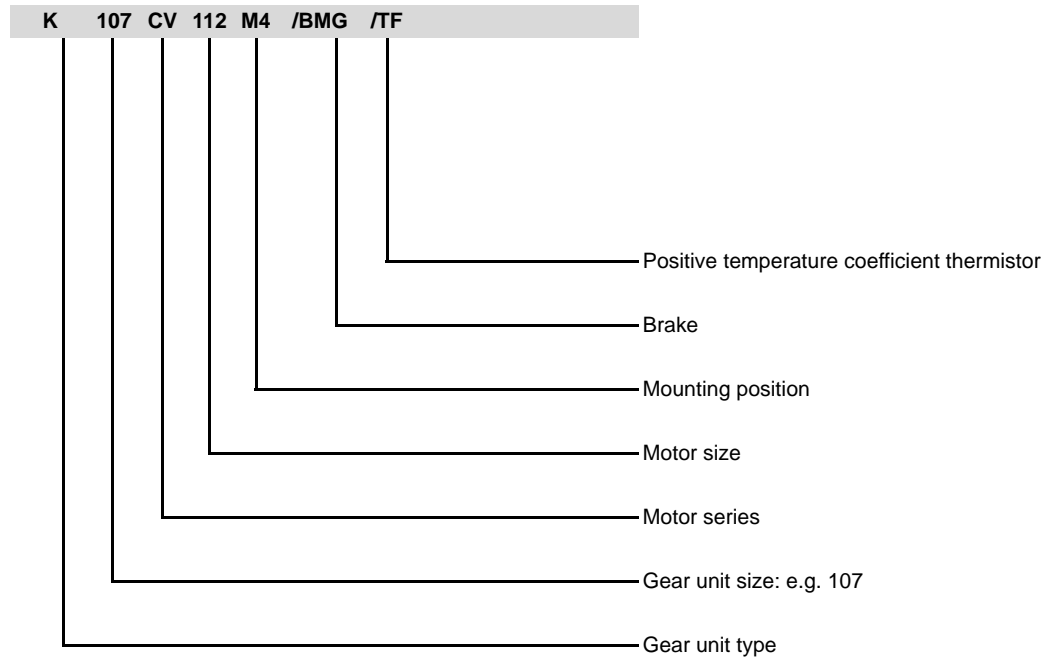


**Product Description and Overview of Types**  
Unit designations for servomotors and options

Example: Order code for helical-bevel servo gearmotors



For example, a helical-bevel servomotor with brake and positive temperature coefficient thermistor has the following unit designation:



**Note!**

The nameplate of the K... helical-bevel servo gearmotor is fixed to the servomotor!



## 2.5 Corrosion and surface protection

### General

SEW-EURODRIVE offers various optional protective measures for operating motors and gear units under special ambient conditions.

The protective measures are made up of two groups:

- Corrosion protection KS for motors
- Surface protection OS for motors and gear units

For motors, optimum protection is offered by a combination of corrosion protection KS and surface protection OS.

In addition, special optional protective measures for the output shafts are also possible.

### Corrosion protection KS

Corrosion protection KS for motors comprises the following measures:

- All retaining screws that are removed in operation are made from stainless steel.
- The nameplates are made from stainless steel.
- Various motor components are provided with a top coating.
- The flange contact surfaces and shaft ends are treated with a temporary anti-corrosion agent.
- Additional measures for brake motors.

A sticker labeled "KORROSIONSSCHUTZ" (corrosion protection) indicates special treatment has been applied.



Motors with a forced cooling fan and motors with a spread shaft encoder (ES..) cannot be supplied with corrosion protection KS.



#### Surface protection OS

Instead of the standard surface protection, motors and gear units are optionally available with exterior surface protection OS1, OS2, OS3 or OS4. The special procedure "Z" can also be performed in addition to OS1, OS2, OS3 and OS4. The special procedure "Z" means that large surface recesses are sprayed with a rubber filling prior to painting.

Surface protection	Coating structure	Required coating thickness (nominal dry film thickness) DIN EN ISO 12944-5 [NDFT]	Suitable for
<b>Standard</b>	1 × dip priming 1 × one-pack topcoat	70 µm	<ul style="list-style-type: none"> <li>• Normal environmental impact</li> <li>• Relative humidity below 90 %</li> <li>• Surface temperature up to max. 120 °C</li> <li>• Corrosivity category C1<sup>1)</sup></li> </ul>
<b>OS1</b>	1 × dip priming 1 × two-pack base coat 1 × two-pack varnish	150 µm	<ul style="list-style-type: none"> <li>• Low environmental impact</li> <li>• Relative humidity max. 95 %</li> <li>• Surface temperature up to max. 120 °C</li> <li>• Corrosivity category C2<sup>1)</sup></li> </ul>
<b>OS2</b>	1 × dip priming 2 × two-pack base coat 1 × two-pack varnish	210 µm	<ul style="list-style-type: none"> <li>• Medium environmental impact</li> <li>• Relative humidity up to 100 %</li> <li>• Surface temperature up to max. 120 °C</li> <li>• Corrosivity category C3<sup>1)</sup></li> </ul>
<b>OS3</b>	1 × dip priming 2 × two-pack base coat 2 × two-pack varnish	270 µm	<ul style="list-style-type: none"> <li>• High environmental impact</li> <li>• Relative humidity up to 100 %</li> <li>• Surface temperature up to max. 120 °C</li> <li>• Corrosivity category C4<sup>1)</sup></li> </ul>
<b>OS4</b>	1 × dip primer 2 × two-pack base coat 2 × two-pack varnish	320 µm	<ul style="list-style-type: none"> <li>• Very high environmental impact</li> <li>• Relative humidity up to 100 %</li> <li>• Surface temperature up to 120 °C</li> <li>• Corrosivity category C5-I<sup>1)</sup></li> </ul>

1) according to DIN EN ISO 12 944-2

#### Special protective measures

Gearmotor output shafts can be treated with special optional protective measures for operation subject to severe environmental pollution or in particularly demanding applications.

Action	Protection principle	Suitable for
<b>Kanisil coating</b>	Surface coating of the contact surface of the oil seal	Severe environmental pollution and in conjunction with FKM oil seal (Viton)
<b>Stainless steel output shaft</b>	Surface protection through high-quality material	Particularly exacting applications in terms of exterior surface protection

#### NOCO<sup>®</sup> fluid

For more information on NOCO<sup>®</sup> fluid, refer to page 10.



## 2.6 Extended storage

### Version

You can also order gear units prepared for "extended storage." In this case, a VCI (volatile corrosion inhibitor) is added to the lubricant in these gear units. Unless specified otherwise, the gear unit will be provided with exterior surface protection OS1. You can order OS2, OS3 or OS4 instead of OS1.

Surface protection	Suitable for	Corrosivity category to DIN EN ISO 12944-2
OS1	Low environmental impact	C2 (low)
OS2	Medium environmental impact	C3 (moderate)
OS3	High environmental impact	C4 (high)
OS4	Severe environmental impact	C5-I (severe)

### Oil fill

Note the following points concerning the oil fill:

- **Mineral oil (CLP) and synthetic oil (CLP HC):** Gear units will be supplied with an oil fill according to the mounting position (M1 ... M6) and are ready for operation.
- **Synthetic oil (CLP PG):** In some cases, gear units are supplied with an increased oil level. Before startup, adjust the oil level to match the required mounting position (M1 ... M6). The oil fill quantities for gear units are specified in Sec. 5.1 "Lubricants" (→ from page 84).



The gear units must remain tightly sealed until taken into operation to prevent the VCI corrosion protection agent from evaporating.

Always check the oil level before you take the gear unit into operation!

### Storage conditions

Comply with the storage conditions specified in the following table for extended storage:

Climate zone	Packaging <sup>1)</sup>	Storage location	Storage time
Temperate (Europe, USA, Canada, China and Russia, excluding tropical zones)	Packed in containers, with desiccant and moisture indicator sealed in the plastic wrap.	With roof, protected against rain and snow, no shock loads.	Up to three years with regular checks on the packaging and moisture indicator (rel. atmospheric humidity < 50 %).
	Open	With roof, enclosed at constant temperature and atmospheric humidity (5°C < $\vartheta$ < 60°C, < 50% relative atmospheric humidity). No sudden temperature fluctuations and controlled ventilation with filter (free from dirt and dust). No aggressive vapors and no shock loads.	Two years or more given regular inspections. Check for cleanliness and mechanical damage as part of the inspection. Check corrosion protection.
Tropical (Asia, Africa, Central and South America, Australia, New Zealand excluding temperate zones)	Packed in containers, with desiccant and moisture indicator sealed in the plastic wrap. Protected against insect damage and mildew by chemical treatment.	With roof, protected against rain, no shock loads.	Up to three years with regular checks on the packaging and moisture indicator (rel. atmospheric humidity < 50 %).
	Open	With roof, enclosed at constant temperature and atmospheric humidity (5°C < $\vartheta$ < 60°C, < 50% relative atmospheric humidity). No sudden temperature fluctuations and controlled ventilation with filter (free from dirt and dust). No aggressive vapors and no shock loads. Protection against insect damage.	Two years or more given regular inspections. Check for cleanliness and mechanical damage as part of the inspection. Check corrosion protection.

1) Packaging must be performed by an experienced company using the packaging materials that have been expressly specified for the particular application.



### 3 Project Planning

#### 3.1 *Additional documentation*

In addition to the information in this catalog, SEW-EURODRIVE offers extensive documentation covering the entire topic of electrical drive engineering. These are mainly the publications in the "Drive Engineering – Practical Implementation" series as well as the manuals and catalogs for electronically controlled drives. You will find additional links to a wide selection of our documentation in many languages for download on the SEW-EURODRIVE homepage (<http://www.sew-eurodrive.com>). The list below includes other documents that are of interest in terms of project planning. You can order these publications from SEW-EURODRIVE.

#### ***Drive Engineer- ing - Practical Implementation***

- Drive Planning
- Controlled AC Drives
- Servo Drives
- EMC in Drive Engineering
- Explosion-Proof Drives to EU Directive 94/9/EC

#### ***Electronic documentation***

- MOVIDRIVE® MD\_60A system manual
- MOVIDRIVE® MDX60/61B system manual
- MOVIDRIVE® compact system manual

#### ***Mechanical brakes***

- "Brakes and Accessories" manual



### 3.2 Drive and gear unit selection data

Certain data is essential to specify the components for your drive precisely. These are:

Data for drive dimensioning			Your entry
$i$	Gear ratio		
$\varphi$	Circumferential backlash	[ ' ]	
$\eta_G$	Efficiency of gear units		
$n_{a \max}$	Maximum output speed	[min <sup>-1</sup> ]	
$n_{am}$	Mean output speed of the gear unit	[min <sup>-1</sup> ]	
$n_e$	Input speed	[min <sup>-1</sup> ]	
$n_{em}$	Mean input speed	[min <sup>-1</sup> ]	
$J_G$	Mass moment of inertia of the gear unit	[kgm <sup>2</sup> ]	
$J_{ext}$	Mass moment of inertia (external) reduced on motor shaft	[kgm <sup>2</sup> ]	
$J_{Mot}$	Mass moment of inertia of the motor	[kgm <sup>2</sup> ]	
$J_{load}$	Mass moment of inertia of the load	[kgm <sup>2</sup> ]	
$k$	Mass moment of inertia ratio $J_{ext} / J_{Mot}$		
$M_1 \dots M_n$	Output torque in time period $t_1$ to $t_n$	[Nm]	
$M_{DYN}$	Dynamic limit torque of the servomotor	[Nm]	
$M_{a \max}$	Maximum output torque	[Nm]	
$M_{e \max}$	Maximum input torque	[Nm]	
$M_{\max}$	Maximum output torque assumed for the drive in project planning	[Nm]	
$M_a(t)$	Acceleration and braking torque	[Nm]	
$M_{eff}$	Effective torque requirement (in relation to the motor)	[Nm]	
$P_{Br}$	Braking power	[W]	
$P_{Br\_peak}$	Peak braking power	[W]	
$P_{Br\_tn}$	Braking power in section $t_n$	[W]	
$t_1 \dots t_n$	Time period 1 to n	[min]	
$t_z$	Cycle time	[s]	
$F_{Ax}$	Axial load (tension and compression) on the output shaft	[N]	
$F_R$	Overhung load on the output shaft	[N]	
$F_{Ra}$	Permitted overhung load on the output shaft. Assumes force application in center of shaft. If not, please specify the exact application point giving the application angle and direction of rotation of the shaft for recalculation.	[N]	
$F_{RxL}$	Permitted overhung load at point x based on the bearing service life	[N]	
$F_{RxW}$	Permitted overhung load at point x based on the shaft strength	[N]	
$x$	Distance between overhung load application point and shaft shoulder	[mm]	
$a, b, c, f$	Gear unit constants as regards the overhung load conversion		
$S., ..\%cdf$	Duty type and cyclic duration factor (cdf) or exact load cycle can be entered.	-	
Required positioning accuracy and speed range			
<b>R, F, K, S</b>	Required gear unit type and mounting position	-	
<b>M1 - M6</b>	Mounting position (→ Sec. Mounting Positions)	-	
<b>IP..</b>	Required enclosure	-	
$\vartheta_{Um_g}$	Ambient temperature	[°C]	
<b>H</b>	Installation altitude	[m above sea level]	



## Project Planning

### Drive and gear unit selection data

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#### ***Determining application data***

It is first necessary to have data on the machine to be driven (mass, speed, setting range, etc.) to design the drive correctly.

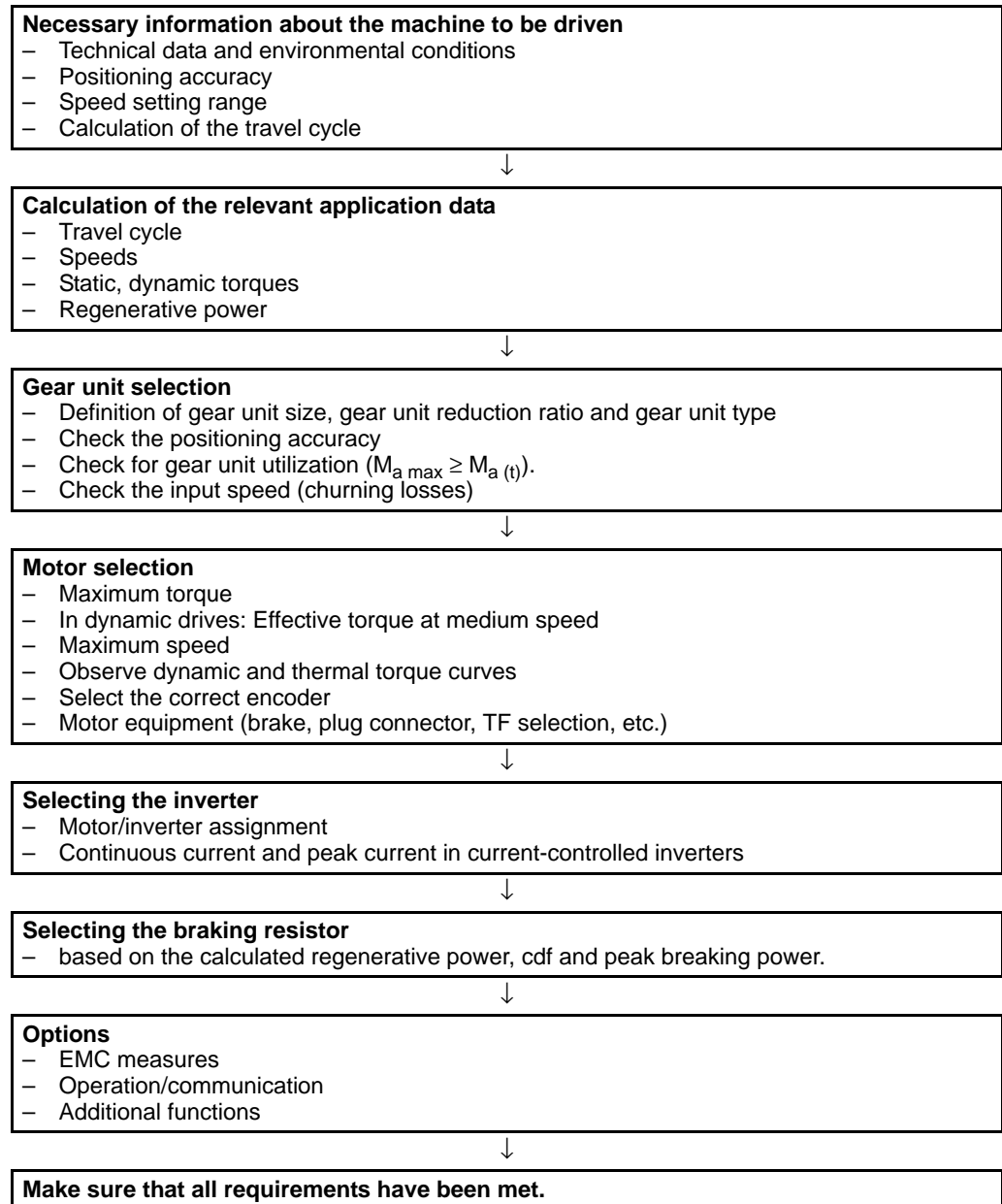
These data help determine the required power, torque and speed. Refer to the "Drive Engineering - Practical Implementation, Drive Planning" publication or the PRODRIVE® project planning software for assistance.



### 3.3 Project planning procedure

**Example**

The following flowchart displays a schematic view of the procedure for planning a project incorporating a positioning drive. The drive consists of a gearmotor that is powered by an inverter.





### 3.4 Project planning for gear units

#### Features of the gear units

The efficiency of gear units is mainly determined by the gearing and bearing friction. Keep in mind that the starting efficiency of a gear unit is always less than its efficiency at operating speed. This factor is especially pronounced in the case of helical-worm gear units.

*R, F, K gear units* The efficiency of helical, parallel shaft and helical-bevel gear units varies with the number of gear stages, between 94 % (3-stage) and 98 % (1-stage).

*S gear units* The gearing of helical-worm gear units produces a high proportion of sliding friction. As a result, these gear units may have higher gearing losses than R, F or K gear units and thus be less efficient.

The efficiency depends on the following factors:

- Gear ratio of the helical-worm gear stage
- Input speed
- Gear unit temperature

SEW gear units are designed as helical worm which makes them significantly more efficient than straightforward worm gear units. The efficiency may reach  $\eta < 0.5$  if the helical-worm gear stage has a very high gear ratio.

*Self-locking* Retrodriving torques on helical-worm gear units produce an efficiency of  $\eta' = 2 - 1/\eta$ , which is significantly less favorable than the forward efficiency  $\eta$ . The helical-worm gear unit is self-locking if the forward efficiency  $\eta \leq 0.5$ . Contact SEW-EURODRIVE if you wish to make technical use of the braking effect of self-locking characteristics.

*Run-in phase* The tooth flanks of new helical-worm gear units are not yet completely smooth. That fact makes for a greater friction angle and less efficiency than during later operation. This effect becomes more apparent the greater the gear ratio. Subtract the following values from the listed efficiency during the run-in phase:

No. of starts	i range	$\eta$ -reduction
2 start	ca. 20 ... 75	ca. 6 %
5 start	ca. 6 ... 25	ca. 3 %

The run-in phase usually lasts 24 hours. The helical-worm gear units achieve their listed rated efficiency values when:

- the gear unit has been run in completely,
- the gear unit has reached nominal operating temperature,
- the recommended lubricant has been filled in and
- the gear unit is working within the rated load range.



*Churning losses*

Churning losses in R, F, K and S gear units are caused by the circulating lubricant. Churning losses depend on the mounting position of the gear unit and the input speed. If possible, use the basic mounting position M1 for R, F, K and S gear units to reduce churning losses to a minimum.

Mean speeds higher than 1500 min<sup>-1</sup> or mounting positions other than M1 require for checking churning losses and the thermal rating. Contact SEW-EURODRIVE in such cases.

*Maximum speeds*

Maximum speeds	
Gear unit sizes	Max. speed
up to 77	4500 min <sup>-1</sup>
87	3900 min <sup>-1</sup>
97	3100 min <sup>-1</sup>
107	2700 min <sup>-1</sup>
127 - 167	2500 min <sup>-1</sup>
187	2000 min <sup>-1</sup>

It is essential to contact SEW-EURODRIVE if higher maximum speeds are involved.

*Design and operating notes*



When input and output elements are mounted on SEW gear units, the **shaft can be used as a stop** for transmission elements (belt pulley, pinion, etc.).



R, F, K gear units can be operated at **ambient temperatures of** between – 10 °C and + 40 °C. S gear units can be operated at **ambient temperatures of** between 0 °C and + 40 °C. Contact SEW-EURODRIVE if ambient temperatures exceed this temperature range!



SEW gear units can be operated up to **altitudes of 1000 m above sea level**. For operation at altitudes above 1000 m above sea level, contact SEW-EURODRIVE.



### 3.5 Overhung and axial loads

#### Determining overhung load

When determining the resulting overhung load, the type of transmission element mounted on the shaft end must be considered. The following transmission element factors  $f_z$  also have to be considered for various transmission elements:

Transmission element	Transmission element factor $f_{z1}$	Comments
Gears	1.15	< 17 teeth
Chain sprockets	1.40	< 13 teeth
Chain sprockets	1.25	< 20 teeth
Narrow V-belt pulleys	1.75	Depending on the pre-tensioning force
Flat belt pulleys	2.50	Depending on the pre-tensioning force
Toothed belt pulleys	2.00 - 2.50	Depending on the pre-tensioning force

The overhung load exerted on the motor or gear shaft is calculated as follows:

$$F_R = \frac{M_d \times 2000}{d_0} \times f_z$$

$F_R$  = Overhung load in N

$M_d$  = Torque in Nm

$d_0$  = Mean diameter of the mounted transmission element in mm

$f_z$  = Transmission element factor

#### Permitted overhung load

The basis for determining the permitted overhung loads is the computation of the rated bearing service life  $L_{H10}$  of the anti-friction bearings (according to ISO 281).

For special operating conditions, the permitted overhung loads can be determined with regard to the modified bearing service life  $L_{na}$  on request.



**The data refer to gearmotors with the force acting midway on the shaft end. Worst case conditions have been assumed for the force application angle  $\alpha$  and the direction of rotation.**

- Only 50 % of the  $F_{Ra}$  value specified in the selection tables is permitted in mounting position M1 with wall attachment on the front face for K and S gear units.
- With foot-mounted and flange-mounted R gearmotors, a maximum of 50 % of the overhung load  $F_{Ra}$  specified in the selection tables is permitted in the case of torque transmission via the flange mounting.

The overhung load is specified for foot-mounted gear units as standard. If the overhung load values of other versions differ from those of the foot-mounted version, these values will appear in a separate column in the selection tables.

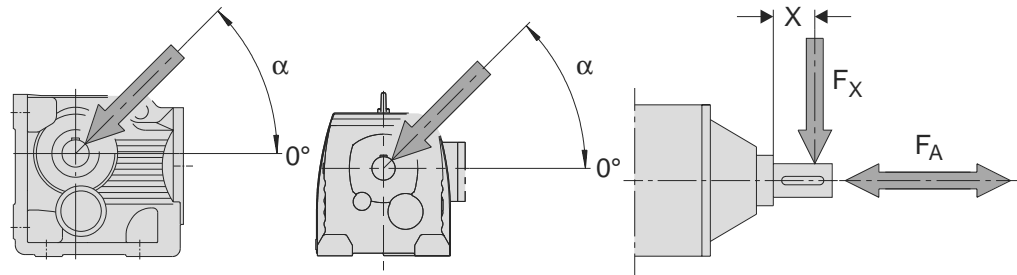


**Higher permitted overhung loads**

Exactly considering the force application angle  $\alpha$  and the direction of rotation makes it possible to achieve a higher overhung load. Higher output shaft loads are permitted if heavy duty bearings are installed, especially with R, F and K gear units. Contact SEW-EURODRIVE in such cases.

**Definition of force application**

Force application is defined according to the following figure:



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Figure 1: Definition of force application point

$F_X$  = Permitted overhung load at point x [N]

$F_A$  = Permitted axial load [N]

**Permitted axial forces**

If there is no overhung load, then an axial force  $F_A$  (tension or compression) amounting to 50 % of the overhung load given in the selection tables is permitted. This condition applies to the following gearmotors:

- Helical gearmotors except for R..137... to R..167...
- Parallel shaft and helical-bevel gearmotors with solid shaft except for F97...
- Helical-worm gearmotors with solid shaft.



Contact SEW-EURODRIVE for all other types of gear units and in the event of significantly greater axial forces or combinations of overhung load and axial force.



**Overhung load conversion for off-center force application**

The permitted overhung loads given in the selection tables must be calculated using the following formulae if force is applied at a point other than the center of the shaft end or if it is applied at a specific distance from the shaft end. The smaller of the two values  $F_{RxL}$  (according to bearing service life) and  $F_{RxW}$  (according to shaft strength) is the permitted value for the overhung load at point x. Note that the gear unit constant c must be different for  $M_N$  and  $M_B$ .

**Overhung load conversion based on bearing service life:**

$$F_{RxL} = F_{Ra} \times \frac{a}{b+x}$$

**Overhung load conversion based on shaft strength:**

$$F_{RxW} = \frac{c}{f+x}$$

- x = Distance between overhung load application point and shaft shoulder [mm]
- $F_{Ra}$  = permitted overhung load [N] (see the rated torque tables)
- $F_{RxL}$  = permitted overhung load [N] at point x based on bearing service life
- $F_{RxW}$  = permitted overhung load [N] at point x based on shaft strength
- a, b, c, f = gear unit constants for overhung load conversion
- $F_{Rx}$  = minimum of  $F_{RxL}$  and  $F_{RxW}$ [N]

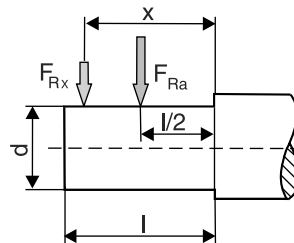


Figure 2: Overhung load  $F_{Rx}$  for off-center force application on a solid shaft

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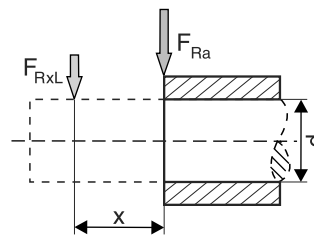


Figure 3: Overhung load  $F_{RxL}$  for off-center force application on a hollow shaft

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Gear unit constants for overhung load conversion

Gear unit type	Gear unit constants for overhung load conversion					
	a [mm]	b [mm]	c [Nmm]	f [mm]	d [mm]	l [mm]
R17	88.5	68.5	$6.527 \cdot 10^4$	17	20	40
R27	106.5	81.5	$1.56 \cdot 10^5$	11.8	25	50
R37	118	93	$1.24 \cdot 10^5$	0	25	50
R47	137	107	$2.44 \cdot 10^5$	15	30	60
R57	147.5	112.5	$3.77 \cdot 10^5$	18	35	70
R67	168.5	133.5	$2.65 \cdot 10^5$	0	35	70
R77	173.7	133.7	$3.97 \cdot 10^5$	0	40	80
R87	216.7	166.7	$8.47 \cdot 10^5$	0	50	100
R97	255.5	195.5	$1.19 \cdot 10^6$	0	60	120
R107	285.5	215.5	$2.06 \cdot 10^6$	0	70	140
R137	343.5	258.5	$6.14 \cdot 10^6$	30	90	170
R147	402	297	$8.65 \cdot 10^6$	33	110	210
R167	450	345	$1.26 \cdot 10^7$	0	120	210
RX57	43.5	23.5	$1.51 \cdot 10^5$	34.2	20	40
RX67	52.5	27.5	$2.42 \cdot 10^5$	39.7	25	50
RX77	60.5	30.5	$1.95 \cdot 10^5$	0	30	60
RX87	73.5	33.5	$7.69 \cdot 10^5$	48.9	40	80
RX97	86.5	36.5	$1.43 \cdot 10^6$	53.9	50	100
RX107	102.5	42.5	$2.47 \cdot 10^6$	62.3	60	120
F27	109.5	84.5	$1.13 \cdot 10^5$	0	25	50
F37	123.5	98.5	$1.07 \cdot 10^5$	0	25	50
F47	153.5	123.5	$1.78 \cdot 10^5$	0	30	60
F57	170.7	135.7	$5.49 \cdot 10^5$	32	35	70
F67	181.3	141.3	$4.12 \cdot 10^5$	0	40	80
F77	215.8	165.8	$7.87 \cdot 10^5$	0	50	100
F87	263	203	$1.19 \cdot 10^6$	0	60	120
F97	350	280	$2.09 \cdot 10^6$	0	70	140
F107	373.5	288.5	$4.23 \cdot 10^6$	0	90	170
F127	442.5	337.5	$9.45 \cdot 10^6$	0	110	210
F157	512	407	$1.05 \cdot 10^7$	0	120	210
K37	123.5	98.5	$1.41 \cdot 10^5$	0	25	50
K47	153.5	123.5	$1.78 \cdot 10^5$	0	30	60
K57	169.7	134.7	$6.8 \cdot 10^5$	31	35	70
K67	181.3	141.3	$4.12 \cdot 10^5$	0	40	80
K77	215.8	165.8	$7.69 \cdot 10^5$	0	50	100
K87	252	192	$1.64 \cdot 10^6$	0	60	120
K97	319	249	$2.8 \cdot 10^6$	0	70	140
K107	373.5	288.5	$5.53 \cdot 10^6$	0	90	170
K127	443.5	338.5	$8.31 \cdot 10^6$	0	110	210
K157	509	404	$1.18 \cdot 10^7$	0	120	210
K167	621.5	496.5	$1.88 \cdot 10^7$	0	160	250
K187	720.5	560.5	$3.04 \cdot 10^7$	0	190	320
S37	118.5	98.5	$6.0 \cdot 10^4$	0	20	40
S47	130	105	$1.33 \cdot 10^5$	0	25	50
S57	150	120	$2.14 \cdot 10^5$	0	30	60
S67	184	149	$3.04 \cdot 10^5$	0	35	70

Values for types not listed are available on request.



### 3.6 Project planning for servomotors

#### Features of synchronous and asynchronous servomotors

##### Synchronous servomotors

Synchronous servomotors are permanent-field synchronous motors. Features of SEW synchronous servomotors:

- Standstill torque of 1 Nm up to 68 Nm, with forced cooling fan up to 95 Nm
- High dynamics (rated torque / mass moment of inertia of the motor)
- High level of enclosure (IP65)
- Robust encoder system (resolver)
- The optimal encoder system with sine/cosine encoder allows for a very wide setting range up to 1:5000
- Motor can be run at slow speeds with high accuracy with the optimal encoder system
- High speeds up to 6000 min<sup>-1</sup> can be set without operation in the field weakening range
- High continuous torque at low speeds and at standstill, without forced cooling fan
- High overload capability
- NeFeB magnets, permanent magnets with high magnetic field density

##### Asynchronous servomotors

Asynchronous servomotors are dynamic AC asynchronous machines with the following features:

- Rated motor torques of 2.5 to 200 Nm
- Applications with very high load moment of inertia are possible
- The encoder system permits a very broad setting range (up to 1:5000)
- Motor can be run at speeds below 1 min<sup>-1</sup> with high accuracy.

##### Protection rating according to IEC 34-5 (EN 60034-5)

- Synchronous servomotors are supplied with IP65 enclosure as standard.
- Asynchronous servomotors are supplied with IP54 enclosure as standard. IP55 or IP65 enclosure is also available on request.

IP	1st digit Protection against foreign objects	2nd digit Protection against water
0	No special protection	No special protection
1	Protection against solid objects Ø 50 mm and larger	Protection against dripping water
2	Protection against solid objects Ø 12 mm and larger	Protection against dripping water when tilted up to 15°
3	Protection against solid objects Ø 12 mm and larger	Protection against solid objects Ø 12 mm and larger
4	Protection against solid objects Ø 12 mm and larger	Protection against splashing water
5	Protection against dust	Protection against water jets
6	Dust-proof	Protection against powerful water jets
7	-	Protection against temporary immersion in water
8	-	Protection against permanent immersion in water



### Applications

#### Acceleration greater than 5 m/s<sup>2</sup>

The rotor of the synchronous servomotor is designed to be extremely low-inertia. This motor is the optimum choice in very dynamic applications. For accelerations greater than 5 m/s<sup>2</sup>, the **synchronous servomotor** is usually the technically and economically best solution.

#### Positioning heavy masses accurately

If the inertia ratio  $J_{\text{ext}} / J_{\text{Mot}}$  is unfavorably high with the low-inertia rotor of the synchronous servomotor ( $k > 10 \dots 15$ ), an asynchronous servomotor with a higher mass moment of inertia  $J_{\text{Mot}}$  may represent the better solution.

#### High motor torques

SEW asynchronous servomotors are available if servomotors with rated torques of > 95 Nm are required.

#### Very slow motor speeds

The asynchronous servomotor is the optimal choice for applications that require extremely low motor speeds < 2.0 min<sup>-1</sup>. The encoder system used (sinusoidal encoder) permits a very high resolution of the actual speed.

A forced cooling fan is required if speeds of < 500 min<sup>-1</sup> are delivered over a long time. Load and time also need to be taken into account.

#### Assignment of gear unit to motor

Permitted combinations of motor and gear unit are indicated by gray fields in the combination overviews.

#### Finite gear unit reduction ratios *i*

Gear units with a whole-number or finite gear ratio should be preferred for positioning tasks in one direction of rotation and synchronization to avoid the accumulation of rounding errors. Gear units with a finite gear ratio are marked with an \* following the gear ratio *i* in the combination overviews and are given in notation with two decimal places.

#### Notes on select- ing servomotors

Project planning for a servomotor involves the following tasks for determining the thermal and dynamic load on the motor:

- Calculating the **effective operating point** for checking the thermal load on the motor.
- Calculating the **maximum operating point** for determining the motor/inverter combination.
- Determining the **inertia ratio**  $J_{\text{ext}} / J_{\text{Mot}}$  for checking the stability of the speed control.
  - $J_{\text{ext}}$  = Mass moment of inertia, reduced on motor shaft
  - $J_{\text{Mot}}$  = Mass moment of inertia of the motor



#### Procedure

- Determining the maximum speed based on aspects of the inertia ratio  $k < 10 \dots 15$ .
- Maximum required torque  $M_{\max}$  at maximum speed  $n_{\max}$  (maximum operating point).

$$M_{\max} < M_{\text{dyn\_Mot}} \text{ at } n_{\max}$$

$M_{\text{dyn\_Mot}}$  corresponds to the maximum torque for the specific motor/inverter combination. This operating point must lie below the characteristic curve for the maximum torque of the motor/MOVIDRIVE® combination.

- Effective torque requirement at average speed of the application (effective operating point).

$$M_{\text{eff}} < M_{\text{N\_Mot}} \text{ at } n_{\text{mean}}$$

This operating point must lie below the characteristic curve for continuous torque to ensure thermal stability of the drive.

#### Speed classes

DFS/CFM synchronous servomotors <sup>1)</sup>			
[min <sup>-1</sup> ]			
2000	3000	4500	6000

1) The BR brake for CFM71, CFM90 and CFM112 motors can be operated up to a maximum of 4500 min<sup>-1</sup>.

CT/CV asynchronous servomotors			
[min <sup>-1</sup> ]			
1200	1700	2100	3000

As all servomotors operate as controlled drives it is necessary to consider the inertia ratio between the load and the motor. This ratio is a decisive factor in determining the quality of closed-loop control. The inertia ratio should not exceed the values listed in the table below. Reduction of the inertia ratio using the motor speed (the selected gear unit reduction ratio) offers hardly any advantage with respect to closed-loop control starting at the value  $J_{\text{ext}} / J_{\text{Mot}} < 8$ . Backlash and elasticity negatively influence the possible dynamic response of the driveline and must be kept to a minimum.

As a result, the maximum speed should be selected such that the following criteria are met:

Driveline	Control characteristics	Inertia ratio $J_{\text{ext}} / J_{\text{Mot}}$
Forged gear rack, reduced backlash gear unit	Low backlash and low elasticity drive	$J_{\text{ext}} / J_{\text{Mot}} < 15$
Toothed belt, reduced backlash gear unit	Common servo applications	$J_{\text{ext}} / J_{\text{Mot}} < 15$
Toothed belt, standard gear unit	Standard applications, couplings with torque buffer (→ elasticity)	$J_{\text{ext}} / J_{\text{Mot}} < 10$



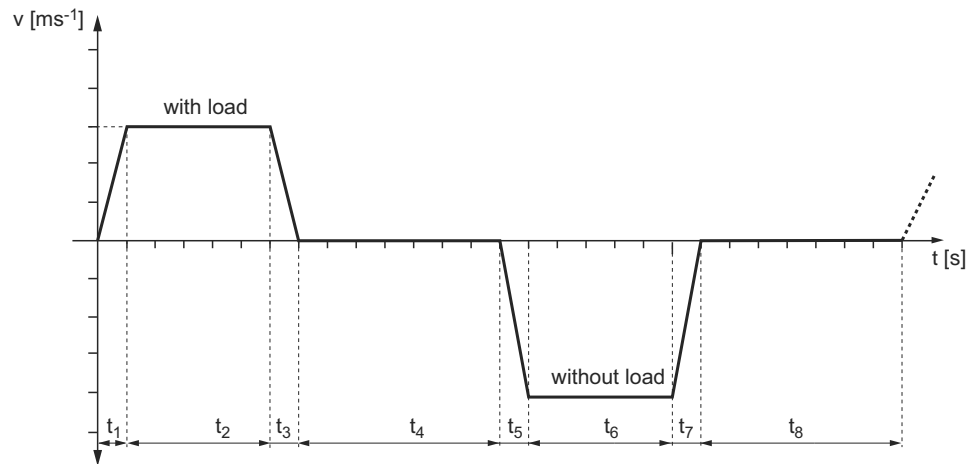
### 3.7 Project planning example

Project planning for a travel drive in S3 operation

Reference data:

Weight of the load:	$m_{\text{load}} = 150 \text{ kg}$
Weight of the carriage:	$m_{\text{carriage}} = 100 \text{ kg}$
Traveling velocity:	$v_{\text{loaded}} = 1 \text{ ms}^{-1}$
Traveling velocity:	$v_{\text{unloaded}} = 1.5 \text{ ms}^{-1}$
Acceleration:	$a_{\text{loaded}} = 5 \text{ ms}^{-2}$
Acceleration:	$a_{\text{unloaded}} = 10 \text{ ms}^{-2}$
Efficiency of the machine:	$\eta_{\text{load}} = 0.9$
Diameter of the carrying wheel:	$D_L = 120 \text{ mm}$
Diameter of the belt pulley:	$D_0 = 100 \text{ mm}$
Additional gear:	$i = 1$
Ambient temperature:	$20^\circ\text{C}$
Transmission element overhung load:	$f_z = 2.5$ (helical-bevel gear unit)

#### Travel cycle



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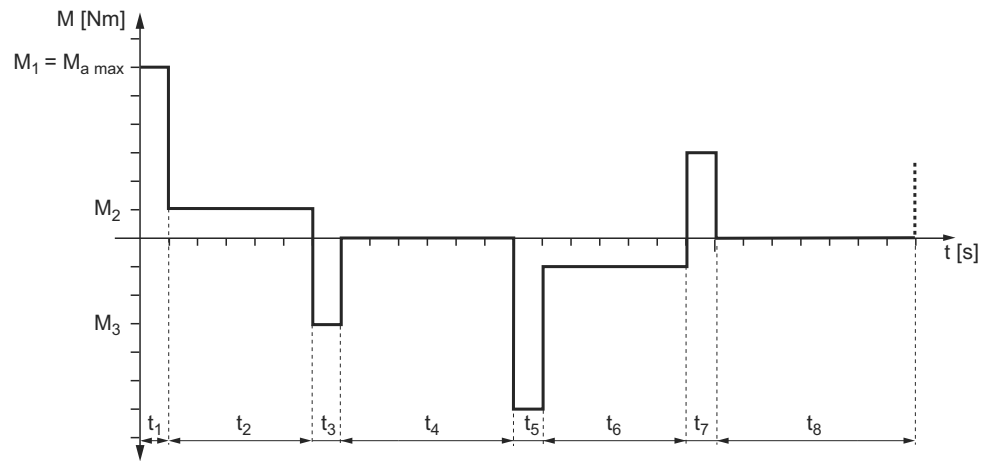
Figure 4: Travel cycle

The following time periods result from the travel cycle:

$t_1 = t_3 = 0.2 \text{ s}$	$v_2 = 1 \text{ ms}^{-1}$	$a_1 = -a_3 = 5 \text{ ms}^{-2}$
$t_2 = 2.9 \text{ s}$	$v_4 = v_8 = 0 \text{ ms}^{-1}$	$a_2 = a_4 = a_6 = a_8 = 0 \text{ ms}^{-2}$
$t_4 = t_8 = 2 \text{ s}$	$v_6 = 1.5 \text{ ms}^{-1}$	$a_5 = -a_7 = 10 \text{ ms}^{-2}$
$t_5 = t_7 = 0.15 \text{ s}$		
$t_6 = 1,917 \text{ s}$		



### Torque diagram



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Figure 5: Torque diagram

The following time periods result from the torque diagram:

$M_1 = 85.5 \text{ Nm}$	$M_5 = -67.27 \text{ Nm}$
$M_2 = 2.2 \text{ Nm}$	$M_6 = -0.87 \text{ Nm}$
$M_3 = -65.3 \text{ Nm}$	$M_7 = 52.93 \text{ Nm}$
$M_4 = M_8 = 0 \text{ Nm}$	



### Selecting the helical-bevel gear unit

**Max. torque  $M_{max}$**  The torque diagram shows that the maximum torque  $M_{max}$  that can occur is 85.5 Nm. The following condition must be met to select a helical-bevel gear unit from the selection tables:

**Selection criterion 1**  $M_{max} \leq M_{a max}$

**Overhung load  $F_R$**  The overhung load is determined by means of  $M_{max}$  and the belt pulley diameter  $D_0$ .

$$F_R = \frac{M_{max} \times 2000}{D_0} \times f_z = \frac{85.5 \text{ Nm} \times 2000}{0.1 \text{ m}} \times 2.5 = 4275 \text{ N}$$

The application point is on the midpoint of the shaft, i. e.  $x = l/2$ .

**Selection criterion 2**  $F_R \leq F_{RA}$

**Gear unit reduction ratio  $i$**  The gear unit reduction ratio is determined by approximation by means of the maximum output speed and an assumed rated motor speed of  $n_N = 3000$  1/min. It has proven to be advantageous to take into account a speed reserve of 10 %.

$$n_{a max} = \frac{v_6}{D_L \times \pi} = \frac{1.5 \text{ m/s}}{0.12 \text{ m} \times \pi} = 3.979 \text{ 1/s} = 238.74 \text{ 1/min}$$

$$i = \frac{n_{N Motor} - 10 \%}{n_{a max}} = \frac{2700 \text{ 1/min}}{238.74 \text{ 1/min}} = 11.31$$

**Gear unit selection** The gear unit can now be selected by means of the determined values  $M_{max}$ ,  $F_R$  and the gear unit reduction ratio  $i$  determined by approximation:

Gear unit: K57

Gear unit reduction ratio:  $i = 11.92$

Maximum output torque:  $M_{a max} = 415 \text{ Nm}$

Efficiency:  $\eta = 0.94$

Overhung load:  $F_{RA} = 4960 \text{ N}$

Moment of inertia:  $J_{gear unit} = 2.11 \times 10^{-4} \text{ kgm}^2$

Check the selection:

$M_{max} \leq M_{a max}$ :  $85.5 \text{ Nm} \leq 415 \text{ Nm} \rightarrow$  **requirement fulfilled.**

$F_R \leq F_{RA}$ :  $4275 \text{ Nm} \leq 4960 \text{ Nm} \rightarrow$  **requirement fulfilled.**

Above example shows how to determine a gear unit by approximation. For exact gear unit selection, contact SEW-EURODRIVE.



#### Selecting the motor

The maximum input torque  $M_{e \max}$  can now be determined from the maximum output torque by taking account of the gear unit efficiency.

$$M_{e \max} = \frac{M_{\max}}{i \times \eta_{\text{gear unit}}} = \frac{85.5 \text{ Nm}}{11.92 \times 0.94} = 7.63 \text{ Nm}$$

This maximum input torque is used for a preliminary motor selection, which still needs to be checked:

#### Preliminary motor selection

$$\begin{aligned} &\Rightarrow \text{CM71S/BR} \\ n_N &= 3000 \text{ min}^{-1} \\ M_0 &= 5 \text{ Nm} \\ I_0 &= 3.3 \text{ A} \\ J_{\text{Mot}} &= 6.65 \times 10^{-4} \text{ kgm}^2 \end{aligned}$$

#### Calculating the input speed

$$n_{a1} = \frac{v_1}{D_L \times \pi} = \frac{1 \text{ m/s}}{0.12 \text{ m} \times \pi} = 2.6526 \text{ 1/s} = 159.156 \text{ 1/min}$$

$$n_{e1} = n_{a1} \times i = 159.156 \text{ 1/min} \times 11.92 = 1897.13 \text{ 1/min}$$

$$n_{a5} = n_{a \max}$$

$$n_{e5} = n_{a5} \times i = 238.74 \text{ 1/min} \times 11.92 = 2845.78 \text{ 1/min}$$



Determining the inertia ratio "k"

$$J_{\text{ext}} = 91.2 \times m \times \left( \frac{v}{n_{\text{Motor}}} \right)^2 + J_{\text{gear unit}}$$

$$J_{\text{ext}} = 91.2 \times 250 \text{ kg} \times \left( \frac{1 \text{ m/s}}{1897.13 \text{ 1/min}} \right)^2 + 2.11 \times 10^{-4} \text{ kgm}^2 = 6.545913 \times 10^{-3} \text{ kgm}^2$$

$$k = \frac{J_{\text{ext}}}{J_{\text{Mot}}} = \frac{6.545913 \times 10^{-3} \text{ kgm}^2}{6.65 \times 10^{-4} \text{ kgm}^2} = 9.84$$

Requirement

$$k \leq 10 - 15$$

Check the requirement:  $9.84 \leq 10 - 15 \rightarrow$  **requirement fulfilled.**



The inertia ratio "k" has a major influence on all control characteristics.

Determining motor torques

In addition to the input torque, the motor must deliver a certain torque to being able to accelerate itself and the gear unit.

$$M_{1 \text{ Mot}} = (J_{\text{Mot}} + J_{\text{gear unit}}) \times \frac{n_{e1}}{9.55 \times t}$$

$$M_{1 \text{ Mot}} = (6.65 \times 10^{-4} \text{ kgm}^2 + 2.11 \times 10^{-4} \text{ kgm}^2) \times \frac{1897.13 \text{ 1/min}}{9.55 \times 0.2 \text{ s}} = 0.87 \text{ Nm}$$

Section  $t_1$

The torque to be delivered by the motor in section 1 is calculated as follows:

$$M_{t1} = M_{e \text{ max}} + M_{1 \text{ Mot}} = 7.63 \text{ Nm} + 0.87 \text{ Nm} = 8.5 \text{ Nm}$$

Section  $t_2$

The torque to be delivered by the motor in section 2 is calculated as follows:

$$M_{t2} = \frac{M_2}{i \times \eta_{\text{gear unit}}} = \frac{2.2 \text{ Nm}}{11.92 \times 0.94} = 0.196 \text{ Nm}$$



#### Section $t_3$

The torque to be delivered by the motor in section 3 is calculated in the same way as in section 1 but with the difference that the efficiency of the motor is advantageous due to the deceleration.

$$M_{t3} = \frac{M_3 \times \eta_{\text{gear unit}}}{i} + M_1 = \frac{-65.3 \text{ Nm} \times 0.94}{11.92} + (-0.87 \text{ Nm}) = -6.02 \text{ Nm}$$

#### Section $t_4$

As the speed in section  $v_4$  is 0 m/s, the motor need not produce any holding torque →  $M_{t4} = 0 \text{ Nm}$ . The brake is applied.

#### Section $t_5$

The torques to be delivered by the motor in sections 5 - 8 are calculated in the same way as for sections 1 - 4.

$$M_{5 \text{ Mot}} = (J_{\text{Mot}} + J_{\text{gear unit}}) \times \frac{n_{e5}}{9.55 \times t}$$

$$M_{5 \text{ Mot}} = (6.65 \times 10^{-4} \text{ kgm}^2 + 2.11 \times 10^{-4} \text{ kgm}^2) \times \frac{-2845,78 \text{ 1/min}}{9.55 \times 0.15 \text{ s}} = -1.74 \text{ Nm}$$

Input torque in section 5:

$$M_{e5} = \frac{M_5}{i \times \eta_{\text{gear unit}}} = \frac{-67.27 \text{ Nm}}{11.92 \times 0.94} = -6 \text{ Nm}$$

The torque to be delivered by the motor in section 5 is calculated as follows:

$$M_{t5} = M_{e5} + M_{5 \text{ Mot}} = -6 \text{ Nm} + (-1.74 \text{ Nm}) = -7.74 \text{ Nm}$$

#### Section $t_6$

The torque to be delivered by the motor in section 6 is calculated as follows:

$$M_{t6} = \frac{M_6}{i \times \eta_{\text{gear unit}}} = \frac{-0.87 \text{ Nm}}{11.92 \times 0.94} = -0.076 \text{ Nm}$$

#### Section $t_7$

The torque to be delivered by the motor in section 7 is calculated as follows:

$$M_{t7} = \frac{M_7 \times \eta_{\text{gear unit}}}{i} + M_{5 \text{ Mot}} = \frac{52.93 \text{ Nm} \times 0.94}{11.92} + 1.74 \text{ Nm} = 5.914 \text{ Nm}$$

#### Section $t_8$

As the speed in section  $v_8$  is 0 m/s, the motor need not produce any holding torque →  $M_{t8} = 0 \text{ Nm}$ . The brake is applied.



**Determining the effective motor torque**

Cycle time

$$t_{\text{cycle}} = t_1 + t_2 + \dots + t_8$$

$$t_{\text{cycle}} = 0.2 \text{ s} + 2.9 \text{ s} + 0.2 \text{ s} + 2 \text{ s} + 0.15 \text{ s} + 1.917 \text{ s} + 0.15 \text{ s} + 2 \text{ s} = 9.517 \text{ s}$$

Effective torque

$$M_{\text{eff}} = \sqrt{\frac{1}{t_{\text{cycle}}} \times (M_{t1}^2 \times t_1 + M_{t2}^2 \times t_2 + \dots + M_{t8}^2 \times t_8)}$$

$$M_{\text{eff}} = \sqrt{\frac{1}{9.517} \times (8.5^2 \times 0.2 + 0.196^2 \times 2.9 + (-6.02)^2 \times 0.2 + 0^2 \times 2 + (-7.74)^2 \times 0.15 + (-0.076)^2 \times 1.917 + 5.91^2 \times 0.15 + 0^2 \times 2)}$$

$$M_{\text{eff}} = 1.946 \text{ Nm}$$

**Determining the mean input speed**

$$\bar{n} = \frac{1}{t_{\text{cycle}}} \times (n_{t1} \times t_1 + n_{t2} \times t_2 + \dots + n_{t8} \times t_8)$$

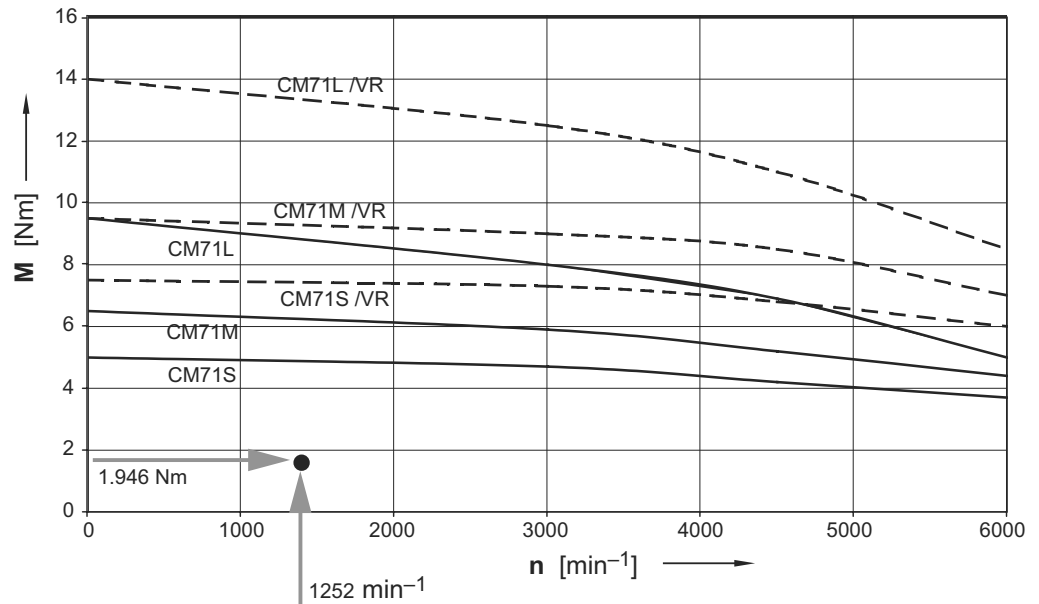
$$\bar{n} = \frac{1}{9.517} \times \left( \frac{1897.13 \times 0.2 + 1897.13 \times 2.9 + 1897.13 \times 0.2 + 0 \times 2 + 2845.78 \times 0.15 + 2845.78 \times 1.917 + 2845.78 \times 0.15 + 0 \times 2}{2} \right)$$

$$\bar{n} = 1251.88 \text{ 1/min}$$



### Determining the operating point

The operating point can be entered in the thermal motor characteristic curve based on the effective motor torque and the mean motor speed:



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Figure 6: Operating point

The effective torque at mean speed must lie below or maximally on the thermal characteristic curve to protect the motor from thermal overload:

Requirement

$M_{\text{eff}} \leq M_0$ :  $1.946 \text{ Nm} \leq 5 \text{ Nm} \rightarrow$  **requirement fulfilled.**



**Checking the dynamic limit torque**

You have to check whether the motor is capable of delivering this dynamic torque by means of the maximum torque and the associated speed.

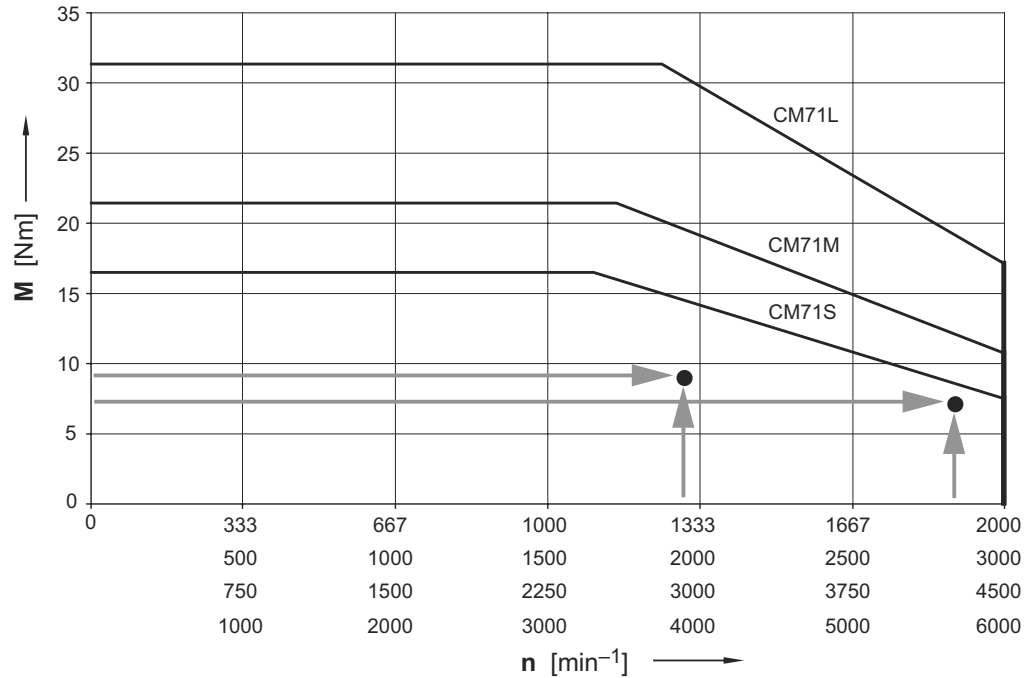


Figure 7: Maximum operating point

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For this purpose, the maximum torque and the associated speed as well as the maximum speed and the associated torque are entered in the diagram as maximum operating points.

The maximum operating points must lie below or maximally on the characteristic curve of the thermal limit torque. Note that the characteristic curve declines in the upper speed range.

**Requirement**

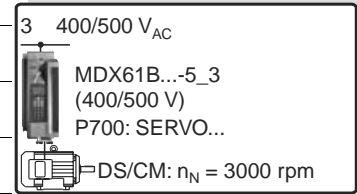
$M_{\max} \leq$  dynamic limit torque is fulfilled.



### Selecting the inverter

Rated speed  $n_N = 3000$  1/min.

Motor		MOVIDRIVE® MDX61B...-5_3 (400/500 V units) in SERVO operating modes (P700)															
		0005	0008	0011	0014	0015	0022	0030	0040	0055	0075	0110	0150	0220	0300	0370	0450
DS56M	$M_{max}$ [Nm] ([lb.in])	2.4 (21.1)	2.8 (24.6)	3.6 (31.7)	3.8 (33.4)	3.5 (30.8)	3.8 (33.4)										
DS56L	$M_{max}$ [Nm] ([lb.in])	3.3 (29.0)	4.0 (35.2)	5.1 (44.9)	6.4 (56.4)	4.9 (43.1)	6.6 (58.1)	7.6 (66.9)									
DS56H	$M_{max}$ [Nm] ([lb.in])	5.7 (50.2)	6.8 (59.9)	8.8 (77.5)	11.2 (98.7)	8.5 (74.9)	11.5 (101)	14.3 (126)	15.2 (133)								
CM71S	$M_{max}$ [Nm] ([lb.in])	6.0 (52.8)	7.2 (63.4)	9.2 (81.0)	11.6 (102)	8.9 (78.4)	11.9 (104)	14.3 (126)	16.5 (145)								
CM71M	$M_{max}$ [Nm] ([lb.in])		7.2 (63.4)	9.3 (81.9)	11.9 (104)	9.0 (79.3)	12.2 (107)	15.1 (133)	19.1 (168)	21.5 (189)							
CM71L	$M_{max}$ [Nm] ([lb.in])			9.5 (83.7)	12.2 (107)	9.2 (81.0)	12.6 (111)	15.9 (140)	21.0 (185)	26.2 (230)	30.8 (271)	31.5 (277)					
CM90S	$M_{max}$ [Nm] ([lb.in])				12.0 (105)	9.0 (79.3)	12.4 (109)	15.7 (138)	21.2 (186)	27.4 (241)	34.0 (299)	40.1 (353)					
CM90M	$M_{max}$ [Nm] ([lb.in])						11.8 (103)	15.0 (132)	20.4 (179)	26.6 (234)	33.7 (296)	47.8 (421)	51.6 (454)				
CM90L	$M_{max}$ [Nm] ([lb.in])								20.7 (182)	27.3 (240)	34.7 (305)	51.1 (450)	65.6 (578)	75.6 (666)			
CM112S	$M_{max}$ [Nm] ([lb.in])								22.2 (195)	29.3 (258)	37.4 (329)	54.8 (482)	69.8 (615)	81.9 (721)			
CM112M	$M_{max}$ [Nm] ([lb.in])									28.2 (248)	36.2 (319)	54.0 (475)	70.7 (623)	95.7 (843)	108.0 (951)		
CM112L	$M_{max}$ [Nm] ([lb.in])										35.8 (345)	53.9 (474)	71.6 (630)	101.0 (890)	126.9 (1118)	147.4 (1298)	156.8 (1381)



The matching inverter can now be selected from the motor selection tables on the basis of the effective torque and the peak torque.

⇒ MDX61B0011-5A3.



### Determining the matching braking resistor

For project planning of the matching braking resistor, the following values must be determined from travel sections during which the motor operates as generator.

- Peak braking power
- Average braking power

Peak braking  
power

$$P_{Br\_peak} = \frac{M_{t7} \times n_{t5}}{9550} = \frac{5.914 \text{ Nm} \times 2845.78 \text{ 1/min}}{9550} = 1.76 \text{ kW}$$

Average braking  
power in section  $t_3$

$$P_{Br\_t3} = \frac{M_{t3} \times \frac{n_{e3}}{2}}{9550} = \frac{6.02 \text{ Nm} \times \frac{1897.13 \text{ 1/min}}{2}}{9550} = 0.6 \text{ kW}$$

Average braking  
power in section  $t_7$

$$P_{Br\_t7} = \frac{M_{t7} \times \frac{n_{e7}}{2}}{9550} = \frac{5.914 \text{ Nm} \times \frac{2845.78 \text{ 1/min}}{2}}{9550} = 0.88 \text{ kW}$$

Effective braking  
power

$$P_{Br} = \frac{P_{Br\_t3} \times t_3 + P_{Br\_t7} \times t_2}{t_{cycle}}$$

$$P_{Br\_t1} = P_{Br\_t2} = P_{Br\_t4} = P_{Br\_t6} = P_{Br\_t8} = 0 \text{ kW}$$

$$P_{Br} = \frac{0.6 \text{ kW} \times 0,2 \text{ s} + 0.88 \text{ kW} \times 0,15 \text{ s}}{9,517 \text{ s}} = 0.0265 \text{ kW}$$



#### Selecting the braking resistor

A preselection of braking resistors that may be connected to the respective inverter is made based on the table "Assignment of braking resistors (see "MOVIDRIVE® MDX60/61B" system manual, Installation section):

MOVIDRIVE® MDX60/61B...-5A3			0005	0008	0011	0014
Size			0			
<b>Braking resistors</b>	<b>Trip current</b>	<b>Part number</b>				
BW090-P52B <sup>1)</sup>	-	824 563 0				
BW072-003	$I_F = 0.6 A_{RMS}$	826 058 3				
BW072-005	$I_F = 1.0 A_{RMS}$	826 060 5				
BW168	$I_F = 2.5 A_{RMS}$	820 604 X				
BW100-006	$I_F = 1.8 A_{RMS}$	821 701 7				
<b>Line chokes</b>		<b>Part numbers</b>				
ND020-013	$\Sigma I_{mains} = 20 A_{AC}$	826 012 5				
<b>Line filter</b>		<b>Part number</b>				
NF009-503	$V_{max} = 550 V_{AC}$	827 412 6				
<b>Output chokes</b>	<b>Inside diameter</b>	<b>Part number</b>				
HD001	d = 50 mm (1.97 in)	813 325 5	for cable cross sections 1.5 ... 16 mm <sup>2</sup> (AWG 16 ... 6)			
HD002	d = 23 mm (0.91 in)	813 557 6	for cable cross sections ≤ 1.5 mm <sup>2</sup> (AWG 16)			
<b>Output filters (only in VFC mode)</b>		<b>Part number</b>				
HF008-503		826 029 X		A		
HF015-503		826 030 3		B		A
HF022-503		826 031 1				B

1) Internal, thermal overload protection, no bimetallic relay required.



The resistor is finally determined from this preselection, the calculated peak braking power and the average braking power of the application. For technical data of the braking resistors, refer to the "MOVIDRIVE® MDX60B/61B system manual, section 3 Technical Data."

Braking resistor type	BW090-P52B	BW100-005	BW100-006	BW072-003	BW072-005	BW168	BW268
Part number	824 563 0	826 269 1	821 701 7	826 058 3	826 060 5	820 604 X	820 715 1
Load capacity at	0.10 kW	0.45 kW	0.6 kW	0.23 kW	0.45 kW	0.8 kW	1.2 kW
100 % cdf		0.60 kW	1.1 kW	0.31 kW	0.60 kW	1.4 kW	2.2 kW
50 % cdf <sup>1)</sup>		0.83 kW	1.9 kW	0.42 kW	0.83 kW	2.6 kW	3.8 kW
25 % cdf		1.11 kW	3.5 kW	0.58 kW	1.11 kW	4.7 kW	6.7 kW
12 % cdf		2.00 kW	5.7 kW	1.00 kW	2.00 kW	7.6 kW	10 kW <sup>2)</sup>
6 % cdf		Note the <b>regenerative power limit</b> of the inverter! (= 150 % of the recommended motor power → Technical Data)					
3 % cdf							
1 % cdf							
Resistance value $R_{BW}$	90 Ω ±35 %	100 Ω ±10 %		72 Ω ±10 %		68 Ω ±10 %	
Trip current (of F16) $I_F$	-	0.8 A <sub>RMS</sub>	1.8 A <sub>RMS</sub>	0.6 A <sub>RMS</sub>	1.0 A <sub>RMS</sub>	2.5 A <sub>RMS</sub>	3.4 A <sub>RMS</sub>
Type	PTC	Flat type	Wire resistor on ceramic core	Flat type		Wire resistor on ceramic core	
Terminals	Cables	Cables	Ceramic terminals 2.5 mm <sup>2</sup> (AWG12)	Cables		Ceramic terminals 2.5 mm <sup>2</sup> (AWG12)	
Enclosure	IP20	IP54	IP20 (when mounted)	IP54		IP20 (when mounted)	
Ambient temperature $\vartheta_U$	-20 ... +45 °C						
Type of cooling	KS = Self-cooling						
for MOVIDRIVE®	0005 ... 0014	0005 ... 0022	0015 ... 0040	0005 ... 0014		0015 ... 0040	

1) cdf = Cyclic duration factor of the braking resistor in relation to a cycle duration  $T_D \leq 120$  s.

2) Physical power limit due to the DC link voltage and the resistance value.

$$6\% \text{ cdf} \triangleq 7.2 \text{ s} \Rightarrow 7.2 \text{ s} \geq 0.2 \text{ s.}$$

**Requirement**

- Peak braking power  $P_{Br\_peak} \leq$  Braking power resistor 6 % cdf.
- Average braking power  $P_{BR} \leq$  Load capacity of the resistor with reference to the cycle time of the application.

**Selection of options and accessories**

You have to select the option card for MOVIDRIVE® MDX61B with the corresponding encoder interface according to the motor encoder:

- DEH11B for Hiperface® encoder
- DER11B for resolver.

Other option cards might also be required (e.g. fieldbus card) depending on the application. For more information on available option cards and accessories (e.g. keypads, etc.), refer to the "MOVIDRIVE® MDX60B/61B" system manual.

For information on prefabricated motor and encoder cables, refer to the MOVIDRIVE® system manual, and to chapter 11 in this catalog.

**4 Mounting Positions****4.1 General information on mounting positions***Mounting position designation*

In the case of gear units, SEW-EURODRIVE distinguishes between mounting positions M1 to M6. The following figure shows the position of the gear unit in mounting positions M1 to M6.

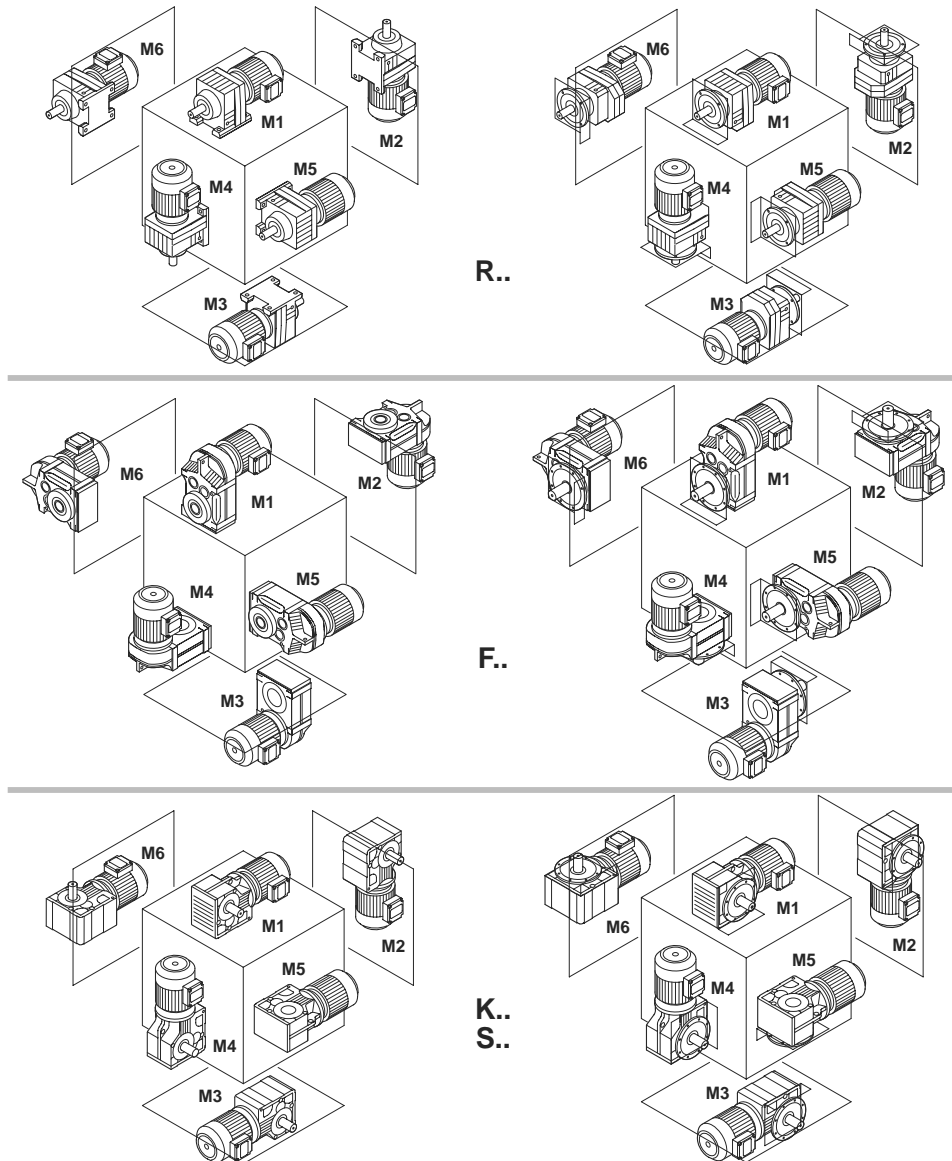


Figure 8: Depiction of mounting positions M1 to M6

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## 4.2 Important order information

The following order information is required for R, F, K and S gearmotors in addition to the mounting position to exactly determine the design of the drive.

- Position of the power plug connector
- Position of the cable entry of the power plug connector
- Position and orientation of the encoder plug connector
- Terminal box position

4

### Plug connector

*Position of power plug connector and cable entry in CFM motors*

Possible positions of the power plug connector are 0°, 90°, 180° or 270° as viewed onto the non-drive end of the motor (onto the fan end).

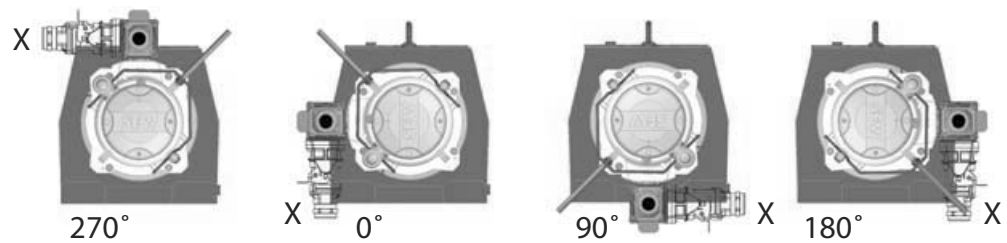
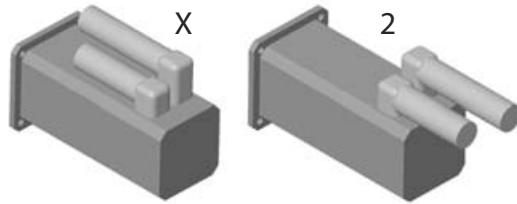


Figure 9: Position "3" of the power plug connector

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### Position of cable entry for DFS motors

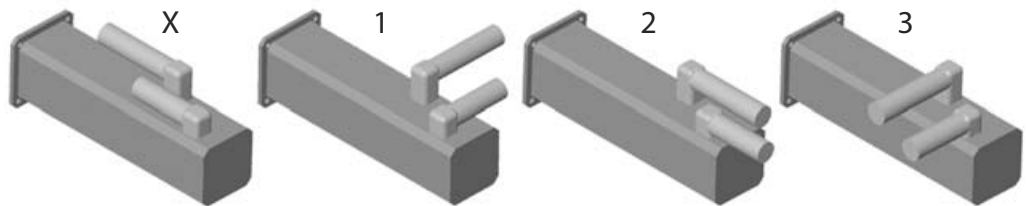
Positions "2" and "X" are possible for DFS56M and DFS56L motors ("X" = standard).



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Figure 10: Cable entry position for DFS56M/L

Positions "1", "2", "3" and "X" are possible for DFS56H and DFS brake motors.



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Figure 11: Cable entry position for DFS56H

### Standard type

Unless indicated otherwise, you will receive the power plug connector type 270° position with cable entry "2".

### Cable entry for DFS motors with plug connector

R F K S	R27 F27	R37 F37 K37 S37	R47-R67	F57-F67	K47-K67	F47 S47	S57	S67
DFS56M	A	A	-	-	-	A	A	-
DFS56L	A	A	-	-	-	A	A	-
DFS56H	B	B	C	C	C	B	B	C



There may be collisions depending on what the customer has installed on the output end.

A means:

- Cable entry position "2" is possible.
- Cable entry positions "1", "3" possible with brake motor.

B means:

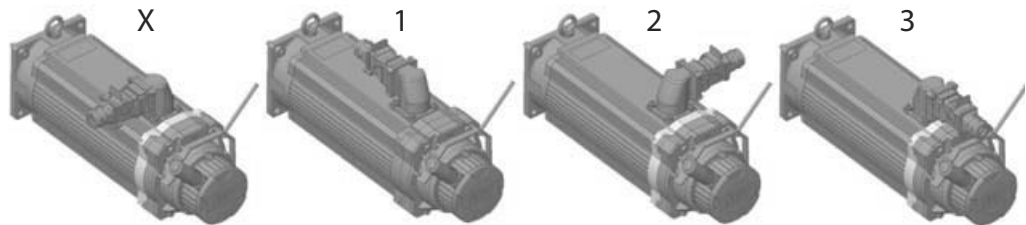
- Cable entry positions "1", "2", "3" are possible.
- Cable entry position "X" only possible at 270°.

C means:

- Cable entry positions "1", "2", "3" are possible.
- Cable entry position "X" is not possible.

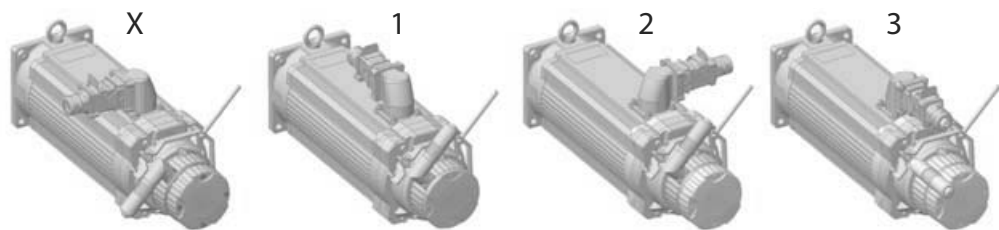
**Cable entry position with CFM motors**

Positions "X", "1", "2" or "3" are possible with CFM motors ("X" = standard).



54684AXX

Figure 12: Cable entry position with CFM..S.5, radial signal plug



54685AXX

Figure 13: Cable entry position with CFM..S.6, angled signal plug

**Standard type**

Unless indicated otherwise, you will receive the power plug connector type 270° position with cable entry "3" and radial encoder plug (CFM..S.5).



**Important:** It is not possible to mount a forced cooling fan to motors with axial encoder plug SM6./SB6.

Cable entry for  
CFM motors with  
plug connector

	R27	R37	R47	R57	R67	R77	R87	R97	R107
CFM71S	D	D	G	G	G	G	-	-	-
CFM71M	D	D	G	G	G	G	-	-	-
CFM71L	D	D	D	F	G	G	-	-	-
CFM90S	D	D	D	D	E	F	G	G	-
CFM90M	-	-	D	D	D	F	G	G	-
CFM90L	-	-	D	D	D	D	F	G	-
CFM112S	-	-	D	D	D	D	F	G	G
CFM112M	-	-	-	-	D	D	F	G	G
CFM112L	-	-	-	-	-	D	D	D	G

	F27	F37	F47	F57	F67	F77	F87	F97	F107
CFM71S	E	E	F	F	F	G	-	-	-
CFM71M	E	E	E	F	F	G	-	-	-
CFM71L	E	E	E	F	F	G	-	-	-
CFM90S	E	E	F	E	E	F	G	G	-
CFM90M	-	-	-	E	E	E	G	G	-
CFM90L	-	-	-	E	E	E	G	G	-
CFM112S	-	-	-	E	E	E	F	G	G
CFM112M	-	-	-	-	E	E	F	G	G
CFM112L	-	-	-	-	-	E	E	F	G

	K27	K37	K47	K57	K67	K77	K87	K97	K107
CFM71S	-	E	E	E	F	G	-	-	-
CFM71M	-	E	E	E	F	G	-	-	-
CFM71L	-	D	E	E	E	G	-	-	-
CFM90S	-	D	E	E	E	F	G	G	-
CFM90M	-	-	D	E	E	E	G	G	-
CFM90L	-	-	-	D	D	D	E	G	-
CFM112S	-	-	-	D	D	B	E	G	G
CFM112M	-	-	-	-	D	D	E	G	G
CFM112L	-	-	-	-	-	D	D	E	G

	S37	S47	S57	S67
CFM71S	D	E	G	G
CFM71M	D	E	G	G
CFM71L		D	D	G
CFM90S	-	D	D	E
CFM90M	-	-	-	E
CFM90L	-	-	-	D
CFM112S	-	-	-	D



There may be collisions depending on what the customer has installed on the output end.

D means:

- Cable entry positions "1", "2", "3", "X" are possible.

E means:

- Cable entry positions "2", "3", "X" are possible.
- Cable entry position "1" only possible at 0°, 180°, 270°.

F means:

- Cable entry positions "2", "3", "X" are possible.
- Cable entry position "1" only possible at 270°.

G means:

- Cable entry positions "2", "3", "X" are possible.
- Cable entry position "1" is not possible.

"-" means:

- Gear unit/motor combination not possible.

### Position of motor terminal box and cable entry

The position of the motor terminal box has so far been specified indicated with 0°, 90°, 180° or 270° as viewed onto the fan guard = B-end (→ Figure 14). A change in the product standard EN 60034 specifies that the following designations for terminal box positions will have to be used in future:

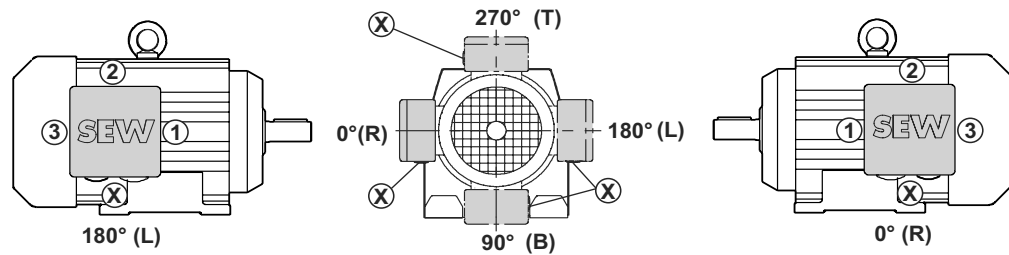
- As viewed onto the output shaft = A-end
- Designation as R (right), B (bottom), L (left) and T (top)

This new designation applies to foot-mounted motors without a gear unit in mounting position B3 (= M1). The previous designation is retained for gearmotors. Figure 14 shows both designations. Where the mounting position of the motor changes, R, B, L and T are rotated accordingly. In motor mounting position B8 (= M3), T is at the bottom.

The position of the cable entry can be selected as well.

The following positions are possible:

- With DFS/CFM motors, positions "X", "2", "3"
- With CT/CV motors, positions "X", "1", "2", "3".



51302AXX

Figure 14: Position of terminal box and cable entry

Unless indicated otherwise, you will receive the terminal box type 0° (R) with cable entry "X". We recommend selecting cable entry "2" with mounting position M3.



- **When the terminal box is in the 90° (B) position**, check to see if the gearmotor has to be supported.
- The following cable entries are possible in the **DT71..BMG** motor with gear unit flange diameters 160 mm and 200 mm:

Terminal box position	0° (R)	90° (B)	180° (L)	270° (T)
Possible cable entries	"X", "3"	"X", "1", "3"	"1", "2"	"X", "1", "3"

### Cable entry in motor terminal box KK5 and KK6

The following cable entries are possible in CFM motors in conjunction with terminal box KK5 / KK6:

- Positions "X", "2", "3".

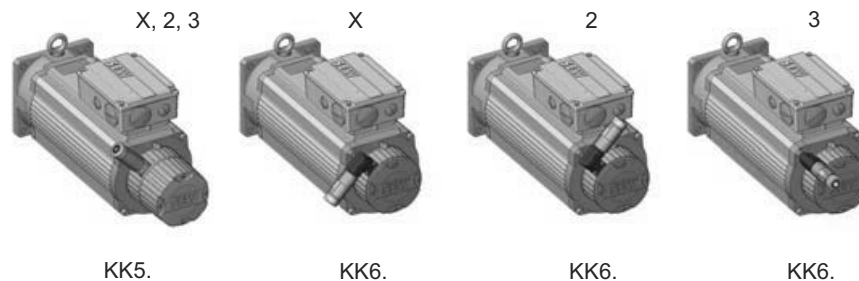
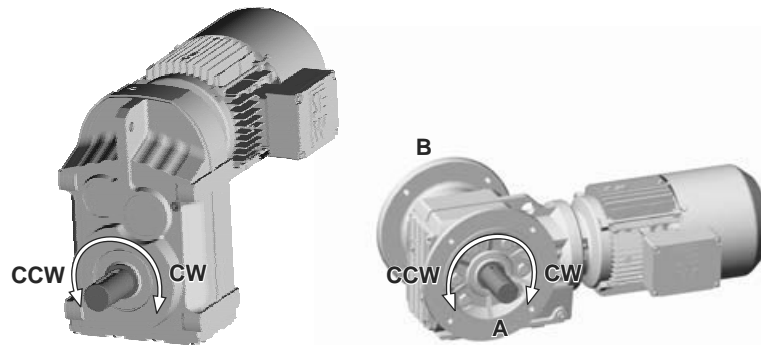


Figure 15: Possible cable entry positions CFM..KK5 and CM..KK6

**Direction of rotation of the drive with a backstop**

If the drive has a backstop RS, it will be necessary to indicate the direction of rotation for the drive. The following definition applies:

Looking onto the output shaft: Clockwise (CW) = Rotating clockwise  
Counterclockwise (CCW)= Rotating counterclockwise



02584BXX

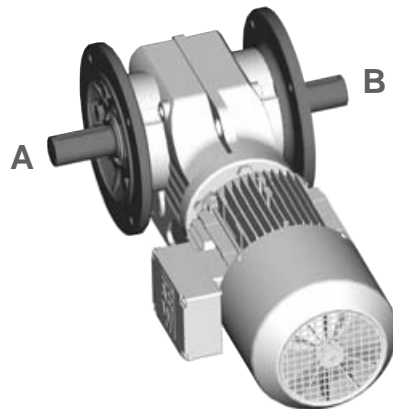
Figure 16: Direction of rotation of output

In right-angle gear units, it is also necessary to indicate if the direction of rotation is given looking onto the A or B end.

**Position of output shaft and output flange**

In right-angle gear units, it is also necessary to indicate the position of the output shaft and the output flange:

- A or B or AB (→ Figure 17)



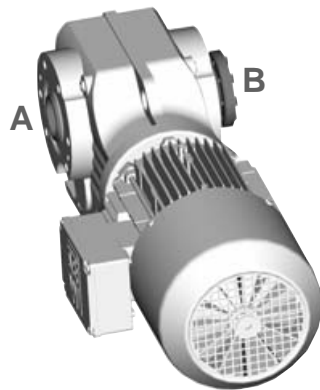
02585BXX

Figure 17: Position of the output shaft and the output flange

### Position of the output end in right-angle gear units

In shaft mounted right-angle gear units with a shrink disc, it is also necessary to indicate whether the A or B end is the output end. In Figure 18, the A end is the output end. The shrink disc is located opposite the output end.

In shaft mounted right-angle gear units, the "output end" is equivalent to the "shaft position" of right-angle gear units with solid shaft.



03204AXX

Figure 18: Position of the output end



You will find the permitted mounting surfaces (= hatched area) in the mounting position sheets (page 62 and the following pages).

**Example:** Only the mounting surface at the bottom is possible with helical-bevel gear units K167/K187 in mounting positions M5 and M6.

### Sample orders

Type (examples)	Mounting position	Shaft position	Flange position	Terminal box position	Cable entry position	Direction of rotation of output
SF77CV100L4	M6	AB	AB	90°	"3"	-
KA97CV132M4	M4	B	-	270°	"2"	-
KH107CV160L4	M1	A	-	180°	"3"	-

### Change in mounting position


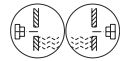


Make sure to read the following information when you operate the gearmotor in a mounting position other than the one indicated in the order:

- Adjust lubricant fill quantity to match the new mounting position
- Adjust position of breather valve
- For helical-bevel gearmotors: Contact the SEW-EURODRIVE customer service prior to changing to mounting position M5 or M6 and when changing from M5 to M6 or vice versa.
- For helical-worm gearmotors: Contact the SEW-EURODRIVE customer service when changing to mounting position M2.

### 4.3 Key to the mounting position sheets

**Symbols used**

The following table shows the symbols used in the mounting position sheets and their meaning:

Symbol	Description
	Breather valve
	Oil level plug
	Oil drain plug
*	With these mounting positions, observe the churning losses given in the "Churning losses" table in section 3.4, page 31.
	Position of the terminal box is "Standard"



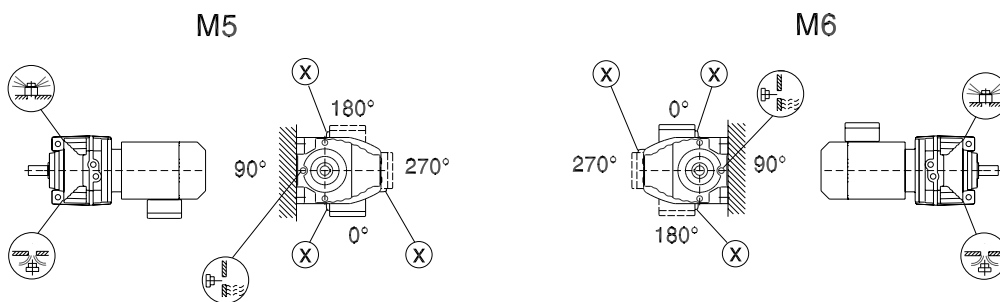
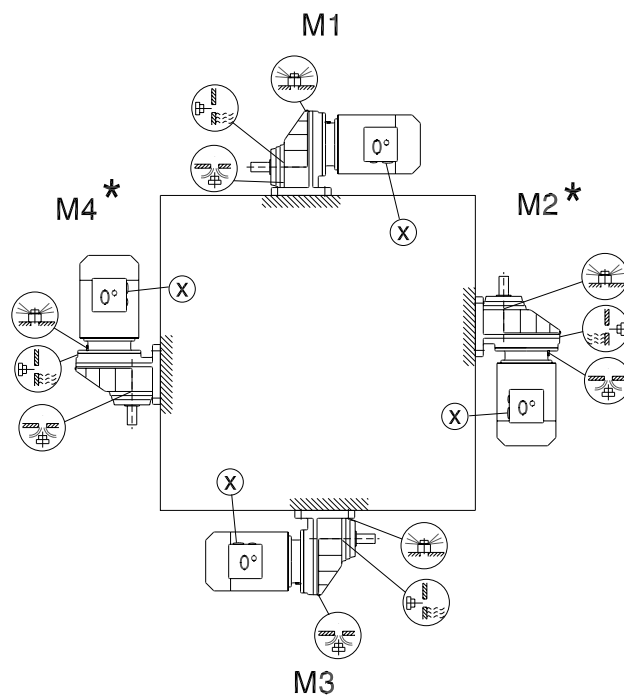
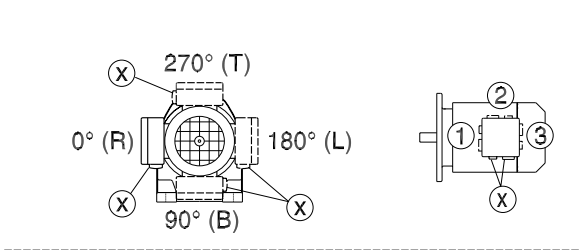
Note the following information regarding display of shafts in the mounting position sheets:

- **For gear units with solid shaft:** The displayed shaft is always on the A end.
- **For shaft mounted gear units:** The shaft with dashed lines represents the customer shaft. The output end (= shaft position) is always shown on the A end.

**4.4 Mounting positions for helical gearmotors**

RX57-RX107

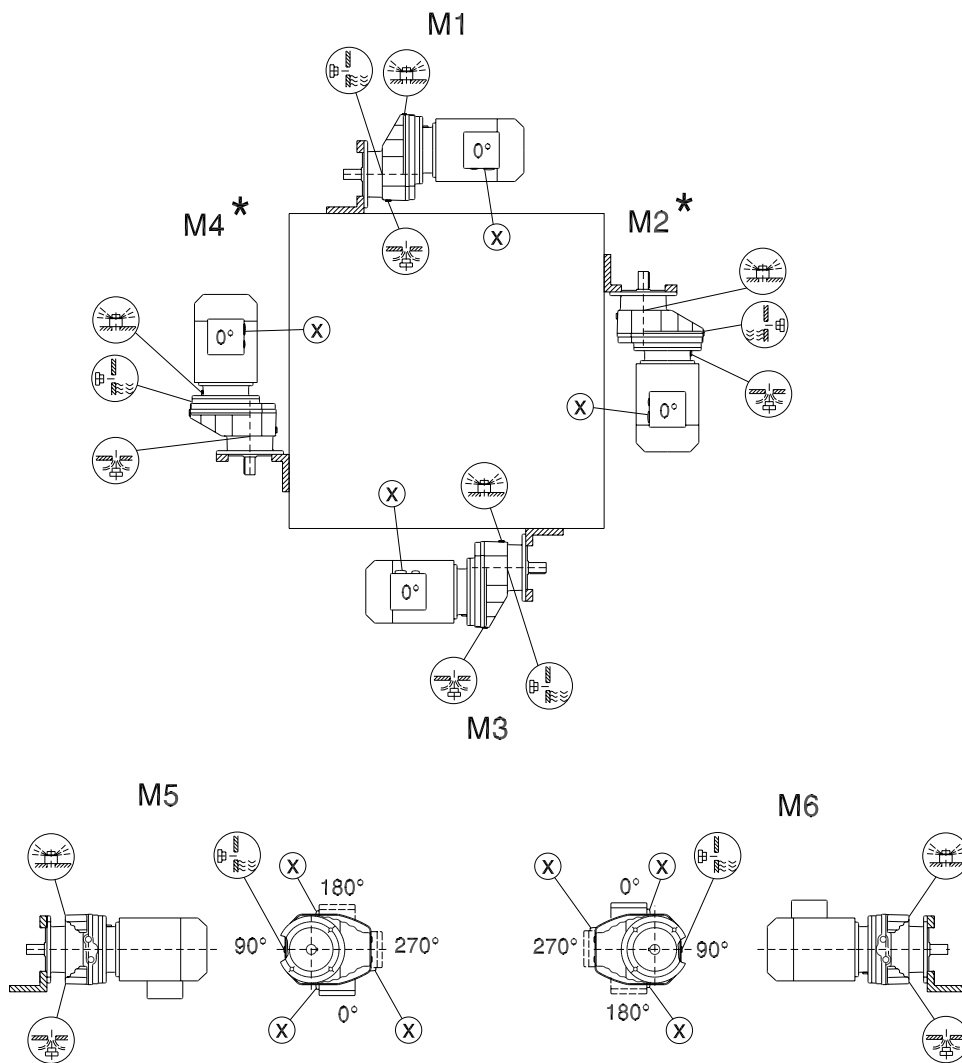
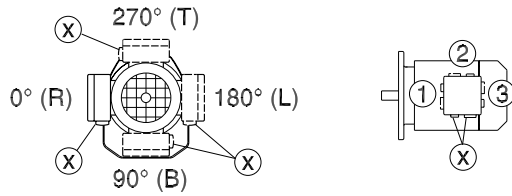
04 043 02 00



\* → page 61

RXF57 - RXF107

04 044 02 00



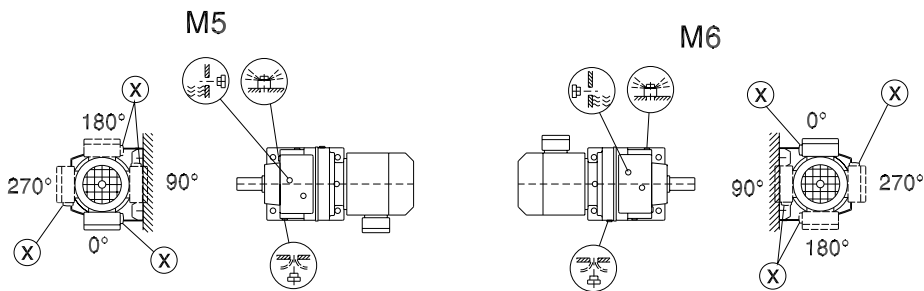
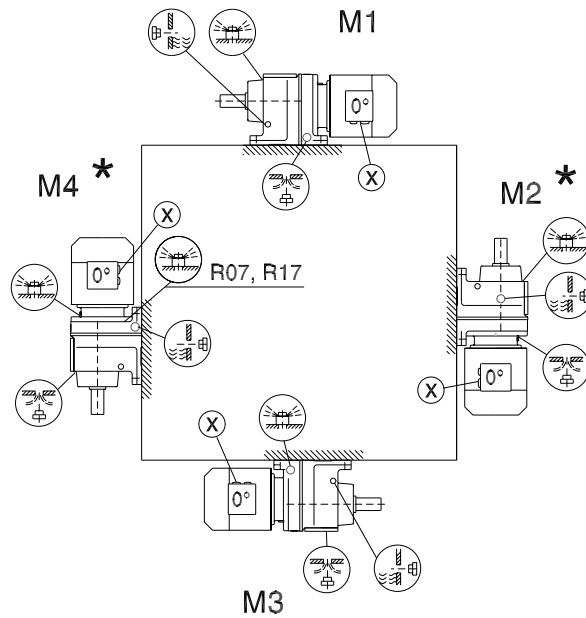
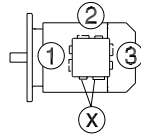
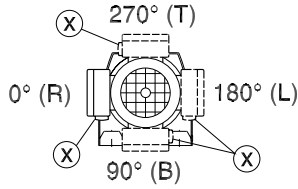
\* → page 61

# Mounting Positions

Mounting positions for helical gearmotors

R17-R167

04 040 03 00

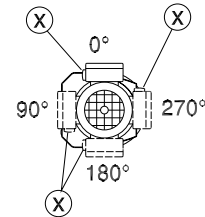
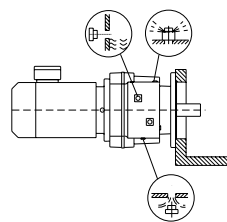
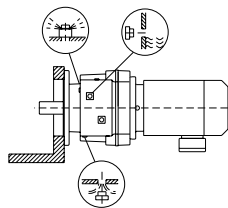
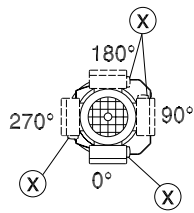
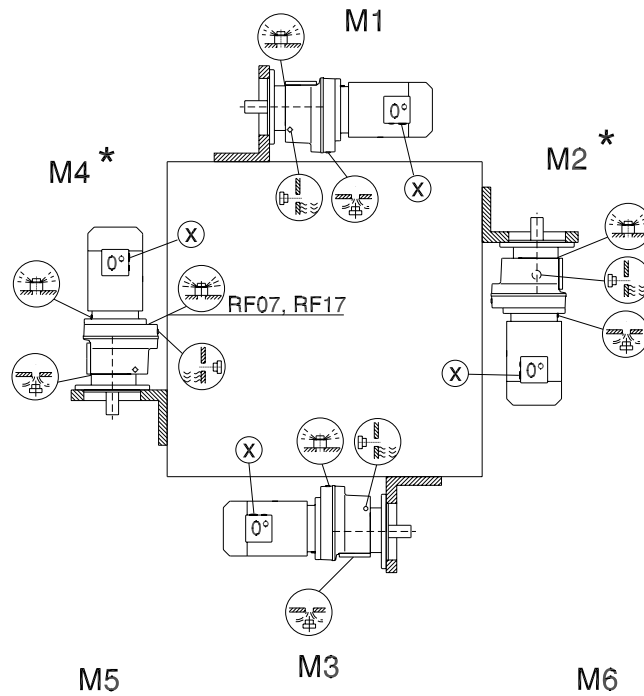
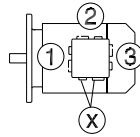
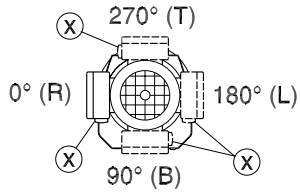


- |               |  |                    |
|---------------|--|--------------------|
| R07           |  | M1, M2, M3, M5, M6 |
| R17, R27      |  | M1, M3, M5, M6     |
| R07, R17, R27 |  |                    |
| R47, R57      |  | M5                 |

\* → page 61

RF17 - RF167

04 041 02 00



RF07		M1, M2, M3, M5, M6
RF17, RF27		M1, M3, M5, M6
RF07, RF17, RF27		
RF47, RF57		M5

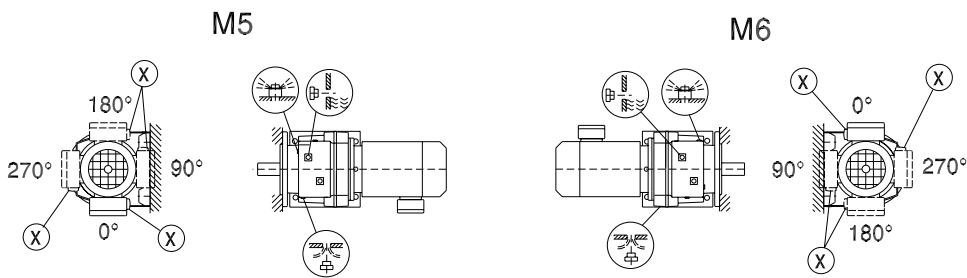
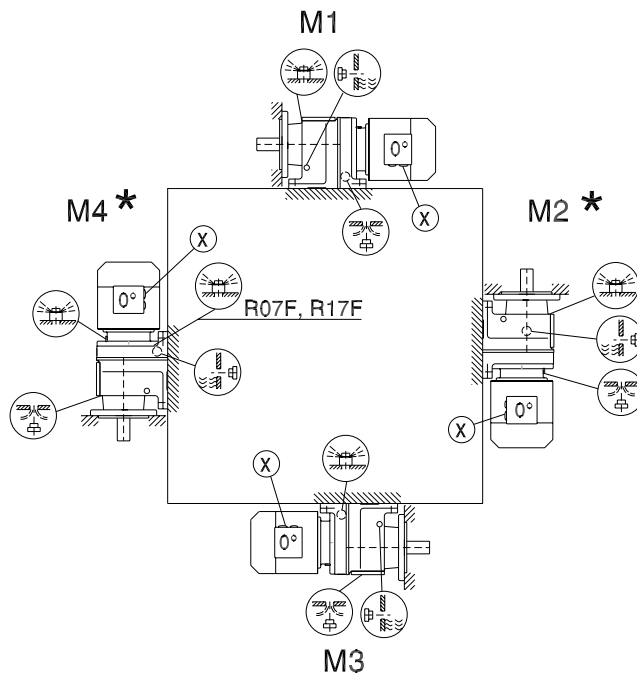
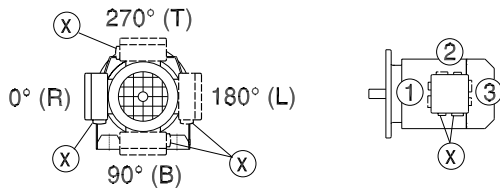
\* → page 61

# Mounting Positions

Mounting positions for helical gearmotors

R17F - R87F

04 042 03 00



R07F		M1, M2, M3, M5, M6
R17F, R27F		M1, M3, M5, M6
R07F, R17F, R27F		
R47F, R57F		M5

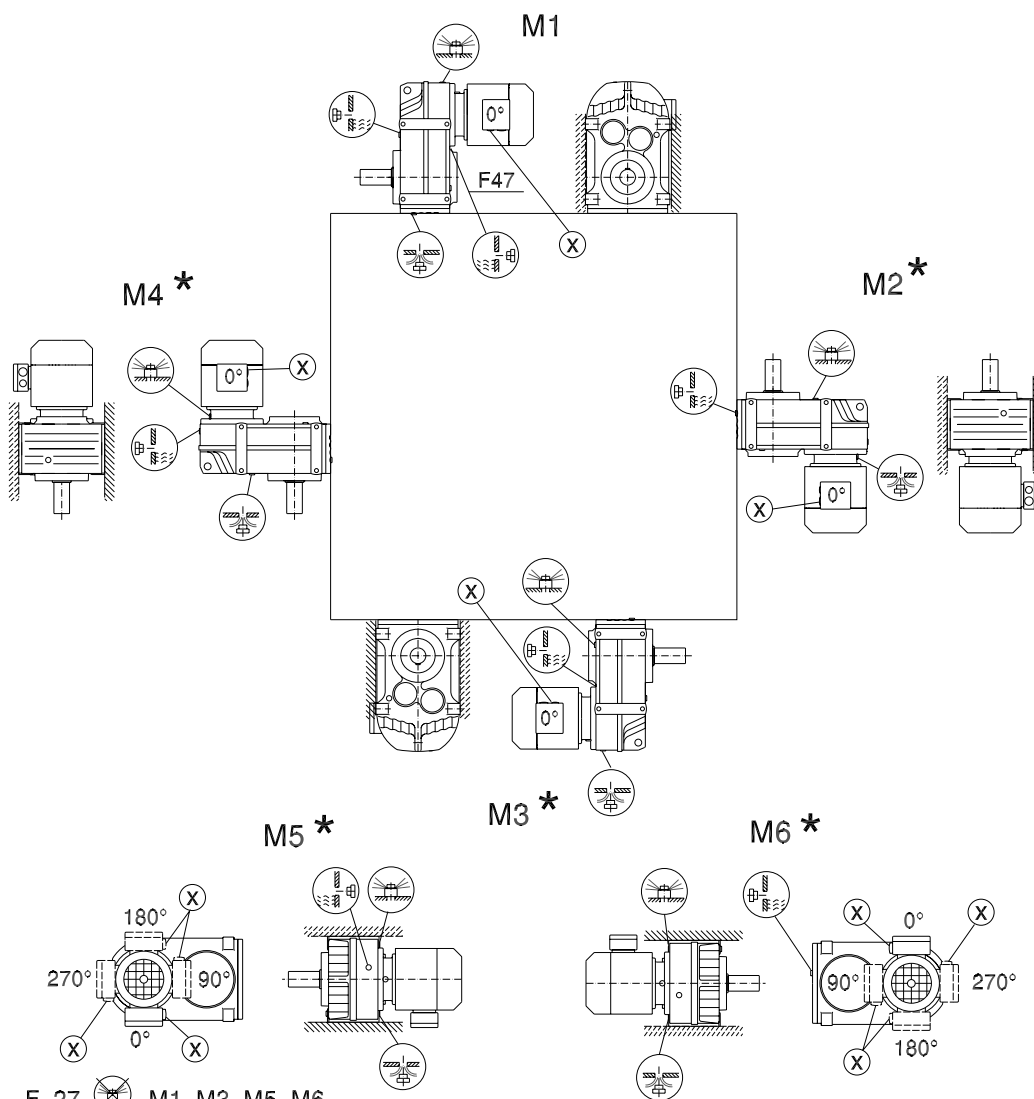
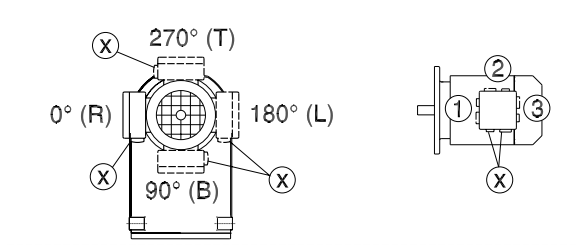
\* → page 61

**Important:** See the information in the "Gearmotors" catalog, section "Project Planning for Gear Units/Overhung and axial loads" (page 36).

4.5 Mounting positions for parallel shaft helical gearmotors

F/FA..B/FH27B-157B, FV27B-107B

42 042 03 00



- F..27 M1, M3, M5, M6
- F..27 M1 - M6
- F..27 M1, M3, M5, M6

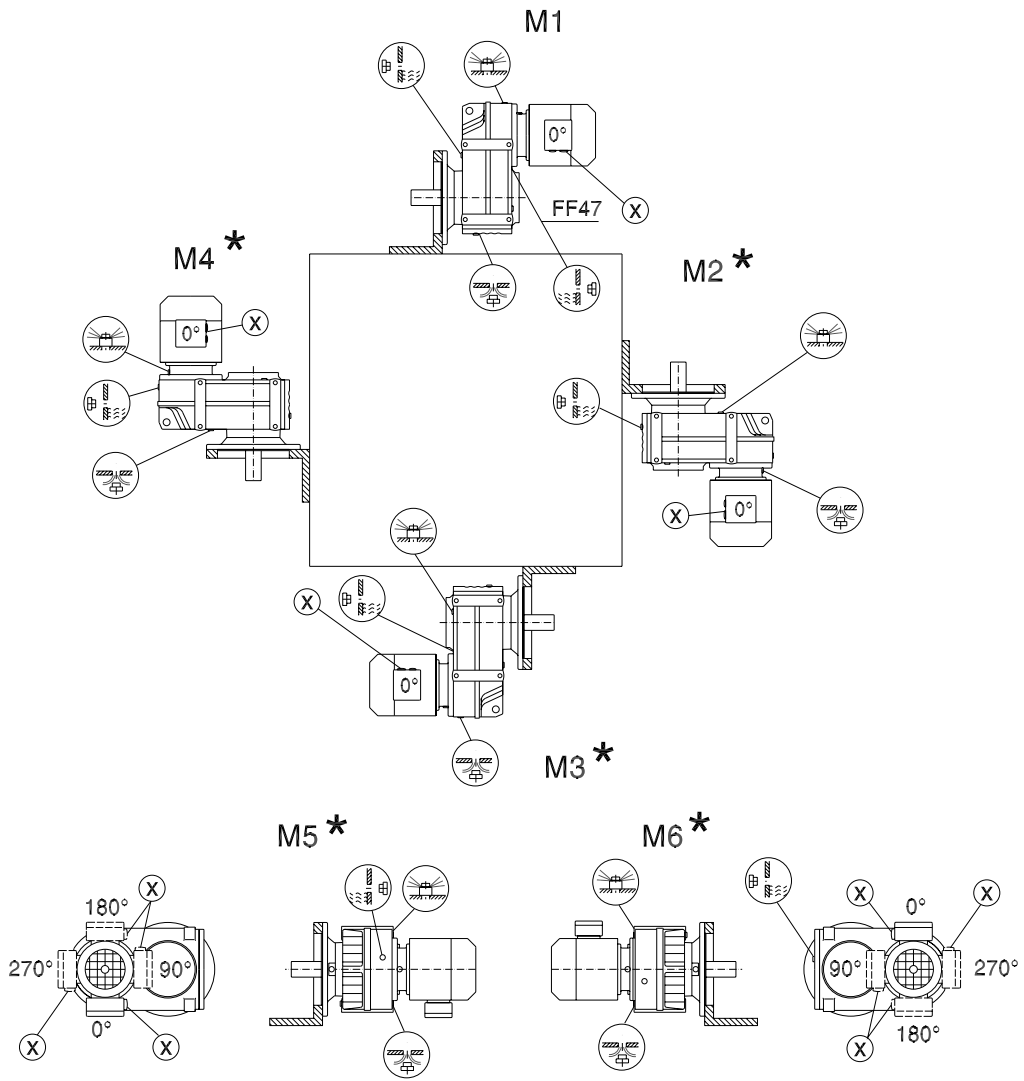
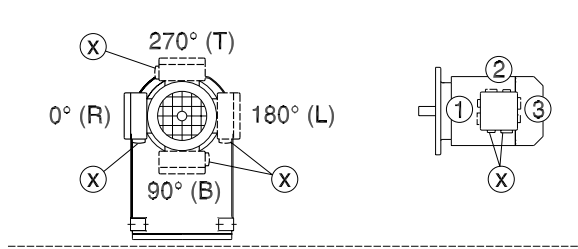
\* → page 61

**Mounting Positions**

Mounting positions for parallel shaft helical gearmotors

**FF/FAF/FHF/FAZ/FHZ27-157, FVF/FVZ27-107**

42 043 03 00

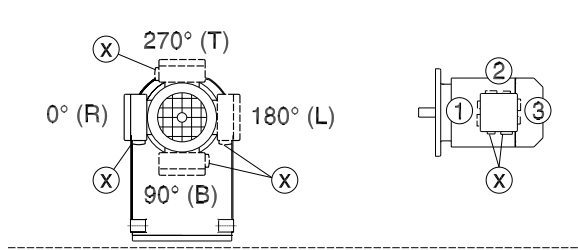


- F..27 M1, M3, M5, M6
- F..27 M1 - M6
- F..27 M1, M3, M5, M6

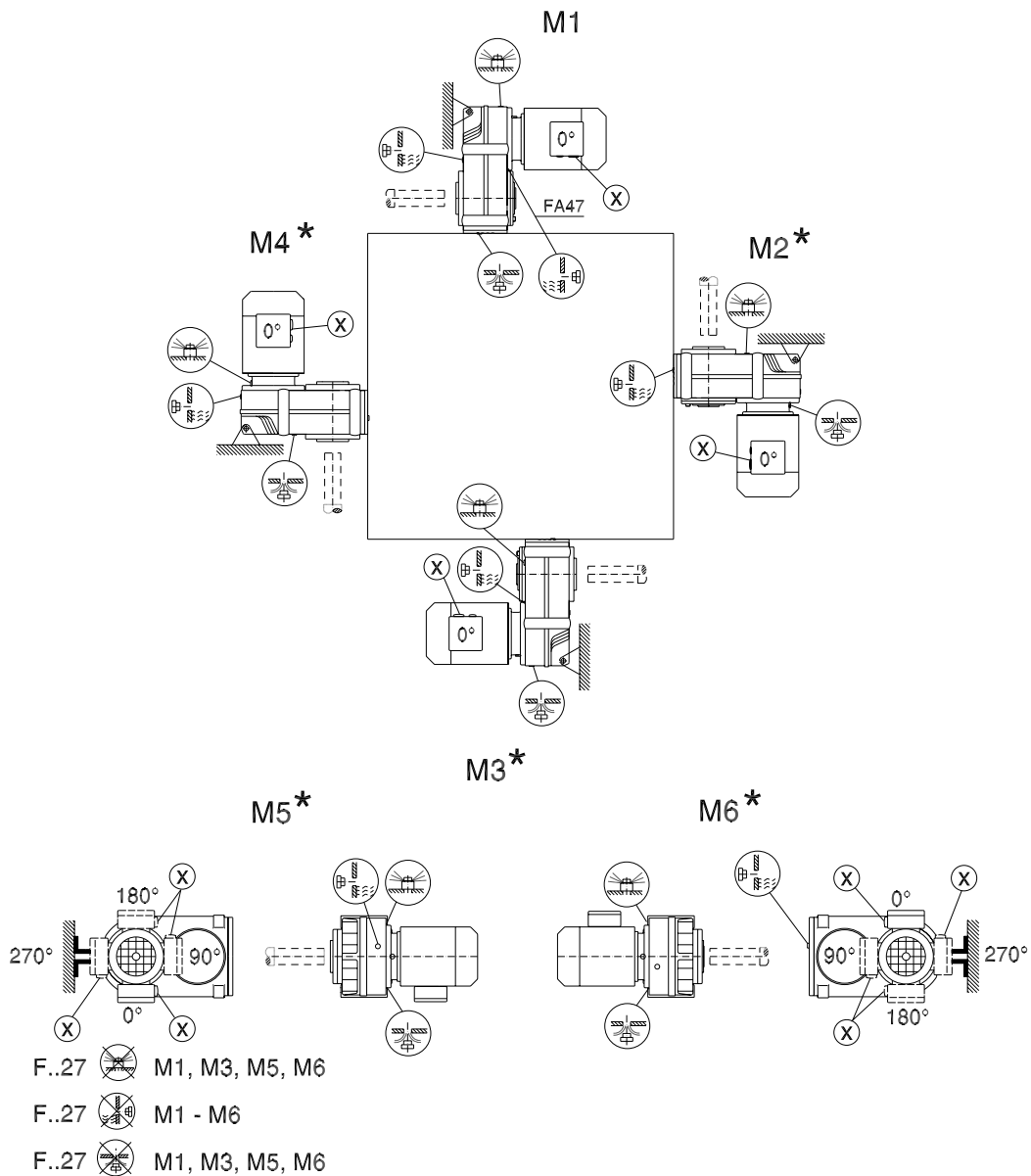
\* → page 61

FA/FH27-157, FV27-107, FT37-97

42 044 03 00



4



- F..27 M1, M3, M5, M6
- F..27 M1 - M6
- F..27 M1, M3, M5, M6

\* → page 61

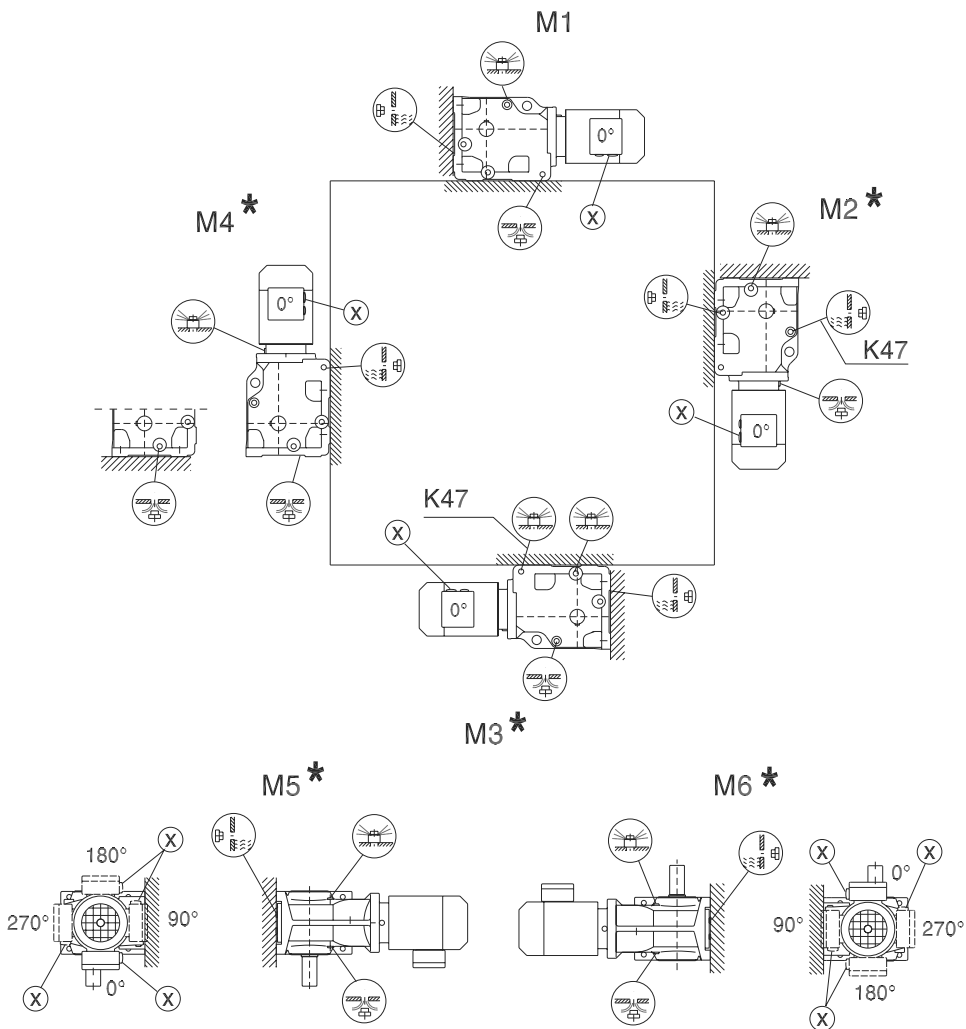
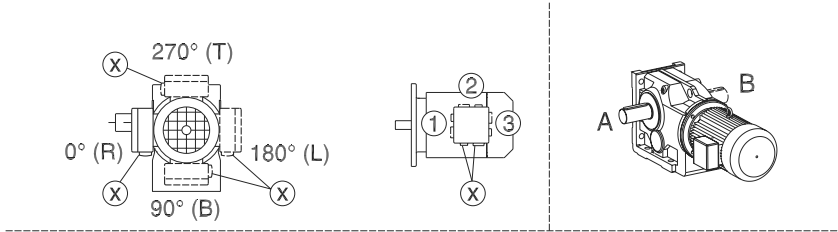
**Mounting Positions**

Mounting positions for helical-bevel gearmotors


**4.6 Mounting positions for helical-bevel gearmotors**

**K/KA..B/KH37B-157B, KV37B-107B**

34 025 03 00

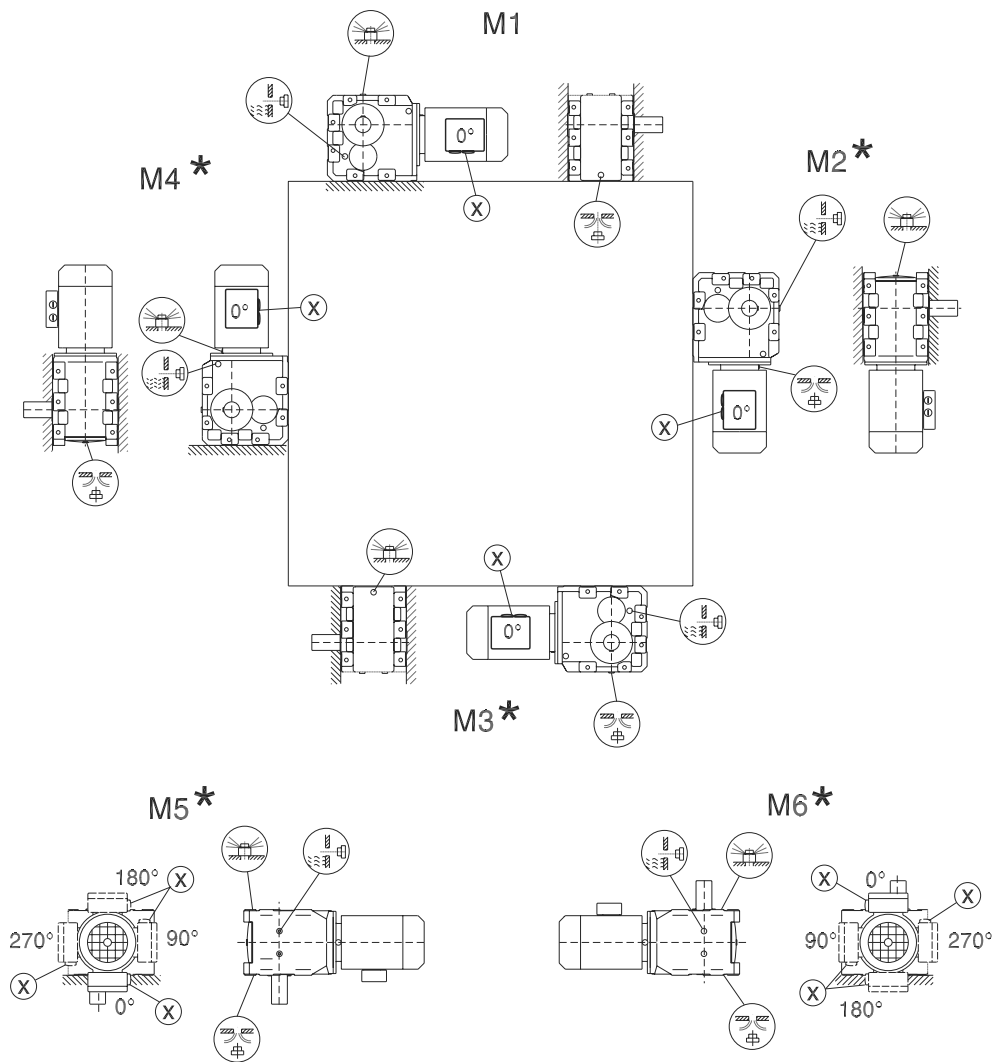
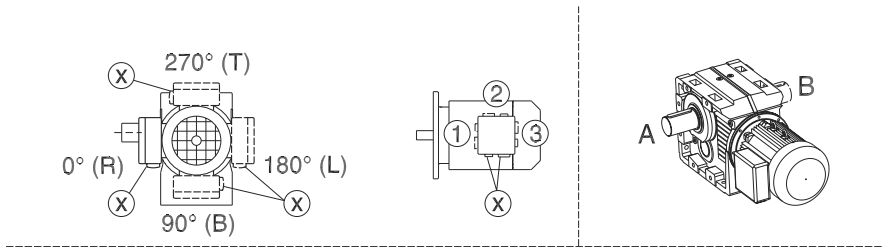


\* → page 61


**Important:** See the  information in the "Gearmotors" catalog, section "Project Planning for Gear Units/Overhung and axial loads" (page 36).

K167-187, KH167B-187B

34 026 03 00



\* → page 61

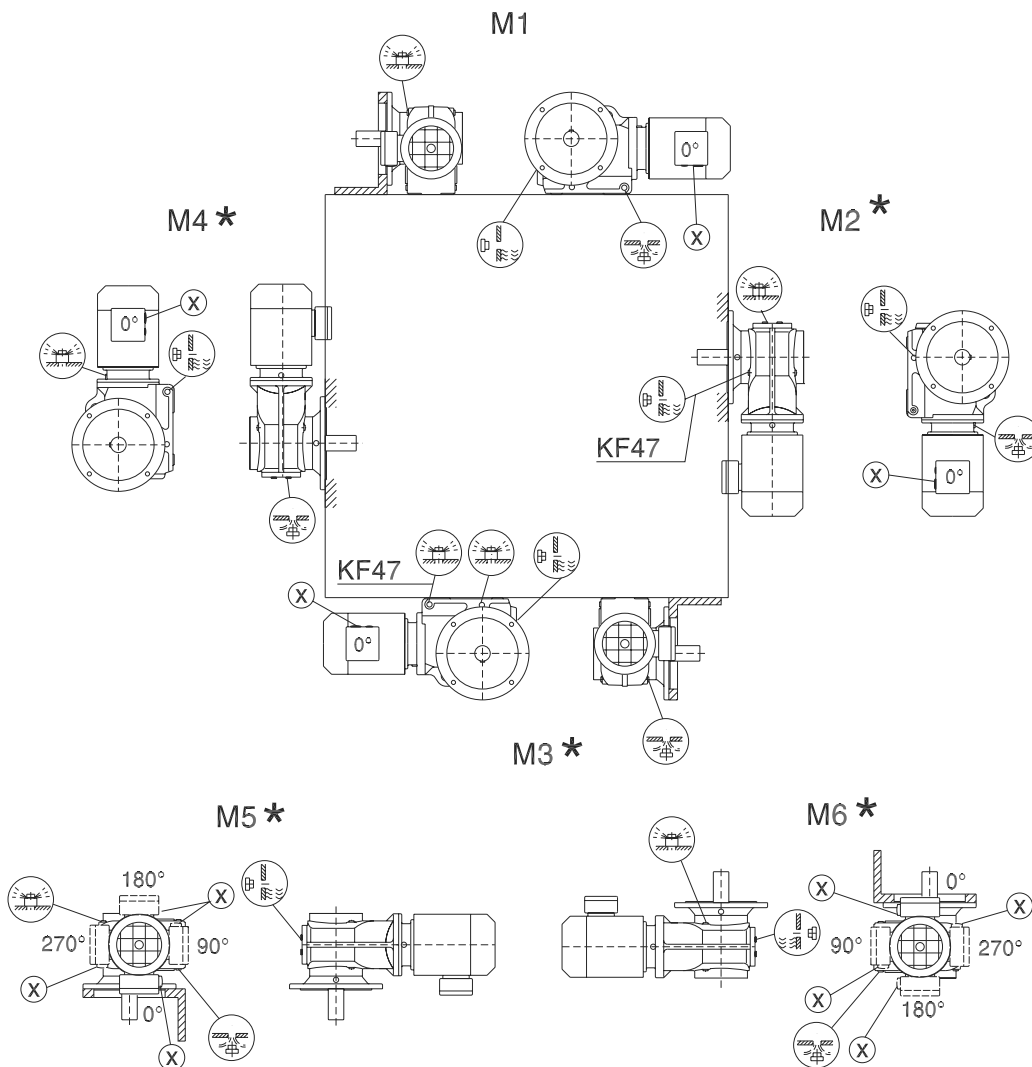
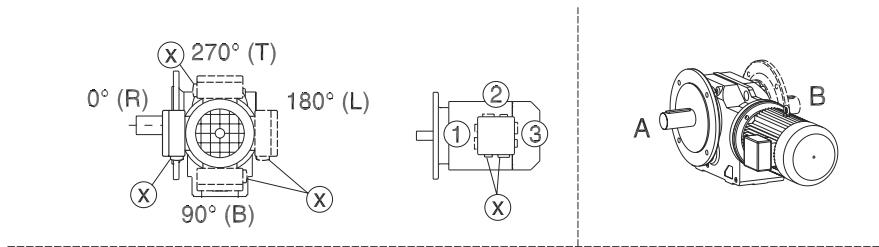
**Important:** See the  information in the "Gearmotors" catalog, section "Project Planning for Gear Units/Overhung and axial loads" (page 36).

**Mounting Positions**

Mounting positions for helical-bevel gearmotors

**KF/KAF/KHF/KAZ/KHZ37-157, KVF/KVZ37-107**

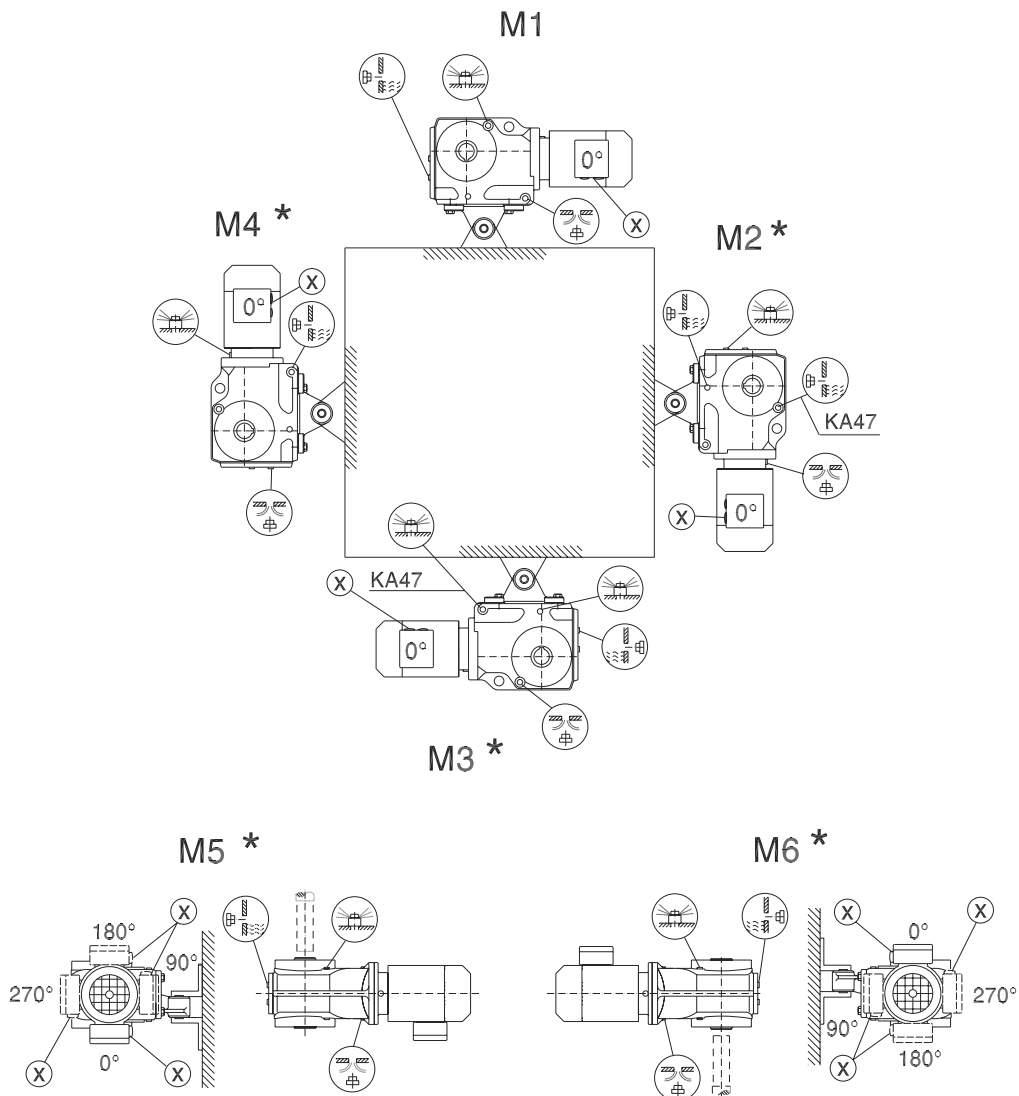
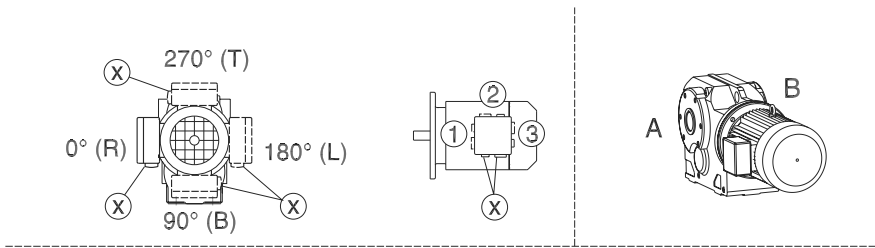
34 027 03 00



\* → page 61

KA/KH37-157, KV37-107, KT37-97

39 025 03 00



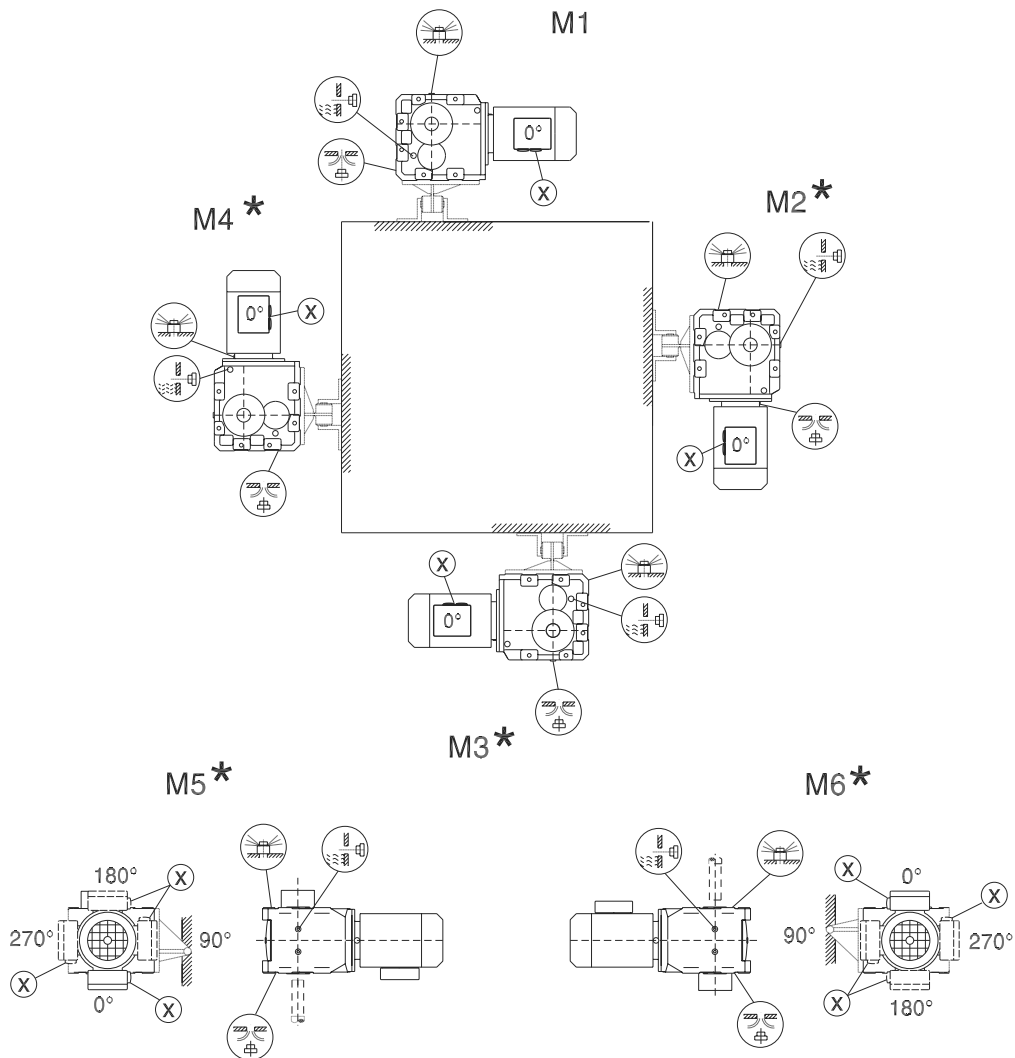
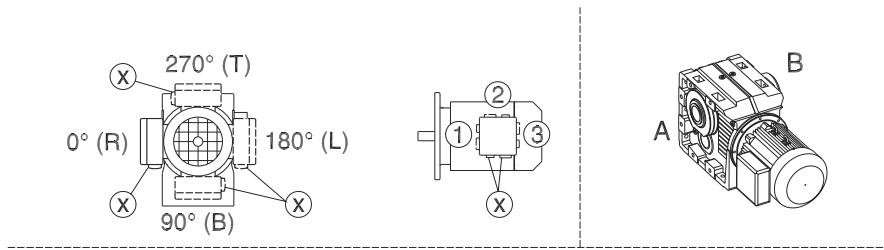
\* → page 61

### Mounting Positions

Mounting positions for helical-bevel gearmotors

KH167-187

39 026 04 00

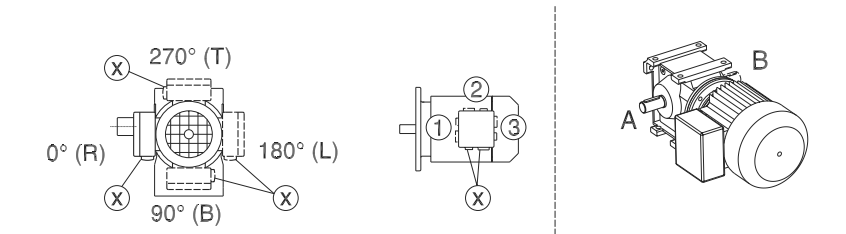


\* → page 61

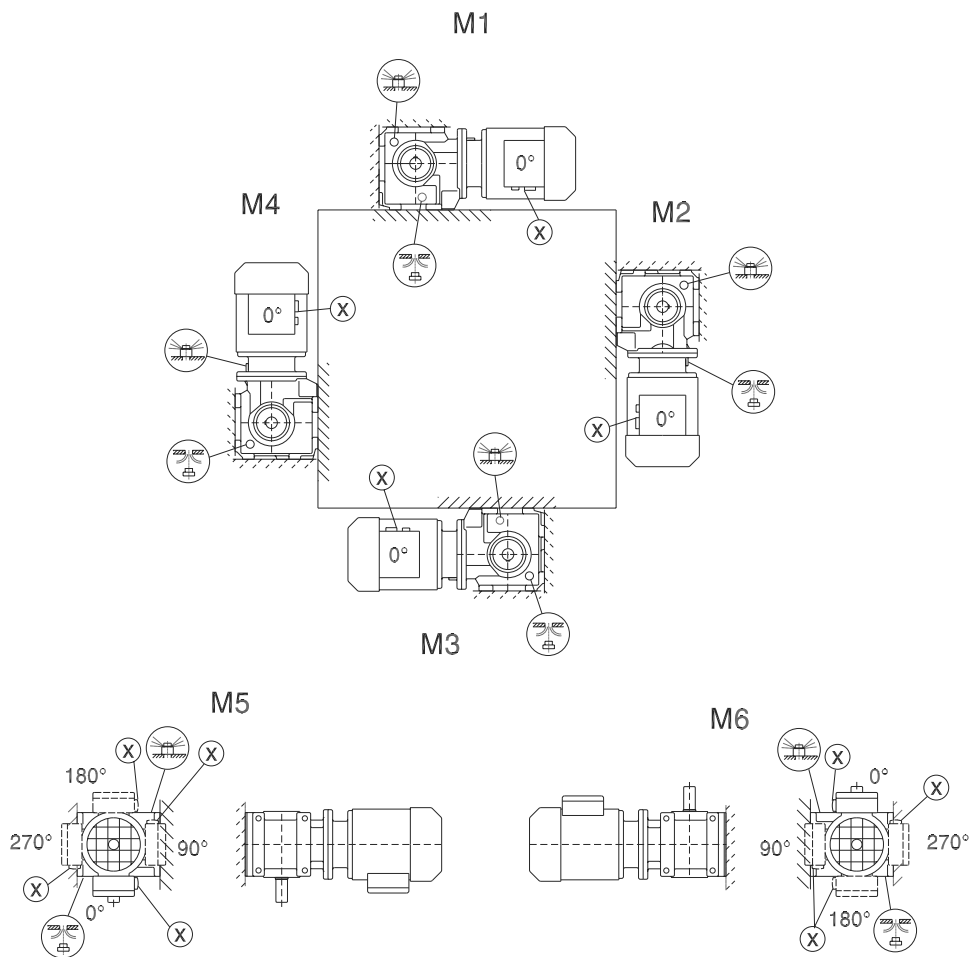
4.7 Mounting positions for helical-worm gearmotors

S37


05 025 03 00



4



\* → page 61

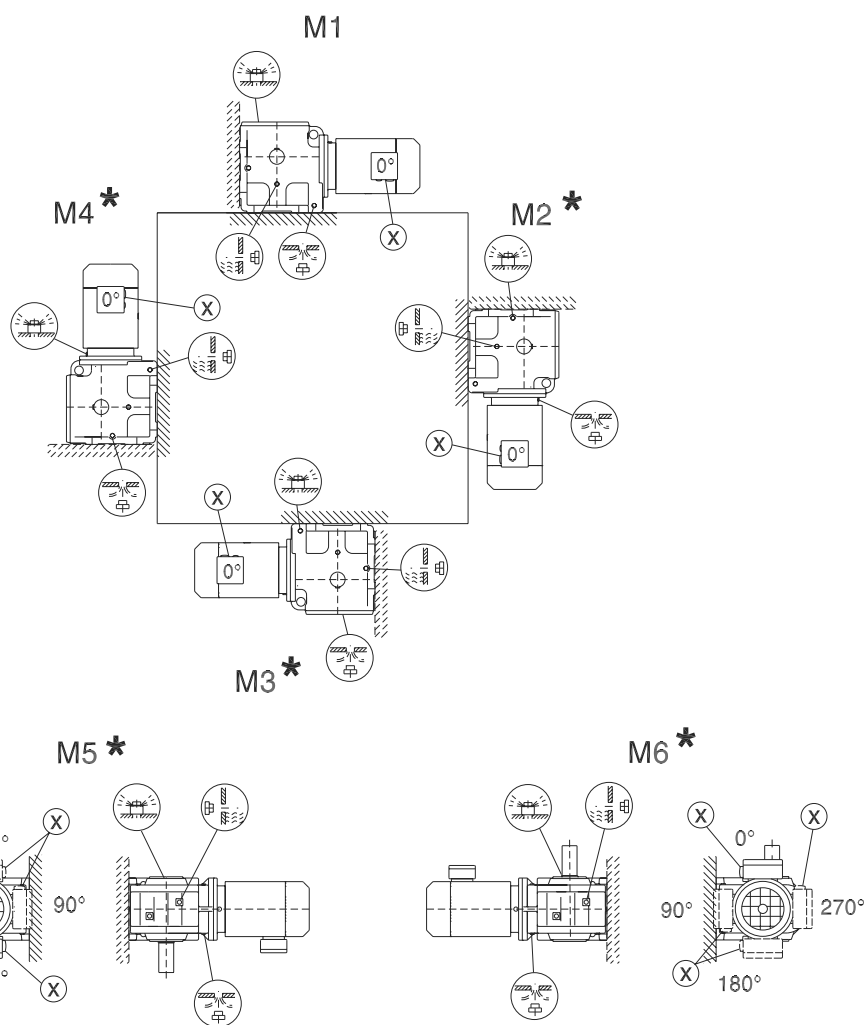
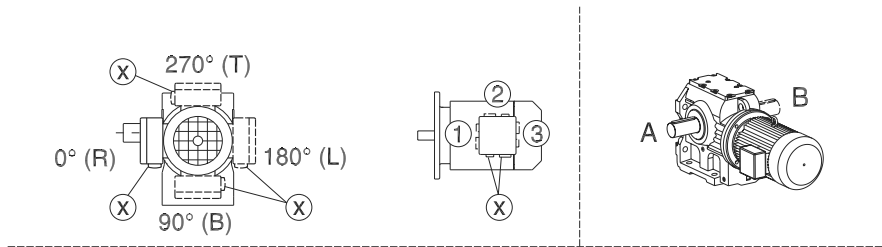
**Important:** See the  information in the "Gearmotors" catalog, section "Project Planning for Gear Units/Overhung and axial loads" (page 36).

**Mounting Positions**

Mounting positions for helical-worm gearmotors

S47-S67

05 026 03 00

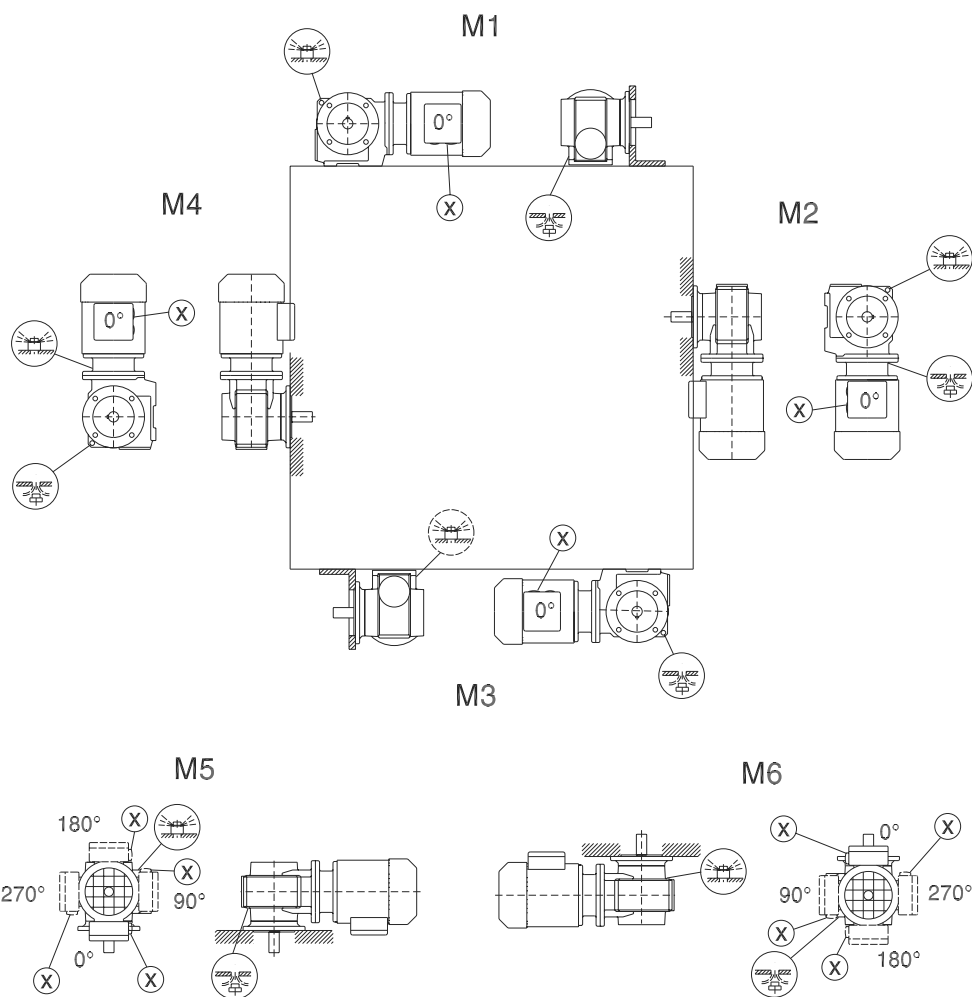
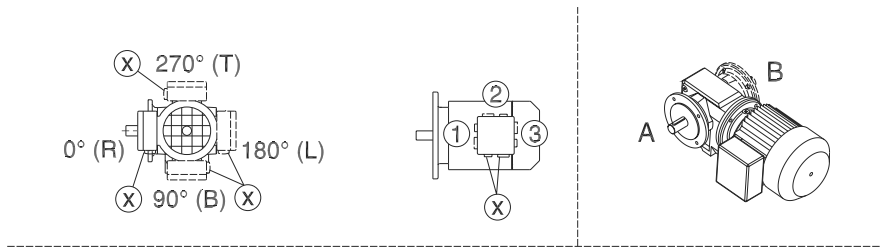


\* → page 61

**Important:** See the ⓘ information in the "Gearmotors" catalog, section "Project Planning for Gear Units/Overhung and axial loads" (page 36).

SF/SAF/SHF37

05 027 03 00



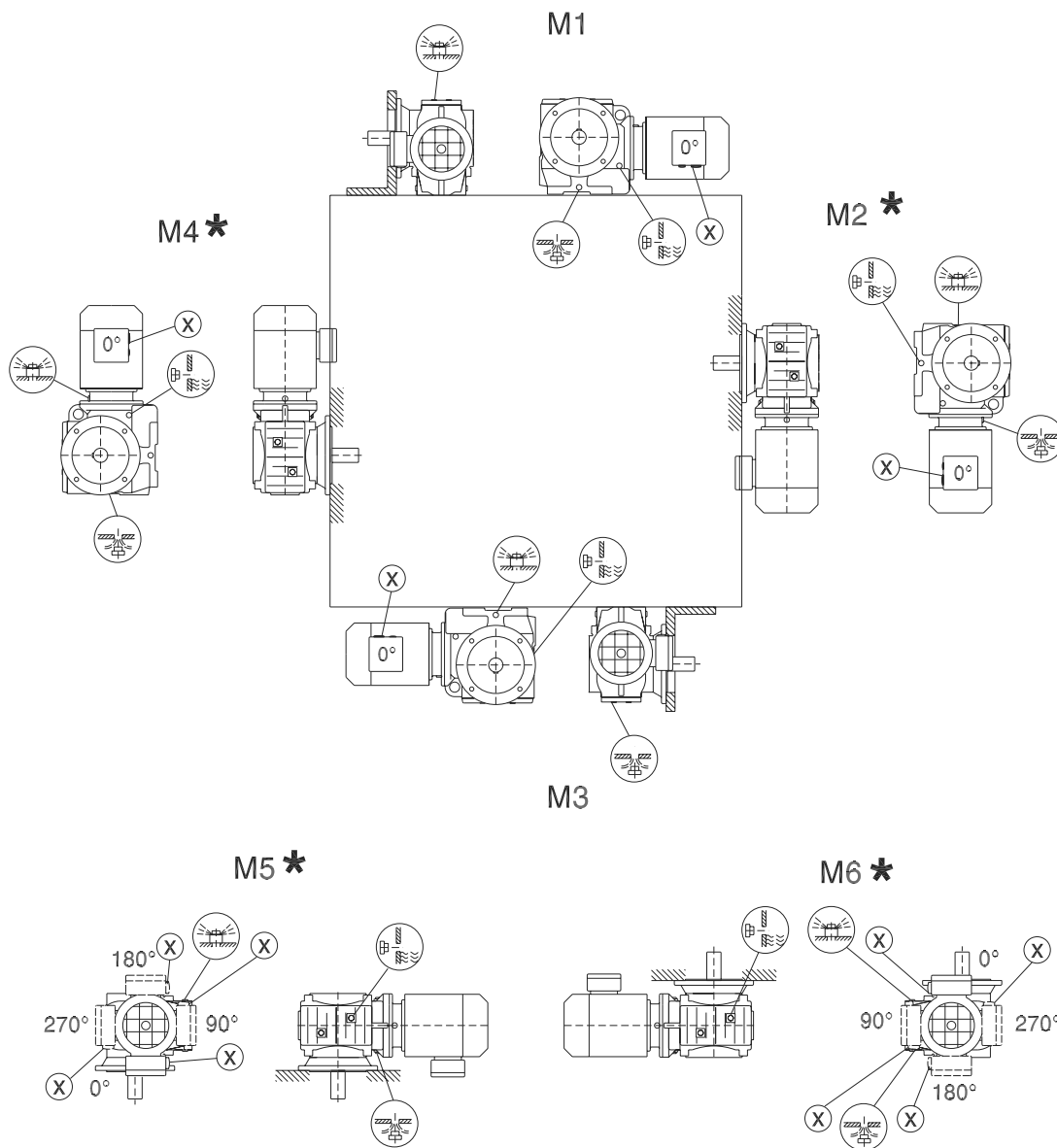
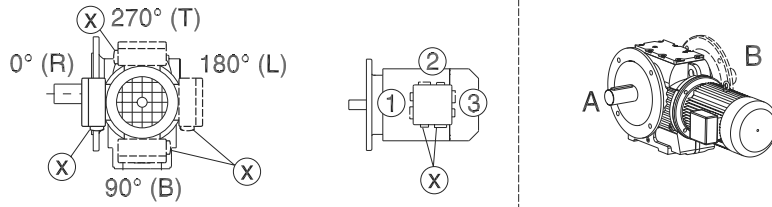
\* → page 61

**Mounting Positions**

Mounting positions for helical-worm gearmotors

SF/SAF/SHF/SAZ/SHZ47-67

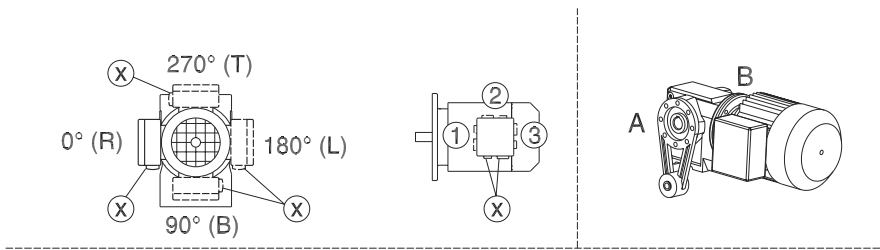
05 028 03 00



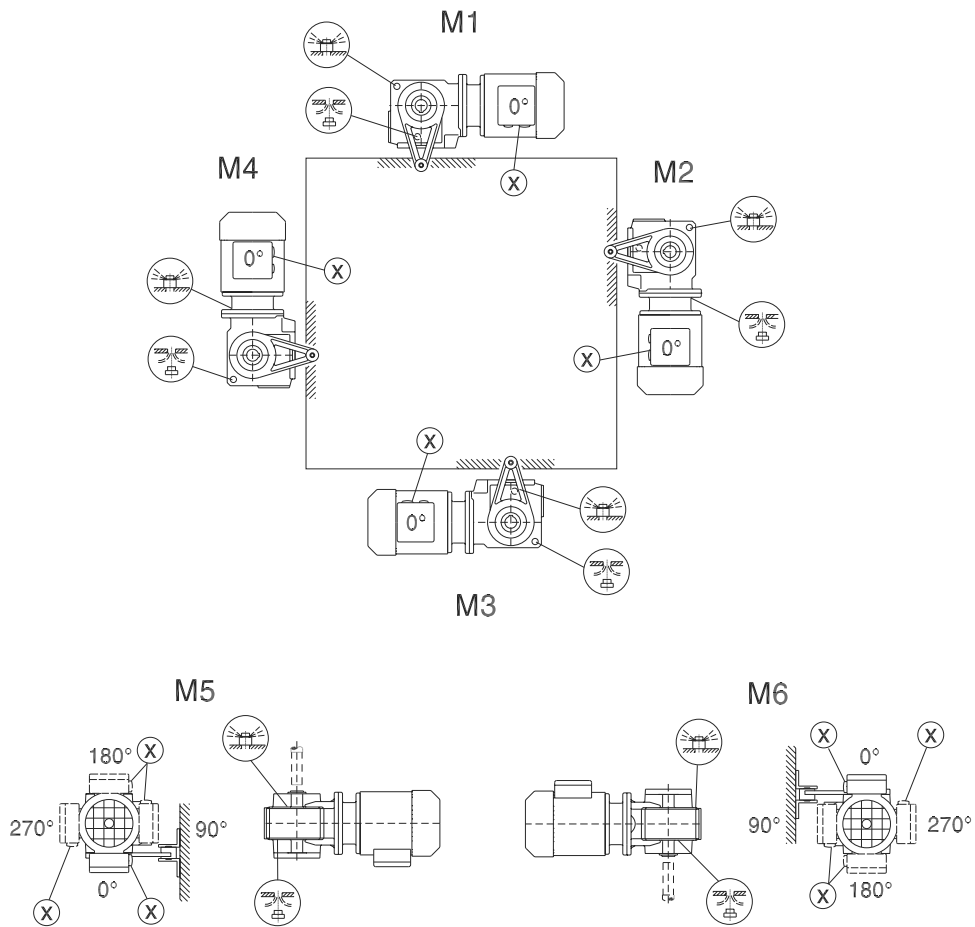
\* → page 61

SA/SH/ST37

28 020 03 00



4



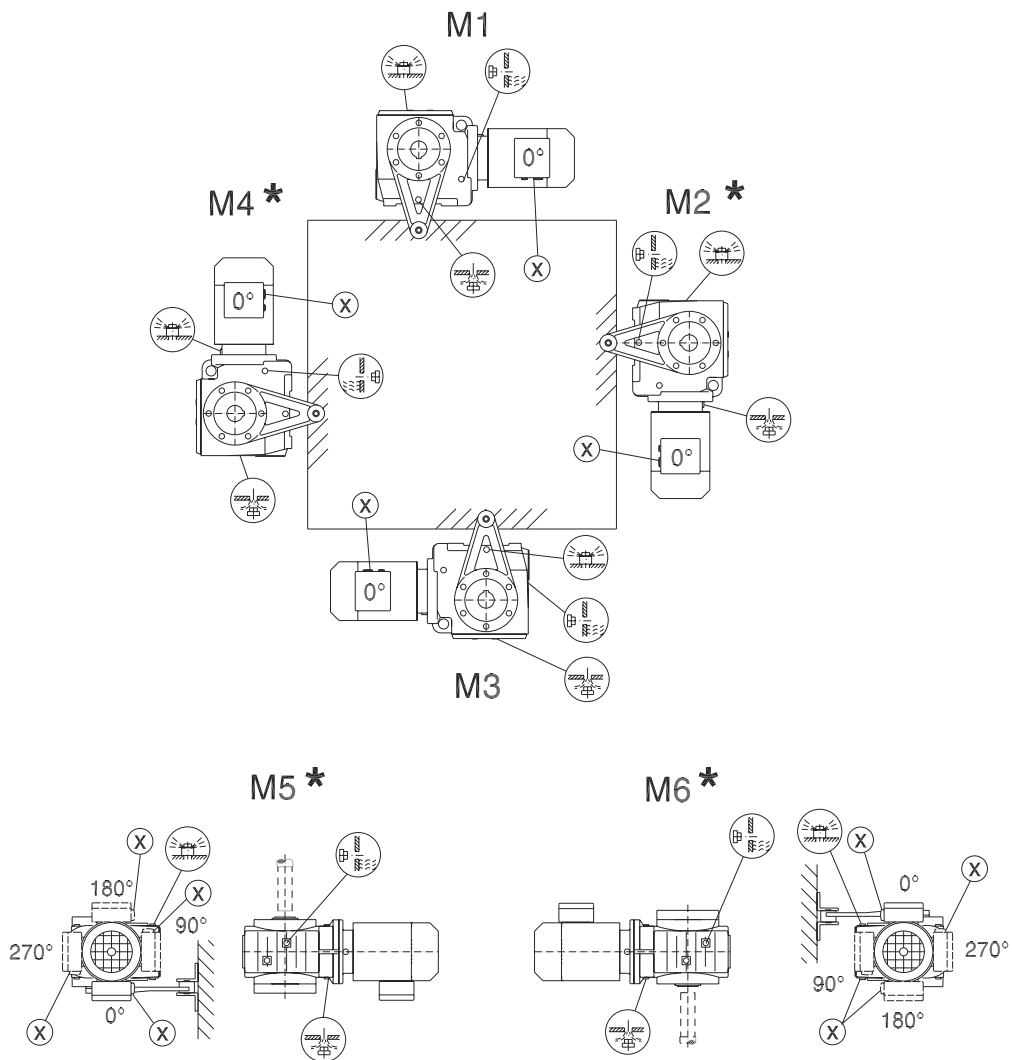
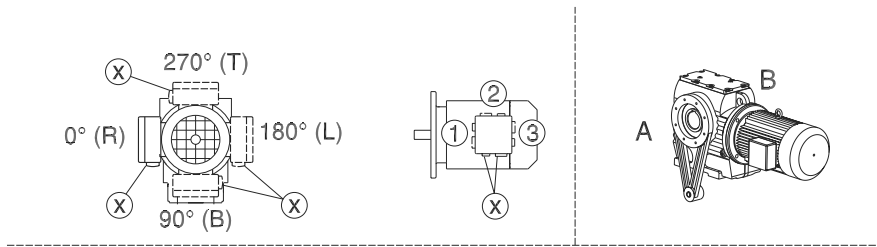
\* → page 61

**Mounting Positions**

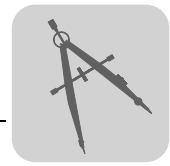
Mounting positions for helical-worm gearmotors

SA/SH/ST47-67

28 021 02 00



\* → page 61



## 5 Design and Operating Notes

### 5.1 Lubricants

**General**

Unless a special arrangement is made, SEW-EURODRIVE supplies the gear units with a lubricant fill adapted for the specific mounting position. The decisive factor is the mounting position (M1 ... M6) specified when ordering the drive.



**Note!**


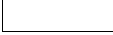


SEW-EURODRIVE fills the gear units with the amount of oil specified for the specific mounting positions. If the mounting position is changed, the amount of oil must be adapted as required. Consequently, a **mounting position may only be changed** after consultation with SEW-EURODRIVE, otherwise your right to claim under warranty **no longer applies**.

**Lubricant table**

The lubricant table on the following page shows the permitted lubricants for SEW-EURODRIVE gear units. Please note the following key to the lubricant table.

**Key to the lubricant table**



Abbreviations used, meaning of shading and notes:

- CLP = Mineral oil
- CLP PG = Polyglycol (W gear units, conforms to USDA-H1)
- CLP HC = Synthetic hydrocarbons
- E = Ester oil (water pollution danger category WGK 1)
- HCE = Synthetic hydrocarbons + ester oil (USDA - H1 certification)
- HLP = Hydraulic oil
-  = Synthetic lubricant (= synthetic anti-friction bearing grease)
-  = Mineral lubricant (= mineral-based anti-friction bearing grease)
- 1) Helical-worm gear units with PG oil: Please contact SEW-EURODRIVE
- 2) Special lubricant for Spiroplan® gear units only
- 3) Recommendation: Select SEW  $f_B \geq 1.2$
- 4) Pay attention to critical starting behavior at low temperatures!
- 5) Low-viscosity grease
- 6) Ambient temperature
-  Lubricant for the food industry (food grade oil)
-  Biodegradable oil (lubricant for use in agriculture, forestry and water resources)



#### **Anti-friction bearing greases**

The anti-friction bearings in gear units and motors are given a factory-fill with the greases listed below.

	Ambient temperature	Manufacturer	Type
Anti-friction bearing in gear unit	-20°C ... +60°C	Mobil	Mobilux EP 2
	-40°C ... +80°C	Mobil	Mobiltemp SHC 100
Anti-friction bearing in motor	-20°C ... +80°C	Esso	Polyrex EM
	+20°C ... +100°C	Klüber	Barrierta L55/2
	-40°C ... +60°C	Kyodo Yushi	Multemp SRL <sup>1)</sup>
<b>Special greases for anti-friction bearings in gear units:</b>			
	-30°C ... +40°C	Aral	Aral Eural Grease EP 2
	-20°C ... +40°C	Aral	Aral Aralube BAB EP2

1) Recommended for continuous operation at ambient temperatures below 0°C, for example in a cold storage.



#### **The following grease quantities are required:**

- For fast-running bearings (gear unit input end): Fill the cavities between the rolling elements one third full with grease.
- For slow-running bearings (in gear units and at gear unit output end): Fill the cavities between the rolling elements two thirds full with grease.

Motor bearings are closed and lubricated for life.



Lubricant table

01 805 792-1

			ISO, NLGI	Mobil®	Shell	FLUOR INDUSTRIAL	ARAL	BP	Tribol	TEXACO	Optimol	FUCHS
R...  K...(HK...)  F... 	Standard -10 +40	DIN (CC)	VG 220	Mobilgear 630	Shell Omala 220	Kiüberoil GEM 1-220	Aral Degol BG 220	BP Energol GR-XP 220	Tribol 1100/220	Meropa 220	Optigear BM 220	Renolin CLP 220
	+80	CLP PG	VG 220	Mobil Glygolye 30	Shell Tivela WB	Kiübersynth GH 6-220	Aral Degol GS 220	BP Enersyn SG-XP 220	Tribol 800/220	Synluibe CLP 220	Optiflex A 220	Renolin Unisyn CLP 220
	+80	CLP HC	VG 220	Mobil SHC 630	Shell Omala 220 HD	Kiübersynth EG 4-220	Aral Degol PAS 220		Tribol 1510/220	Pinnacle EP 220	Optigear Synthetic A 220	
	+40		VG 150	Mobil SHC 629		Kiübersynth EG 4-150				Pinnacle EP 150		
	+25	CLP (CC)	VG 150 VG 100	Mobilgear 627	Shell Omala 100	Kiüberoil GEM 1-150	Aral Degol BG 100	BP Energol GR-XP 100	Tribol 1100/100	Meropa 150	Optigear BM 100	Renolin CLP 150
	+10	HLP (HM)	VG 68-46 VG 32	Mobil D.T.E. 13M	Shell Tellus T 32	Kiüberoil GEM 1-68	Aral Degol BG 46			Rando EP Ashless 46	Optigear 32	Renolin B 46 HVI
	+10	CLP HC	VG 32	Mobil SHC 624		Kiüber-Summit HySyn FG-32				Cetus PAO 46		
	-20	HLP (HM)	VG 22 VG 15	Mobil D.T.E. 11M	Shell Tellus T 15	Isoflex MT 30 ROT		BP Energol HLP-HM 10		Rando HDZ 15		
	-20	CLP (CC)	VG 680	Mobilgear 636	Shell Omala 680	Kiüberoil GEM 1-680	Aral Degol BG 680	BP Energol GR-XP 680	Tribol 1100/680	Meropa 680	Optigear BM 680	Renolin CLP 680
	+60	CLP PG	VG 680 <sup>1)</sup>	Mobil Glygolye HE 680		Kiübersynth GH 6-680		BP Enersyn SG-XP 680	Tribol 800/680	Synluibe CLP 680		
S...(HS...) 	+80	CLP HC	VG 460	Mobil SHC 634	Shell Omala 460 HD	Kiübersynth EG 4-460				Pinnacle EP 460		
	+10		VG 150	Mobil SHC 629		Kiübersynth EG 4-150				Pinnacle EP 150		
	+10	CLP (CC)	VG 150 VG 100	Mobilgear 627	Shell Omala 100	Kiüberoil GEM 1-150	Aral Degol BG 100	BP Energol GR-XP 100	Tribol 1100/100	Meropa 100	Optigear BM 100	Renolin CLP 150
	+20	CLP PG	VG 220 <sup>1)</sup>	Mobil Glygolye 30		Kiübersynth GH 6-220				Synluibe CLP 220	Optiflex A 220	
	0	CLP HC	VG 32	Mobil SHC 624		Kiüber-Summit HySyn FG-32				Cetus PAO 46		
	+40	HCE	VG 460		Shell Cassida Fluid GL 460	Kiüberoil 4UH1-460	Aral Eural Gear 460				Optieib GT 460	
	+40	E	VG 460			Kiüberbio CA2-460	Aral Degol BAB 460				Optisynth BS 460	
	+60	DIN 51 818 <sup>5)</sup>	00	Glygolye Grease 00	Shell Tivela GL 00	Kiübersynth GE 46-1200				Multifak 6833 EP 00		
	-15		000 - 0	Mobilux EP 004	Shell Alvania GL 00		Aralub MFL 00	BP Energol LS-EP 00		Multifak EP 000	Longtime PD 00	Renolin SF 7 - 041



#### Lubricant fill quantities

The specified fill quantities are **recommended values**. The precise values vary depending on the number of stages and gear ratio. When filling, it is essential to check the **oil level plug since it indicates the precise oil capacity**.

The following tables show guide values for lubricant fill quantities in relation to the mounting position M1 ... M6.

#### Helical (R) gear units

##### RX..

Gear unit	Fill quantity in liters					
	M1	M2	M3	M4	M5	M6
RX57	0.60	0.80	1.30	1.30	0.90	0.90
RX67	0.80	0.80	1.70	1.90	1.10	1.10
RX77	1.10	1.50	2.60	2.70	1.60	1.60
RX87	1.70	2.50	4.80	4.80	2.90	2.90
RX97	2.10	3.40	7.4	7.0	4.80	4.80
RX107	3.90	5.6	11.6	11.9	7.7	7.7

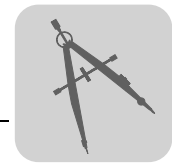
##### RXF..

Gear unit	Fill quantity in liters					
	M1	M2	M3	M4	M5	M6
RXF57	0.50	0.80	1.10	1.10	0.70	0.70
RXF67	0.70	0.80	1.50	1.40	1.00	1.00
RXF77	0.90	1.30	2.40	2.00	1.60	1.60
RXF87	1.60	1.95	4.90	3.95	2.90	2.90
RXF97	2.10	3.70	7.1	6.3	4.80	4.80
RXF107	3.10	5.7	11.2	9.3	7.2	7.2

##### R.., R..F

Gear unit	Fill quantity in liters					
	M1 <sup>1)</sup>	M2 <sup>1)</sup>	M3	M4	M5	M6
R17	0.25	0.55	0.35	0.55	0.35	0.35
R27	0.25/0.40	0.70	0.50	0.70	0.50	0.50
R37	0.30/0.95	0.85	0.95	1.05	0.75	0.95
R47	0.70/1.50	1.60	1.50	1.65	1.50	1.50
R57	0.80/1.70	1.90	1.70	2.10	1.70	1.70
R67	1.10/2.30	2.60/3.50	2.80	3.20	1.80	2.00
R77	1.20/3.00	3.80/4.10	3.60	4.10	2.50	3.40
R87	2.30/6.0	6.7/8.2	7.2	7.7	6.3	6.5
R97	4.60/9.8	11.7/14.0	11.7	13.4	11.3	11.7
R107	6.0/13.7	16.3	16.9	19.2	13.2	15.9
R137	10.0/25.0	28.0	29.5	31.5	25.0	25.0
R147	15.4/40.0	46.5	48.0	52.0	39.5	41.0
R167	27.0/70.0	82.0	78.0	88.0	66.0	69.0

1) The larger gear unit of multi-stage gear units must be filled with the larger oil volume.



RF..

Gear unit	Fill quantity in liters					
	M1 <sup>1)</sup>	M2 <sup>1)</sup>	M3	M4	M5	M6
RF07	0.12	0.20	0.20	0.20	0.20	0.20
RF17	0.25	0.55	0.35	0.55	0.35	0.35
RF27	0.25/0.40	0.70	0.50	0.70	0.50	0.50
RF37	0.35/0.95	0.90	0.95	1.05	0.75	0.95
RF47	0.65/1.50	1.60	1.50	1.65	1.50	1.50
RF57	0.80/1.70	1.80	1.70	2.00	1.70	1.70
RF67	1.20/2.50	2.70/3.60	2.70	2.60	1.90	2.10
RF77	1.20/2.60	3.80/4.10	3.30	4.10	2.40	3.00
RF87	2.40/6.0	6.8/7.9	7.1	7.7	6.3	6.4
RF97	5.1/10.2	11.9/14.0	11.2	14.0	11.2	11.8
RF107	6.3/14.9	15.9	17.0	19.2	13.1	15.9
RF137	9.5/25.0	27.0	29.0	32.5	25.0	25.0
RF147	16.4/42.0	47.0	48.0	52.0	42.0	42.0
RF167	26.0/70.0	82.0	78.0	88.0	65.0	71.0

1) The larger gear unit of multi-stage gear units must be filled with the larger oil volume.

Parallel shaft heli-  
cal (F) gear units

F., FA..B, FH..B, FV..B

Gear unit	Fill quantity in liters					
	M1	M2	M3	M4	M5	M6
F..27	0.60	0.80	0.65	0.70	0.60	0.60
F..37	0.95	1.25	0.70	1.25	1.00	1.10
F..47	1.50	1.80	1.10	1.90	1.50	1.70
F..57	2.60	3.50	2.10	3.50	2.80	2.90
F..67	2.70	3.80	1.90	3.80	2.90	3.20
F..77	5.9	7.3	4.30	8.0	6.0	6.3
F..87	10.8	13.0	7.7	13.8	10.8	11.0
F..97	18.5	22.5	12.6	25.2	18.5	20.0
F..107	24.5	32.0	19.5	37.5	27.0	27.0
F..127	40.5	54.5	34.0	61.0	46.3	47.0
F..157	69.0	104.0	63.0	105.0	86.0	78.0

FF..

Gear unit	Fill quantity in liters					
	M1	M2	M3	M4	M5	M6
FF27	0.60	0.80	0.65	0.70	0.60	0.60
FF37	1.00	1.25	0.70	1.30	1.00	1.10
FF47	1.60	1.85	1.10	1.90	1.50	1.70
FF57	2.80	3.50	2.10	3.70	2.90	3.00
FF67	2.70	3.80	1.90	3.80	2.90	3.20
FF77	5.9	7.3	4.30	8.1	6.0	6.3
FF87	10.8	13.2	7.8	14.1	11.0	11.2
FF97	19.0	22.5	12.6	25.6	18.9	20.5
FF107	25.5	32.0	19.5	38.5	27.5	28.0
FF127	41.5	55.5	34.0	63.0	46.3	49.0
FF157	72.0	105.0	64.0	106.0	87.0	79.0



FA.., FH.., FV.., FAF.., FAZ.., FHF.., FHZ.., FVF.., FVZ.., FT..

Gear unit	Fill quantity in liters					
	M1	M2	M3	M4	M5	M6
F..27	0.60	0.80	0.65	0.70	0.60	0.60
F..37	0.95	1.25	0.70	1.25	1.00	1.10
F..47	1.50	1.80	1.10	1.90	1.50	1.70
F..57	2.70	3.50	2.10	3.40	2.90	3.00
F..67	2.70	3.80	1.90	3.80	2.90	3.20
F..77	5.9	7.3	4.30	8.0	6.0	6.3
F..87	10.8	13.0	7.7	13.8	10.8	11.0
F..97	18.5	22.5	12.6	25.2	18.5	20.0
F..107	24.5	32.0	19.5	37.5	27.0	27.0
F..127	39.0	54.5	34.0	61.0	45.0	46.5
F..157	68.0	103.0	62.0	104.0	85.0	77.0

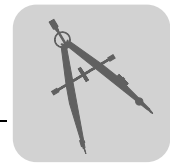
*Helical-bevel (K)  
gear units*

K.., KA..B, KH..B, KV..B

Gear unit	Fill quantity in liters					
	M1	M2	M3	M4	M5	M6
K..37	0.50	1.00	1.00	1.25	0.95	0.95
K..47	0.80	1.30	1.50	2.00	1.60	1.60
K..57	1.20	2.30	2.50	2.80	2.60	2.40
K..67	1.10	2.40	2.60	3.45	2.60	2.60
K..77	2.20	4.10	4.40	5.8	4.20	4.40
K..87	3.70	8.0	8.7	10.9	8.0	8.0
K..97	7.0	14.0	15.7	20.0	15.7	15.5
K..107	10.0	21.0	25.5	33.5	24.0	24.0
K..127	21.0	41.5	44.0	54.0	40.0	41.0
K..157	31.0	62.0	65.0	90.0	58.0	62.0
K..167	33.0	95.0	105.0	123.0	85.0	84.0
K..187	53.0	152.0	167.0	200	143.0	143.0

KF..

Gear unit	Fill quantity in liters					
	M1	M2	M3	M4	M5	M6
KF37	0.50	1.10	1.10	1.50	1.00	1.00
KF47	0.80	1.30	1.70	2.20	1.60	1.60
KF57	1.30	2.30	2.70	3.15	2.90	2.70
KF67	1.10	2.40	2.80	3.70	2.70	2.70
KF77	2.10	4.10	4.40	5.9	4.50	4.50
KF87	3.70	8.2	9.0	11.9	8.4	8.4
KF97	7.0	14.7	17.3	21.5	15.7	16.5
KF107	10.0	21.8	25.8	35.1	25.2	25.2
KF127	21.0	41.5	46.0	55.0	41.0	41.0
KF157	31.0	66.0	69.0	92.0	62.0	62.0



KA.., KH.., KV.., KAF.., KHF.., KVF.., KAZ.., KHZ.., KVZ.., KT..

Gear unit	Fill quantity in liters					
	M1	M2	M3	M4	M5	M6
K..37	0.50	1.00	1.00	1.40	1.00	1.00
K..47	0.80	1.30	1.60	2.15	1.60	1.60
K..57	1.30	2.30	2.70	3.15	2.90	2.70
K..67	1.10	2.40	2.70	3.70	2.60	2.60
K..77	2.10	4.10	4.60	5.9	4.40	4.40
K..87	3.70	8.2	8.8	11.1	8.0	8.0
K..97	7.0	14.7	15.7	20.0	15.7	15.7
K..107	10.0	20.5	24.0	32.4	24.0	24.0
K..127	21.0	41.5	43.0	52.0	40.0	40.0
K..157	31.0	66.0	67.0	87.0	62.0	62.0
K..167	33.0	95.0	105.0	123.0	85.0	84.0
K..187	53.0	152.0	167.0	200	143.0	143.0

5

Helical-worm (S)  
gear units

S..

Gear unit	Fill quantity in liters					
	M1	M2	M3 <sup>1)</sup>	M4	M5	M6
S..37	0.25	0.40	0.50	0.55	0.40	0.40
S..47	0.35	0.80	0.70/0.90	1.00	0.80	0.80
S..57	0.50	1.20	1.00/1.20	1.45	1.30	1.30
S..67	1.00	2.00	2.20/3.10	3.10	2.60	2.60

1) The larger gear unit of multi-stage gear units must be filled with the larger oil volume.

SF..

Gear unit	Fill quantity in liters					
	M1	M2	M3 <sup>1)</sup>	M4	M5	M6
SF37	0.25	0.40	0.50	0.55	0.40	0.40
SF47	0.40	0.90	0.90/1.05	1.05	1.00	1.00
SF57	0.50	1.20	1.00/1.50	1.55	1.40	1.40
SF67	1.00	2.20	2.30/3.00	3.20	2.70	2.70

1) The larger gear unit of multi-stage gear units must be filled with the larger oil volume.

SA.., SH.., SAF.., SHZ.., SAZ.., SHF.., ST..

Gear unit	Fill quantity in liters					
	M1	M2	M3 <sup>1)</sup>	M4	M5	M6
S..37	0.25	0.40	0.50	0.50	0.40	0.40
S..47	0.40	0.80	0.70/0.90	1.00	0.80	0.80
S..57	0.50	1.10	1.00/1.50	1.50	1.20	1.20
S..67	1.00	2.00	1.80/2.60	2.90	2.50	2.50

1) The larger gear unit of multi-stage gear units must be filled with the larger oil volume.



## 5.2 Installation/removal of gear units with hollow shafts and keys



- Always use the supplied NOCO<sup>®</sup> fluid for installation. The fluid prevents contact corrosion and facilitates subsequent removal.
- The key dimension X is defined by the customer, however X must be > DK.

### Installation

SEW-EURODRIVE recommends two variants for installation of gear units with hollow shaft and key onto the input shaft of the driven machine (= customer shaft):

1. Use the supplied fastening parts for installation.
2. Use the optional installation/removal kit for installation.

### 1. Supplied fastening parts

The following fastening parts are supplied as standard:

- Retaining screw with washer (2)
- Circlip (3)

### Customer shaft

- Installation length of customer shaft with contact shoulder (A) must be L8 - 1 mm.
- Installation length of customer shaft without contact shoulder (B) must equal L8.

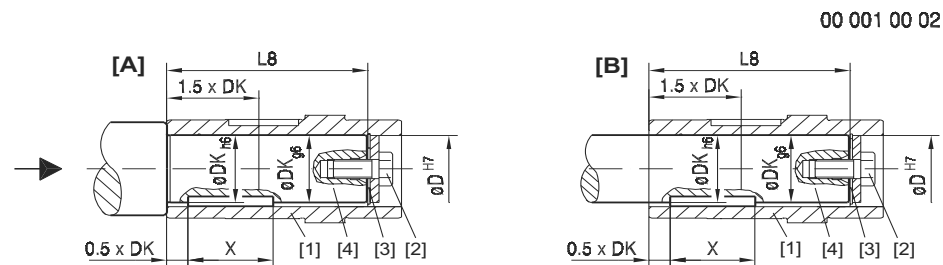


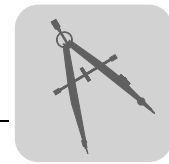
Figure 19: Customer shaft with contact shoulder (A) and without contact shoulder (B)

- |                                 |                    |
|---------------------------------|--------------------|
| (1) Hollow shaft                | (3) Circlip        |
| (2) Retaining screw with washer | (4) Customer shaft |

### Dimensions and tightening torque

The retaining screw (2) must be tightened to the tightening torque MS given in the following table.

Gear unit type	D <sup>H7</sup> [mm]	DK [mm]	L8 [mm]	MS [Nm]
SA..37	20	20	104	8
FA..27, SA..47	25	25	88, 105	20
FA..37, KA..37, SA..47	30	30	105	20
SA..57			132	
FA..47, KA..47, SA..57	35	35	132	20
FA..57, KA..57	40	40	142	40
FA..67, KA..67			156	
SA..67			144	
SA..67	45	45	144	40
FA..77, KA..77, SA..77	50	50	183	40
FA..87, KA..87	60	60	210	80
SA..77, SA..87			180, 220	
FA..97, KA..97	70	70	270	80
SA..87, SA..97			220, 260	
FA..107, KA..107, SA..97	90	90	313, 313, 255	200
FA..127, KA..127	100	100	373	200
FA..157, KA..157	120	120	460	200



**2. Installation / removal kit**

You can also use the optional installation/removal kit for installation. You order the kit for the specific gear unit type(s) by quoting the part numbers in the table below. The scope of delivery includes:

- Spacer tube for installation without contact shoulder (5)
- Retaining screw for installation (2)
- Forcing washer for removal (7)
- Locked nut for removal (8)

The short retaining screw supplied as standard is not used.

*Customer shaft*

- The installation length of the customer shaft must be LK2. **Do not use the spacer** if the customer shaft **has a contact shoulder (A)**.
- The installation length of the customer shaft must be LK2. **Use the spacer** if the customer shaft **has no contact shoulder (B)**.

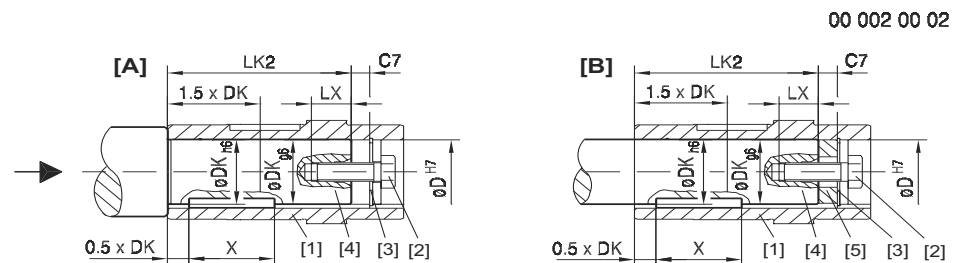


Figure 20: Customer shaft with contact shoulder (A) and without contact shoulder (B)

- (1) Hollow shaft
- (2) Retaining screw with washer
- (3) Circlip
- (4) Customer shaft
- (5) Spacer

*Dimensions, tightening torques and part numbers*

The retaining screw (2) must be tightened to the tightening torque MS given in the following table.

Type	DH7 [mm]	DK [mm]	LK2 [mm]	LX+2 [mm]	C7 [mm]	MS [Nm]	Part number of installation/removal kit
SA..37	20	20	92	16	12	8	643 683 8
FA..27, SA..47	25	25	72, 89	22	16	20	643 684 6
FA..37, KA..37 SA..47, SA..57	30	30	89 89, 116	22	16	20	643 685 4
FA..47, KA..47, SA..57	35	35	114	28	18	20	643 686 2
FA..57, KA..57 FA..67, KA..67, SA..67	40	40	124 138, 138, 126	36	18	40	643 687 0
SA..67	45	45	126	36	18	40	643 688 9
FA..77, KA..77, SA..77	50	50	165	36	18	40	643 689 7
FA..87, KA..87 SA..77, SA..87	60	60	188 158, 198	42	22	80	643 690 0
FA..97, KA..97 SA..87, SA..97	70	70	248 198, 238	42	22	80	643 691 9
FA..107, KA..107 SA..97	90	90	287 229	50	26	200	643 692 7
FA..127, KA..127	100	100	347	50	26	200	643 693 5
FA..157, KA..157	120	120	434	50	26	200	643 694 3



## Design and Operating Notes

### Installation/removal of gear units with hollow shafts and keys

#### Removal

Applies only if installation/removal kit was previously used for installation (→ Figure 20).

Proceed as follows for removal:

1. Loosen the retaining screw (6).
2. Remove the circlip (3) and, if used, the spacer tube (5).
3. According to Figure 21 place the forcing washer (7) and the locked nut (8) between the customer shaft (4) and circlip (3).
4. Re-install the circlip (3).
5. Re-install the retaining screw (6). You can now push the gear unit off the shaft.

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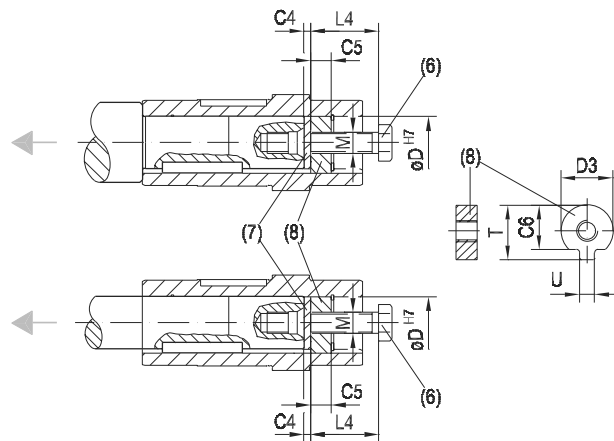
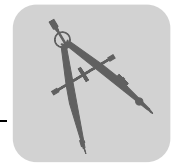


Figure 21: Removal

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- (6) Retaining bolt
- (7) Forcing washer
- (8) Locked nut for removal

Type	$D^{H7}$ [mm]	M	C4 [mm]	C5 [mm]	C6 [mm]	$U^{-0.5}$ [mm]	$T^{-0.5}$ [mm]	$D3^{-0.5}$ [mm]	L4 [mm]	Part number of installation/removal kit
SA37..	20	M6	5	6	15.5	5.5	22.5	19.7	2.5	643 683 8
FA27.., SA..47	25	M10	5	10	20	7.5	28	24.7	35	643 684 6
FA..37, KA..37, SA..47, SA..57	30	M10	5	10	25	7.5	33	29.7	35	643 685 4
FA..47, KA..47, SA..57	35	M12	5	12	29	9.5	38	34.7	45	643 686 2
FA..57, KA..57, FA..67, KA..67, SA..67	40	M16	5	12	34	11.5	41.9	39.7	50	643 687 0
SA..67	45	M16	5	12	38.5	13.5	48.5	44.7	50	643 688 9
FA..77, KA..77, SA..77	50	M16	5	12	43.5	13.5	53.5	49.7	50	643 689 7
FA..87, KA..87, SA..77, SA..87	60	M20	5	16	56	17.5	64	59.7	60	643 690 0
FA..97, KA..97, SA..87, SA..97	70	M20	5	16	65.5	19.5	74.5	69.7	60	643 691 9
FA..107, KA..107, SA..97	90	M24	5	20	80	24.5	95	89.7	70	643 692 7
FA..127, KA..127	100	M24	5	20	89	27.5	106	99.7	70	643 693 5
FA..157, KA..157	120	M24	5	20	107	31	127	119.7	70	643 694 3



### 5.3 Gear units with hollow shaft

#### Chamfers on hollow shafts

The following illustration shows the chamfers on parallel shaft helical, helical-bevel and helical-worm gear units with hollow shaft (A) and hollow shaft with shrink disc (H):

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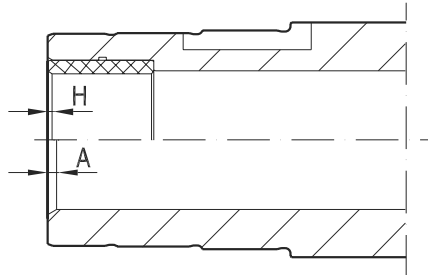


Figure 22: Chamfers on hollow shafts

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Gear unit	Version	
	Hollow shaft (A)	Hollow shaft with shrink disc (H)
F..27	2 × 30°	0.5 × 45°
F./K../S..37	2 × 30°	0.5 × 45°
F./K../S..47	2 × 30°	0.5 × 45°
S..57	2 × 30°	0.5 × 45°
F./K..57	2 × 30°	3 × 2°
F./K../S..67	2 × 30°	3 × 2°
F./K..77	2 × 30°	3 × 2°
F./K..87	3 × 30°	3 × 2°
F./K..97	3 × 30°	3 × 2°
F./K..107	3 × 30°	3 × 2°
F./K..127	5 × 30°	1.5 × 30°
F./K..157	5 × 30°	1.5 × 30°
KH167	-	1.5 × 30°
KH187	-	1.5 × 30°

#### Special motor/gear unit combinations

Please note for parallel shaft helical gearmotors with hollow shaft (FA..B, FV..B, FH..B, FAF, FVF, FHF, FA, FV, FH, FT, FAZ, FVZ, FHZ):

- If you are using a customer shaft pushed through on the motor end, there may be a collision when a "small gear unit" is used in combination with a "large motor".
- Check the motor dimension AC to decide whether there will be a collision with a pushed-through customer shaft.

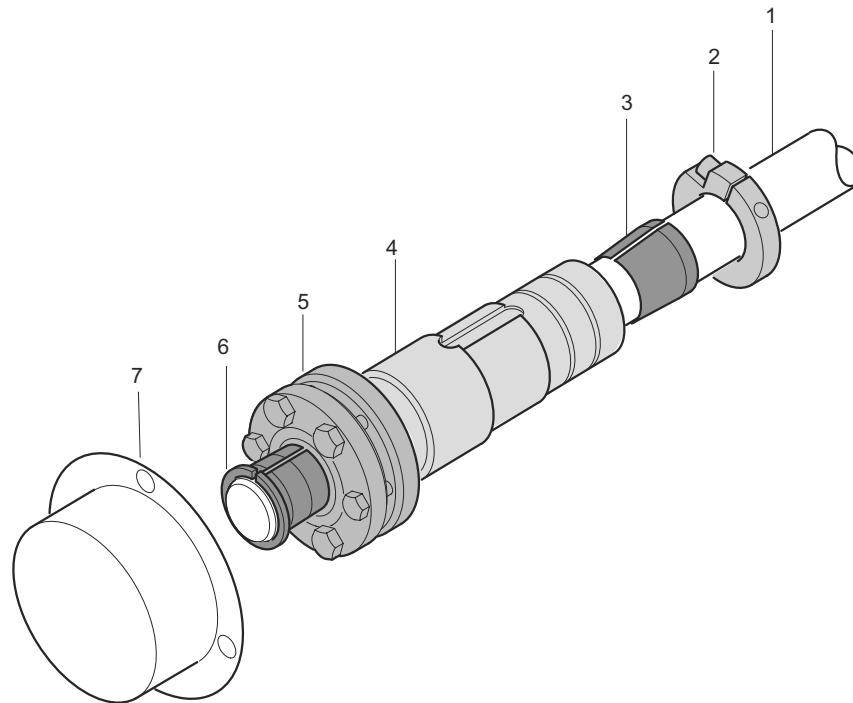


#### 5.4 TorqLOC® hollow shaft mounting system for gear units with hollow shaft

##### Description of TorqLOC®

The TorqLOC® hollow shaft mounting system is used for achieving a non-positive connection between customer shaft and the hollow shaft in the gear unit. As a result, the TorqLOC® hollow shaft mounting system is an alternative to the hollow shaft with shrink disc, the hollow shaft with key and the splined hollow shaft that have been used so far.

The TorqLOC® hollow shaft mounting system consists of the following components:



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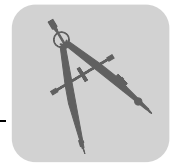
Figure 23: Components of the TorqLOC® hollow shaft mounting system

1. Customer shaft
2. Clamping ring
3. Conical bronze bushing
4. Hollow shaft in gear unit
5. Shrink disc
6. Conical steel bushing
7. Fixed cover

##### Advantages of TorqLOC®

The TorqLOC® hollow shaft mounting system is characterized by the following advantages:

- Cost saving because the customer shaft can be made from drawn material up to quality h11.
- Cost saving because different customer shaft diameters can be covered by one hollow shaft diameter and different bushings.
- Simple installation since there is no need to accommodate any shaft connections.
- Removal is easy even after many hours of operation because the formation of contact corrosion has been reduced and the conical connections can easily be released.



**Technical data**

The TorqLOC® hollow shaft mounting system is approved for input torques of 92 Nm to 4300 Nm.

The following gear units are available with TorqLOC® hollow shaft mounting system:

- Parallel shaft helical gear units in gear unit sizes 37 to 97 (FT37 ... FT97)
- Helical-bevel gear units in gear unit sizes 37 to 67 (KT37 ... KT97)
- Helical-worm gear units in gear unit sizes 37 to 97 (ST37 ... ST97)

**Available options**

The following options are available for gear units with TorqLOC® hollow shaft mounting system:

- Helical-bevel and helical-worm gear units KT.., ST.. : The "torque arm" (../T) option is available.
- Parallel shaft helical gear units FT.. : The "rubber buffer" (../G) option is available.



#### 5.5 Option, shouldered hollow shaft with shrink disc

As an option, gear units with hollow shaft and shrink disc (parallel shaft helical gear units FH/FHF/FHZ37-157, helical-bevel gear units KH/KHF/KHZ37-157 and helical-worm gear units SH/SHF/SHZ47-97) can be supplied with a larger bore diameter  $D'$ .

As standard,  $D' = D$ .

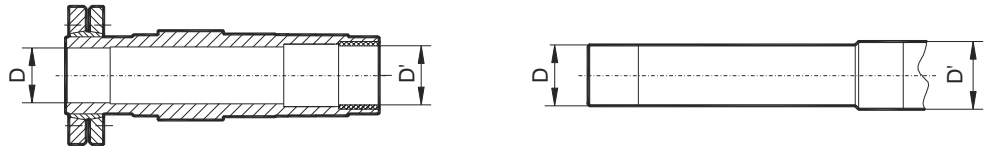


Figure 24: Optional bore diameter  $D'$

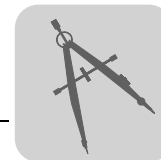
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Gear unit	Bore diameter D / optionally $D'$ [mm]
FH/FHF/FHZ37, KH/KHF/KHZ37, SH/SHF/SHZ47	30 / 32
FH/FHF/FHZ47, KH/KHF/KHZ47, SH/SHF/SHZ57	35 / 36
FH/FHF/FHZ57, KH/KHF/KHZ57	40 / 42
FH/FHF/FHZ67, KH/KHF/KHZ67, SH/SHF/SHZ67	40 / 42
FH/FHF/FHZ77, KH/KHF/KHZ77	50 / 52
FH/FHF/FHZ87, KH/KHF/KHZ87	65 / 66
FH/FHF/FHZ97, KH/KHF/KHZ97	75 / 76
FH/FHF/FHZ107, KH/KHF/KHZ107	95 / 96
FH/FHF/FHZ127, KH/KHF/KHZ127	105 / 106
FH/FHF/FHZ157, KH/KHF/KHZ157	125 / 126

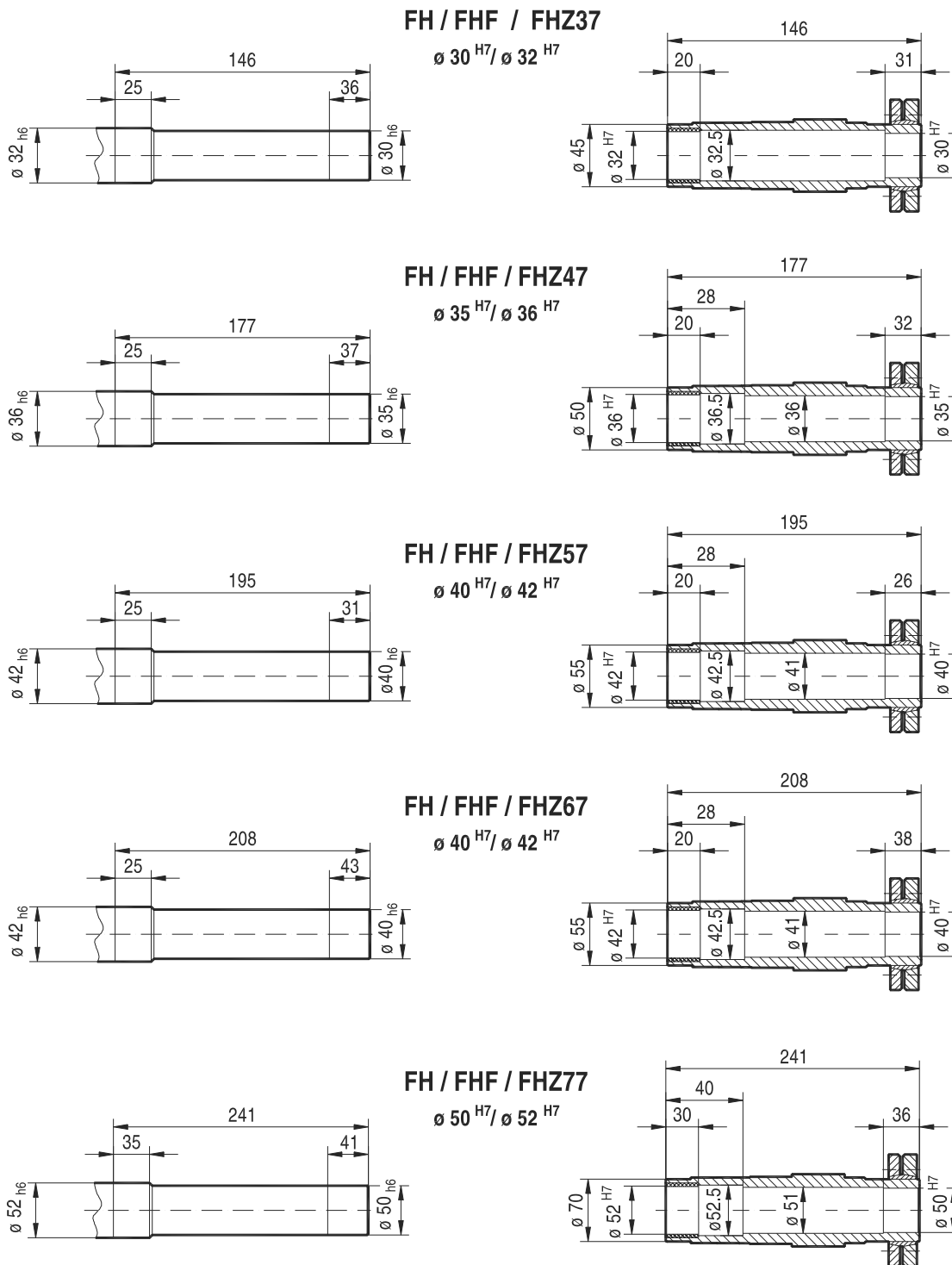
Diameter  $D$  /  $D'$  must be specified when ordering gear units with a shouldered hollow shaft (optional bore diameter  $D'$ ).

#### Sample order

FH37 CM71L with hollow shaft 30/32 mm.

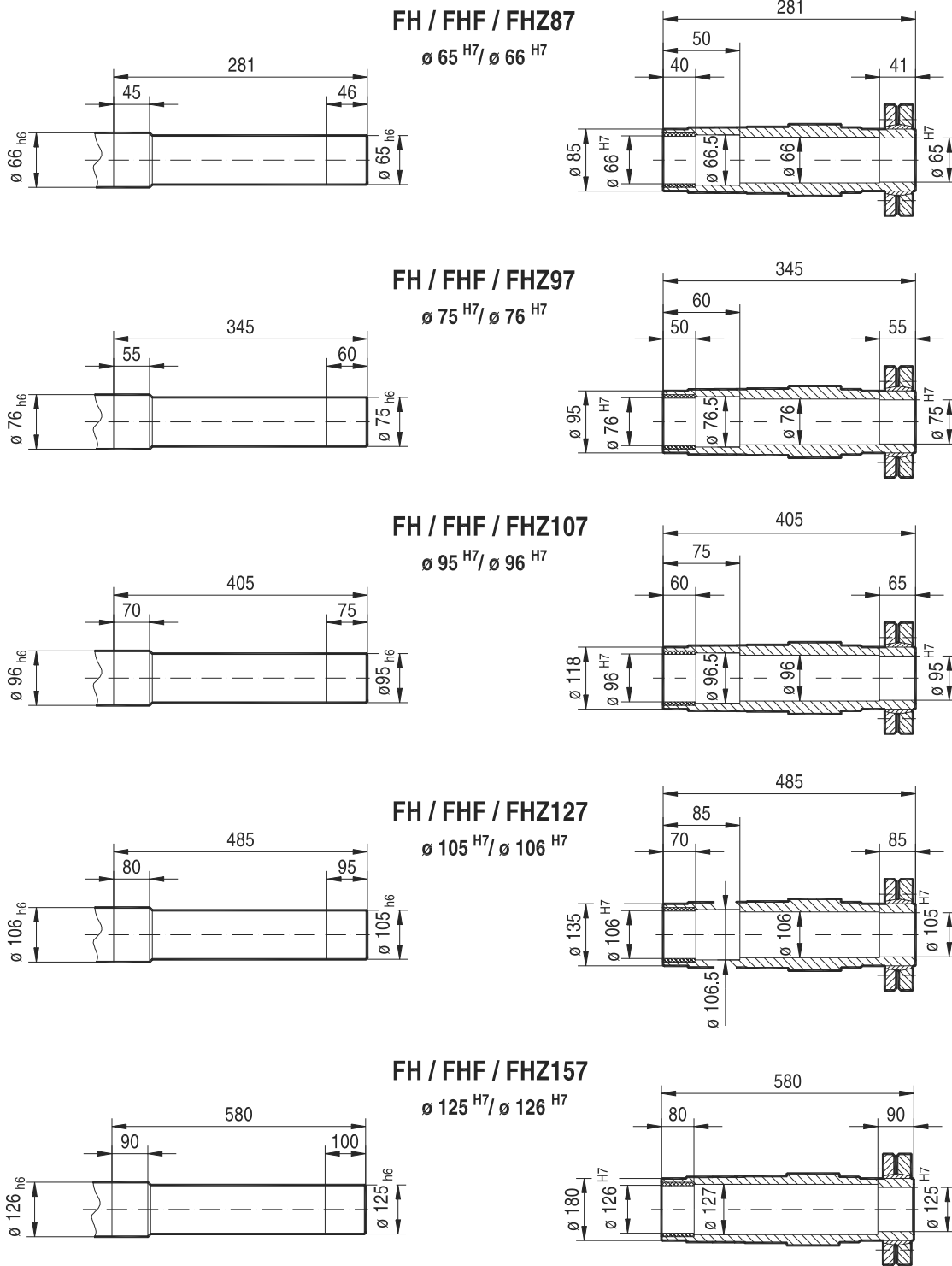


Parallel shaft helical gear unit with shouldered hollow shaft



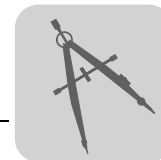
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Figure 25: Shouldered hollow shaft FH/FHF/FHZ37...77



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Figure 26: Shouldered hollow shaft FH/FHF/FHZ87...157



Helical-bevel gear unit with shouldered hollow shaft

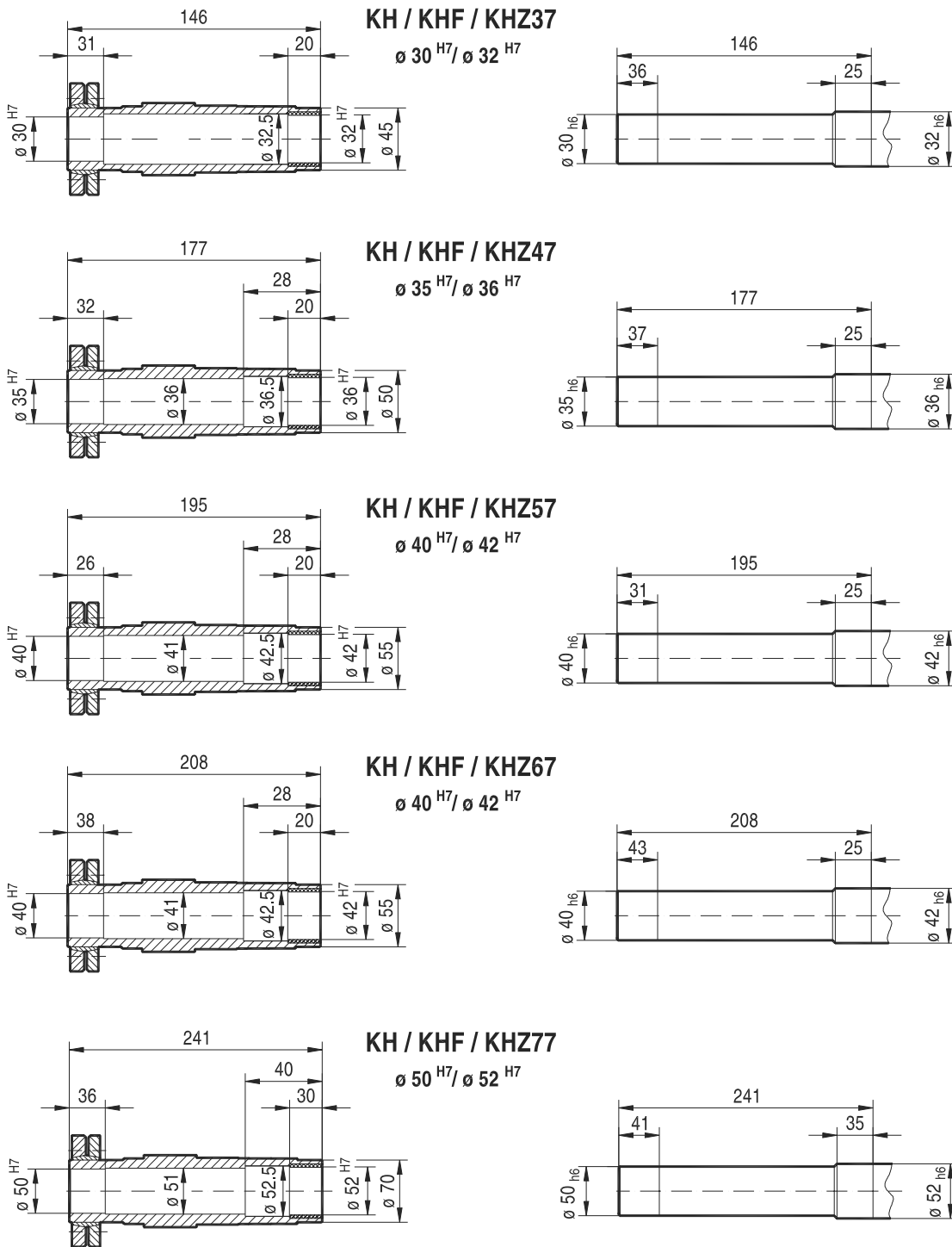
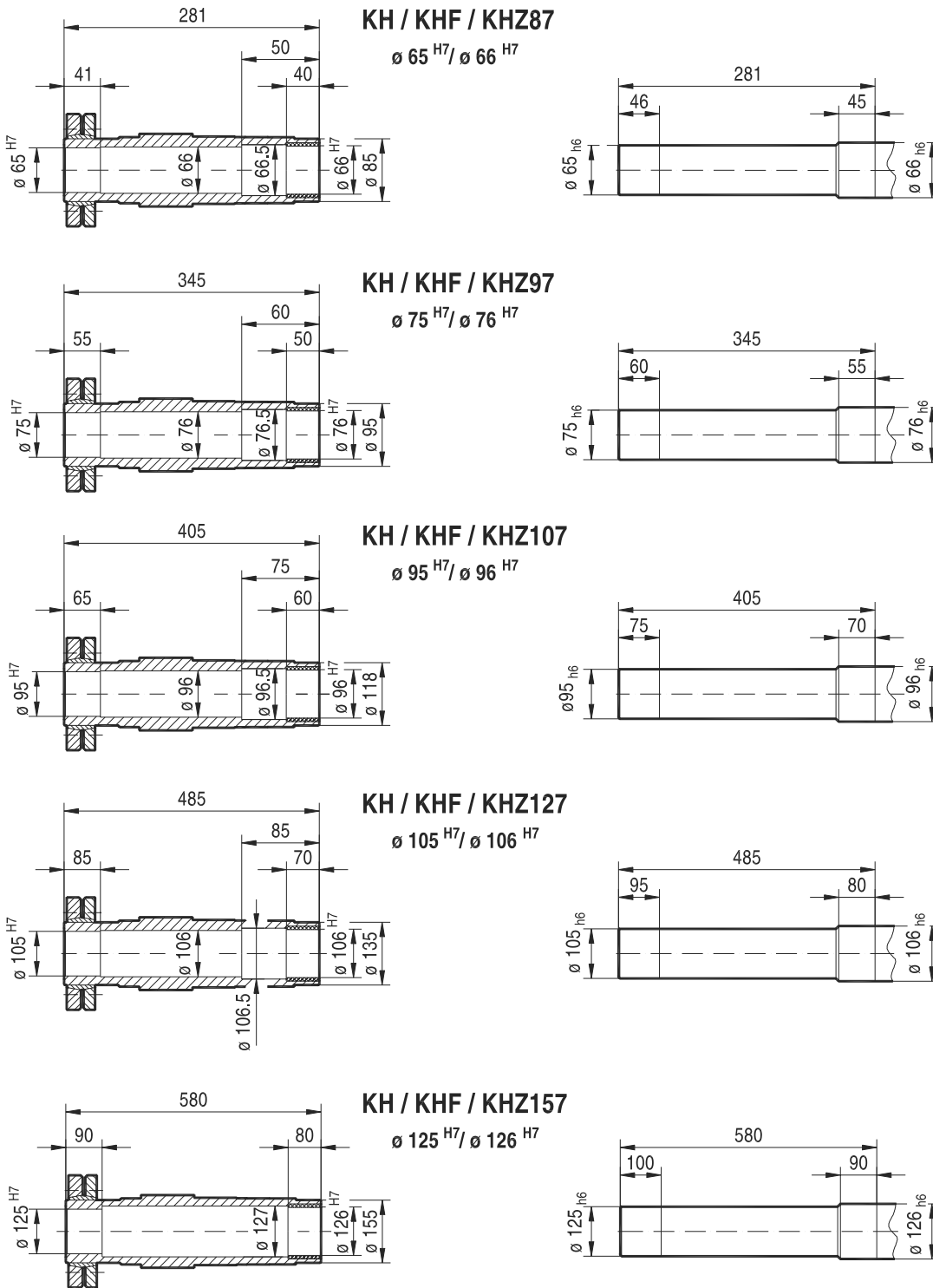


Figure 27: Shouldered hollow shaft KH/KHF/KHZ37...77

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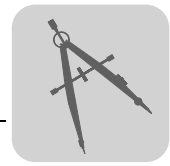


**Design and Operating Notes**  
Option, shouldered hollow shaft with shrink disc



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Figure 28: Shouldered hollow shaft KH/KHF/KHZ87...157



Helical-worm gear unit with shouldered hollow shaft

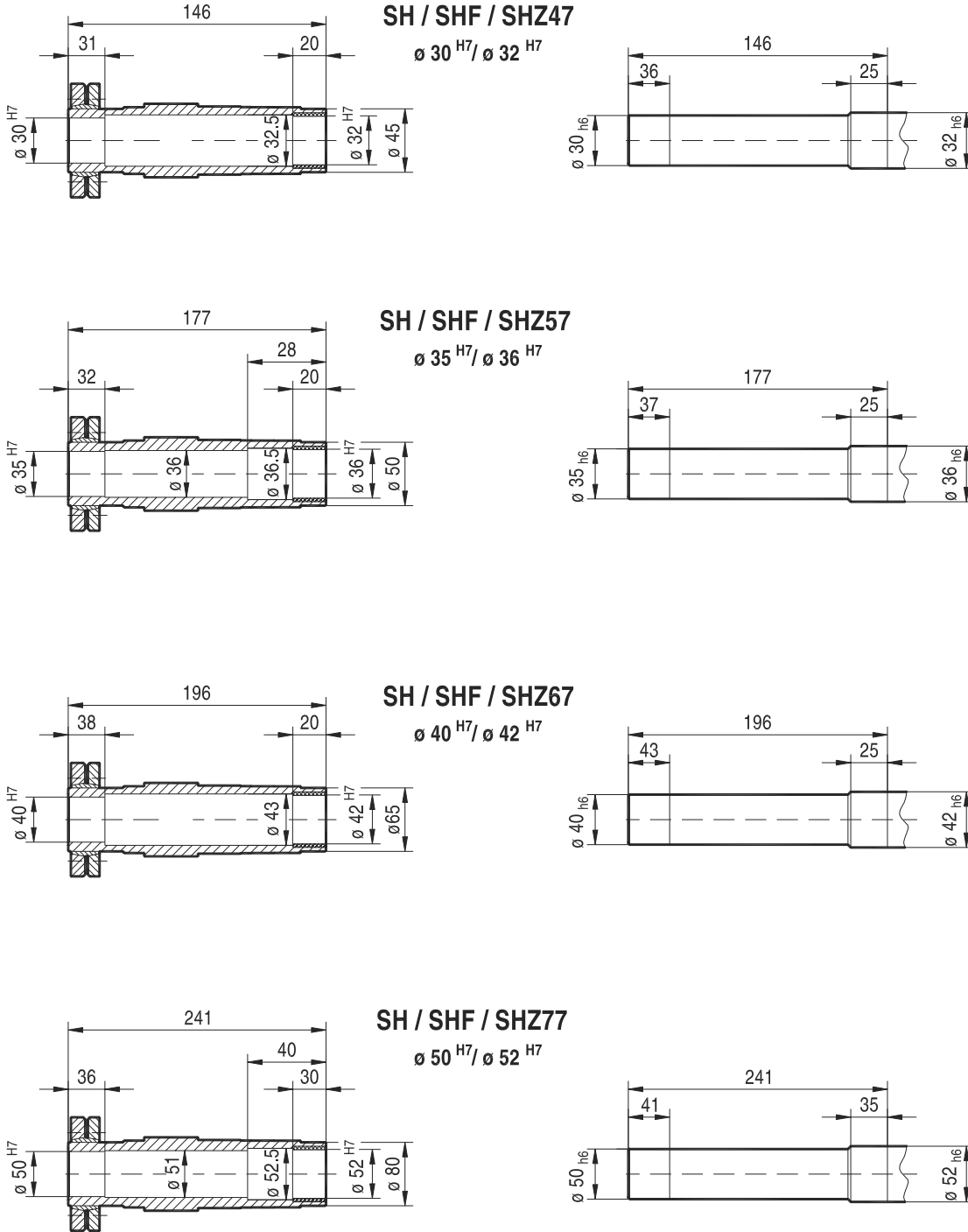
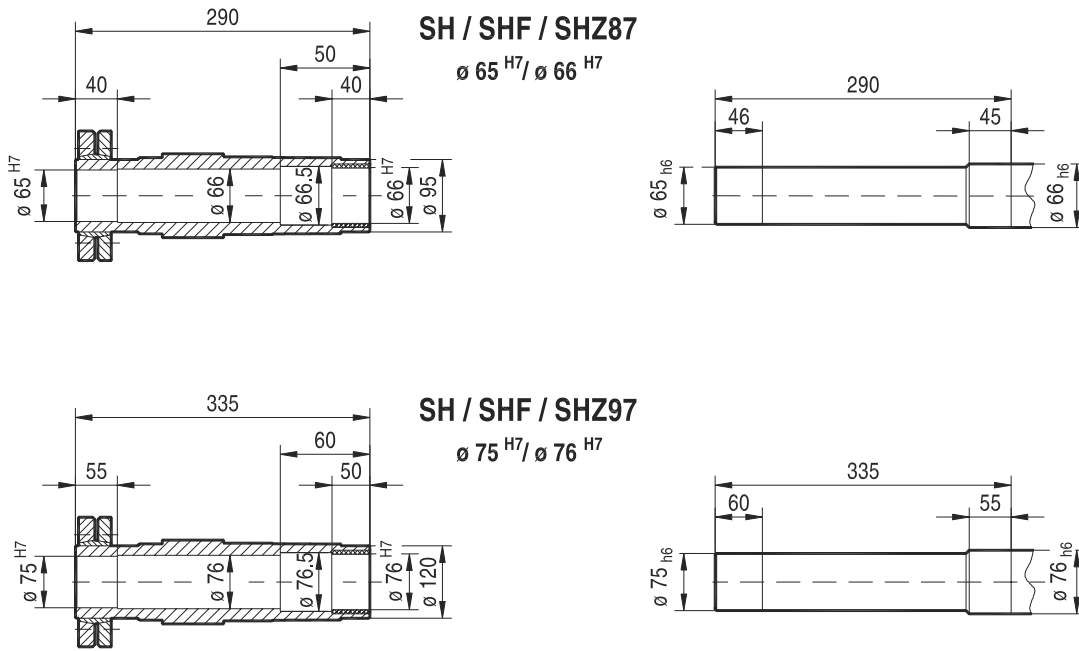


Figure 29: Shouldered hollow shaft SH/SHF/SHZ47...77

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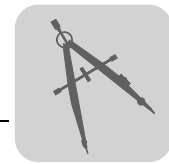


**Design and Operating Notes**  
Option, shouldered hollow shaft with shrink disc



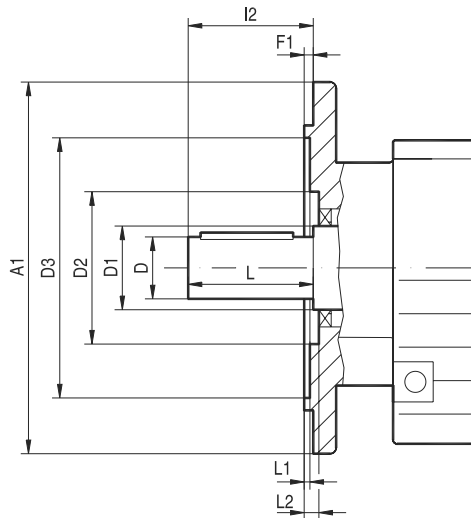
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Figure 30: Shouldered hollow shaft SH/SHF/SHZ87...97



5.6 Flange contours of RF.. and R..F gearmotors

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Check dimensions L1 and L2 for selection and installation of output elements.

Type	A1	D	D1	D2		D3	F1	I2	L	L1		L2
				RF	R..F					RF	R..F	
RF17, R17F	120	20	25	46	46	65	3	40	40	1	1	5
	140				-	78	3			1	-	5
	160 <sup>1)</sup>				-	95	3.5			1	-	6
RF27, R27F	120	25	30	54	54	66	3	50	50	1	1	6
	140				-	79	3			3	-	7
	160				-	92	3.5			3	-	7
RF37, R37F	120	25	35	60	63	70	3	50	50	5	4	7
	160				-	96	3.5			1	-	7.5
	200 <sup>1)</sup>				-	119	3.5			1	-	7.5
RF47, R47F	140	30	35	72	64	82	3	60	60	4	1	6
	160				-	96	3.5			0.5	-	6.5
	200				-	116	3.5			0.5	-	6.5
RF57, R57F	160	35	40	76	75	96	3.5	70	70	4	2.5	5
	200				-	116	3.5			0	-	5
	250 <sup>1)</sup>				-	160	4			0.5	-	5.5
RF67, R67F	200	35	50	90	90	118	3.5	70	70	2	4	7
	250				-	160	4			1	-	7.5
RF77, R77F	250	40	52	112	100	160	4	80	80	0.5	2.5	7
	300 <sup>1)</sup>				-	210	4			0.5	-	7
RF87, R87F	300	50	62	123	122	210	4	100	100	0	1.5	8
	350				-	226	5			1	-	9
RF97	350	60	72	136		236	5	120	120	0		9
	450					320						
RF107	350	70	82	157		232	5	140	140	0		11
	450			186		316						
RF137	450	90	108	180		316	5	170	170	0		10
	550					416						
RF147	450	110	125	210		316	5	210	210	0		10
	550					416						
RF167	550	120	145	290		416	5	210	210	1		10
	660					517				6	2	

1) Important: Flange projects under the foot surface in the case of R..F



#### 5.7 Fastening of gear units

Use bolts of quality 8.8 to fasten gear units and gearmotors.

##### Exception

In case of the following flange-mounted helical gearmotors (RF..) and foot/flange-mounted helical gearmotors (R..F), use bolts of **quality 10.9** to fasten the customer flange to transmit the rated torques:

- RF37, R37F with flange  $\varnothing$  120 mm
- RF47, R47F with flange  $\varnothing$  140 mm
- RF57, R57F with flange  $\varnothing$  160 mm

#### 5.8 Torque arms

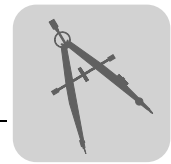
##### Available torque arms

Gear unit	Size					
	27	37	47	57	67	77
KA, KH, KV, KT	-	643 425 8	643 428 2	643 431 2	643 431 2	643 434 7
SA, SH, ST	-	126 994 1	644 237 4	644 240 4	644 243 9	644 246 3
FA, FH, FV, FT Rubber buffers (2 pcs.)	013 348 5	013 348 5	013 348 5	013 348 5	013 348 5	013 349 3

Gear unit	Size				
	87	97	107	127	157
KA, KH, KV, KT	643 437 1	643 440 1	643 443 6	643 294 8	-
SA, SH, ST	644 249 8	644 252 8	-	-	-
FA, FH, FV, FT Rubber buffers (2 pcs.)	013 349 3	013 350 7	013 350 7	013 351 5	013 347 7

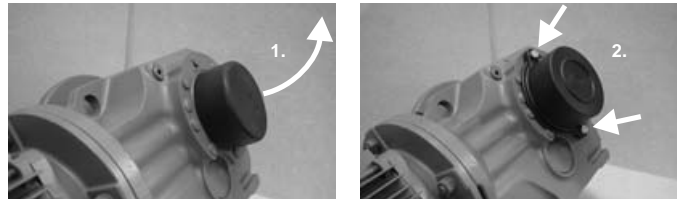
##### Torque arms for KH167.., KH187..

As standard, torque arms are not available for gear unit sizes KH167.. and KH187... Please contact SEW-EURODRIVE for design proposals if you require torque arms for these gear units.



### 5.9 Fixed covers

As standard, parallel shaft helical gear units, helical-bevel gear units and helical-worm gear units with hollow shafts and shrink disks from size 37 up to and including size 97 have a cover that turns with the unit. If for safety reasons fixed covers are required for these gear units, you can order them for the respective gear unit types by quoting the part numbers in the following tables. As standard, parallel shaft helical gear units and helical-bevel gear units with hollow shafts and shrink discs of size 107 and parallel shaft helical gear units of size 27 come equipped with a fixed cover.

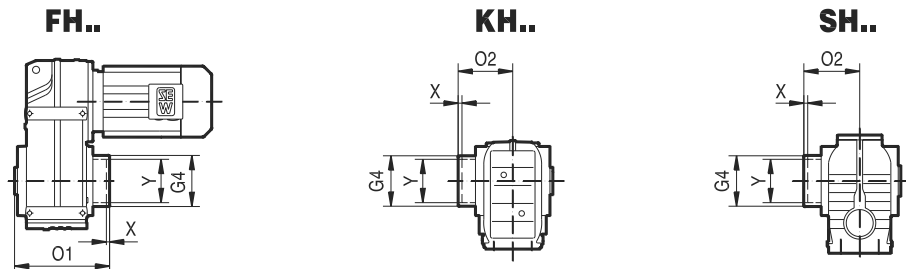


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Figure 31: Replacing a rotating cover with a fixed cover

1. Pull off the rotating cover.
2. Install and fasten fixed cover.

#### Part numbers and dimensions



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Parallel shaft helical gearmotors	FH..37	FH..47	FH..57	FH..67	FH..77	FH..87	FH..97
Part number	643 513 0	643 514 9	643 515 7	643 515 7	643 516 5	643 517 3	643 518 1
Max. size of CT/CV motor that can be mounted	CT80..	CT80..	CT80..	CV132S	CV160M	CV180..	CV180..
Max. DS/CM motor size that can be mounted	CM71L	CM71L	CM90L	CM112M	CM112L	CM112H	CM112H
G4	78	88	100	100	121	164	185
O1	157	188.5	207.5	221.5	255	295	363.5
X	2	4.5	7.5	6	6	4	6.5
Y	75	83	83	93	114	159	174

Helical-bevel gearmotors <sup>1)</sup>	KH..37	KH..47	KH..57	KH..67	KH..77	KH..87	KH..97
Part number	643 513 0	643 514 9	643 515 7	643 515 7	643 516 5	643 517 3	643 518 1
G4	78	88	100	100	121	164	185
O2	95	111.5	122.5	129	147	172	210.5
X	0	1.5	5.5	3	1	2	4.5
Y	75	83	83	93	114	159	174

1) Not possible in foot-mounted helical-bevel gear units with hollow shafts and shrink discs (KH..B).

Helical-worm gearmotors	SH..37	SH..47	SH..57	SH..67	SH..77	SH..87	SH..97
Part number	643 512 2	643 513 0	643 514 9	643 515 7	643 516 5	643 517 3	643 518 1
G4	59	78	88	100	121	164	185
O2	88	95	111.5	123	147	176	204.5
X	1	0	1.5	3	1	0	0.5
Y	53	75	83	93	114	159	174



**6 Important Information on Selection Tables and Dimension Sheets**

**6.1 Notes on combination overviews**

For working with the combination overviews, refer to the information on the fold out page at the end of the catalog.

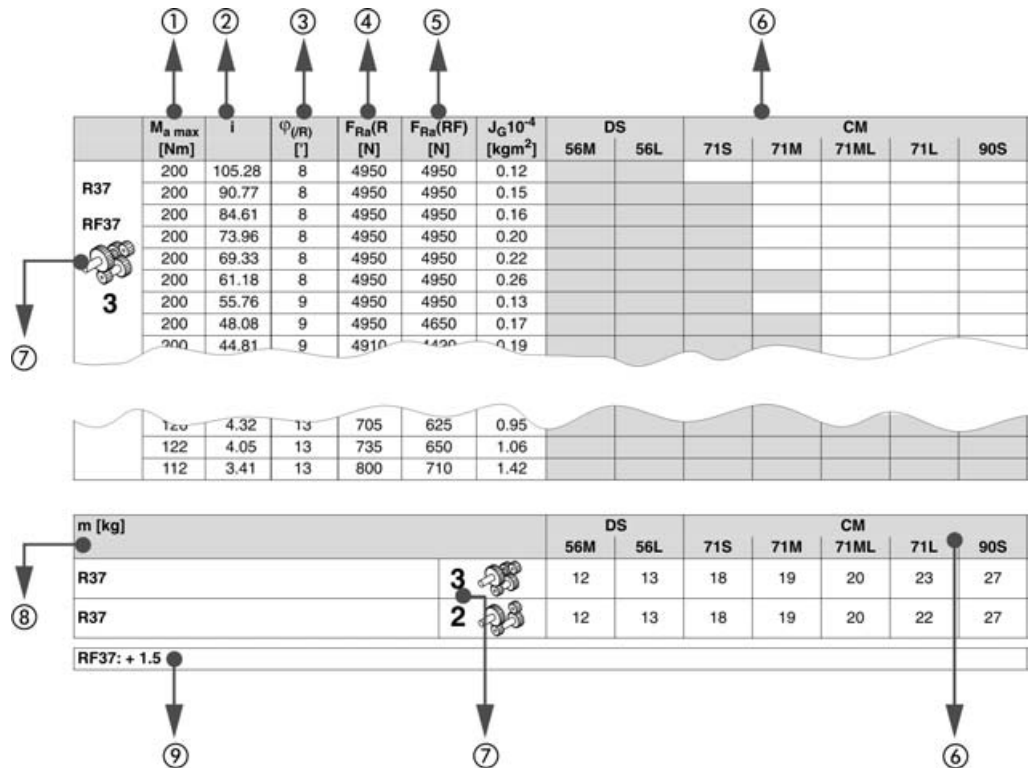


Figure 32: Combination table

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	Possible motor / gear unit combination		
*	Finite i		
1	Maximum output torque (input speed: - 1500 1/min in R, F, K, S gear units.	7	<b>3</b> 3 stage <b>2</b> 2 stage
2	Gear ratio	8	Weights without oil fill
3	Backlash in angular minutes of the reduced backlash gear unit	9	Additional weights for other types
4	Permitted overhung load (foot-mounted gear units)		
5	Permitted overhung load (flange-mounted gear units)		
6	Motor size		



## 6.2 Notes on dimension sheets

### Scope of delivery



= Standard parts supplied by SEW-EURODRIVE.



= Standard parts not supplied by SEW-EURODRIVE.

### Tolerances

#### Shaft heights

The following tolerances apply to the dimensions given:

h	≤ 250 mm	→ -0.5 mm
h	> 250 mm	→ -1 mm

**Foot-mounted gear units:** Check the mounted motor because it may project below the mounting surface.

#### Shaft ends

Diameter tolerance:

∅	≤ 50 mm	→ ISO k6
∅	> 50 mm	→ ISO m6

Center bores according to DIN 332, shape DR:

∅	= 7...10 mm	→ M3
∅	> 10...13 mm	→ M4
∅	> 13...16 mm	→ M5
∅	> 16...21 mm	→ M6
∅	> 21...24 mm	→ M8
∅	> 24...30 mm	→ M10
∅	> 30...38 mm	→ M12
∅	> 38...50 mm	→ M16
∅	> 50...85 mm	→ M20
∅	> 85...130 mm	→ M24
∅	> 130 mm	→ M30

Keys: according to DIN 6885 (domed type).

#### Hollow shafts

Diameter tolerance:

∅	→ ISO H7 measured with plug gauge
---	-----------------------------------

#### Multiple-spline shafts

Dm	= Measuring roller diameter
Me	= Check size

#### Flanges

Centering shoulder tolerance:

∅	≤ 230 mm (flange sizes A120...A300)	→ ISO j6
∅	> 230 mm (flange sizes A350...A660)	→ ISO h6

Up to three different flange dimensions are available for each size of helical gear unit, AC (brake) motor and explosion-proof AC (brake) motor. The possible flanges per size are indicated in the relevant dimension sheets.



#### **Lifting eyebolts, suspension eye lugs**

The following units are supplied without special transport fixtures:

- Helical gear units R07...R27
- CT/CV motors up to size 100
- DS motors

All other gear units and motors are equipped with cast-on suspension eye lugs, screw-on suspension eye lugs or screw-on lifting eyebolts.

Gear unit/motor type	Screw-on,		cast-on suspension eye lugs
	lifting eyebolts	suspension eye lugs	
R..37-R..57	-	•	-
R..67-R..167	•	-	-
RX57-RX67	-	•	-
RX77-RX107	•	-	-
F..27-F..157	-	-	•
K..37-K..157	-	-	•
K..167-K..187	•	-	-
S..37-S..47	-	•	-
S..57-S..97	-	-	•
≥ CV112	•	-	-
CFM71 .. 112	-	•	-

#### **Breather valves**

The gear unit dimension drawings are always shown with screw plugs. The corresponding screw plug is replaced by an activated breather valve at the factory depending on the ordered mounting position M1...M6. This means the contour dimensions may be slightly different.

#### **Shrink disc connection**

Hollow shaft gear unit with shrink disc connection: If required, request a detailed data sheet on the shrink disc, data sheet no. 33 753 .. 95.

#### **Splined hollow shaft**

FV.. hollow shaft gear units in sizes 27 ... 107 and KV.. in sizes 37 ... 107 are delivered with a splined hollow shaft according to DIN 5480.

#### **Rubber buffer for FA/FH/FV/FT**

$f = \text{Spring travel at } M_{a \text{ max}}$

#### **Motor dimensions**

##### **Brake motors**

For brake motors,

- the dimensions ADS apply instead of AD,
- and the dimensions LBS instead of LB.

##### **Motor options**

The motor dimensions may differ as a result of motor options. Refer to the dimension sheets of the motor options.

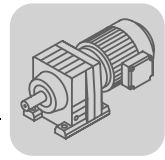
##### **Special designs**

The dimensions of the terminal box on special designs such as KS, CSA, VIK, low voltage or voltage changeover may deviate from the standard dimensions.

##### **EN 50347**

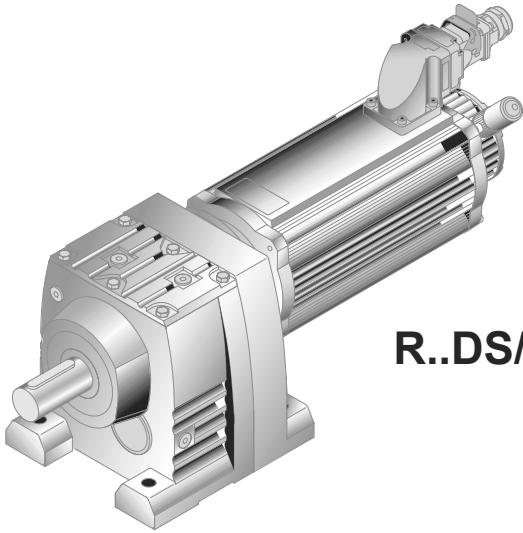
European standard EN 50347 became effective in August 2001. This standard adopts the dimension designations for three-phase AC motors of sizes 56 to 315M and flange sizes 65 to 740 from the IEC 72-1 standard.

The new dimension designations given in EN 50347 / IEC 72-1 are used for the dimensions in question in the dimension tables of the dimensions sheets.

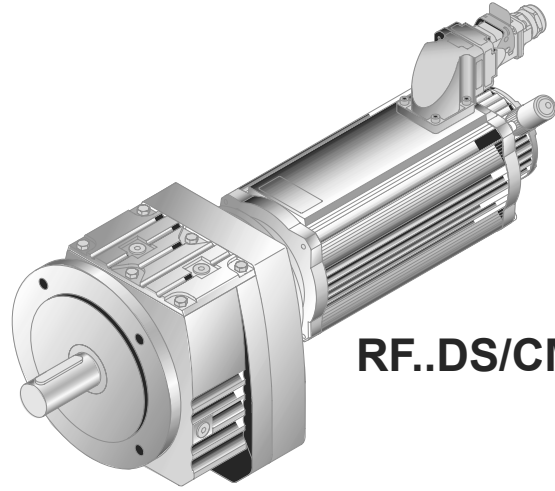


7 R..DS/CM..

7.1 R, RF, R..F, RX, RXF..DS/CM

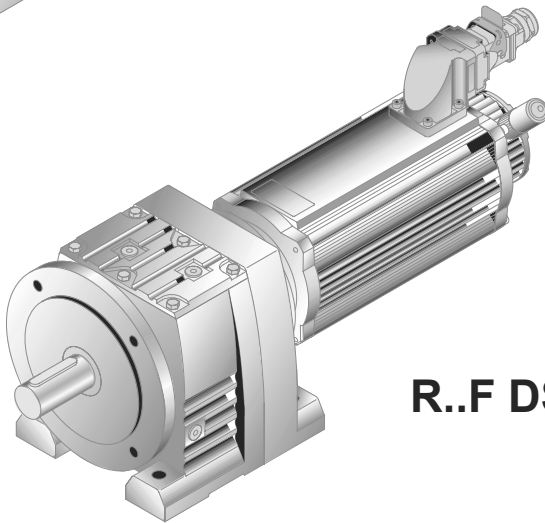


R..DS/CM..

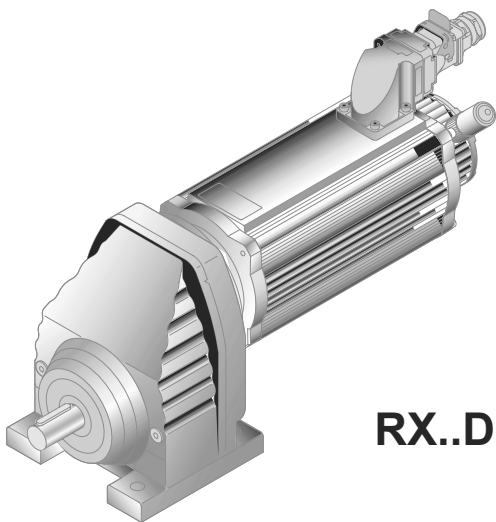


RF..DS/CM..

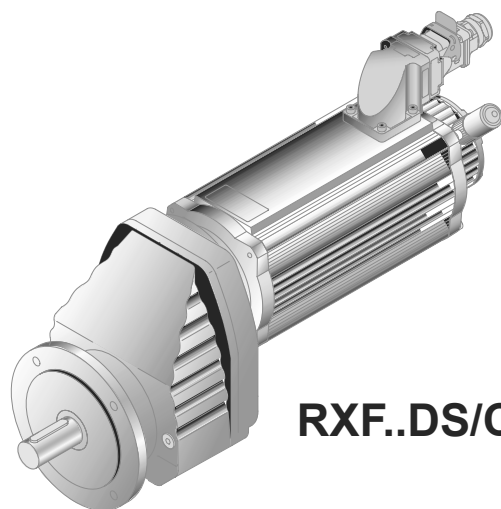
7



R..F DS/CM..

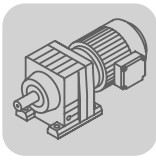


RX..DS/CM..



RXF..DS/CM..

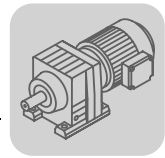
52490AXX


**7.2 RX57 DS/CM.. [Nm]**

	$M_a \text{ max}$ [Nm]	$i$	$\varphi$ (R) [ ' ]	$F_{Ra}(RX)$ [N]	$J_G 10^{-4}$ [kgm <sup>2</sup> ]	DS 56H	71S	71M	CM 71L	90S	90M
RX57	68	4.35	-	2570	0.26						
	69	3.79	-	2420	0.32						
RXF57	69	3.55*	-	2350	0.35						
	65	3.14	-	2260	0.42						
	67	2.91	-	2040	0.44						
	69	2.64*	-	1680	0.55						
	69	2.37	-	1380	0.64						
	69	2.04	-	950	0.85						
	69	1.92*	-	770	0.94						
	69	1.65	-	320	1.22						
	68	1.48	-	4	1.44						
	63	1.30	-	28	1.90						

$m$ [kg]	DS 56H	71S	71M	CM 71L	90S	90M
RX57	13	18	19	23	27	29

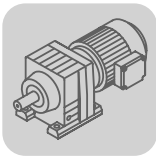
**RXF57: + 1.9 kg**



**RX57 DS/CM..**

	M <sub>a max</sub> [Nm]	i	φ (f/R) [ ' ]	F <sub>Ra</sub> (RX) [N]	J <sub>G</sub> 10 <sup>-4</sup> [kgm <sup>2</sup> ]	CM		
						90L	112S	112M
RX57	68	4.35	-	2570	0.26			
	69	3.79	-	2420	0.32			
RXF57	69	3.55*	-	2350	0.35			
	65	3.14	-	2260	0.42			
	67	2.91	-	2040	0.44			
	69	2.64*	-	1680	0.55			
	69	2.37	-	1380	0.64			
	69	2.04	-	950	0.85			
	69	1.92*	-	770	0.94			
	69	1.65	-	320	1.22			
	68	1.48	-	4	1.44			
	63	1.30	-	28	1.90			

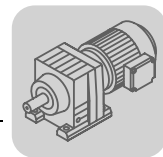
m [kg]	CM		
	90L	112S	112M
RX57	34	36	40
RXF57: + 1.9 kg			


**7.3 RX67 DS/CM.. [Nm]**

	$M_{a \max}$ [Nm]	i	$\varphi$ (R) [ ' ]	$F_{Ra}(RX)$ [N]	$J_G 10^{-4}$ [kgm <sup>2</sup> ]	DS 56H	71S	71M	CM 71L	90S	90M
RX67	75	5.18	-	3490	0.34						
	82	4.53	-	3260	0.42						
RXF67	80	4.30*	-	3210	0.47						
	87	3.77	-	3010	0.69						
	100	3.20*	-	2720	0.88						
	106	2.89	-	2560	1.02						
	118	2.54	-	1830	1.32						
	123	2.40*	-	1360	1.44						
	134	2.04	-	66	1.78						
	126	1.86	-	69	2.07						
	114	1.61	-	97	2.59						
	104	1.40*	-	64	3.22						

m [kg]	DS 56H	71S	71M	CM 71L	90S	90M
RX67	16	21	22	25	30	32

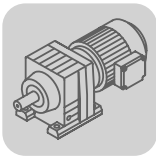
**RXF67: + 4.0 kg**



**RX67 DS/CM..**

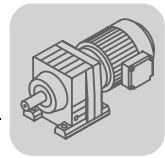
	M <sub>a</sub> max [Nm]	i	φ (°/R) [ ' ]	F <sub>Ra</sub> (RX) [N]	J <sub>G</sub> 10 <sup>-4</sup> [kgm <sup>2</sup> ]	CM		
						90L	112S	112M
RX67	75	5.18	-	3490	0.34			
	82	4.53	-	3260	0.42			
RXF67	80	4.30*	-	3210	0.47			
	87	3.77	-	3010	0.69			
	100	3.20*	-	2720	0.88			
	106	2.89	-	2560	1.02			
	118	2.54	-	1830	1.32			
	123	2.40*	-	1360	1.44			
	134	2.04	-	66	1.78			
	126	1.86	-	69	2.07			
	114	1.61	-	97	2.59			
	104	1.40*	-	64	3.22			

m [kg]	CM		
	90L	112S	112M
RX67	37	38	43
RXF67: + 4.0 kg			


**7.4 RX77 CM.. [Nm]**

	M <sub>a</sub> max [Nm]	i	φ (R) [ ' ]	F <sub>Ra</sub> (RX) [N]	J <sub>G</sub> 10 <sup>-4</sup> [kgm <sup>2</sup> ]	CM					
						71S	71M	71L	90S	90M	90L
RX77	110	5.63	-	5170	0.81						
	103	5.35*	-	5110	0.90						
RXF77	123	4.73	-	4780	1.26						
	143	4.04*	-	4380	1.60						
	153	3.70	-	4180	1.86						
	182	3.25*	-	2980	2.31						
	193	3.08*	-	2340	2.50						
	215	2.70	-	900	3.05						
	215	2.43	-	305	3.36						
	200	2.13	-	245	4.11						
	187	1.88*	-	150	4.98						
	173	1.67	-	139	5.99						
	155	1.42	-	145	7.64						

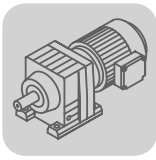
m [kg]	CM					
	71S	71M	71L	90S	90M	90L
RX77	30	31	35	39	42	47
RXF77: + 2.3 kg						



**RX77 CM..**

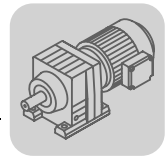
	M <sub>a</sub> max [Nm]	i	φ (/R) [ ' ]	F <sub>Ra</sub> (RX) [N]	J <sub>G</sub> 10 <sup>-4</sup> [kgm <sup>2</sup> ]	CM		
						112S	112M	112L
RX77	110	5.63	-	5170	0.81			
	103	5.35*	-	5110	0.90			
RXF77	123	4.73	-	4780	1.26			
	143	4.04*	-	4380	1.60			
	153	3.70	-	4180	1.86			
	182	3.25*	-	2980	2.31			
	193	3.08*	-	2340	2.50			
	215	2.70	-	900	3.05			
	215	2.43	-	305	3.36			
	200	2.13	-	245	4.11			
	187	1.88*	-	150	4.98			
	173	1.67	-	139	5.99			
	155	1.42	-	145	7.64			

m [kg]	CM		
	112S	112M	112L
RX77	48	52	67
RXF77: + 2.3 kg			


**7.5 RX87 CM.. [Nm]**

	$M_{a \max}$ [Nm]	i	$\varphi$ (R) [ ' ]	$F_{Ra}(RX)$ [N]	$J_G 10^{-4}$ [kgm <sup>2</sup> ]	CM						
						90S	90M	90L	112S	112M	112L	112H
RX87	192	6.45	-	6680	2.72							
	225	5.56*	-	6150	3.42							
RXF87	250	5.07	-	5810	3.93							
	290	4.50*	-	5350	4.82							
	305	3.78	-	4880	6.20							
	405	3.48	-	2420	6.87							
	405	3.09	-	1650	8.14							
	405	2.76*	-	910	9.41							
	405	2.48	-	192	10.93							
	385	2.15	-	0	13.17							
	355	1.93	-	0	15.35							
	315	1.60*	-	0	19.25							
	290	1.39	-	0	24.69							

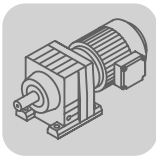
m [kg]	CM						
	90S	90M	90L	112S	112M	112L	112H
RX87	57	59	64	64	68	83	90
RXF87: + 5.0 kg							



7.6 RX97 CM.. [Nm]

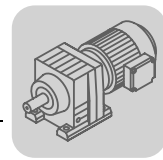
	M <sub>a max</sub> [Nm]	i	φ (R) [ ' ]	F <sub>Ra</sub> (RX) [N]	J <sub>G</sub> 10 <sup>-4</sup> [kgm <sup>2</sup> ]	CM						
						90S	90M	90L	112S	112M	112L	112H
RX97	225	8.23	-	9320	3.97							
	260	7.16*	-	8720	5.07							
RXF97	300	6.56	-	8280	5.83							
	420	5.79	-	7420	9.17							
	395	4.91	-	7020	11.79							
	595	4.52	-	5850	13.00							
	595	4.04	-	4970	15.30							
	595	3.64*	-	4140	17.63							
	595	3.30	-	3350	20.24							
	595	2.92	-	2450	23.99							
	595	2.64	-	1630	27.50							
	595	2.24*	-	162	33.32							
	570	1.96	-	0	40.89							
	505	1.64	-	0	50.70							
	455	1.42	-	0	61.22							

m [kg]	CM						
	90S	90M	90L	112S	112M	112L	112H
RX97	81	83	88	88	92	105	115
RXF97: + 8.6 kg							




**7.7 RX107 CM.. [Nm]**

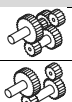
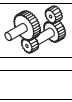
	M <sub>a max</sub> [Nm]	i	φ (R) [ ' ]	F <sub>Ra</sub> (RX) [N]	J <sub>G</sub> 10 <sup>-4</sup> [kgm <sup>2</sup> ]	CM			
						112S	112M	112L	112H
RX107	460	6.63*	-	9430	11.61				
	455	5.61	-	8830	14.85				
RXF107	695	5.19	-	7610	16.52				
	695	4.65	-	7220	19.47				
	830	4.20*	-	5950	25.01				
	830	3.81	-	5090	28.68				
	830	3.38	-	4050	33.87				
	830	3.07	-	3180	38.69				
	830	2.64*	-	1760	47.03				
	830	2.30	-	515	56.79				
	765	1.95	-	192	70.37				
	705	1.71	-	131	84.32				
	645	1.44	-	0	111.45				

m [kg]	CM			
	112S	112M	112L	112H
RX107	125	125	140	145
RXF107: + 17 kg				

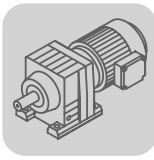


7.8 R27 DS/CM.. [Nm]

	M <sub>a</sub> max [Nm]	i	φ (R) [ ' ]	F <sub>Ra</sub> (R) [N]	F <sub>Ra</sub> (RF) [N]	J <sub>G</sub> 10 <sup>-4</sup> [kgm <sup>2</sup> ]	DS			CM							
							56M	56L	56H	71S	71M	71L	90S				
<b>R27</b> <b>RF27</b>  <b>3</b>	130	135.09	-	4230	3640	0.08											
	130	123.91	-	4230	3640	0.09											
	130	105.49	-	4230	3640	0.12											
	130	90.96	-	4230	3640	0.15											
	130	84.78	-	4230	3640	0.16											
	130	74.11	-	4170	3640	0.20											
	130	69.47	-	4070	3640	0.22											
	130	61.30	-	3880	3640	0.26											
	130	55.87	-	3740	3540	0.13											
	130	48.17	-	3530	3340	0.16											
	130	44.90	-	3430	3250	0.18											
	130	39.25	-	3260	3080	0.22											
	130	36.79	-	3170	3000	0.25											
	130	32.47	-	3020	2860	0.31											
	130	28.78	-	2870	2720	0.37											
	130	24.47	-	2690	2540	0.49											
	<b>R27</b> <b>RF27</b>  <b>2</b>	130	28.37	-	2860	2700	0.12										
130		26.09	-	2760	2610	0.14											
130		22.32	-	2590	2450	0.18											
130		19.35	-	2440	2310	0.22											
130		18.08	-	2370	2240	0.24											
130		15.63	-	2230	2070	0.29											
130		13.28*	-	2040	1800	0.39											
129		11.86	-	1860	1640	0.47											
122		10.13	-	1780	1570	0.61											
122		9.41	-	790	695	0.21											
116		8.16	-	765	675	0.26											
112		7.63*	-	795	700	0.29											
106		6.59	-	780	690	0.36											
99		5.60*	-	785	695	0.48											
95		5.00*	-	770	675	0.58											
87		4.27	-	830	735	0.76											
85		4.00*	-	820	725	0.85											
79	3.37	-	820	720	1.12												

m [kg]		DS			CM			
		56M	56L	56H	71S	71M	71L	90S
R27	<b>3</b> 	6.1	7.1	7.8	12	13	-	-
	<b>2</b> 	5.8	6.8	7.5	12	13	17	21

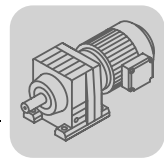
RF27: -- kg


**7.9 R37 DS/CM.. [Nm]**



	$M_a \text{ max}$ [Nm]	i	$\varphi$ (i/R) [ ' ]	$F_{Ra}(R)$ [N]	$F_{Ra}(RF)$ [N]	$J_G 10^{-4}$ [kgm <sup>2</sup> ]	DS			CM						
							56M	56L	56H	71S	71M	71L	90S			
<b>R37</b> <b>RF37</b>  <b>3</b>	200	134.82	8	4950	4950	0.08										
	200	123.66	8	4950	4950	0.09										
	200	105.28	8	4950	4950	0.12										
	200	90.77	8	4950	4950	0.15										
	200	84.61	8	4950	4950	0.16										
	200	73.96	8	4950	4950	0.20										
	200	69.33	8	4950	4950	0.22										
	200	61.18	8	4950	4950	0.26										
	200	55.76	9	4950	4950	0.13										
	200	48.08	9	4950	4650	0.17										
	200	44.81	9	4910	4420	0.19										
	200	39.17	9	4520	4010	0.23										
	200	36.72	9	4300	3820	0.25										
	200	32.40	9	3900	3460	0.31										
	200	28.73	9	3520	3120	0.39										
	200	24.42	9	3040	2690	0.53										
	<b>R37</b> <b>RF37</b>  <b>2</b>	200	28.32	7	3480	3080	0.13									
185		26.03	7	3650	3240	0.15										
200		22.27	7	2780	2460	0.19										
200		19.31	7	2380	2110	0.23										
200		18.05	8	2200	1960	0.26										
200		15.60	8	1830	1620	0.31										
190		13.25	8	1720	1520	0.43										
183		11.83	8	1650	1470	0.51										
170		10.11	8	1670	1480	0.66										
167		9.47	8	1620	1430	0.74										
156		7.97	8	1580	1400	0.96										
144		6.67	12	870	770	0.43										
142		5.67	12	640	565	0.59										
135		5.06	13	670	595	0.72										
126		4.32	13	705	625	0.95										
122		4.05	13	735	650	1.06										
112		3.41	14	800	710	1.42										



m [kg]		DS			CM			
		56M	56L	56H	71S	71M	71L	90S
R37	<b>3</b>	12	13	14	18	19	23	-
	<b>2</b>	12	13	13	18	19	22	27

**RF37: + 1.5 kg**

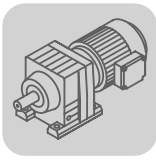


7.10 R47 DS/CM.. [Nm]

	$M_a \text{ max}$ [Nm]	$i$	$\varphi$ (f/R) [ ' ]	$F_{Ra}(R)$ [N]	$J_G 10^{-4}$ [kgm <sup>2</sup> ]	DS 56H	71S	71M	71L	CM 90S	90M	90L	112S
<b>R47</b> <b>RF47</b>  <b>3</b>	300	93.68	7	5420	0.43								
	300	84.90	7	5420	0.52								
	300	76.23	7	5420	0.60								
	300	68.54	8	5420	0.33								
	300	64.21	8	5420	0.37								
	300	56.73	8	5360	0.44								
	300	52.69	8	5210	0.47								
	300	47.75	8	5000	0.56								
	300	42.87	8	4790	0.67								
	300	36.93	8	4500	0.85								
	300	34.73	8	4390	0.93								
	300	29.88	8	4120	1.17								
	300	26.70	8	3930	1.36								
	300	23.59	8	3730	1.74								
	<b>R47</b> <b>RF47</b>  <b>2</b>	300	26.74	7	3930	0.29							
300		23.28	7	3710	0.36								
295		19.27	7	3290	0.48								
290		17.89	7	3150	0.51								
275		16.22	7	3190	0.63								
265		14.56	7	3090	0.74								
250		12.54	7	2990	0.95								
245		11.79	7	2930	1.05								
230		10.15	7	2800	1.34								
220		9.07	8	2700	1.58								
205		8.01	8	2620	2.03								
163		7.76*	10	2640	0.77								
159		6.96	10	2540	0.93								
156		6.00	10	2400	1.19								
155		5.64*	10	2340	1.32								
150		4.85	10	2210	1.71								
146		4.34	11	2130	2.04								
144	3.83	11	2020	2.63									

m [kg]		DS 56H	71S	71M	71L	CM 90S	90M	90L	112S
R47	<b>3</b> 	18	22	23	27	31	-	-	-
	<b>2</b> 	17	22	23	26	31	33	38	39

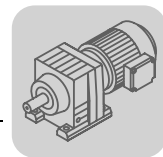
RF47: -- kg


**7.11 R57 DS/CM.. [Nm]**



	$M_a \text{ max}$ [Nm]	$i$	$\varphi$ (i/R) [ ' ]	$F_{Ra}(R)$ [N]	$J_G 10^{-4}$ [kgm <sup>2</sup> ]	DS 56H	71S	71M	CM 71L	90S	90M	
<b>R57</b>	450	128.77	7	7110	0.32							
	450	120.63	7	7110	0.35							
<b>RF57</b>	450	106.58	7	7110	0.42							
	450	98.99	7	7110	0.45							
<b>RM57</b>	450	89.71	7	7110	0.54							
	450	80.55	7	7110	0.62							
 <b>3</b>	450	69.23	7	6970	0.35							
	450	64.85	8	6780	0.38							
	450	57.29	8	6440	0.46							
	450	53.22	8	6250	0.49							
	450	48.23	8	5990	0.60							
	450	43.30	8	5730	0.70							
	450	37.30*	8	5370	0.89							
	450	35.07	8	5230	0.97							
	450	30.18	8	4890	1.28							
	450	26.97	8	4650	1.50							
	 <b>2</b>	450	26.31	6	4600	0.45						
		450	24.99*	6	4500	0.51						
		450	21.93	7	4240	0.73						
		450	18.60*	7	3920	0.94						
		450	16.79	7	3740	1.10						
435		14.77*	7	3570	1.42							
430		13.95*	7	3450	1.55							
405		11.88	7	3320	1.93							
390		10.79	7	3220	2.25							
370		9.35	7	3080	2.83							
375		9.06	9	1780	1.28							
355		7.97	9	1800	1.65							
350		7.53	9	1730	1.81							
335		6.41	9	1560	2.29							
320		5.82	10	1620	2.68							
305	5.05	10	1540	3.41								
280	4.39	10	1720	4.30								



$m$ [kg]		DS 56H	71S	71M	CM 71L	90S	90M
<b>R57</b>	<b>3</b>	23	27	29	32	36	39
	<b>2</b>	22	26	28	31	35	38

**RF57: + 3.4 kg / RM57: + 15 kg**

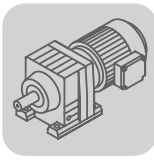




**R57 DS/CM..**



	M <sub>a</sub> max [Nm]	i	φ (R) [ ' ]	F <sub>Ra</sub> (R) [N]	J <sub>G</sub> 10 <sup>-4</sup> [kgm <sup>2</sup> ]	CM			
						90L	112S	112M	
<b>R57</b>	450	128.77	7	7110	0.32				
	450	120.63	7	7110	0.35				
<b>RF57</b>	450	106.58	7	7110	0.42				
	450	98.99	7	7110	0.45				
<b>RM57</b>	450	89.71	7	7110	0.54				
	450	80.55	7	7110	0.62				
 <b>3</b>	450	69.23	7	6970	0.35				
	450	64.85	8	6780	0.38				
	450	57.29	8	6440	0.46				
	450	53.22	8	6250	0.49				
	450	48.23	8	5990	0.60				
	450	43.30	8	5730	0.70				
	450	37.30*	8	5370	0.89				
	450	35.07	8	5230	0.97				
	450	30.18	8	4890	1.28				
	450	26.97	8	4650	1.50				
	<b>R57</b>	450	26.31	6	4600	0.45			
		450	24.99*	6	4500	0.51			
	<b>RF57</b>	450	21.93	7	4240	0.73			
		450	18.60*	7	3920	0.94			
 <b>2</b>	<b>RM57</b>	450	16.79	7	3740	1.10			
		435	14.77*	7	3570	1.42			
		430	13.95*	7	3450	1.55			
		405	11.88	7	3320	1.93			
		390	10.79	7	3220	2.25			
		370	9.35	7	3080	2.83			
		375	9.06	9	1780	1.28			
		355	7.97	9	1800	1.65			
		350	7.53	9	1730	1.81			
		335	6.41	9	1560	2.29			
		320	5.82	10	1620	2.68			
		305	5.05	10	1540	3.41			
		280	4.39	10	1720	4.30			

m [kg]		90L	CM 112S	112M
<b>R57</b>	<b>3</b> 	-	-	-
	<b>2</b> 	43	44	49

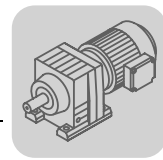
RF57: + 3.4 kg / RM57: + 15 kg


**7.12 R67 DS/CM.. [Nm]**



	$M_a \text{ max}$ [Nm]	$i$	$\varphi$ (i/R) [ ' ]	$F_{Ra}(R)$ [N]	$J_G 10^{-4}$ [kgm <sup>2</sup> ]	DS 56H	71S	71M	CM 71L	90S	90M	
<b>R67</b>	600	158.14	6	7560	0.26							
	600	137.67	6	7560	0.32							
<b>RF67</b>	600	128.97	6	7560	0.36							
	600	113.94	6	7560	0.42							
<b>RM67</b>	600	105.83	6	7560	0.45							
	600	95.91	6	7560	0.54							
 <b>3</b>	600	86.11	6	7560	0.63							
	600	74.17	7	7560	0.81							
	600	69.75	7	7560	0.88							
	600	61.26	7	7560	0.47							
	600	56.89	7	7560	0.50							
	600	51.56	7	7560	0.61							
	600	46.29	7	7560	0.72							
	580	39.88*	7	7790	0.93							
	570	37.50	7	7900	1.03							
	540	32.27	7	8210	1.31							
	520	28.83	7	8400	1.54							
	<b>R67</b>	540	28.13	6	8210	0.50						
		540	26.72	6	8210	0.56						
	<b>RF67</b>	560	23.44	6	8010	0.80						
		600	19.89	6	7350	1.04						
 <b>2</b>	<b>RM67</b>	590	17.95	6	6900	1.21						
	560	15.79	6	6720	1.57							
	550	14.91	6	6580	1.72							
	520	12.70	6	6260	2.16							
	500	11.54	7	6140	2.53							
	470	10.00	7	5980	3.20							
	440	8.70*	7	5800	4.03							
	380	7.79	8	5510	2.14							
	370	7.36*	8	5470	2.36							
	330	6.27	9	5440	3.04							
	310	5.70	9	5300	3.60							
	290	4.93	9	5070	4.63							
	270	4.29	10	4860	5.92							



$m$ [kg]		DS 56H	71S	71M	CM 71L	90S	90M
<b>R67</b>	<b>3</b> 	30	34	35	39	43	46
	<b>2</b> 	29	33	34	38	42	45

**RF67: + 3.2 kg / RM67: + 19 kg**

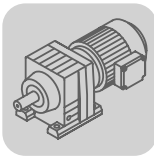




**R67 DS/CM..**



	M <sub>a</sub> max [Nm]	i	φ (R) [ ' ]	F <sub>Ra</sub> (R) [N]	J <sub>G</sub> 10 <sup>-4</sup> [kgm <sup>2</sup> ]	CM			
						90L	112S	112M	
<b>R67</b>	600	158.14	6	7560	0.26				
	600	137.67	6	7560	0.32				
<b>RF67</b>	600	128.97	6	7560	0.36				
	600	113.94	6	7560	0.42				
<b>RM67</b>	600	105.83	6	7560	0.45				
	600	95.91	6	7560	0.54				
 <b>3</b>	600	86.11	6	7560	0.63				
	600	74.17	7	7560	0.81				
	600	69.75	7	7560	0.88				
	600	61.26	7	7560	0.47				
	600	56.89	7	7560	0.50				
	600	51.56	7	7560	0.61				
	600	46.29	7	7560	0.72				
	580	39.88*	7	7790	0.93				
	570	37.50	7	7900	1.03				
	540	32.27	7	8210	1.31				
	520	28.83	7	8400	1.54				
	 <b>2</b>	540	28.13	6	8210	0.50			
		540	26.72	6	8210	0.56			
		<b>R67</b>	560	23.44	6	8010	0.80		
		<b>RF67</b>	600	19.89	6	7350	1.04		
<b>RM67</b>		590	17.95	6	6900	1.21			
		560	15.79	6	6720	1.57			
550		14.91	6	6580	1.72				
520		12.70	6	6260	2.16				
500		11.54	7	6140	2.53				
470		10.00	7	5980	3.20				
440		8.70*	7	5800	4.03				
380		7.79	8	5510	2.14				
370		7.36*	8	5470	2.36				
330		6.27	9	5440	3.04				
310		5.70	9	5300	3.60				
290	4.93	9	5070	4.63					
270	4.29	10	4860	5.92					

m [kg]		90L	CM 112S	112M
<b>R67</b>	<b>3</b> 	51	-	-
	<b>2</b> 	50	51	55

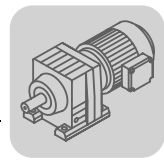
RF67: + 3.2 kg / RM67: + 19 kg


**7.13 R77 CM.. [Nm]**



	M <sub>a</sub> max [Nm]	i	φ (i/R) [ ' ]	F <sub>Ra</sub> (R) [N]	J <sub>G</sub> 10 <sup>-4</sup> [kgm <sup>2</sup> ]	CM						
						71S	71M	71L	90S	90M	90L	
<b>R77</b>	820	145.67	6	9920	0.42							
	820	138.39	6	9920	0.46							
<b>RF77</b>	820	121.42	6	9920	0.68							
	820	102.99	6	9920	0.86							
<b>RM77</b>	820	92.97	6	9920	0.99							
	820	81.80	6	9920	1.24							
 <b>3</b>	820	77.24	7	9920	1.34							
	820	65.77	7	9920	1.61							
	820	57.68	7	9920	0.97							
	820	52.07	7	9920	1.14							
	820	45.81	7	9920	1.43							
	820	43.26	7	9920	1.56							
	820	36.83	7	9920	1.92							
	820	33.47	7	9920	2.21							
	820	29.00	7	9920	2.95							
	780	25.23	7	9550	3.70							
	<b>R77</b>	820	23.37	6	8380	1.70						
		820	21.43	6	7770	1.99						
	<b>RF77</b>	780	18.80	6	7520	2.48						
		780	17.82*	6	7170	2.69						
	 <b>2</b>	<b>RM77</b>	740	15.60	6	6960	3.28					
		720	14.05	6	6640	3.66						
		690	12.33	6	6340	4.49						
		660	10.88	7	6110	5.47						
		630	9.64	7	5930	6.61						
		630	8.59	7	3760	3.72						
		610	7.74	8	3600	4.19						
		580	6.79	8	3520	5.18						
		540	5.99*	8	3670	6.35						
		510	5.31*	8	3690	7.74						



m [kg]		CM					
		71S	71M	71L	90S	90M	90L
<b>R77</b>	<b>3</b> 	40	41	45	49	52	57
	<b>2</b> 	39	40	43	48	50	55

**RF77: + 5.7 kg / RM77: + 31 kg**

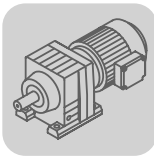


**R77 CM..**

	M <sub>a</sub> max [Nm]	i	φ (R) [ ' ]	F <sub>Ra</sub> (R) [N]	J <sub>G</sub> 10 <sup>-4</sup> [kgm <sup>2</sup> ]	CM		
						112S	112M	112L
 <b>3</b>	R77	820	145.67	6	9920	0.42		
	R77	820	138.39	6	9920	0.46		
	RF77	820	121.42	6	9920	0.68		
	RF77	820	102.99	6	9920	0.86		
	RM77	820	92.97	6	9920	0.99		
	RM77	820	81.80	6	9920	1.24		
	RM77	820	77.24	7	9920	1.34		
	RM77	820	65.77	7	9920	1.61		
	RM77	820	57.68	7	9920	0.97		
	RM77	820	52.07	7	9920	1.14		
	RM77	820	45.81	7	9920	1.43		
	RM77	820	43.26	7	9920	1.56		
	RM77	820	36.83	7	9920	1.92		
	RM77	820	33.47	7	9920	2.21		
	RM77	820	29.00	7	9920	2.95		
	RM77	780	25.23	7	9550	3.70		
 <b>2</b>	R77	820	23.37	6	8380	1.70		
	R77	820	21.43	6	7770	1.99		
	RF77	780	18.80	6	7520	2.48		
	RF77	780	17.82*	6	7170	2.69		
	RM77	740	15.60	6	6960	3.28		
	RM77	720	14.05	6	6640	3.66		
	RM77	690	12.33	6	6340	4.49		
	RM77	660	10.88	7	6110	5.47		
	RM77	630	9.64	7	5930	6.61		
	RM77	630	8.59	7	3760	3.72		
	RM77	610	7.74	8	3600	4.19		
	RM77	580	6.79	8	3520	5.18		
	RM77	540	5.99*	8	3670	6.35		
	RM77	510	5.31*	8	3690	7.74		

m [kg]		112S	CM 112M	112L
R77	<b>3</b> 	58	62	-
	<b>2</b> 	56	61	76

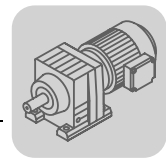
RF77: + 5.7 kg / RM77: + 31 kg


**7.14 R87 CM.. [Nm]**



	$M_a \text{ max}$ [Nm]	i	$\varphi$ (I/R) [°]	$F_{Ra}(R)$ [N]	$J_G 10^{-4}$ [kgm <sup>2</sup> ]	CM							
						90S	90M	90L	112S	112M	112L	112H	
<b>R87</b>	1550	155.34	6	16900	1.60								
	1550	142.41	6	16900	1.86								
<b>RF87</b>	1550	124.97	6	16900	2.27								
	1550	118.43*	6	16900	2.44								
<b>RM87</b>	1550	103.65	6	16900	2.97								
	1550	93.38	6	16900	3.30								
 <b>3</b>	1550	81.92	6	16900	3.95								
	1550	72.57	6	16600	2.18								
	1550	63.68*	6	15000	2.69								
	1550	60.35*	6	14300	2.91								
	1550	52.82	6	12700	3.64								
	1550	47.58	7	16900	4.14								
	1550	41.74	7	16900	5.07								
	1550	36.84*	7	16400	6.20								
	1550	32.66*	7	15600	7.55								
	1500	27.88	7	14700	9.77								
	 <b>2</b>	1500	34.40*	5	8770	3.59							
		1550	31.40	5	7140	4.13							
		1550	27.84*	6	14600	5.08							
		1550	23.40	6	13500	6.57							
		<b>RM87</b>	1500	21.51	6	13200	7.30						
1440			19.10	6	12700	8.69							
1390		17.08*	6	12200	10.10								
1340		15.35	6	11800	11.78								
1280		13.33	6	11200	14.29								
1230		11.93	6	10800	16.75								
1180		9.90*	6	10100	21.28								
1210		9.14*	6	10200	11.30								
1160		8.22	7	9900	13.27								
1070		7.13	7	9510	16.27								
1020		6.39	7	9190	19.22								
910		5.30*	7	8730	24.86								



$m$ [kg]		90S	90M	90L	CM			
					112S	112M	112L	112H
<b>R87</b>	<b>3</b>	76	79	84	84	88	105	110
	<b>2</b>	75	77	82	82	86	100	110

**RF87: + 7.1 kg / RM87: + 37 kg**

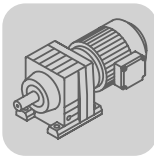


7.15 R97 CM.. [Nm]

	M <sub>a</sub> max [Nm]	i	φ (f/R) [ ° ]	F <sub>Ra</sub> (R) [N]	J <sub>G</sub> 10 <sup>-4</sup> [kgm <sup>2</sup> ]	CM							
						90S	90M	90L	112S	112M	112L	112H	
<b>R97</b>	3000	216.28	6	19800	2.79								
	3000	186.30	6	19800	3.51								
<b>RF97</b>	3000	170.02	6	19800	4.03								
	3000	150.78	6	19800	4.91								
<b>RM97</b>	3000	126.75	6	19800	6.29								
	3000	116.48	6	19800	6.99								
 <b>3</b>	3000	103.44	6	19800	8.42								
	3000	92.48	6	19800	9.84								
	3000	83.15	6	19400	11.38								
	3000	72.17	6	16800	13.84								
	3000	65.21	6	19800	7.11								
	3000	59.92	6	19800	7.95								
	3000	53.21	6	19800	9.51								
	3000	47.58	6	19800	11.12								
	3000	42.78	6	19200	13.05								
	3000	37.13	6	18000	15.97								
	2890	33.25	6	17400	18.85								
	2670	27.58	6	16400	24.33								
	 <b>2</b>	2560	32.05	5	9630	9.75							
		2560	27.19	5	7500	12.59							
		2830	25.03	5	15400	13.95							
		2720	22.37	5	14800	16.49							
<b>RM97</b>		2610	20.14	5	14400	19.09							
		2500	18.24	6	14000	22.03							
2400		16.17	6	13400	26.27								
2300		14.62	6	13000	30.28								
2190		12.39	6	12300	37.20								
2090		10.83	6	11700	45.97								
2030		9.29	6	11800	28.47								
2030		8.39	6	11300	32.97								
2000		7.12	6	10600	40.95								
1890		6.21	6	10100	50.88								
1780		5.20	6	9560	64.99								
1630		4.50*	6	9220	80.28								

m [kg]		90S	90M	90L	CM			
					112S	112M	112L	112H
<b>R97</b>	<b>3</b> 	120	120	125	125	130	145	150
	<b>2</b> 	115	115	120	120	125	140	150

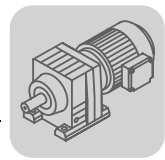
RF97: + 17 kg / RM97: + 68 kg


**7.16 R107 CM.. [Nm]**

	M <sub>a</sub> max [Nm]	i	φ (i/R) [ ' ]	F <sub>Ra</sub> (R) [N]	J <sub>G</sub> 10 <sup>-4</sup> [kgm <sup>2</sup> ]	CM				
						112S	112M	112L	112H	
<b>R107</b>	4300	203.16	7	29500	9.16					
	4300	172.34	7	29500	11.82					
<b>RF107</b>	4300	158.68	7	29500	13.09					
	4300	141.83	7	29500	15.36					
<b>RM107</b>	4300	127.68	7	29500	17.78					
	4300	115.63	7	29500	20.44					
 <b>3</b>	4300	102.53	7	29500	24.51					
	4300	92.70	7	29500	28.03					
	4300	78.57	7	29500	33.91					
	4300	72.88	7	29500	16.75					
	4300	65.60*	7	28400	19.41					
	4300	59.41	7	27200	22.42					
	4300	52.68	7	25900	27.05					
	4300	47.63	7	24800	31.17					
	4300	40.37*	7	23100	38.33					
	4300	35.26	7	21700	47.07					
	4300	29.49	7	20100	59.54					
	<b>R107</b>	4300	30.77	7	20500	17.91				
		4300	27.58	7	19500	21.20				
	<b>RF107</b>	4300	24.90*	7	18600	27.13				
		4300	22.62	7	17800	31.25				
 <b>2</b>	<b>RM107</b>	4300	20.07	7	16800	37.13				
	4300	18.21	7	16000	42.66					
	4300	15.65	7	14900	52.39					
	4300	13.66	7	13900	63.83					
	4300	11.59	7	12800	80.16					
	4300	10.13	7	11900	97.14					
	4300	8.56	7	10900	129.37					
	2970	7.86	9	13400	69.70					
	2970	6.66	9	12400	88.32					
	2970	5.82	9	11700	107.82					
2900	4.92	9	10900	144.32						

m [kg]		CM			
		112S	112M	112L	112H
<b>R107</b>	<b>3</b>	185	190	205	205
	<b>2</b>	180	180	195	200

**RF107: + 6.0 kg / RM107: + 94 kg**

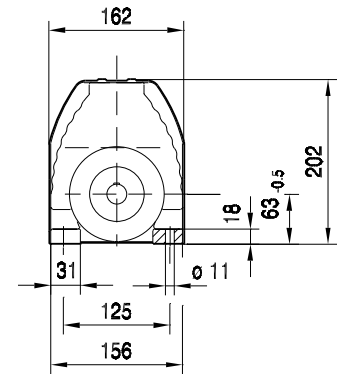
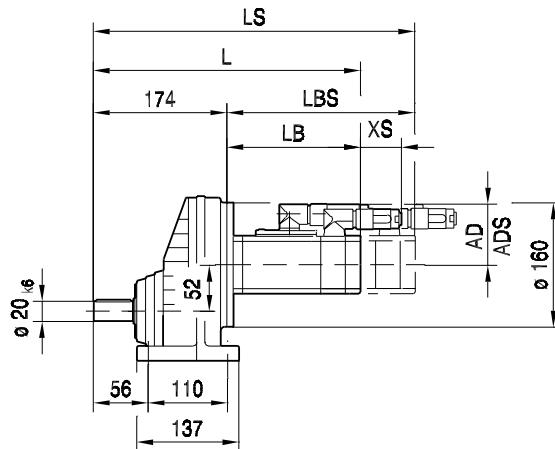
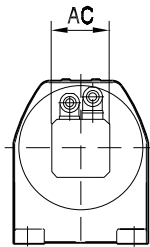


7.17 R..DS/CM..[mm]

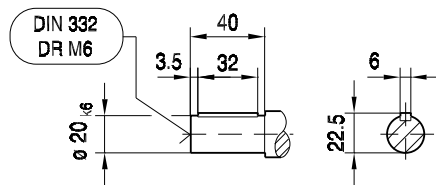
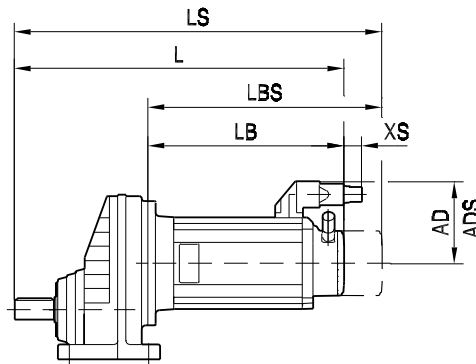
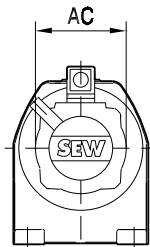
**RX57..**

**DS56..**

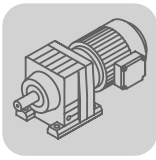
04 050 01 01



**CM..**



(→ 105)	DS56H	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L	CM112S	CM112M		
AC	73	117	117	117	142	142	142	186	186		
AD	77	122	122	122	140	140	140	162	162		
ADS	77	122	122	122	140	140	140	162	162		
L	440	406	426	466	458	485	543	498	522		
LS	440	488	508	548	554	581	639	588	612		
LB	266	232	252	292	284	311	369	324	348		
LBS	266	314	334	374	380	407	465	414	438		
XS	51	45	45	45	50	50	50	36	36		

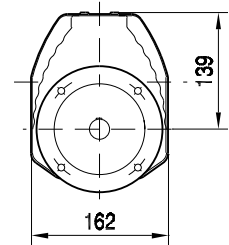
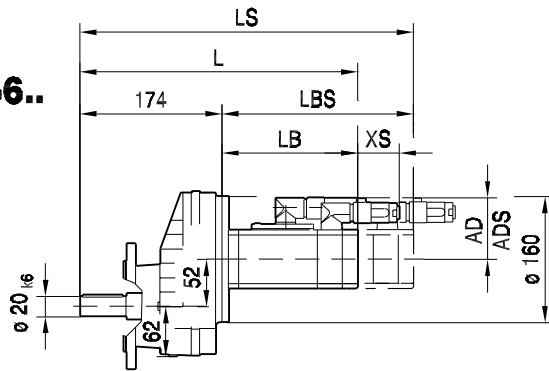
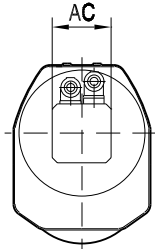


R..DS/CM..  
R..DS/CM..[mm]

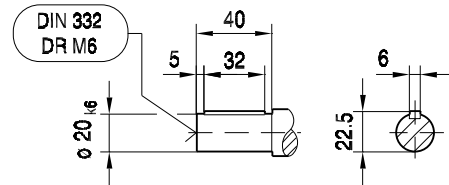
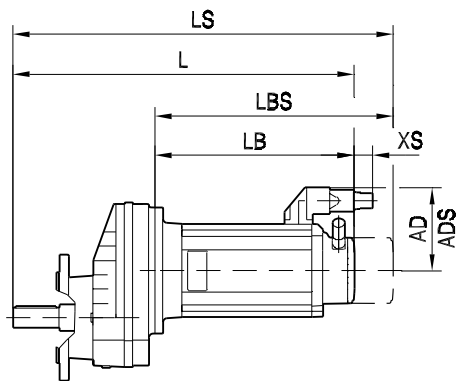
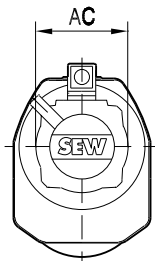
04 051 01 01

**RXF57..**

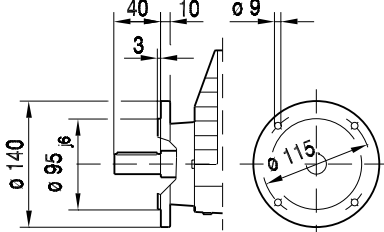
**DS56..**



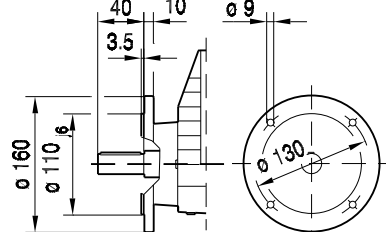
**CM..**



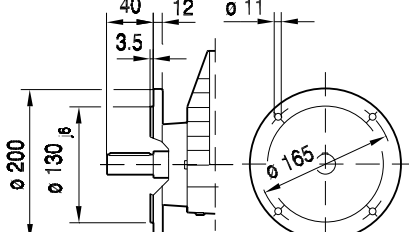
**ø 140**



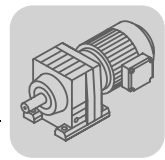
**ø 160**



**ø 200**

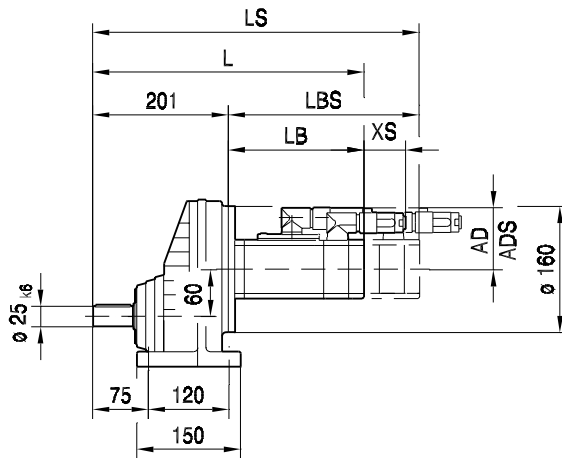
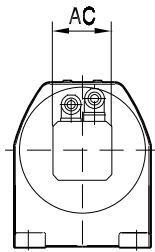


(→ 105)	DS56H	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L	CM112S	CM112M		
AC	73	117	117	117	142	142	142	186	186		
AD	77	122	122	122	140	140	140	162	162		
ADS	77	122	122	122	140	140	140	162	162		
L	440	406	426	466	458	485	543	498	522		
LS	440	488	508	548	554	581	639	588	612		
LB	266	232	252	292	284	311	369	324	348		
LBS	266	314	334	374	380	407	465	414	438		
XS	51	45	45	45	50	50	50	36	36		

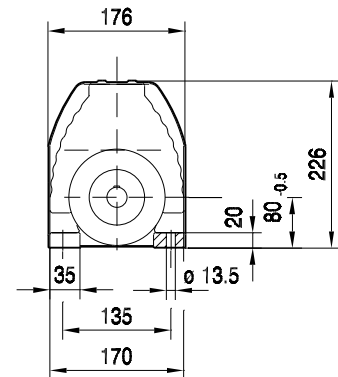


**RX67..**

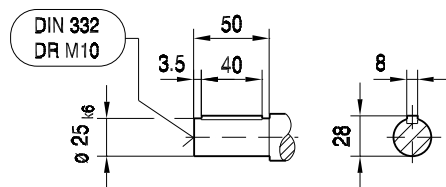
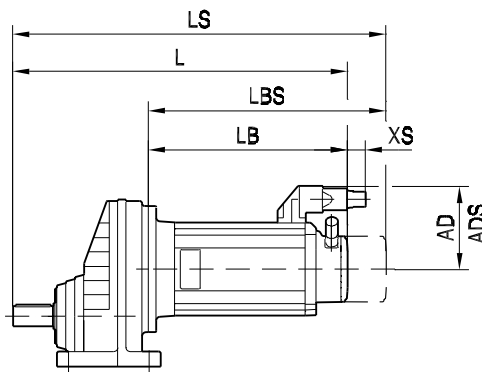
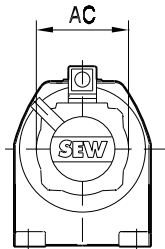
**DS56..**



04 052 01 01

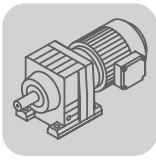


**CM..**



7

(→ 105)	DS56H	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L	CM112S	CM112M		
AC	73	117	117	117	142	142	142	186	186		
AD	77	122	122	122	140	140	140	162	162		
ADS	77	122	122	122	140	140	140	162	162		
L	467	433	453	493	485	512	570	525	549		
LS	467	515	535	575	581	608	666	615	639		
LB	266	232	252	292	284	311	369	324	348		
LBS	266	314	334	374	380	407	465	414	438		
XS	51	45	45	45	50	50	50	36	36		

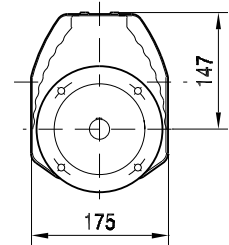
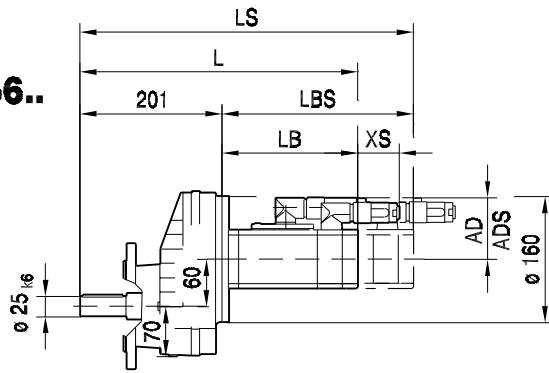
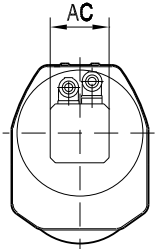


R..DS/CM..  
R..DS/CM..[mm]

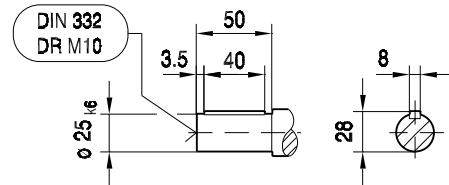
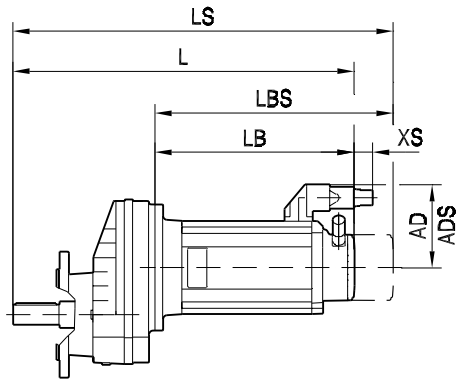
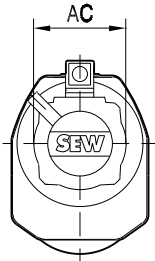
04 053 01 01

**RXF67..**

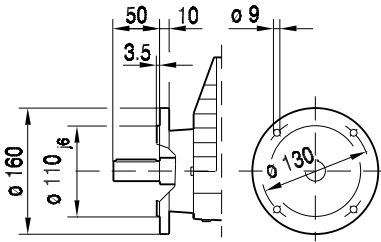
**DS56..**



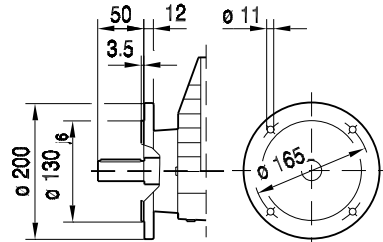
**CM..**



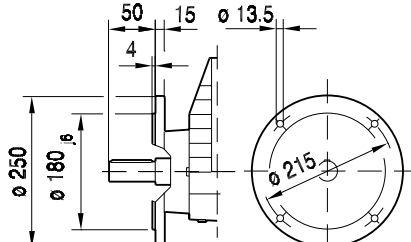
**ø 160**



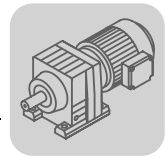
**ø 200**



**ø 250**

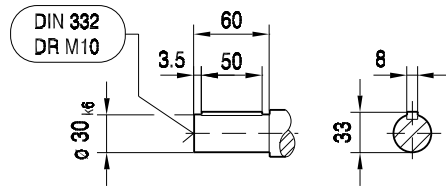
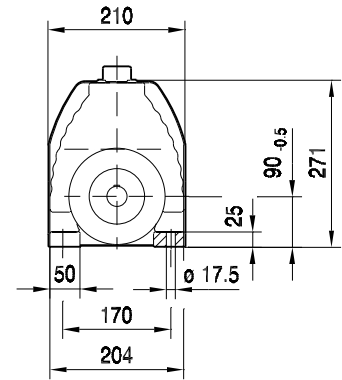
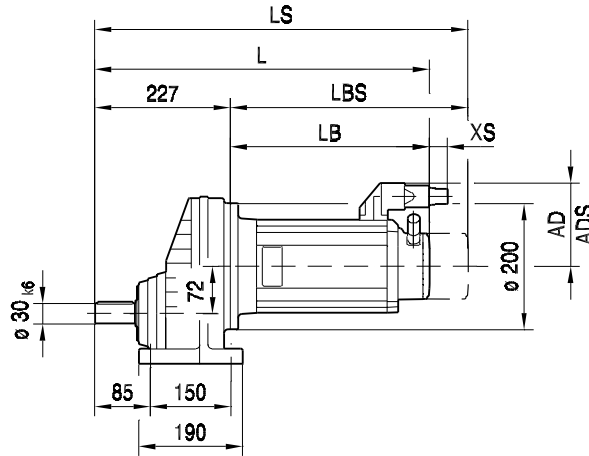
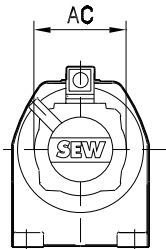


(→ 105)	DS56H	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L	CM112S	CM112M		
AC	73	117	117	117	142	142	142	186	186		
AD	77	122	122	122	140	140	140	162	162		
ADS	77	122	122	122	140	140	140	162	162		
L	467	433	453	493	485	512	570	525	549		
LS	467	515	535	575	581	608	666	615	639		
LB	266	232	252	292	284	311	369	324	348		
LBS	266	314	334	374	380	407	465	414	438		
XS	51	45	45	45	50	50	50	36	36		



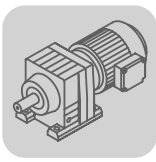
04 054 01 01

**RX77..**



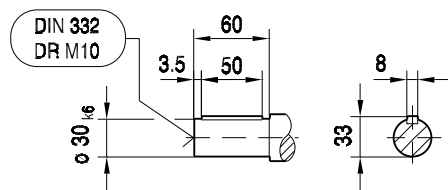
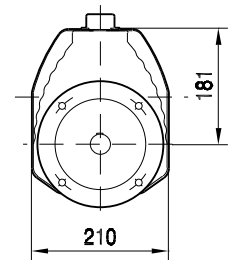
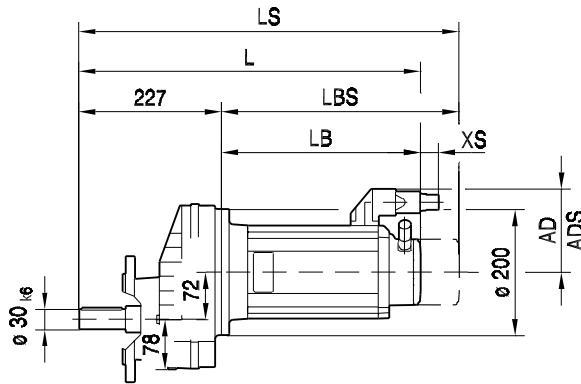
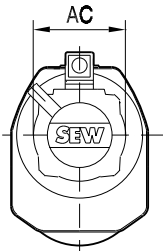
7

(→ 105)	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L	CM112S	CM112M	CM112L		
AC	117	117	117	142	142	142	186	186	186		
AD	122	122	122	140	140	140	162	162	162		
ADS	122	122	122	140	140	140	162	162	162		
L	453	473	512	503	530	584	539	566	628		
LS	535	555	594	599	626	680	629	656	718		
LB	226	246	285	276	303	357	312	339	401		
LBS	308	328	367	372	399	453	402	429	491		
XS	45	45	45	50	50	50	36	36	36		

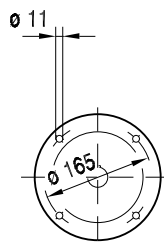
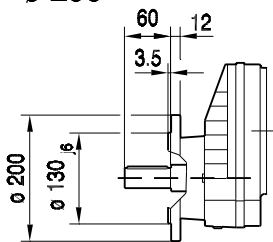


04 055 01 01

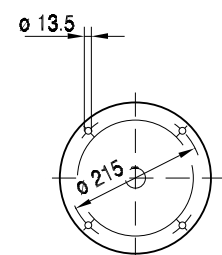
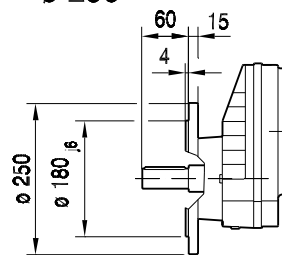
**RXF77..**



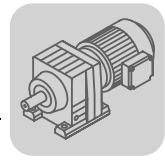
**ø 200**



**ø 250**

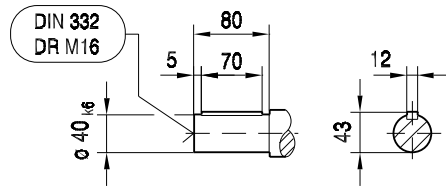
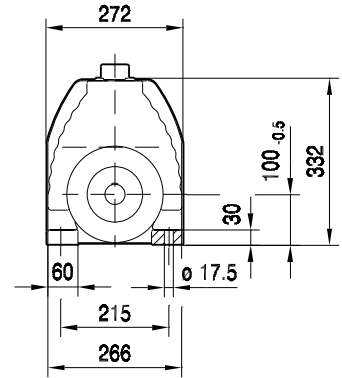
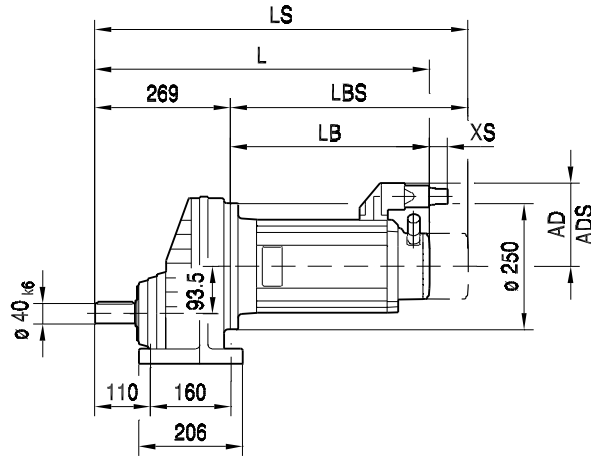
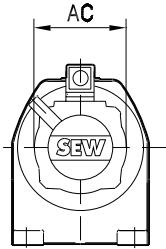


(→ 105)	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L	CM112S	CM112M	CM112L		
AC	117	117	117	142	142	142	186	186	186		
AD	122	122	122	140	140	140	162	162	162		
ADS	122	122	122	140	140	140	162	162	162		
L	453	473	512	503	530	584	539	566	628		
LS	535	555	594	599	626	680	629	656	718		
LB	226	246	285	276	303	357	312	339	401		
LBS	308	328	367	372	399	453	402	429	491		
XS	45	45	45	50	50	50	36	36	36		



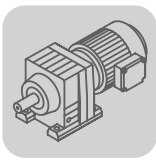
04 056 01 01

**RX87..**



7

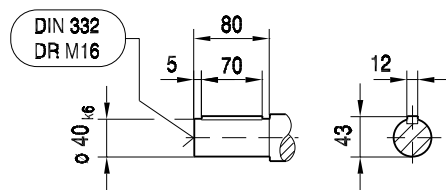
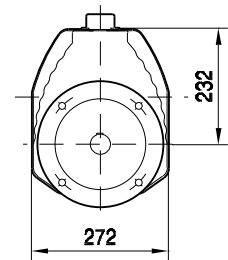
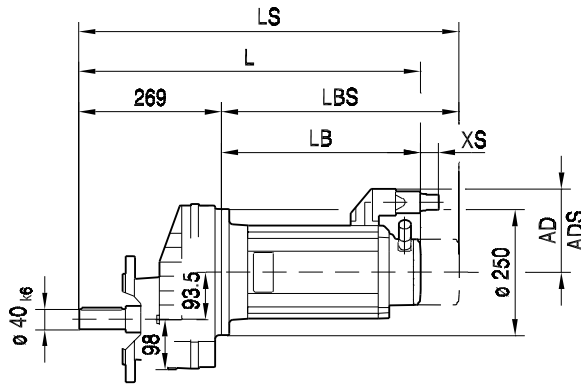
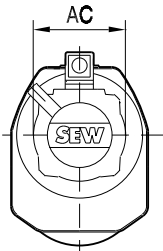
(→ 105)	CM90S	CM90M	CM90L	CM112S	CM112M	CM112L	CM112H			
AC	142	142	142	186	186	186	186			
AD	140	140	140	162	162	162	162			
ADS	140	140	140	162	162	162	162			
L	541	568	622	576	603	665	795			
LS	637	664	718	666	693	755	860			
LB	272	299	353	307	334	396	526			
LBS	368	395	449	397	424	486	591			
XS	50	50	50	36	36	36	36			



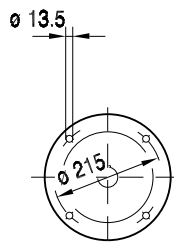
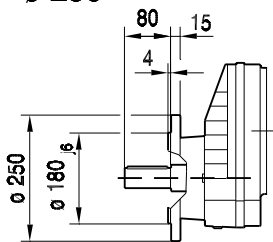
R..DS/CM..  
R..DS/CM..[mm]

04 057 01 01

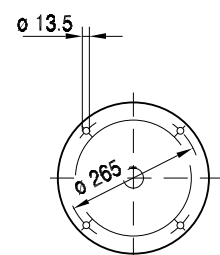
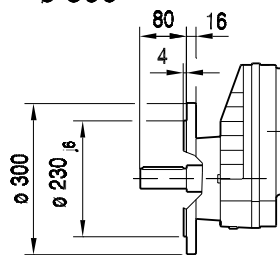
**RXF87..**



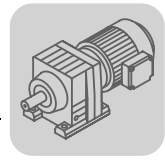
**ø 250**



**ø 300**

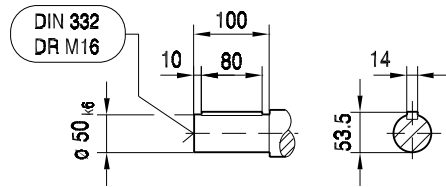
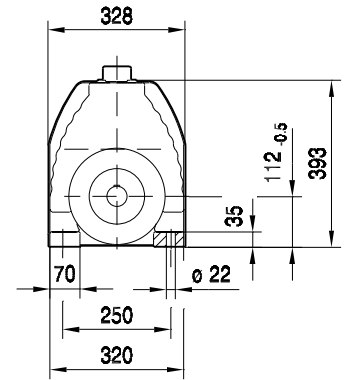
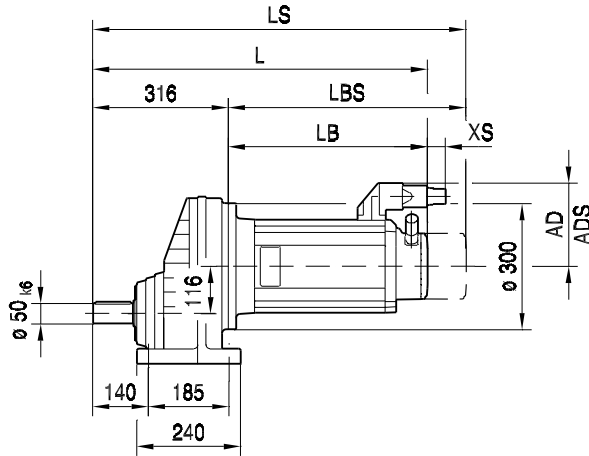
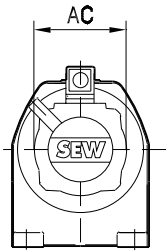


(→ 105)	CM90S	CM90M	CM90L	CM112S	CM112M	CM112L	CM112H			
AC	142	142	142	186	186	186	186			
AD	140	140	140	162	162	162	162			
ADS	140	140	140	162	162	162	162			
L	541	568	622	576	603	665	795			
LS	637	664	718	666	693	755	860			
LB	272	299	353	307	334	396	526			
LBS	368	395	449	397	424	486	591			
XS	50	50	50	36	36	36	36			



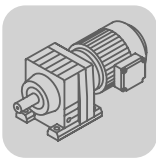
04 058 01 01

**RX97..**

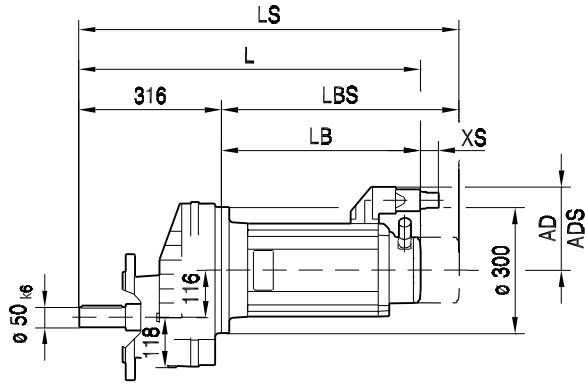
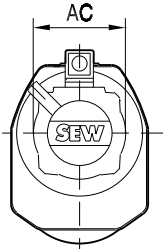


7

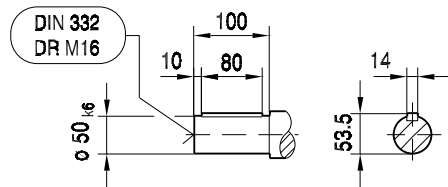
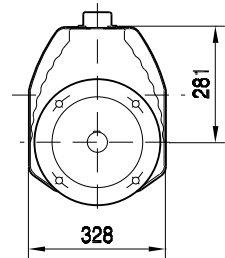
(→ 105)	CM90S	CM90M	CM90L	CM112S	CM112M	CM112L	CM112H			
AC	142	142	142	186	186	186	186			
AD	140	140	140	162	162	162	162			
ADS	140	140	140	162	162	162	162			
L	582	609	663	618	645	707	837			
LS	678	705	759	708	735	797	902			
LB	266	293	347	302	329	391	521			
LBS	362	389	443	392	419	481	586			
XS	50	50	50	36	36	36	36			



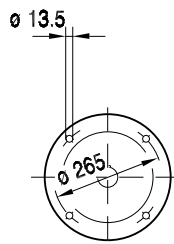
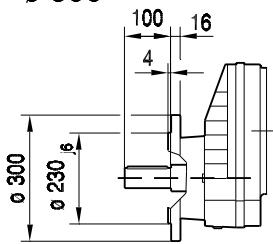
**RXF97..**



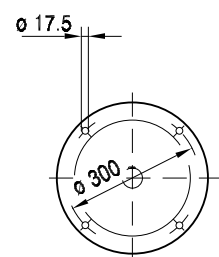
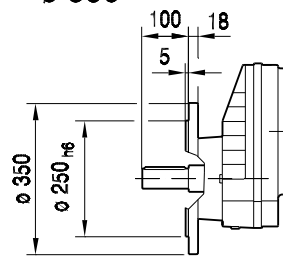
04 059 01 01



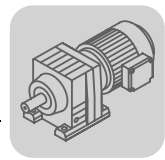
**ø 300**



**ø 350**

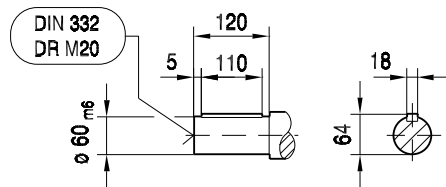
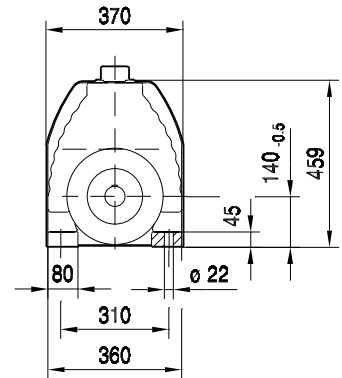
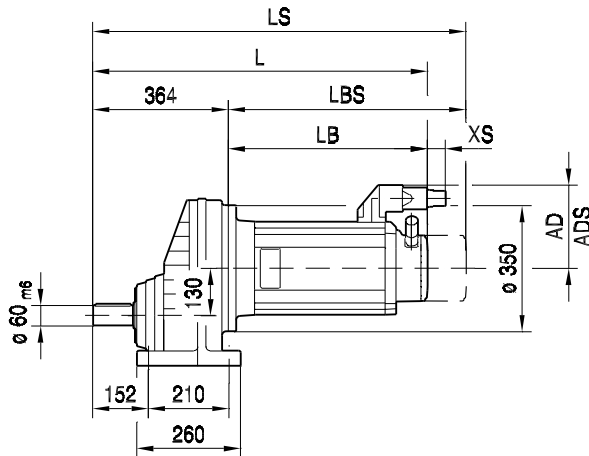
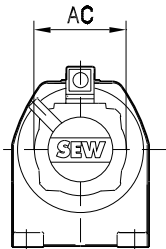


(→ 105)	CM90S	CM90M	CM90L	CM112S	CM112M	CM112L	CM112H			
AC	142	142	142	186	186	186	186			
AD	140	140	140	162	162	162	162			
ADS	140	140	140	162	162	162	162			
L	582	609	663	618	645	707	837			
LS	678	705	759	708	735	797	902			
LB	266	293	347	302	329	391	521			
LBS	362	389	443	392	419	481	586			
XS	50	50	50	36	36	36	36			



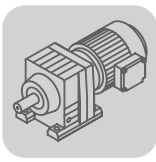
**RX107..**

04 060 01 01



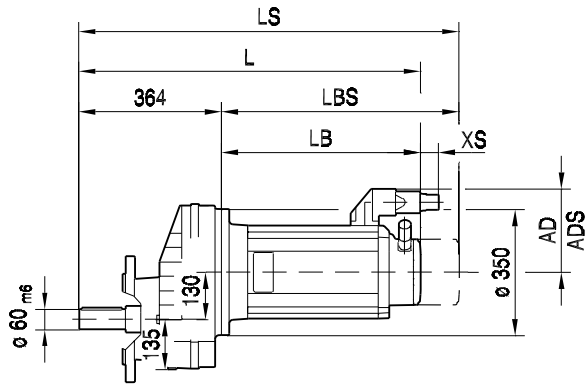
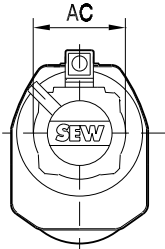
7

(→ 105)	CM112S	CM112M	CM112L	CM112H						
AC	186	186	186	186						
AD	162	162	162	162						
ADS	162	162	162	162						
L	660	687	749	879						
LS	750	777	839	944						
LB	296	323	385	515						
LBS	386	413	475	580						
XS	36	36	36	36						

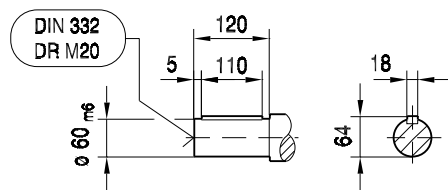
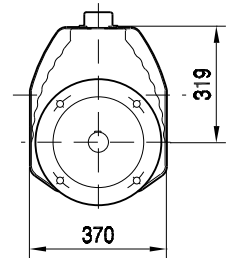


R..DS/CM..  
R..DS/CM..[mm]

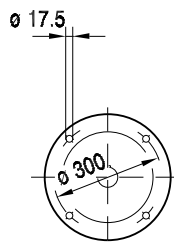
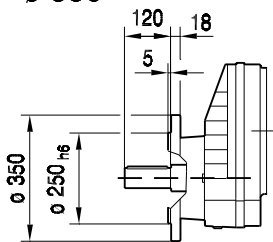
**RXF107..**



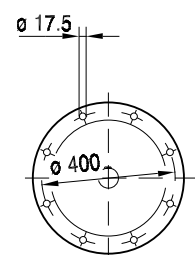
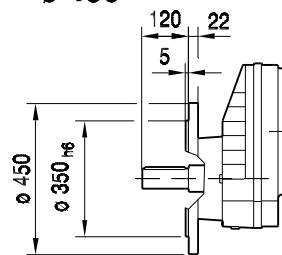
**04 061 01 01**



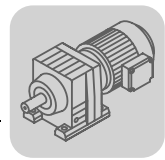
**ø 350**



**ø 450**

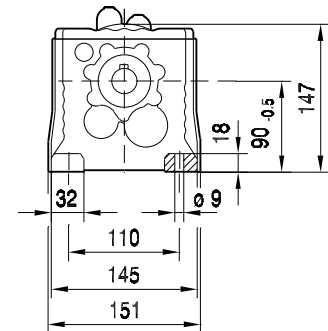
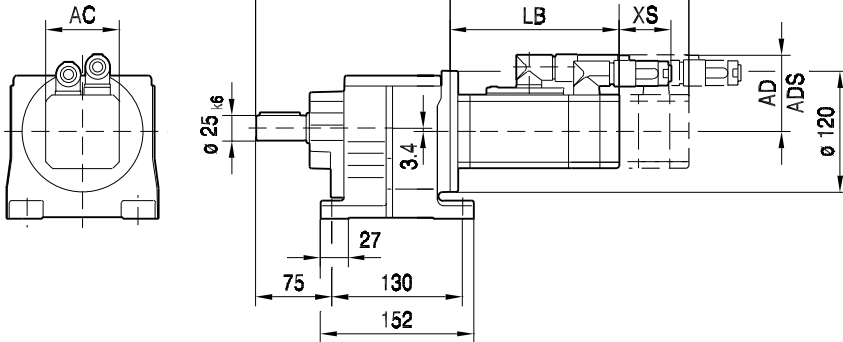


(→ 105)	CM112S	CM112M	CM112L	CM112H						
AC	186	186	186	186						
AD	162	162	162	162						
ADS	162	162	162	162						
L	660	687	749	879						
LS	750	777	839	944						
LB	296	323	385	515						
LBS	386	413	475	580						
XS	36	36	36	36						

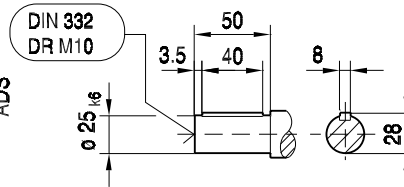
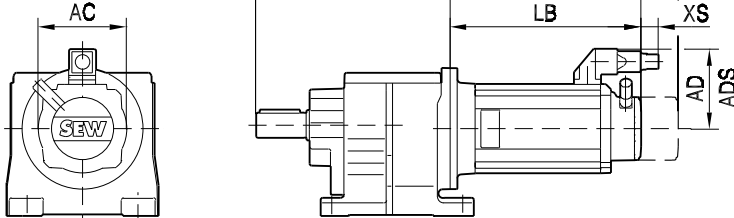


04 062 01 01

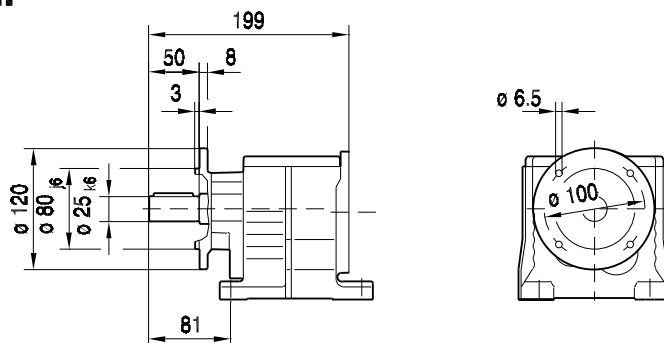
**R27..  
DS56..**



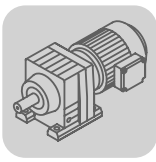
**CM..**



**R27F..**



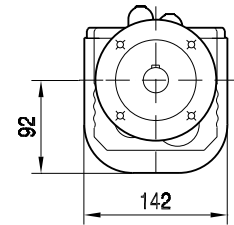
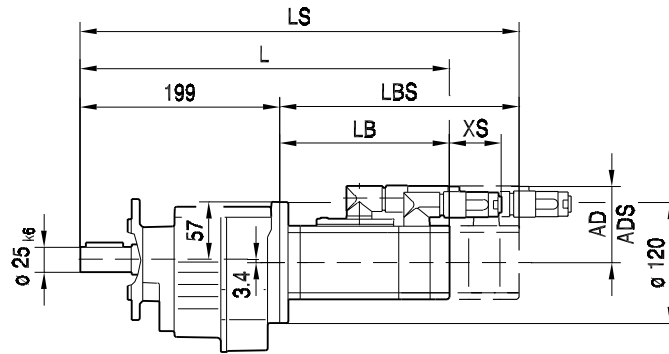
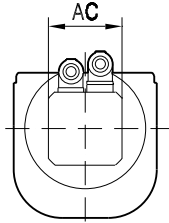
(→ 105)	DS56M	DS56L	DS56H	CM71S	CM71M	CM71L	CM90S			
AC	73	73	73	117	117	117	142			
AD	71	71	77	122	122	122	140			
ADS	77	77	77	122	122	122	140			
L	330	362	465	431	451	494	486			
LS	360	392	465	513	533	576	582			
LB	137	169	272	238	258	301	293			
LBS	167	199	272	320	340	383	389			
XS	70	70	51	45	45	45	50			



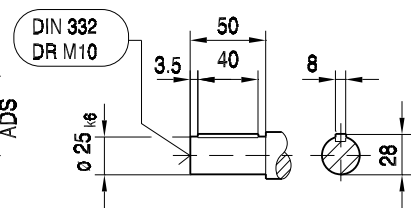
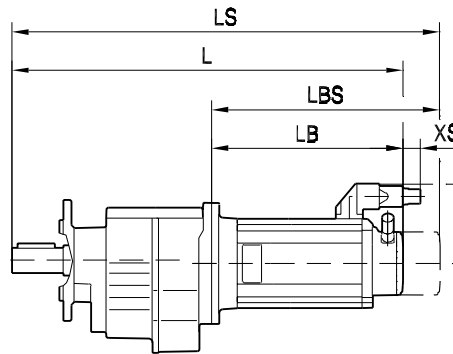
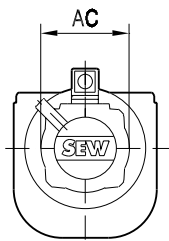
04 063 01 01

RF27..

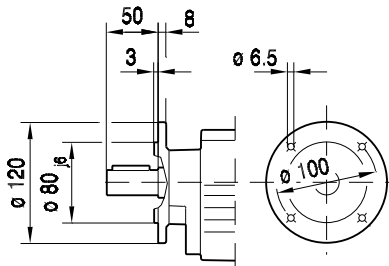
DS56..



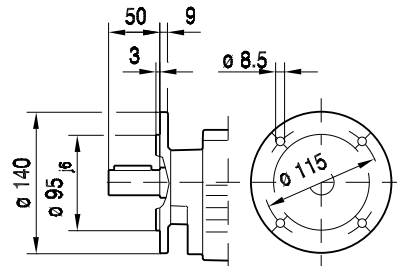
CM..



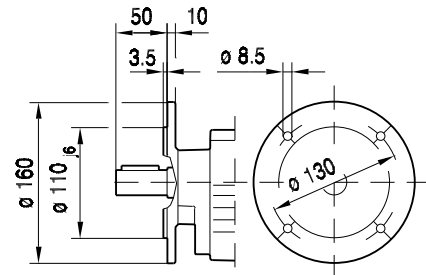
ø 120



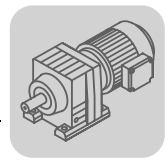
ø 140



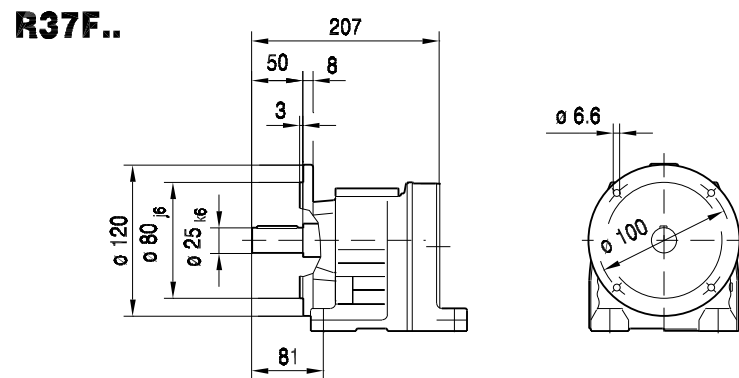
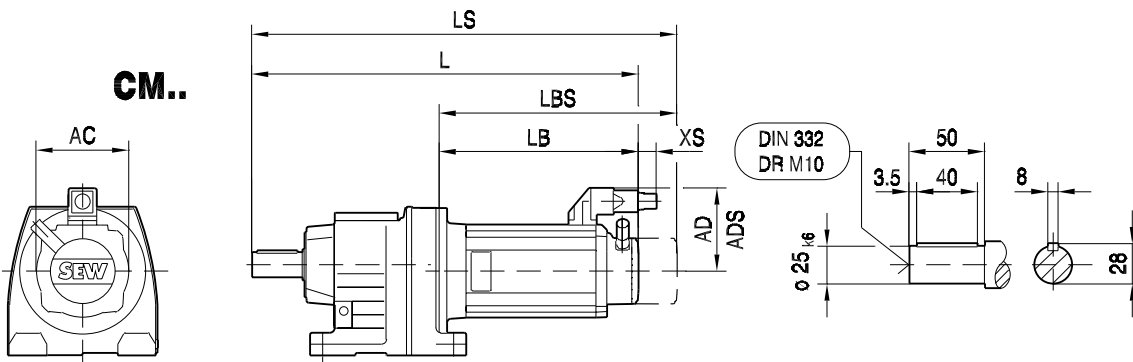
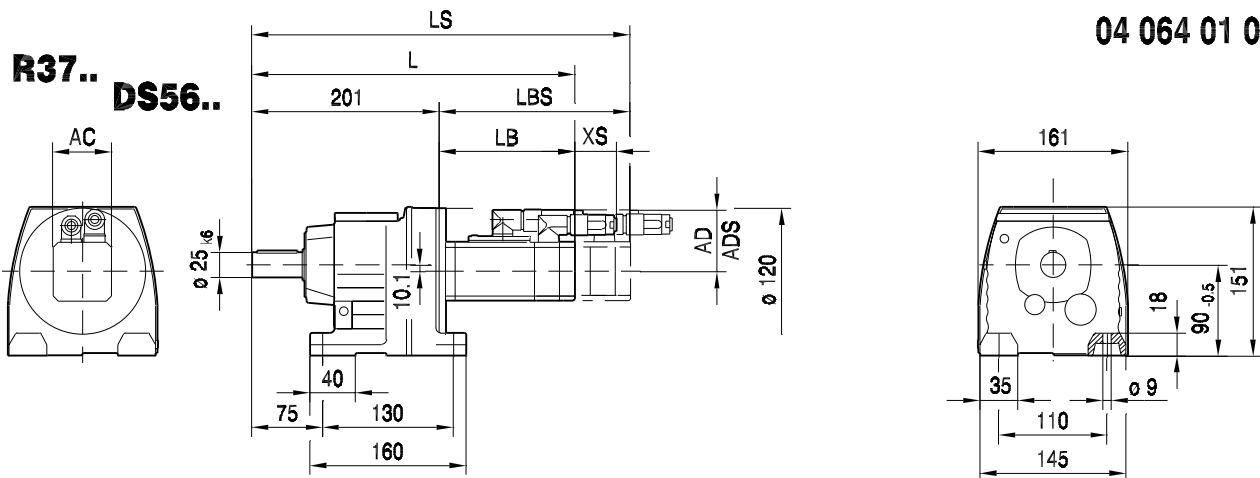
ø 160



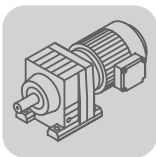
(→ 105)	DS56M	DS56L	DS56H	CM71S	CM71M	CM71L	CM90S			
AC	73	73	73	117	117	117	142			
AD	71	71	77	122	122	122	140			
ADS	77	77	77	122	122	122	140			
L	336	368	471	437	457	500	492			
LS	366	398	471	519	539	582	588			
LB	137	169	272	238	258	301	293			
LBS	167	199	272	320	340	383	389			
XS	70	70	51	45	45	45	50			



04 064 01 01



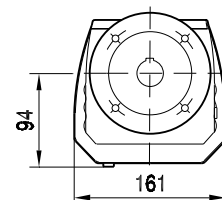
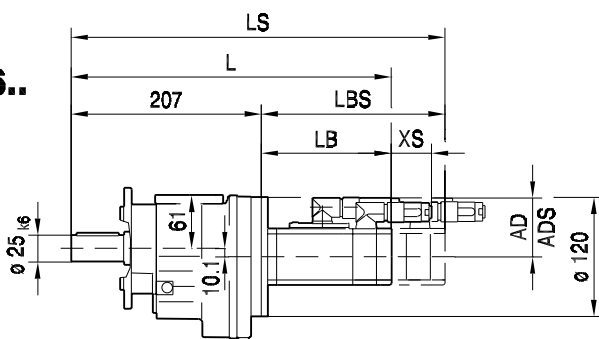
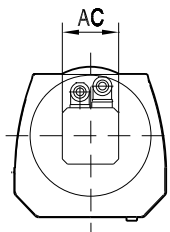
(→ 105)	DS56M	DS56L	DS56H	CM71S	CM71M	CM71L	CM90S			
AC	73	73	73	117	117	117	142			
AD	71	71	77	122	122	122	140			
ADS	77	77	77	122	122	122	140			
L	338	370	473	439	459	502	494			
LS	368	400	473	521	541	584	590			
LB	137	169	272	238	258	301	293			
LBS	167	199	272	320	340	383	389			
XS	70	70	51	45	45	45	50			



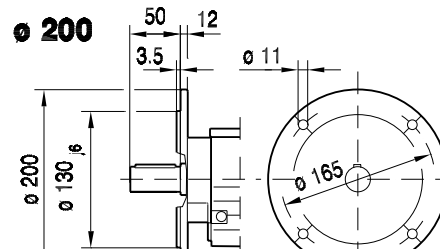
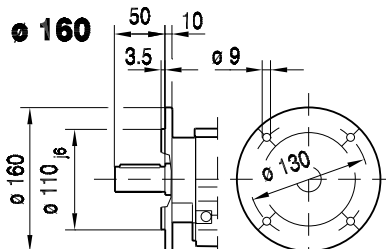
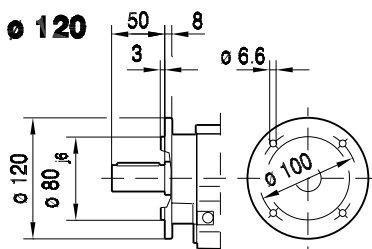
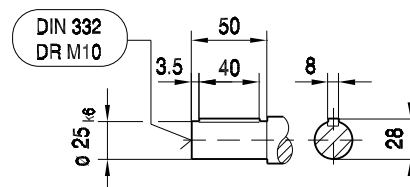
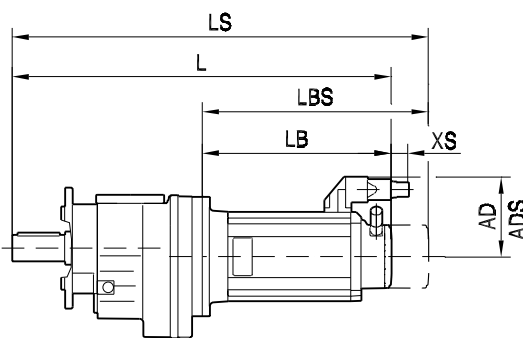
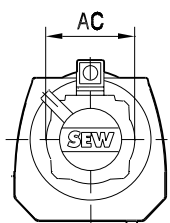
04 065 01 01

RF37..

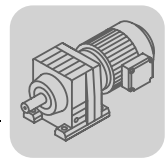
DS56..



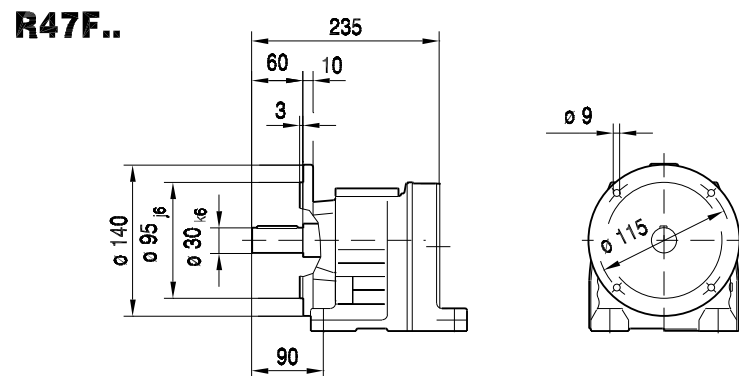
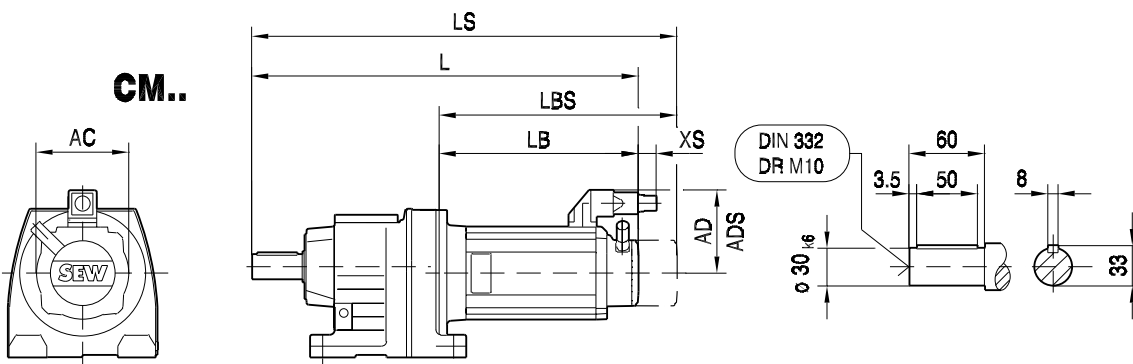
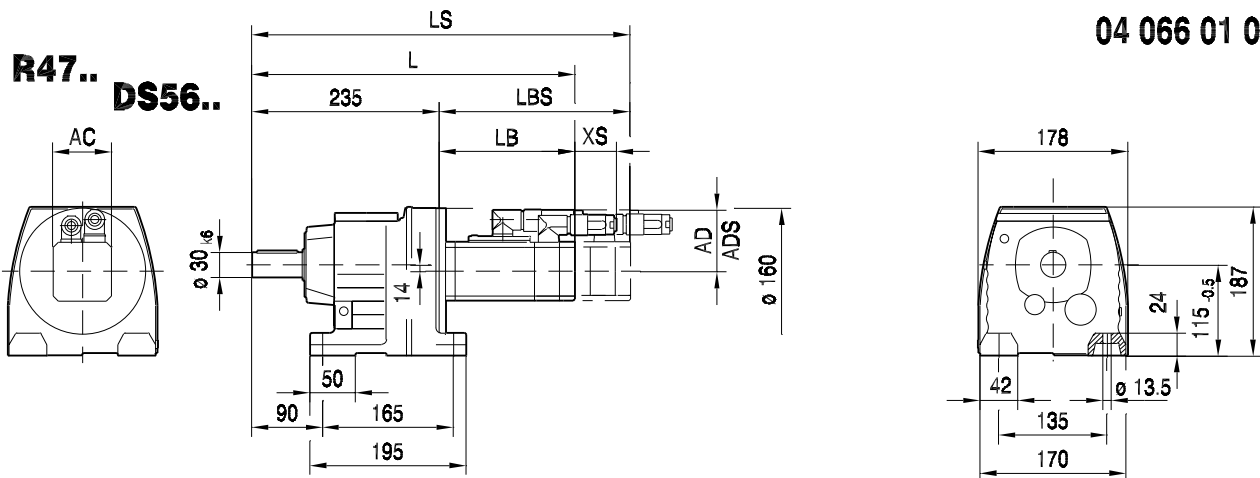
CM..



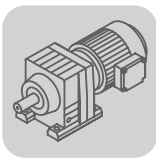
(→ 105)	DS56M	DS56L	DS56H	CM71S	CM71M	CM71L	CM90S			
AC	73	73	73	117	117	117	142			
AD	71	71	77	122	122	122	140			
ADS	77	77	77	122	122	122	140			
L	344	376	479	445	465	508	500			
LS	374	406	479	527	547	590	596			
LB	137	169	272	238	258	301	293			
LBS	167	199	272	320	340	383	389			
XS	70	70	51	45	45	45	50			



04 066 01 01



(→ 105)	DS56H	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L	CM112S			
AC	73	117	117	117	142	142	142	186			
AD	77	122	122	122	140	140	140	162			
ADS	77	122	122	122	140	140	140	162			
L	501	467	487	527	519	546	604	559			
LS	501	549	569	609	615	642	700	649			
LB	266	232	252	292	284	311	369	324			
LBS	266	314	334	374	380	407	465	414			
XS	51	45	45	45	50	50	50	36			

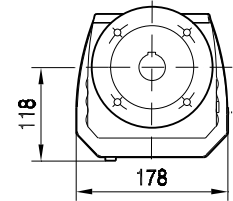
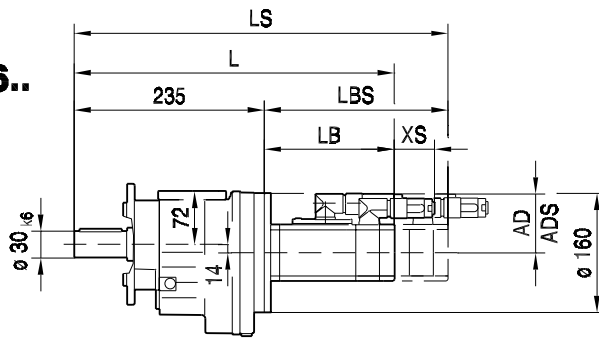
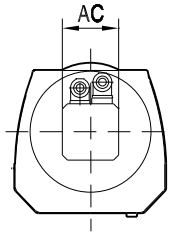


R..DS/CM..  
R..DS/CM..[mm]

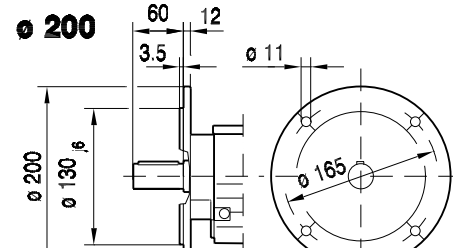
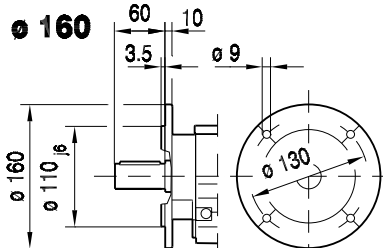
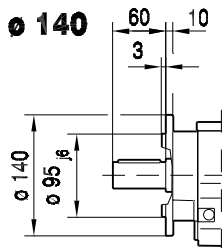
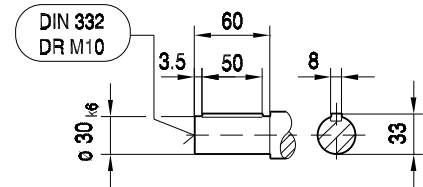
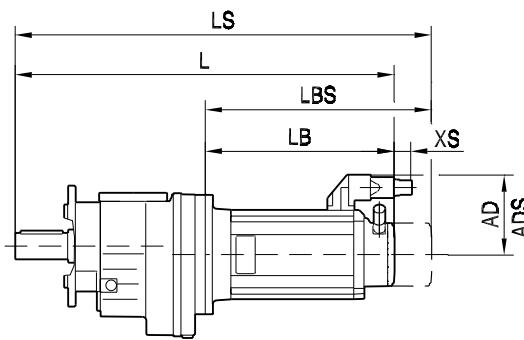
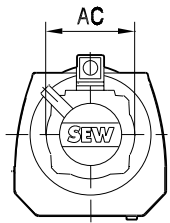
04 067 01 01

RF47..

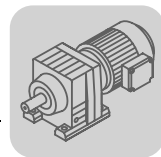
DS56..



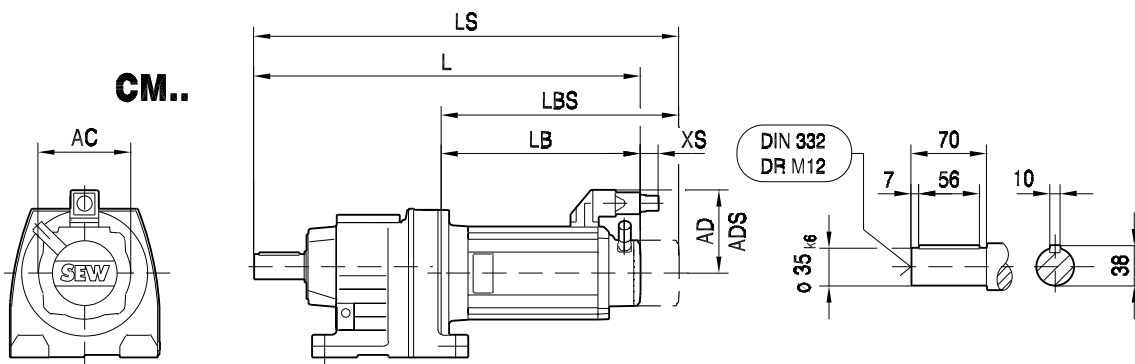
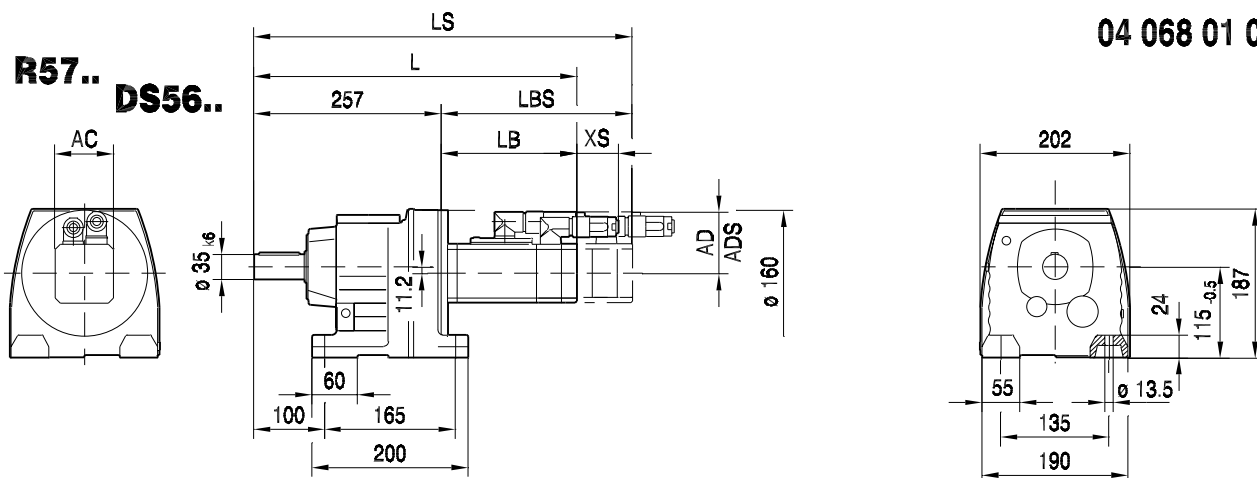
CM..



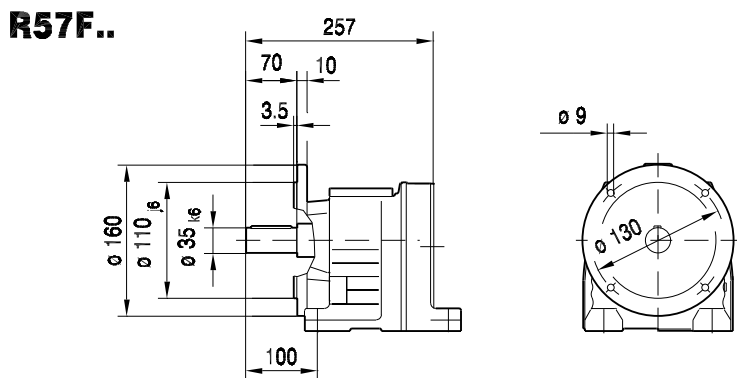
(→ 105)	DS56H	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L	CM112S		
AC	73	117	117	117	142	142	142	186		
AD	77	122	122	122	140	140	140	162		
ADS	77	122	122	122	140	140	140	162		
L	501	467	487	527	519	546	604	559		
LS	501	549	569	609	615	642	700	649		
LB	266	232	252	292	284	311	369	324		
LBS	266	314	334	374	380	407	465	414		
XS	51	45	45	45	50	50	50	36		



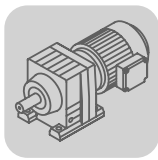
04 068 01 01



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(→ 105)	DS56H	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L	CM112S	CM112M		
AC	73	117	117	117	142	142	142	186	186		
AD	77	122	122	122	140	140	140	162	162		
ADS	77	122	122	122	140	140	140	162	162		
L	523	489	509	549	541	568	626	581	605		
LS	523	571	591	631	637	664	722	671	695		
LB	266	232	252	292	284	311	369	324	348		
LBS	266	314	334	374	380	407	465	414	438		
XS	51	45	45	45	50	50	50	36	36		

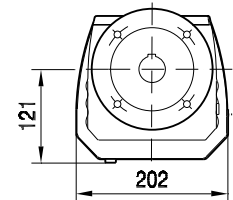
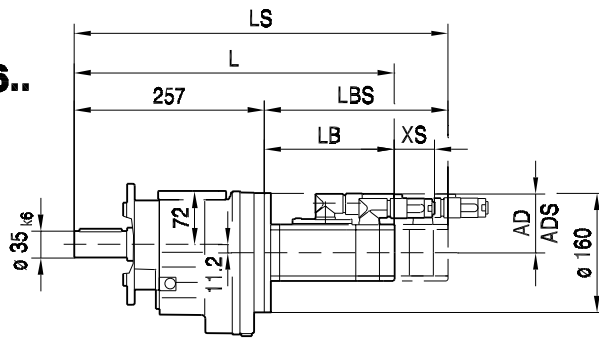
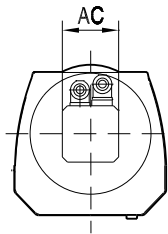


R..DS/CM..  
R..DS/CM..[mm]

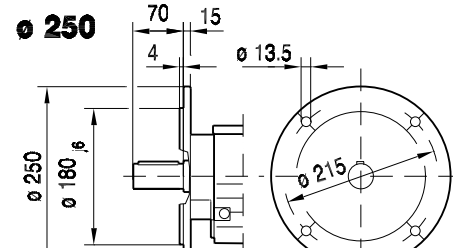
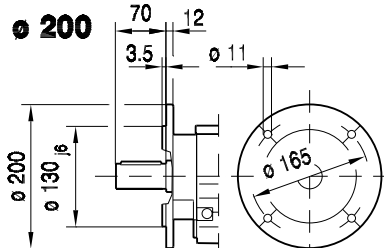
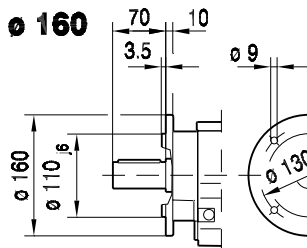
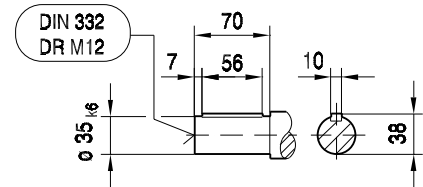
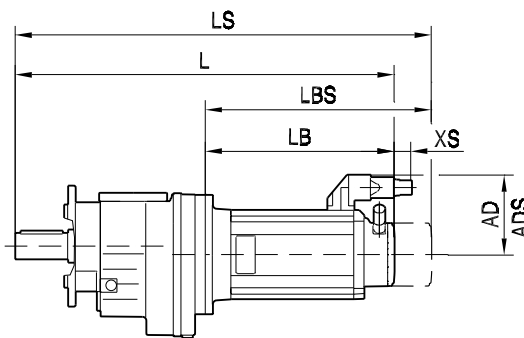
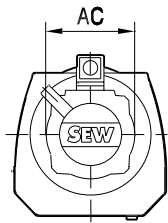
04 069 01 01

RF57..

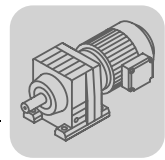
DS56..



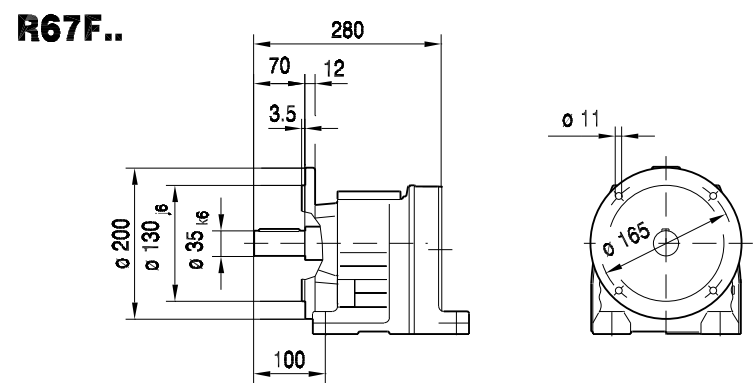
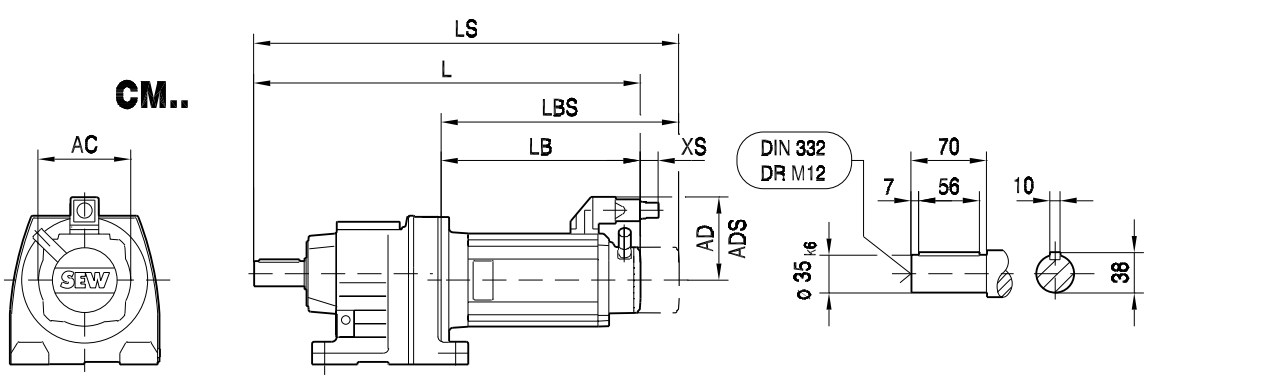
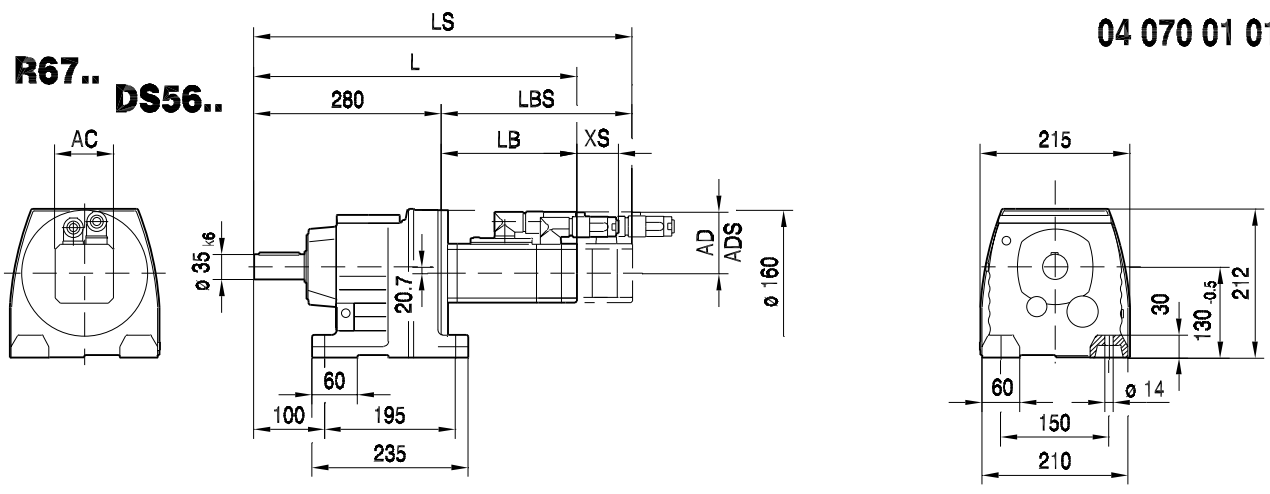
CM..



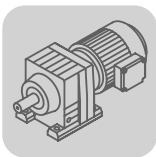
(→ 105)	DS56H	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L	CM112S	CM112M		
AC	73	117	117	117	142	142	142	186	186		
AD	77	122	122	122	140	140	140	162	162		
ADS	77	122	122	122	140	140	140	162	162		
L	523	489	509	549	541	568	626	581	605		
LS	523	571	591	631	637	664	722	671	695		
LB	266	232	252	292	284	311	369	324	348		
LBS	266	314	334	374	380	407	465	414	438		
XS	51	45	45	45	50	50	50	36	36		



04 070 01 01



(→ 105)	DS56H	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L	CM112S	CM112M		
AC	73	117	117	117	142	142	142	186	186		
AD	77	122	122	122	140	140	140	162	162		
ADS	77	122	122	122	140	140	140	162	162		
L	546	512	532	572	564	591	649	604	628		
LS	546	594	614	654	660	687	745	694	718		
LB	266	232	252	292	284	311	369	324	348		
LBS	266	314	334	374	380	407	465	414	438		
XS	51	45	45	45	50	50	50	36	36		

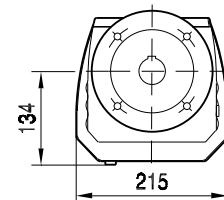
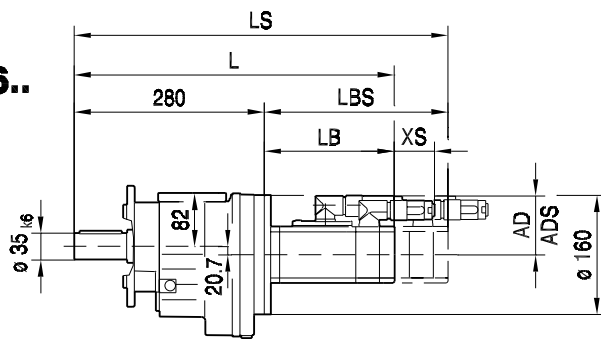
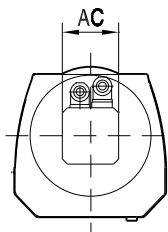


R..DS/CM..  
R..DS/CM..[mm]

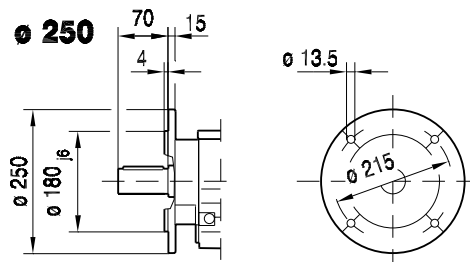
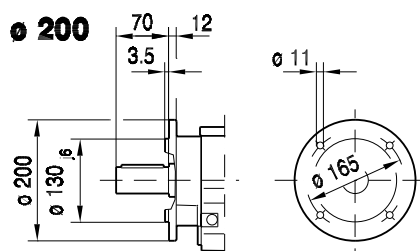
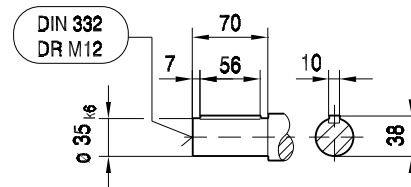
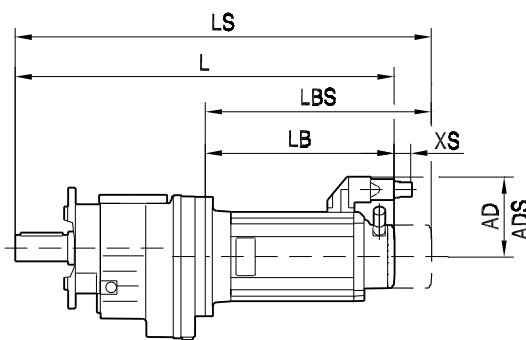
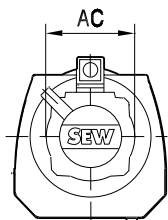
04 071 01 01

RF67..

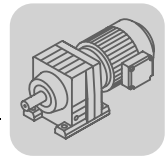
DS56..



CM..

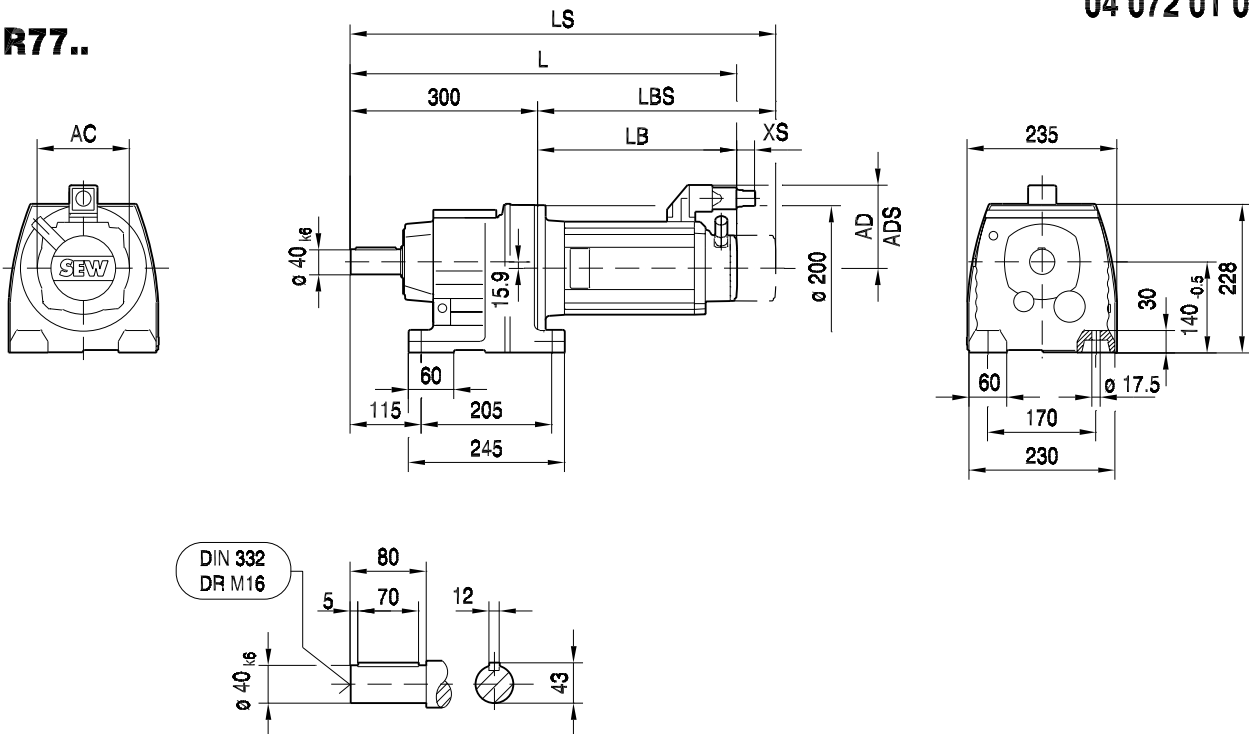


(→ 105)	DS56H	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L	CM112S	CM112M		
AC	73	117	117	117	142	142	142	186	186		
AD	77	122	122	122	140	140	140	162	162		
ADS	77	122	122	122	140	140	140	162	162		
L	546	512	532	572	564	591	649	604	628		
LS	546	594	614	654	660	687	745	694	718		
LB	266	232	252	292	284	311	369	324	348		
LBS	266	314	334	374	380	407	465	414	438		
XS	51	45	45	45	50	50	50	36	36		

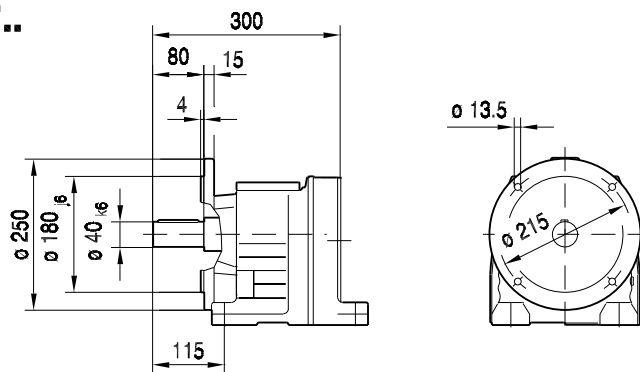


04 072 01 01

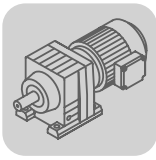
**R77..**



**R77F..**

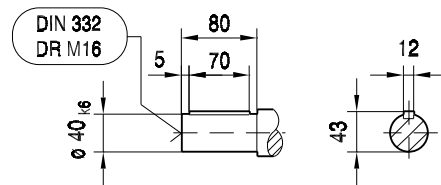
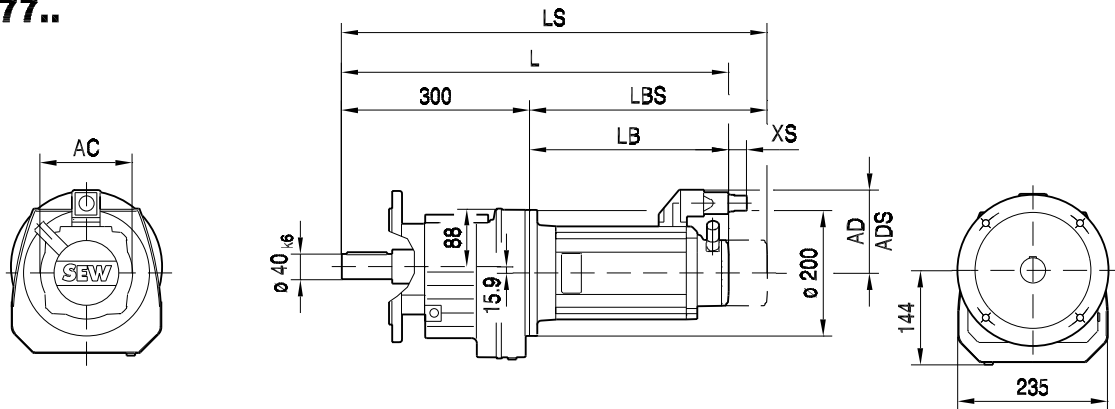


(→ 105)	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L	CM112S	CM112M	CM112L		
AC	117	117	117	142	142	142	186	186	186		
AD	122	122	122	140	140	140	162	162	162		
ADS	122	122	122	140	140	140	162	162	162		
L	526	546	585	576	603	657	612	639	701		
LS	608	628	667	672	699	753	702	729	791		
LB	226	246	285	276	303	357	312	339	401		
LBS	308	328	367	372	399	453	402	429	491		
XS	45	45	45	50	50	50	36	36	36		

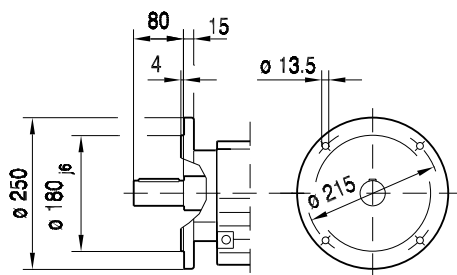


04 073 01 01

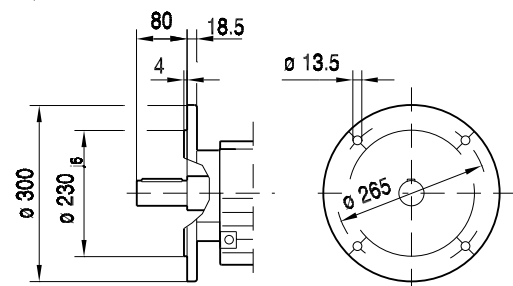
RF77..



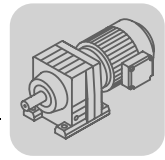
**$\varnothing 250$**



**$\varnothing 300$**

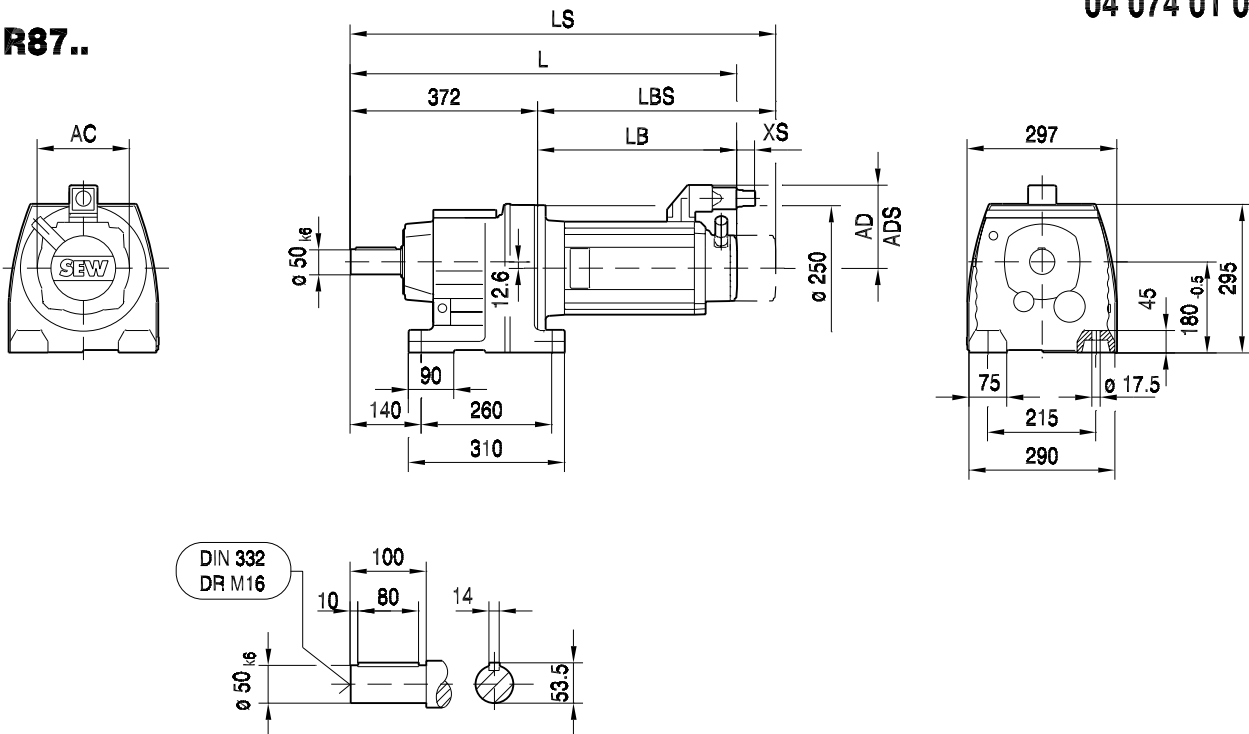


(→ 105)	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L	CM112S	CM112M	CM112L		
AC	117	117	117	142	142	142	186	186	186		
AD	122	122	122	140	140	140	162	162	162		
ADS	122	122	122	140	140	140	162	162	162		
L	526	546	585	576	603	657	612	639	701		
LS	608	628	667	672	699	753	702	729	791		
LB	226	246	285	276	303	357	312	339	401		
LBS	308	328	367	372	399	453	402	429	491		
XS	45	45	45	50	50	50	36	36	36		



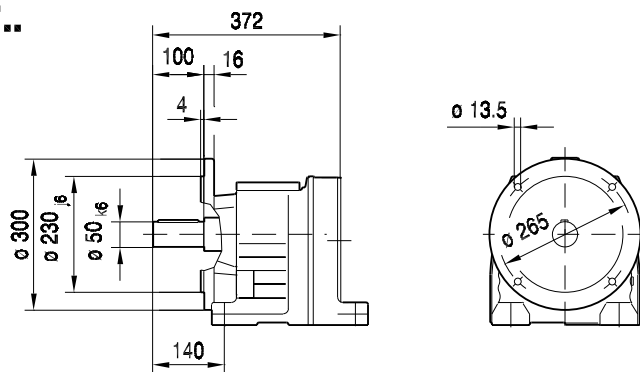
04 074 01 01

**R87..**

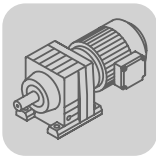


7

**R87F..**

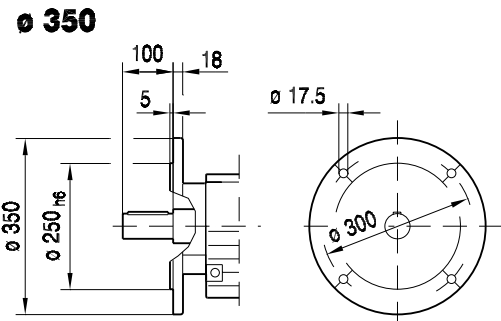
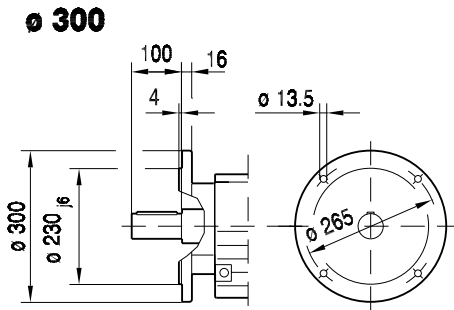
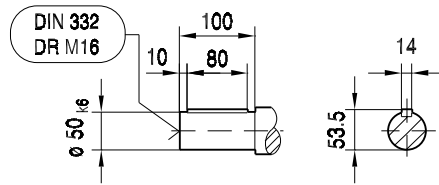
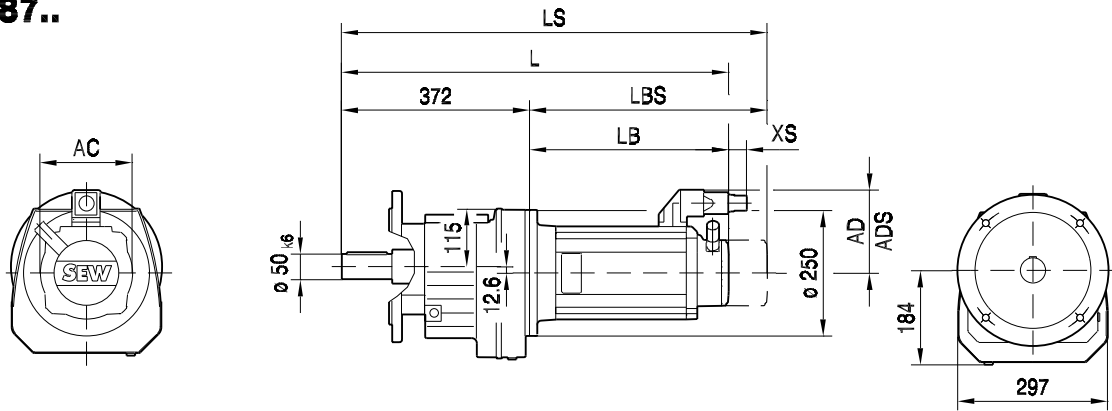


(→ 105)	CM90S	CM90M	CM90L	CM112S	CM112M	CM112L	CM112H			
AC	142	142	142	186	186	186	186			
AD	140	140	140	162	162	162	162			
ADS	140	140	140	162	162	162	162			
L	644	671	725	679	706	768	898			
LS	740	767	821	769	796	858	963			
LB	272	299	353	307	334	396	526			
LBS	368	395	449	397	424	486	591			
XS	50	50	50	36	36	36	36			

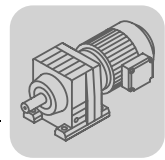


04 075 01 01

**RF87..**

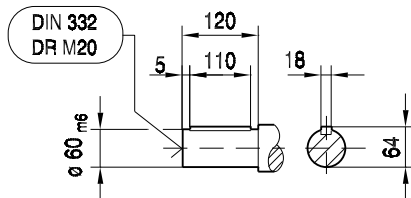
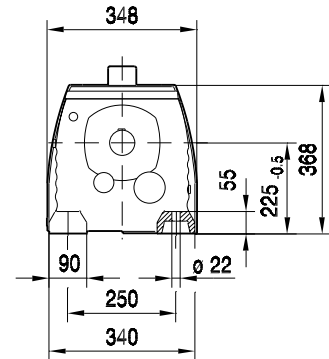
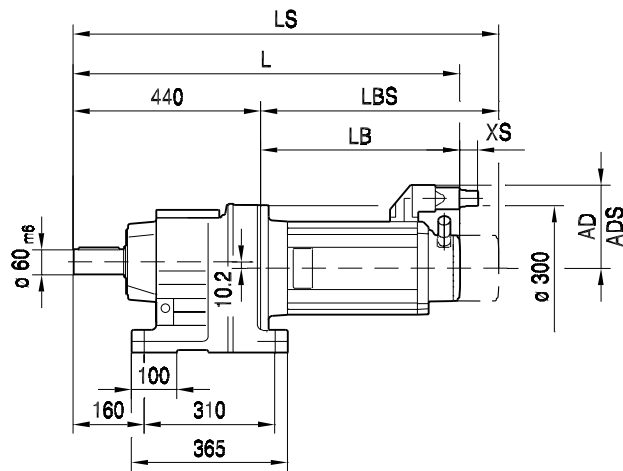
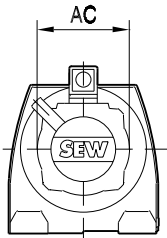


(→ 105)	CM90S	CM90M	CM90L	CM112S	CM112M	CM112L	CM112H			
AC	142	142	142	186	186	186	186			
AD	140	140	140	162	162	162	162			
ADS	140	140	140	162	162	162	162			
L	644	671	725	679	706	768	898			
LS	740	767	821	769	796	858	963			
LB	272	299	353	307	334	396	526			
LBS	368	395	449	397	424	486	591			
XS	50	50	50	36	36	36	36			



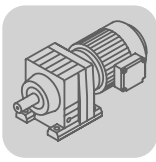
04 076 01 01

R97..



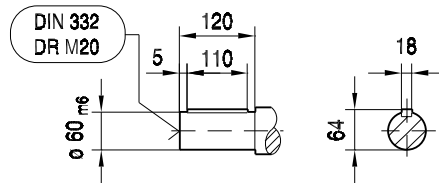
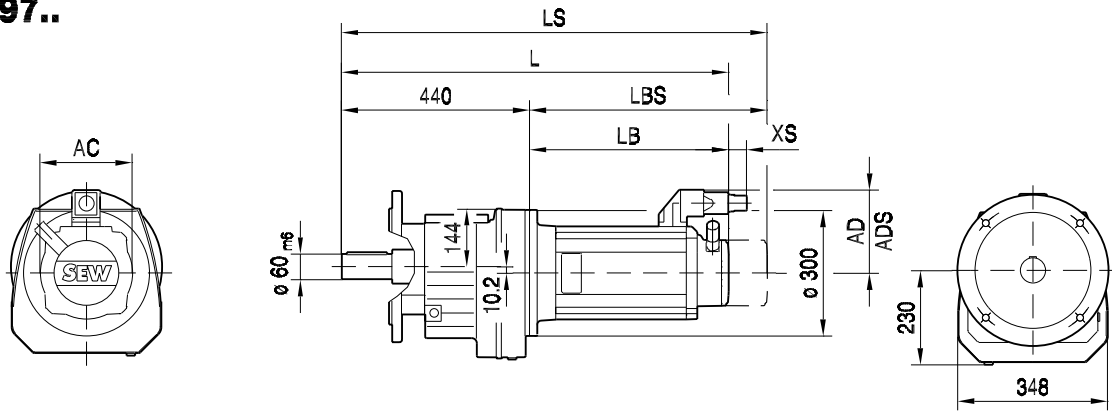
7

(→ 105)	CM90S	CM90M	CM90L	CM112S	CM112M	CM112L	CM112H			
AC	142	142	142	186	186	186	186			
AD	140	140	140	162	162	162	162			
ADS	140	140	140	162	162	162	162			
L	706	733	787	742	769	831	961			
LS	802	829	883	832	859	921	1026			
LB	266	293	347	302	329	391	521			
LBS	362	389	443	392	419	481	586			
XS	50	50	50	36	36	36	36			

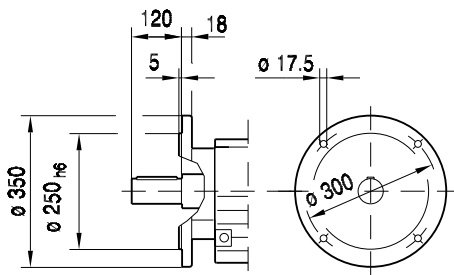


04 077 01 01

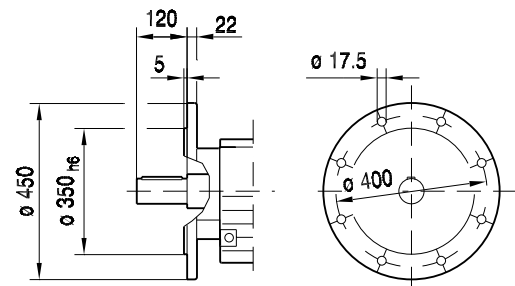
**RF97..**



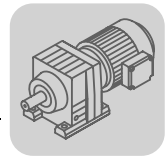
**ø 350**



**ø 450**

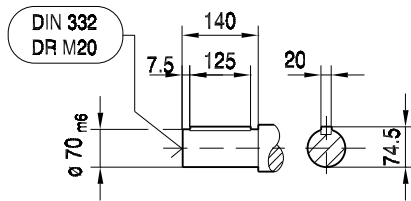
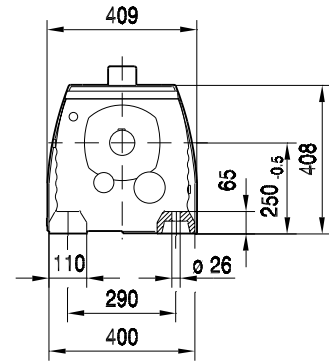
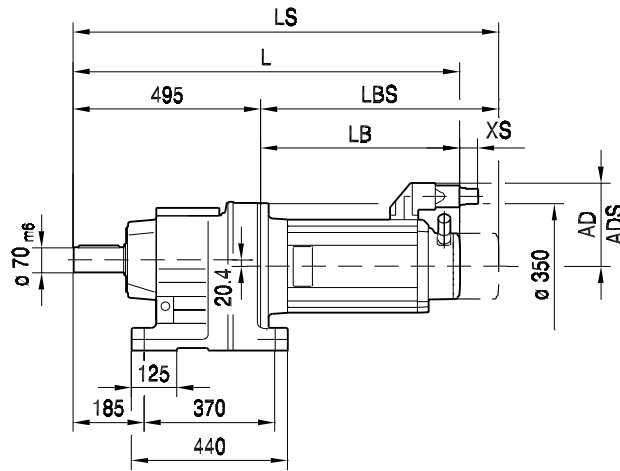
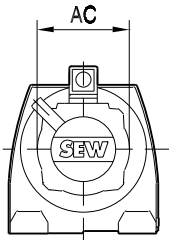


(→ 105)	CM90S	CM90M	CM90L	CM112S	CM112M	CM112L	CM112H			
AC	142	142	142	186	186	186	186			
AD	140	140	140	162	162	162	162			
ADS	140	140	140	162	162	162	162			
L	706	733	787	742	769	831	961			
LS	802	829	883	832	859	921	1026			
LB	266	293	347	302	329	391	521			
LBS	362	389	443	392	419	481	586			
XS	50	50	50	36	36	36	36			



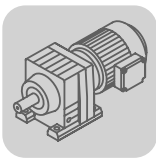
04 078 01 01

R107..



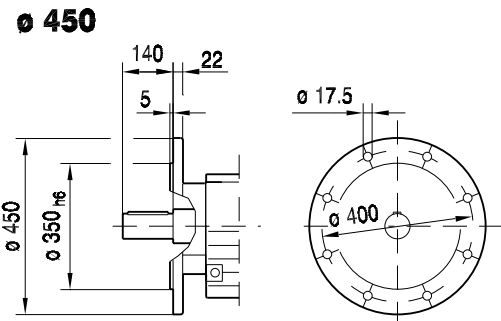
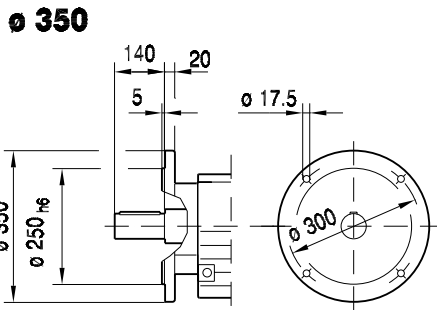
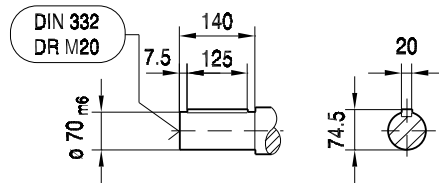
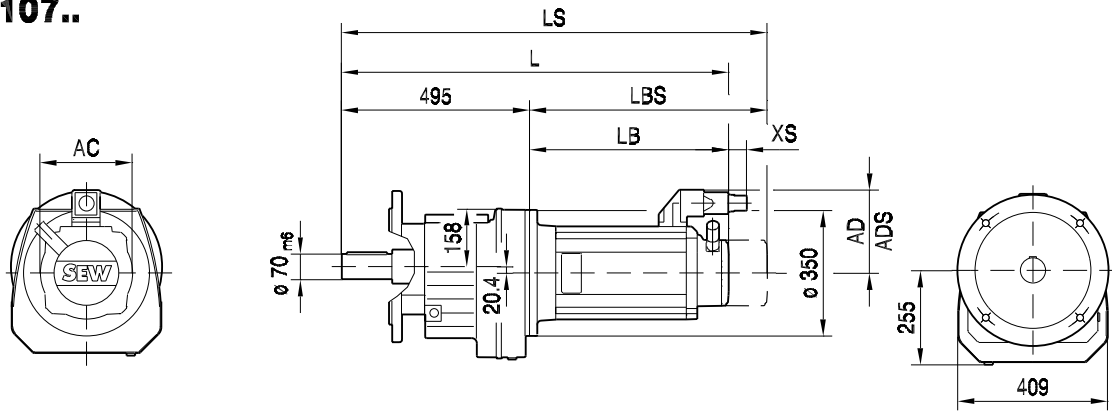
7

(→ 105)	CM112S	CM112M	CM112L	CM112H						
AC	186	186	186	186						
AD	162	162	162	162						
ADS	162	162	162	162						
L	791	818	880	1010						
LS	881	908	970	1075						
LB	296	323	385	515						
LBS	386	413	475	580						
XS	36	36	36	36						



04 079 01 01

**RF107..**

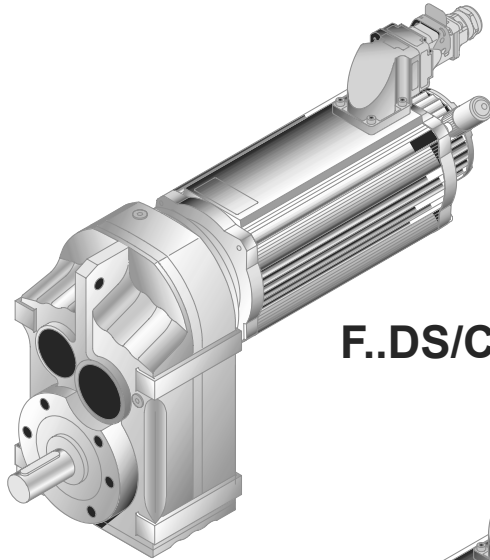


(→ 105)	CM112S	CM112M	CM112L	CM112H						
AC	186	186	186	186						
AD	162	162	162	162						
ADS	162	162	162	162						
L	791	818	880	1010						
LS	881	908	970	1075						
LB	296	323	385	515						
LBS	386	413	475	580						
XS	36	36	36	36						

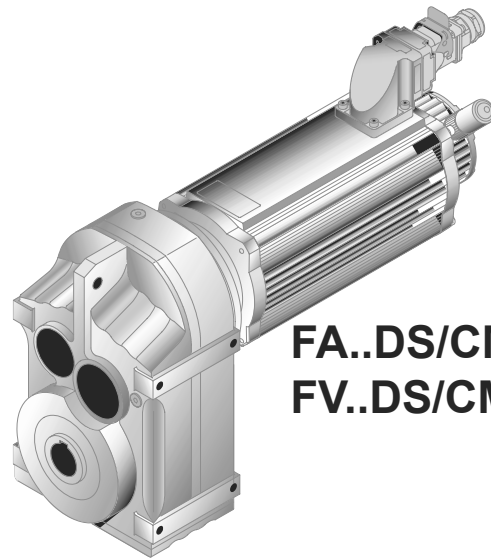


8 F..DS/CM..

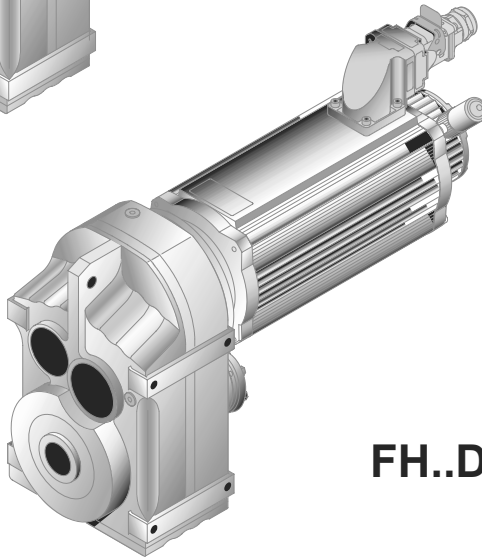
8.1 F, FA, FV, FH, FF, FAF, FVF, FHF, FA..B, FV..B, FH..B, FAZ, FVZ, FAF, FVF.. DS/CM



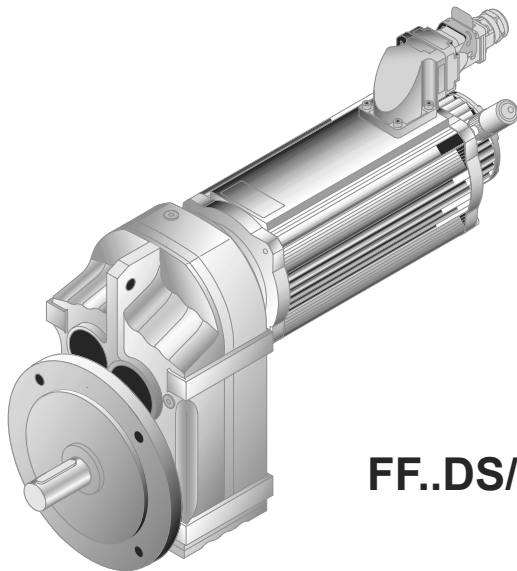
F..DS/CM..



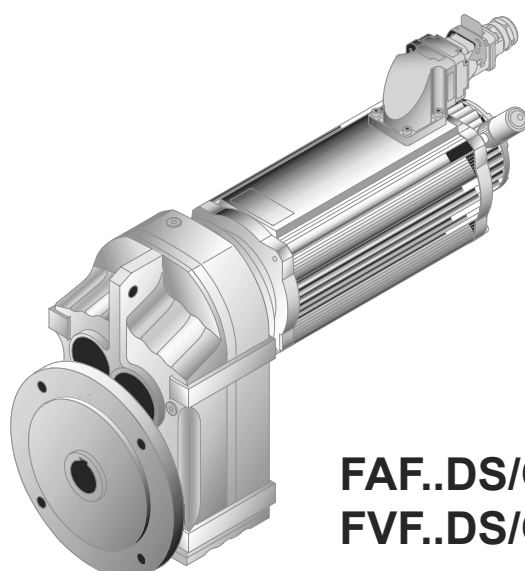
FA..DS/CM..  
FV..DS/CM..



FH..DS/CM..



FF..DS/CM..

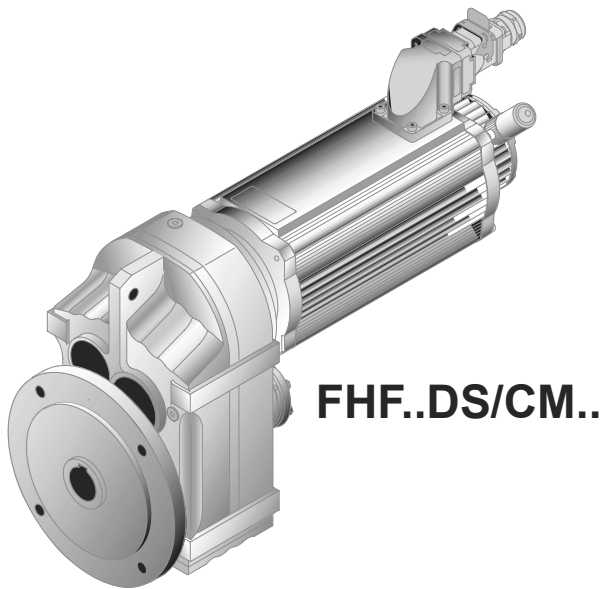
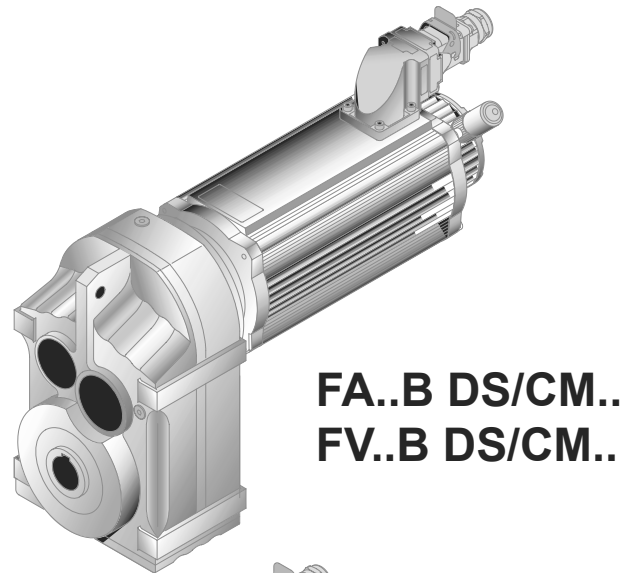
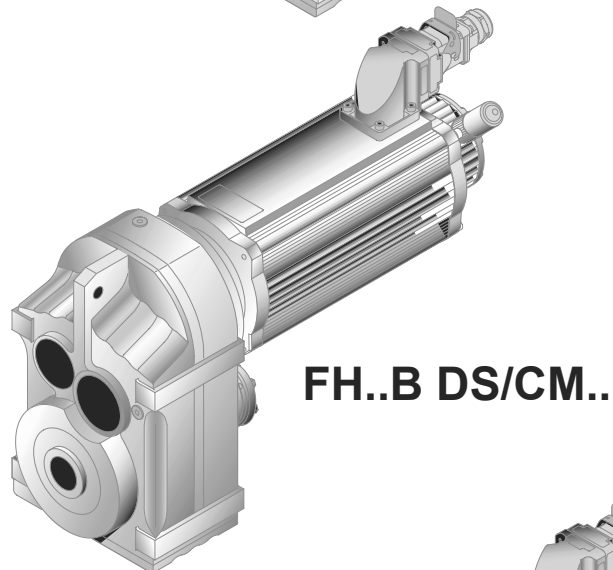
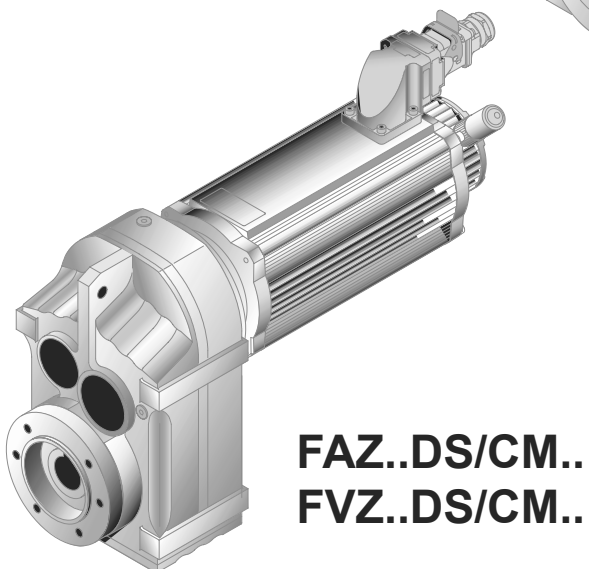
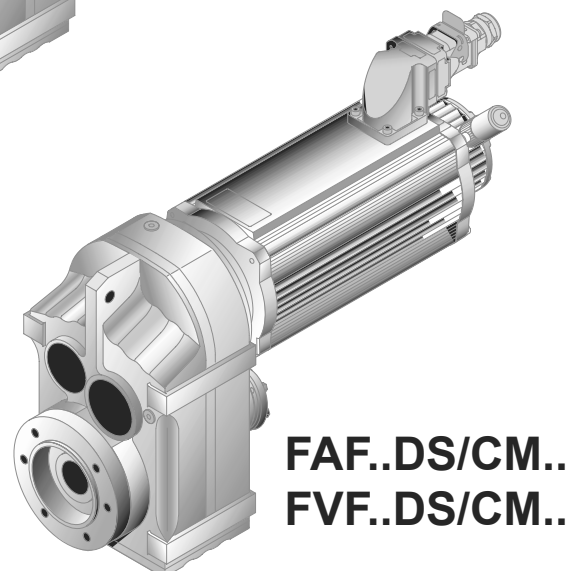


FAF..DS/CM..  
FVF..DS/CM..

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**F..DS/CM..**



F, FA, FV, FH, FF, FAF, FVF, FHF, FA..B, FV..B, FH..B, FAZ, FVZ, FAF, FVF..



**FHF..DS/CM..****FA..B DS/CM..  
FV..B DS/CM..****FH..B DS/CM..****FAZ..DS/CM..  
FVZ..DS/CM..****FAF..DS/CM..  
FVF..DS/CM..**

52495AXX



8.2 F27 DS/CM.. [Nm]

	M <sub>a</sub> max [Nm]	i	φ (R) [ ' ]	F <sub>Ra</sub> (F) [N]	F <sub>Ra</sub> (FA) [N]	J <sub>G</sub> 10 <sup>-4</sup> [kgm <sup>2</sup> ]	DS / CM							
							56M	56L	56H	71S	71M	71L	90S	
FA27	130	140.74	-	4500	4500	0.08								
	130	129.09	-	4500	4500	0.09								
FAF27	130	109.90	-	4500	4500	0.12								
	130	94.76	-	4500	4500	0.15								
F27	130	88.32	-	4500	4500	0.16								
	130	77.21	-	4500	4500	0.20								
FF27	130	72.37	-	4500	4500	0.22								
	130	63.86	-	4280	4500	0.26								
 3	130	56.62	-	4060	4500	0.31								
	130	50.19	-	3860	4500	0.17								
	130	46.78	-	3740	4500	0.18								
	130	40.89	-	3530	4500	0.23								
	130	38.33	-	3430	4500	0.26								
	130	33.83	-	3240	4250	0.31								
	130	29.56	-	3050	4000	0.13								
	130	27.18	-	2930	3840	0.15								
	FA27	130	23.25	-	2720	3570	0.19							
		130	20.15	-	2540	3340	0.23							
FAF27	130	18.84	-	2460	3230	0.26								
	130	16.28	-	2290	3000	0.32								
F27	130	13.84	-	2110	2760	0.43								
	130	12.35	-	1990	2610	0.51								
 2	130	10.55	-	1830	2400	0.67								
	130	9.88	-	1760	2310	0.74								
	130	9.40	-	1590	2080	0.33								
	123	8.13	-	1520	2000	0.42								
	114	6.91	-	1470	1920	0.56								
	109	6.17	-	1420	1860	0.68								
	100	5.27	-	1380	1810	0.90								
	96	4.93	-	1370	1790	1.01								
	87	4.16	-	1330	1740	1.35								

m [kg]		56M	DS 56L	56H	71S	CM		
						71M	71L	90S
FA27	 3	7.7	8.7	9.4	-	-	-	-
	 2	7.5	8.5	9.2	13	15	18	23



FAF27: + 0.70 kg / F27: + 0.50 kg / FF27: + 1.3 kg





## F..DS/CM..

### F37 DS/CM.. [Nm]

### 8.3 F37 DS/CM.. [Nm]



	M <sub>a</sub> max [Nm]	i	φ (R) [ ' ]	F <sub>Ra</sub> (F) [N]	F <sub>Ra</sub> (FA) [N]	J <sub>G</sub> 10 <sup>-4</sup> [kgm <sup>2</sup> ]	DS							
							56M	56L	56H	71S	71M	71L	90S	
FA37	200	128.51	7	4290	7000	0.08								
	200	117.88	7	4290	7000	0.10								
FAF37	200	100.36	7	4290	7000	0.12								
	200	86.53	7	4290	7000	0.15								
F37	200	80.65	7	4290	7000	0.17								
	200	70.50	7	4290	7000	0.21								
FF37	200	66.09	7	4290	7000	0.23								
	200	58.32	7	4290	6860	0.27								
 3	200	54.54	8	4290	6660	0.15								
	200	51.70	7	4290	6510	0.34								
	200	47.02	8	4290	6240	0.19								
	200	43.83	8	4290	6050	0.21								
	200	38.31	8	4290	5690	0.26								
	200	35.91	8	4290	5530	0.29								
	200	31.69	8	4160	5220	0.35								
	200	28.09	8	3930	4930	0.45								
	200	23.88	8	3640	4560	0.60								
	 2	200	23.63	6	3620	4540	0.29							
		200	20.57	6	3380	4240	0.36							
		200	19.27	6	3270	4100	0.40							
		200	17.03	6	3070	3850	0.48							
		200	15.81	6	2960	3710	0.52							
		200	14.33	7	2810	3520	0.63							
200		12.87	7	2650	3330	0.74								
190		11.08	7	2530	3170	0.94								
185		10.42	7	2490	3120	1.03								
175		8.97	7	2370	2970	1.31								
170		8.01	7	2270	2850	1.54								
145		7.44	10	2260	2840	0.83								
140		6.74	10	2190	2750	1.01								
135		6.05	10	2120	2650	1.22								
125		5.21	10	2040	2560	1.58								
120	4.90	11	2030	2540	1.76									
110	4.22	11	1960	2460	2.29									
105	3.77	12	1900	2380	2.77									

m [kg]		DS			CM			
		56M	56L	56H	71S	71M	71L	90S
FA37	3 	14	15	16	20	21	25	-
	2 	14	15	15	20	21	24	29



FAF37: + 1.5 kg / F37: -- kg / FF37: + 2.3 kg



8.4 F47 DS/CM.. [Nm]

	M <sub>a</sub> max [Nm]	i	φ (R) [ ' ]	F <sub>Ra</sub> (F) [N]	F <sub>Ra</sub> (FA) [N]	J <sub>G</sub> 10 <sup>-4</sup> [kgm <sup>2</sup> ]	DS			CM				
							56M	56L	56H	71S	71M	71L	90S	
FA47	400	190.76	6	5920	10000	0.13								
	400	175.38	6	5920	10000	0.14								
FAF47	400	150.06	6	5920	9340	0.18								
	400	130.07	6	5920	8750	0.23								
F47	400	121.57	6	5920	8480	0.25								
	400	105.09	6	5920	7920	0.30								
FF47	400	89.29	6	5920	7320	0.40								
	400	79.72	6	5920	6920	0.48								
 3	400	68.09	6	5920	6400	0.61								
	400	65.36	7	5920	6260	0.29								
	400	56.49	7	5920	5810	0.36								
	400	48.00*	7	5920	5320	0.48								
	400	42.86	7	5920	5000	0.58								
	400	36.61	7	5920	4570	0.76								
	400	34.29	7	5920	4400	0.85								
	400	28.88	7	5590	3960	1.13								
	 2	400	30.86	6	5780	4130	0.46							
		400	29.32	6	5640	4000	0.52							
		400	25.72	6	5280	3680	0.75							
		400	21.82	6	4850	3310	0.96							
		400	19.70	6	4600	3080	1.11							
		400	17.33	6	4290	2810	1.39							
		400	16.36	6	4160	2690	1.52							
400		13.93	6	3800	2380	1.85								
400		12.66	6	3590	2200	2.12								
400		10.97	6	3300	1930	2.62								
330		8.96	8	3120	1860	1.64								
380		7.88	8	2510	1170	2.08								
380		7.44*	8	2400	1080	2.29								
350		6.34	8	2360	1120	2.92								
340		5.76	9	2270	1080	3.43								
320	4.99	9	2200	1070	4.37									

8

m [kg]		56M	DS 56L	56H	71S	CM		
		56M	56L	56H	71S	71M	71L	90S
FA47	 3	19	20	20	25	26	29	34
	 2	18	19	20	24	25	29	33



FAF47: + 2.7 kg / F47: + 0.80 kg / FF47: + 3.9 kg





## F..DS/CM..

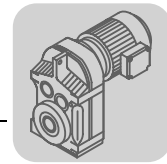
### F57 DS/CM.. [Nm]

#### 8.5 F57 DS/CM.. [Nm]



	M <sub>a</sub> max [Nm]	i	φ (R) [ ' ]	F <sub>Ra</sub> (F) [N]	F <sub>Ra</sub> (FF) [N]	F <sub>Ra</sub> (FA) [N]	J <sub>G</sub> 10 <sup>-4</sup> [kgm <sup>2</sup> ]	DS										
								56H	71S	71M	71L	CM						
FA57	600	157.09	6	9200	7900	11500	0.19											
	600	136.16	6	9200	7900	11500	0.23											
FAF57	600	127.27	6	9200	7900	11200	0.26											
	600	110.01	6	9200	7900	10400	0.31											
F57	600	93.47	6	9200	7900	9620	0.42											
	600	83.46	6	9200	7900	9100	0.51											
FF57	600	72.98	6	9200	7900	8500	0.28											
	600	68.22	6	9200	7900	8210	0.31											
 3	600	58.97	7	9200	7900	7600	0.38											
	600	50.10	7	9200	7900	6960	0.52											
	600	44.73	7	8870	7900	6530	0.64											
	600	38.21	7	8230	7900	5960	0.84											
	600	35.79	7	7980	7900	5740	0.94											
	590	30.15	7	7400	7600	5240	1.26											
	FA57	500	34.24	6	8410	8500	6350	0.43										
		545	29.94	6	7640	7820	5560	0.53										
	FAF57	535	28.45	6	7520	7690	5470	0.59										
		575	24.96	6	6820	7030	4760	0.84										
F57	600	21.17	6	6130	6360	4080	1.09											
	600	19.11	6	5800	6040	3790	1.29											
 2	600	16.81	6	5410	5660	3440	1.62											
	600	15.88	6	5240	5490	3290	1.78											
	600	13.52	6	4780	5040	2880	2.21											
	600	12.29	6	4520	4790	2640	2.57											
	600	10.64	6	4140	4420	2310	3.24											
	420	9.31	8	4590	4780	3010	2.02											
	420	8.19	8	4290	4480	2740	2.61											
	420	7.73	8	4150	4350	2620	2.89											
	420	6.58	8	3790	3990	2300	3.78											
	420	5.98	9	3580	3790	2110	4.49											
415	5.18	9	3320	3530	1890	5.81												



m [kg]		DS							
		56H	71S	71M	71L	CM			
						90S	90M	90L	112S
FA57	3 	28	32	34	37	41	44	49	-
	2 	27	32	33	37	41	43	48	50

FAF57: + 5.5 kg / F57: -- kg / FF57: + 6.7 kg



8.6 F67 DS/CM.. [Nm]

	M <sub>a max</sub> [Nm]	i	φ (R) [ ' ]	F <sub>Ra</sub> (F) [N]	F <sub>Ra</sub> (FA) [N]	J <sub>G</sub> 10 <sup>-4</sup> [kgm <sup>2</sup> ]	DS 56H	71S	71M	CM 71L	90S	90M		
FA67	820	195.39	6	10300	13000	0.34								
	820	170.85	6	10300	12300	0.42								
FAF67	820	162.31	6	10300	12000	0.47								
	820	142.40	6	10300	11300	0.68								
F67	820	120.79	6	10300	10400	0.85								
	820	109.04	6	10300	9870	0.98								
FF67	820	95.94	6	10300	9230	1.24								
	820	90.59	6	10300	8950	1.35								
 3	820	79.76	6	10300	8360	0.76								
	820	67.65	6	10300	7630	0.97								
	820	61.07	6	10300	7190	1.13								
	820	53.73	6	10300	6670	1.42								
	820	50.74	6	10300	6440	1.57								
	820	43.20	6	10300	5820	1.93								
	780	39.26	6	10700	5730	2.23								
	740	34.01	6	11000	5490	2.77								
	 2	820	36.30	5	10300	5190	0.98							
		820	32.08	5	10300	4770	1.36							
		FAF67	820	27.41	5	10300	4250	1.73						
			820	25.13	5	10300	3970	2.02						
		F67	820	22.05	5	10300	3580	2.52						
			820	20.90*	5	10300	3420	2.73						
		FF67	820	18.29	6	10300	3040	3.35						
820			16.48	6	10300	2750	3.77							
820			14.46	6	10300	2400	4.60							
820			12.76	6	10300	2080	5.56							
820			11.31	6	10300	1790	6.69							
820			9.66	6	10300	1420	8.53							
530			9.08	8	11100	2460	3.98							
570			8.60	8	10600	2030	4.36							
610			7.53	8	9850	1430	5.47							
620			6.78	9	9390	1140	6.34							
610			5.95	9	8940	960	7.99							
590			5.25	9	8600	880	9.96							
560	4.66	9	8350	900	12.32									
500	3.97	10	8160	1100	16.32									

m [kg]		DS 56H	71S	71M	CM 71L	90S	90M
FA67	3 	32	36	37	41	45	48
	2 	31	35	36	40	44	47



FAF67: + 6.3 kg / F67: + 2.8 kg / FF67: + 8.9 kg





## F..DS/CM..

### F67 DS/CM.. [Nm]

#### F67 DS/CM..



	$M_a \text{ max}$ [Nm]	i	$\varphi$ (°/R) [ ' ]	$F_{Ra}(F)$ [N]	$F_{Ra}(FA)$ [N]	$J_G 10^{-4}$ [kgm <sup>2</sup> ]	CM			
							90L	112S	112M	
<b>FA67</b>	820	195.39	6	10300	13000	0.34				
	820	170.85	6	10300	12300	0.42				
<b>FAF67</b>	820	162.31	6	10300	12000	0.47				
	820	142.40	6	10300	11300	0.68				
<b>F67</b>	820	120.79	6	10300	10400	0.85				
	820	109.04	6	10300	9870	0.98				
<b>FF67</b>	820	95.94	6	10300	9230	1.24				
	820	90.59	6	10300	8950	1.35				
 <b>3</b>	820	79.76	6	10300	8360	0.76				
	820	67.65	6	10300	7630	0.97				
	820	61.07	6	10300	7190	1.13				
	820	53.73	6	10300	6670	1.42				
	820	50.74	6	10300	6440	1.57				
	820	43.20	6	10300	5820	1.93				
	780	39.26	6	10700	5730	2.23				
	740	34.01	6	11000	5490	2.77				
	<b>FA67</b>	820	36.30	5	10300	5190	0.98			
		820	32.08	5	10300	4770	1.36			
	<b>FAF67</b>	820	27.41	5	10300	4250	1.73			
		820	25.13	5	10300	3970	2.02			
	<b>F67</b>	820	22.05	5	10300	3580	2.52			
		820	20.90*	5	10300	3420	2.73			
 <b>2</b>	<b>FF67</b>	820	18.29	6	10300	3040	3.35			
		820	16.48	6	10300	2750	3.77			
	820	14.46	6	10300	2400	4.60				
	820	12.76	6	10300	2080	5.56				
	820	11.31	6	10300	1790	6.69				
	820	9.66	6	10300	1420	8.53				
	530	9.08	8	11100	2460	3.98				
	570	8.60	8	10600	2030	4.36				
	610	7.53	8	9850	1430	5.47				
	620	6.78	9	9390	1140	6.34				
	610	5.95	9	8940	960	7.99				
	590	5.25	9	8600	880	9.96				
	560	4.66	9	8350	900	12.32				
	500	3.97	10	8160	1100	16.32				



m [kg]		CM		
		90L	112S	112M
<b>FA67</b>	 <b>3</b>	53	54	-
	 <b>2</b>	52	53	57

FAF67: + 6.3 kg / F67: + 2.8 kg / FF67: + 8.9 kg





8.7 F77 CM.. [Nm]



	M <sub>a</sub> max [Nm]	i	φ (R) [°]	F <sub>Ra</sub> (F) [N]	F <sub>Ra</sub> (FA) [N]	J <sub>G</sub> 10 <sup>-4</sup> [kgm <sup>2</sup> ]	CM						
							71S	71M	71L	90S	90M	90L	
FA77	1500	198.31	5	15700	17500	0.82							
	1500	188.40	5	15700	17100	0.91							
FAF77	1500	166.47	5	15700	16100	1.28							
	1500	142.27	5	15700	14900	1.61							
F77	1500	130.42	5	15700	14200	1.87							
	1500	114.45	5	15700	13300	2.28							
FF77	1500	108.46*	5	15700	12900	2.46							
	1500	94.93	5	15700	12000	3.00							
 3	1500	85.52	6	15700	11400	3.33							
	1500	75.02	6	15700	10500	3.99							
	1500	72.50	6	15700	10300	1.91							
	1500	66.46	6	15700	9810	2.23							
	1500	58.32	6	15700	9060	2.76							
	1500	55.27	6	15700	8760	3.04							
	1500	48.37	6	15700	8040	3.75							
	1500	43.58	6	15700	7500	4.27							
	1500	38.23	6	15700	6850	5.24							
	1500	33.74	6	15700	6250	6.42							
	1500	29.91	6	15700	5700	7.83							
	1450	25.54	6	16100	5260	10.15							
	FA77	1110	36.58	5	17900	8660	3.04						
		1380	31.51	5	16500	6560	3.84						
	FAF77	1430	28.75	5	16200	5880	4.43						
		1500	25.50*	5	15700	5000	5.46						
F77	1500	21.43	5	15700	4280	7.11							
	1500	19.70	5	15700	3940	7.94							
FF77	1500	17.49	5	15700	3490	9.50							
	1500	15.64*	5	15700	3080	11.24							
 2	1500	14.06	5	15400	2700	13.16							
	1500	12.20	5	14500	2210	16.08							
	1500	10.93	6	13800	1850	18.96							
	1080	9.30	7	13400	2090	11.62							
	1080	8.26	7	12700	1740	14.17							
	1080	7.39	7	12200	1420	16.95							
	1080	6.64	8	11600	1120	20.25							
	1080	5.76	8	10900	745	25.54							
	1080	5.16	8	10400	465	30.78							
	1010	4.28	8	9890	465	41.67							

m [kg]		CM					
		71S	71M	71L	90S	90M	90L
FA77	 3	59	60	64	68	71	76
	 2	57	59	62	67	69	74

FAF77: + 6.6 kg / F77: + 3.8 kg / FF77: + 14 kg


**F..DS/CM..**  
**F77 CM.. [Nm]**
**F77 CM..**



	M <sub>a</sub> max [Nm]	i	φ (R) [ ' ]	F <sub>Ra</sub> (F) [N]	F <sub>Ra</sub> (FA) [N]	J <sub>G</sub> 10 <sup>-4</sup> [kgm <sup>2</sup> ]	CM			
							112S	112M	112L	
<b>FA77</b>	1500	198.31	5	15700	17500	0.82				
	1500	188.40	5	15700	17100	0.91				
<b>FAF77</b>	1500	166.47	5	15700	16100	1.28				
	1500	142.27	5	15700	14900	1.61				
<b>F77</b>	1500	130.42	5	15700	14200	1.87				
	1500	114.45	5	15700	13300	2.28				
<b>FF77</b>	1500	108.46*	5	15700	12900	2.46				
	1500	94.93	5	15700	12000	3.00				
 <b>3</b>	1500	85.52	6	15700	11400	3.33				
	1500	75.02	6	15700	10500	3.99				
	1500	72.50	6	15700	10300	1.91				
	1500	66.46	6	15700	9810	2.23				
	1500	58.32	6	15700	9060	2.76				
	1500	55.27	6	15700	8760	3.04				
	1500	48.37	6	15700	8040	3.75				
	1500	43.58	6	15700	7500	4.27				
	1500	38.23	6	15700	6850	5.24				
	1500	33.74	6	15700	6250	6.42				
	1500	29.91	6	15700	5700	7.83				
	1450	25.54	6	16100	5260	10.15				
	1110	36.58	5	17900	8660	3.04				
	<b>FA77</b>	1380	31.51	5	16500	6560	3.84			
	<b>FAF77</b>	1430	28.75	5	16200	5880	4.43			
		1500	25.50*	5	15700	5000	5.46			
	<b>F77</b>	1500	21.43	5	15700	4280	7.11			
1500		19.70	5	15700	3940	7.94				
 <b>2</b>	<b>FF77</b>	1500	17.49	5	15700	3490	9.50			
	1500	15.64*	5	15700	3080	11.24				
	1500	14.06	5	15400	2700	13.16				
	1500	12.20	5	14500	2210	16.08				
	1500	10.93	6	13800	1850	18.96				
	1080	9.30	7	13400	2090	11.62				
	1080	8.26	7	12700	1740	14.17				
	1080	7.39	7	12200	1420	16.95				
	1080	6.64	8	11600	1120	20.25				
	1080	5.76	8	10900	745	25.54				
	1080	5.16	8	10400	465	30.78				
1010	4.28	8	9890	465	41.67					



m [kg]		112S	CM 112M	112L
<b>FA77</b>	<b>3</b> 	77	81	96
	<b>2</b> 	75	80	94

**FAF77: + 6.6 kg / F77: + 3.8 kg / FF77: + 14 kg**

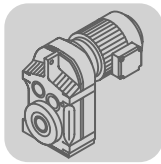



8.8 F87 CM.. [Nm]



	M <sub>a</sub> max [Nm]	i	φ (l/R) [ ' ]	F <sub>Ra</sub> (F) [N]	F <sub>Ra</sub> (FA) [N]	J <sub>G</sub> 10 <sup>-4</sup> [kgm <sup>2</sup> ]	CM							
							90S	90M	90L	112S	112M	112L	112H	
FA87	3000	228.93	7	19800	26400	2.79								
	3000	197.20	7	19800	24400	3.51								
FAF87	3000	179.97	7	19800	23200	4.04								
	3000	159.61	7	19800	21700	4.93								
F87	3000	134.16	7	19800	19600	6.31								
	3000	123.29	7	19800	18600	7.02								
FF87	3000	109.49	7	19800	17300	8.26								
	3000	97.89	7	19800	16200	9.88								
 3	3000	88.01	7	19800	15100	11.44								
	3000	76.39	7	19800	13700	13.91								
	3000	68.40	7	18800	12600	16.25								
	3000	56.75	7	17000	11000	20.50								
	2940	50.36	7	16100	10300	11.41								
	2820	45.28	8	15600	9990	13.26								
	2720	39.30	8	14800	9380	16.26								
	2610	35.19	8	14300	9100	19.20								
	2510	29.20	8	13200	8260	24.84								
	FA87	2610	33.92	7	14000	8830	10.13							
		2450	28.78	7	13300	8460	13.12							
	FAF87	3000	26.50	7	10600	5140	14.58							
3000		23.68	7	9780	4400	17.27								
F87	3000	21.32*	7	9050	3730	20.06								
	3000	19.31	7	8380	3120	23.20								
 2	3000	17.12	7	7590	2410	28.05								
	3000	15.48	7	6960	1830	32.40								
	3000	13.12*	7	5960	920	40.03								
	3000	11.46	7	5190	220	49.30								
	2880	9.58	7	4680	0	62.73								
	1530	8.29	7	8540	5230	35.82								
	1530	7.35	7	7950	4690	43.82								
	1530	6.65	7	7470	4260	51.74								
	1530	5.63	7	6720	3570	67.08								
	1530	4.92	7	6130	3040	85.13								
1460	4.12	7	5700	2760	113.95									

m [kg]		90S	90M	90L	CM			
					112S	112M	112L	112H
FA87	3 	110	110	115	115	120	135	140
	2 	105	110	115	110	115	130	140

FAF87: + 13 kg / F87: + 5.7 kg / FF87: + 21 kg


**8.9 F97 CM.. [Nm]**



	M <sub>a</sub> max [Nm]	i	φ (f/R) [ ' ]	F <sub>Ra</sub> (F) [N]	F <sub>Ra</sub> (FA) [N]	J <sub>G</sub> 10 <sup>-4</sup> [kgm <sup>2</sup> ]	CM							
							90S	90M	90L	112S	112M	112L	112H	
<b>FA97</b>	4300	276.77	6	29900	40000	5.10								
	4300	253.41	6	29900	40000	5.86								
<b>FAF97</b>	4300	223.88	6	29900	40000	9.18								
	4300	189.92	6	29900	40000	11.76								
<b>F97</b>	4300	174.87	6	29900	40000	12.99								
	4300	156.30	6	29900	40000	15.39								
<b>FF97</b>	4300	140.71	6	29900	40000	17.82								
	4300	127.42	6	29900	40000	20.41								
 <b>3</b>	4300	112.99	6	29900	38700	24.57								
	4300	102.16	6	29900	36800	28.11								
	4300	97.58	6	29900	36000	12.85								
	4300	89.85	6	29900	34500	14.27								
	4300	86.59	6	29900	33900	34.02								
	4300	80.31	6	29900	32600	16.88								
	4300	75.63	6	29900	31600	41.67								
	4300	72.29	6	29400	30900	19.69								
	4300	65.47	6	28000	29300	22.61								
	4300	58.06	6	26300	27400	27.30								
	4300	52.49	6	24900	25900	31.48								
	4300	44.49	6	22800	23600	38.76								
	4300	38.86	6	21100	21800	47.92								
	4300	32.50	6	19000	19500	60.34								
	<b>FA97</b>	3070	43.28	6	26700	28300	12.91							
		3070	36.64	6	24700	26100	16.66							
	<b>FAF97</b>	4300	33.91	6	19500	20000	18.64							
		4300	30.39	6	18300	18600	22.11							
	<b>F97</b>	4300	27.44*	6	17100	17400	28.25							
		4300	24.92	6	16100	16300	32.61							
<b>FF97</b>	4300	22.11	6	14900	15000	38.85								
	4300	20.07	6	13900	13900	44.75								
	4300	17.25*	6	12500	12400	55.22								
	4300	15.06	6	11300	11000	67.43								
	4300	12.77	6	9880	9470	85.31								
	4100	11.16	6	9490	9100	103.89								
	2360	9.06	9	12800	13300	61.49								
	2360	8.22	9	12100	12500	72.23								
	2360	7.07	9	11100	11400	92.15								
	2250	6.17	9	10600	10900	116.37								
	2150	5.23	9	9960	10200	153.18								
	2050	4.57	9	9540	9780	192.73								
	1800	3.87	9	9570	9900	266.11								



m [kg]		CM						
		90S	90M	90L	112S	112M	112L	112H
<b>FA97</b>	<b>3</b> 	175	175	180	180	185	200	205
	<b>2</b> 	165	170	175	175	180	195	200

**FAF97: + 22 kg / F97: + 7.5 kg / FF97: + 40 kg**



8.10 F107 CM.. [Nm]

	M <sub>a</sub> max [Nm]	i	φ (f/R) [°]	F <sub>Ra</sub> (F) [N]	F <sub>Ra</sub> (FA) [N]	F <sub>Ra</sub> (FAF) [N]	J <sub>G</sub> 10 <sup>-4</sup> [kgm <sup>2</sup> ]	CM				
								112S	112M	112L	112H	
FA107	7680	254.40*	5	49800	56700	65000	11.54					
	7680	215.37	5	49800	52200	65000	14.75					
FAF107	7680	199.31	5	49800	50100	65000	16.41					
	7680	178.64	5	49800	47400	65000	19.33					
F107	7680	161.28*	5	49800	44900	65000	24.96					
FF107	7680	146.49	5	49800	42600	65000	28.60					
	7680	129.97	5	49800	39900	65000	34.01					
 3	7680	117.94	5	49800	37800	65000	38.66					
	7680	101.38*	5	49800	34600	65000	46.88					
	7680	92.47*	6	49800	32700	65000	26.67					
	7680	88.49	5	49800	31800	65000	56.40					
	7680	83.99	6	49800	30800	65000	30.70					
	7680	74.52	6	49800	28600	65000	36.71					
	7680	67.62	6	49600	26800	65000	42.08					
	7680	58.12*	6	46400	24100	65000	51.22					
	7680	50.73	6	43800	21900	65000	62.19					
	7680	43.03	6	40700	19300	65000	77.27					
	7680	37.61	6	38300	17200	65000	94.35					
	7680	31.80	6	35400	14800	65000	125.47					
	FA107	7400	33.79*	5	37200	16700	65000	43.00				
		7840	27.57	5	32600	12300	65000	66.34				
	FAF107	7840	25.14	5	31200	11100	62600	75.96				
		7840	21.76*	5	29000	9280	58800	92.16				
F107	7840	19.20*	5	27100	7780	55700	111.68					
FF107	7840	16.58	5	25100	6090	52200	138.20					
	7680	14.67	5	23700	5300	49900	164.04					
 2	7000	12.33	5	23400	5870	48300	208.89					
	6500	9.96	5	22100	5540	45500	280.05					
	4910	9.69	7	24600	9010	48600	153.69					
	4800	8.37	7	23200	8100	46100	194.52					
	4600	7.40	7	22500	7800	44500	236.03					
	4600	6.22	7	20200	6350	41400	310.82					
	4600	5.03	7	15500	3580	37800	439.29					

m [kg]		CM			
		112S	112M	112L	112H
FA107	3 	255	260	275	280
	2 	245	250	265	270

FAF107: + 21 kg / F107: + 17 kg / FF107: + 44 kg



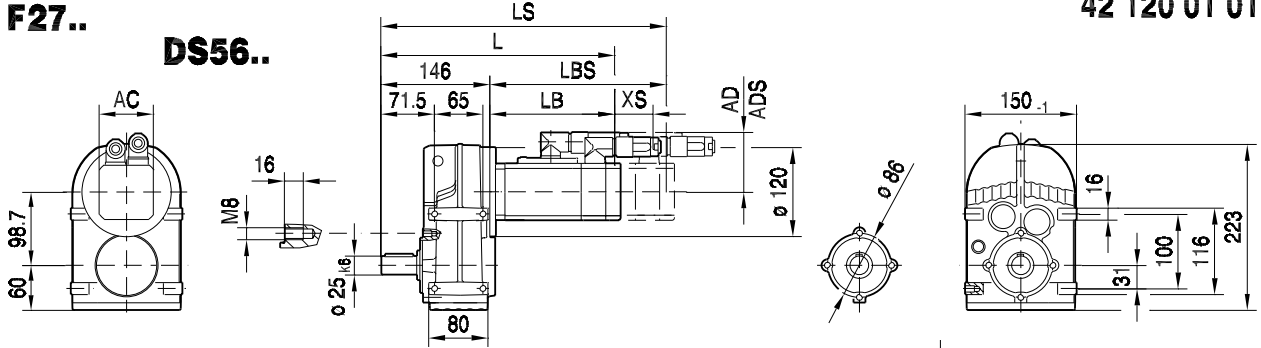
F..DS/CM..  
F..DS/CM..[mm]

8.11 F..DS/CM..[mm]

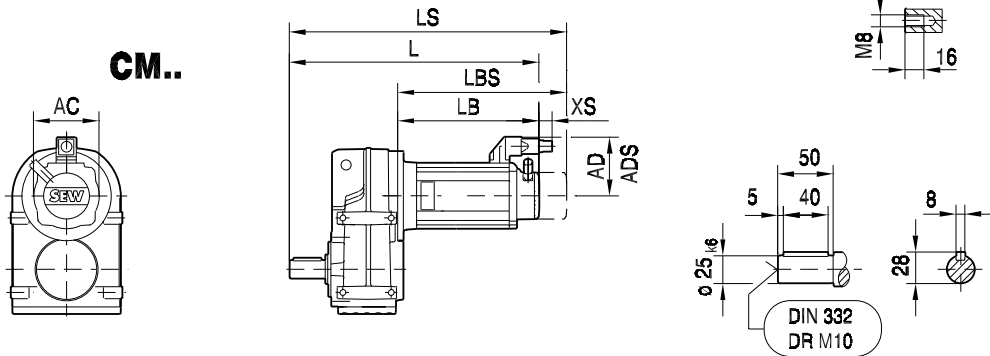
42 120 01 01

F27..

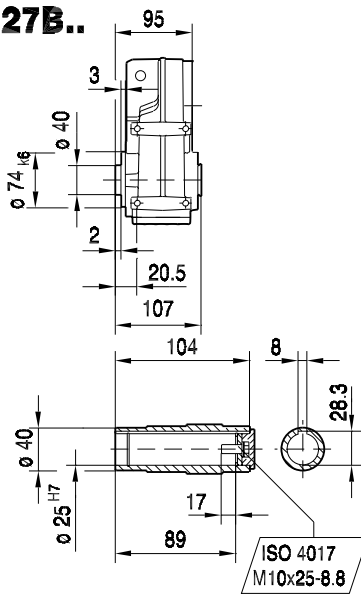
DS56..



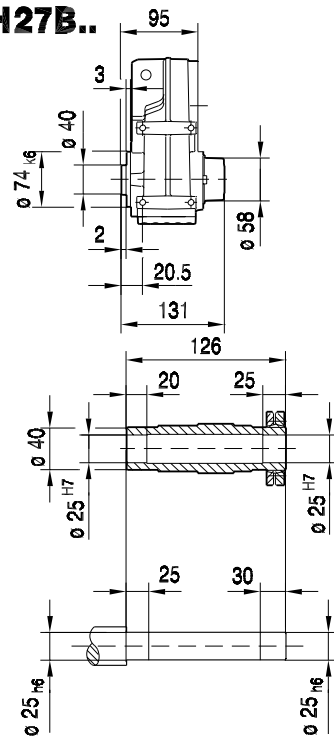
CM..



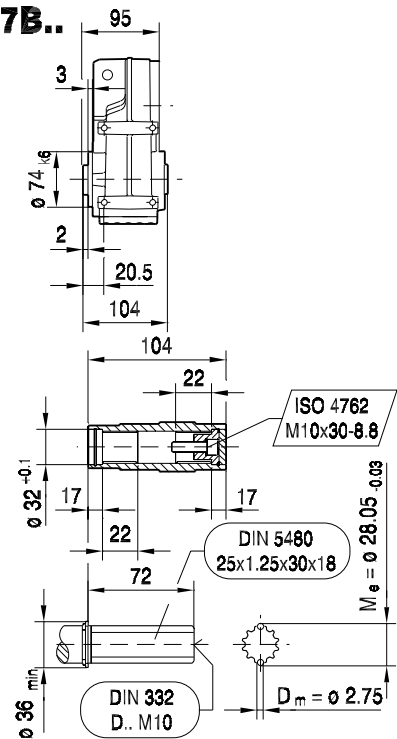
FA27B..



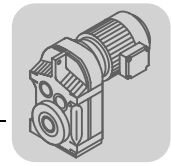
FH27B..



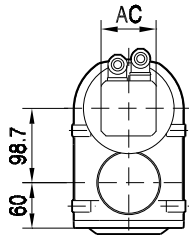
FV27B..



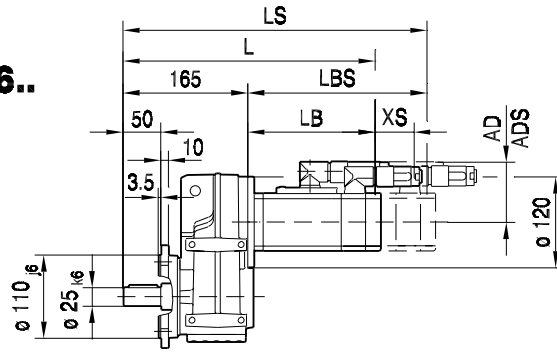
(→ 105)	DS56M	DS56L	DS56H	CM71S	CM71M	CM71L	CM90S				
AC	73	73	73	117	117	117	142				
AD	71	71	77	122	122	122	140				
ADS	77	77	77	122	122	122	140				
L	283	315	418	384	404	447	439				
LS	313	345	418	466	486	529	535				
LB	137	169	272	238	258	301	293				
LBS	167	199	272	320	340	383	389				
XS	70	70	51	45	45	45	50				



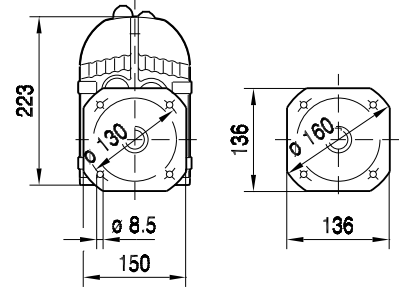
FF27..



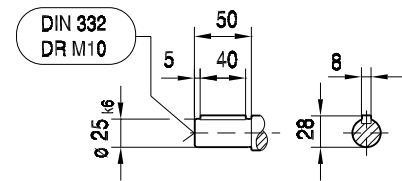
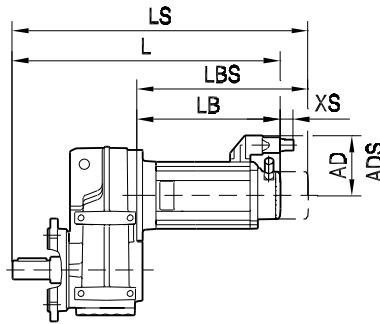
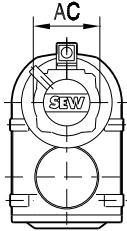
DS56..



42 121 01 01

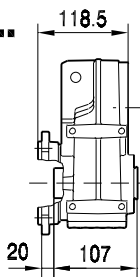


CM..

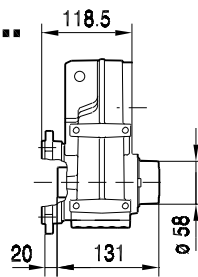


8

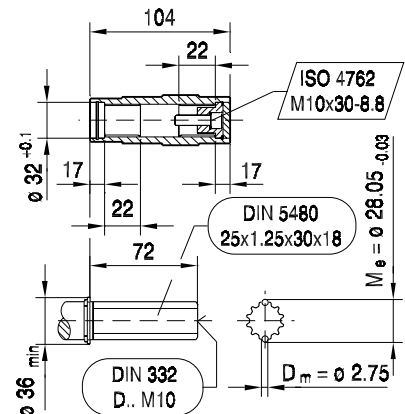
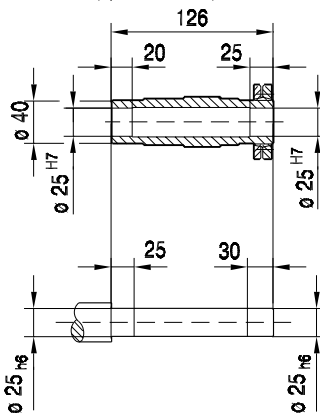
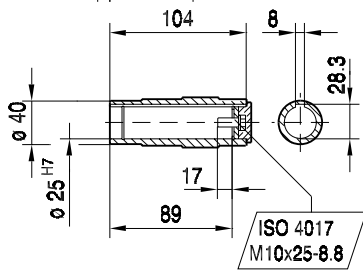
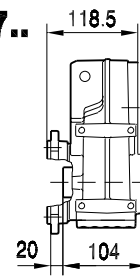
FAF27..



FHF27..



FVF27..

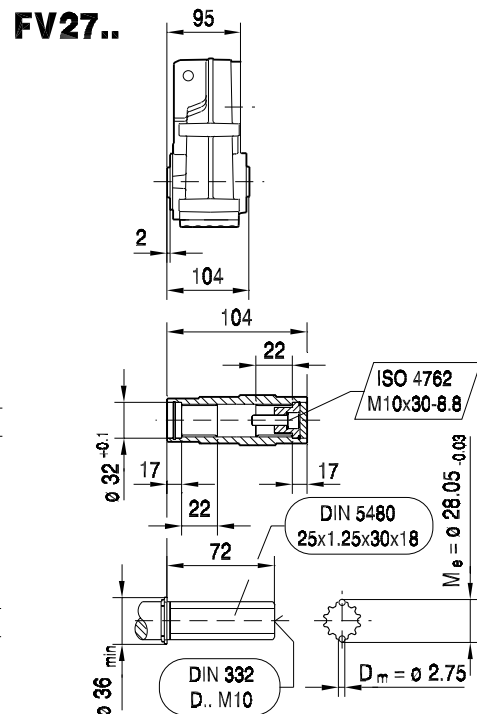
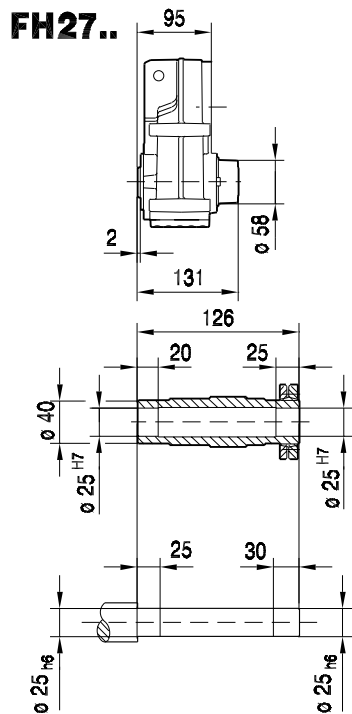
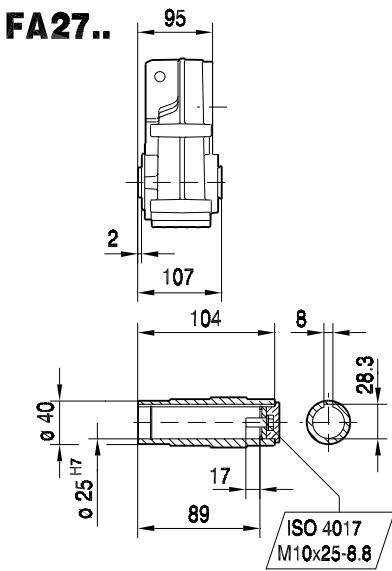
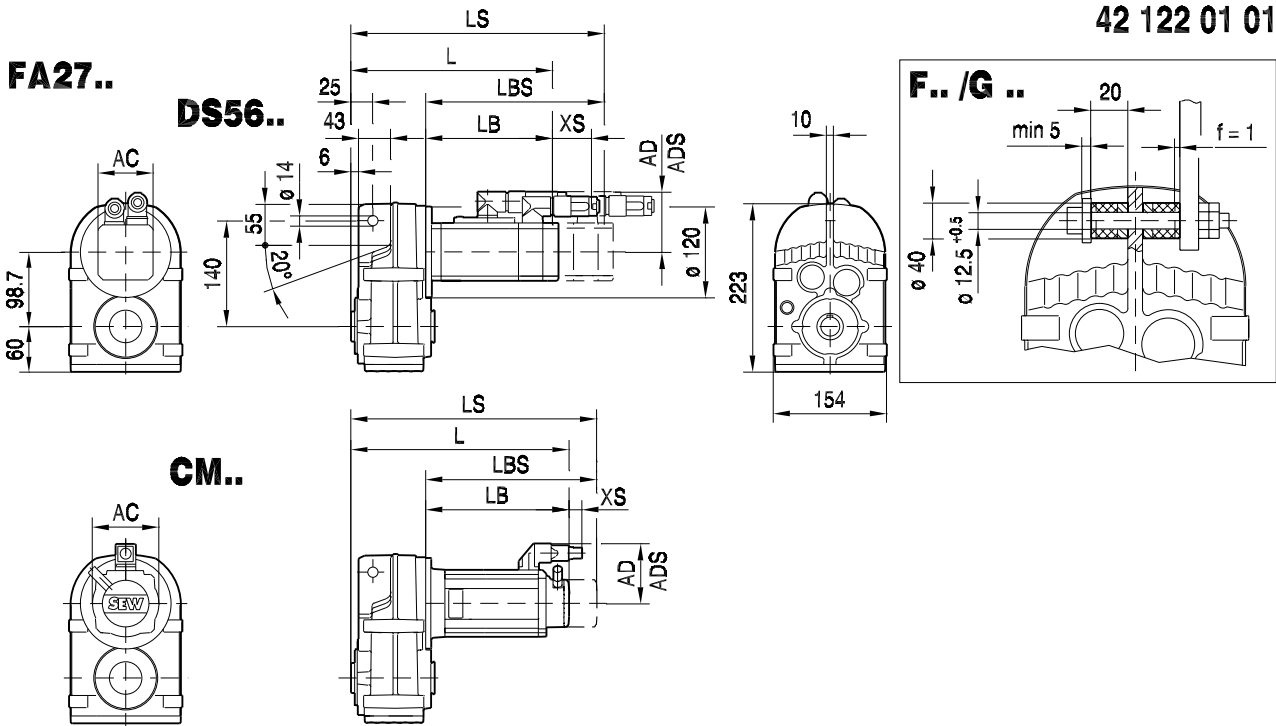


(→ 105)	DS56M	DS56L	DS56H	CM71S	CM71M	CM71L	CM90S			
AC	73	73	73	117	117	117	142			
AD	71	71	77	122	122	122	140			
ADS	77	77	77	122	122	122	140			
L	302	334	437	403	423	466	458			
LS	332	364	437	485	505	548	554			
LB	137	169	272	238	258	301	293			
LBS	167	199	272	320	340	383	389			
XS	70	70	51	45	45	45	50			

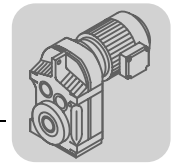


F..DS/CM..  
F..DS/CM..[mm]

42 122 01 01

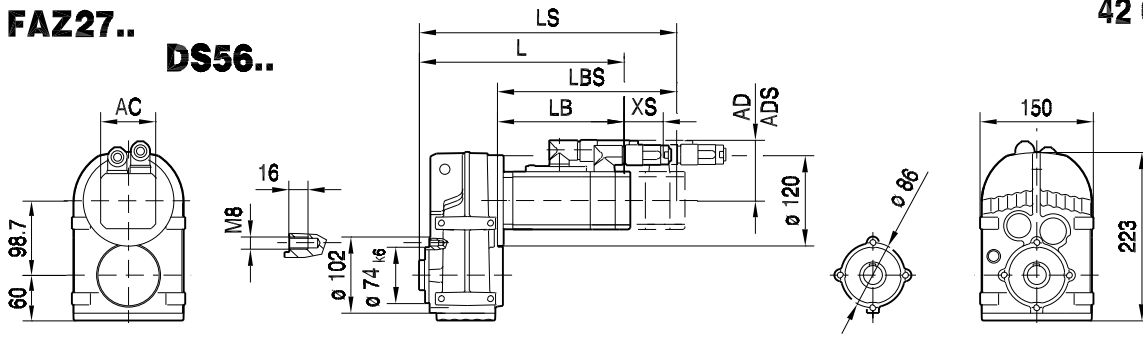


(→ 105)	DS56M	DS56L	DS56H	CM71S	CM71M	CM71L	CM90S				
AC	73	73	73	117	117	117	142				
AD	71	71	77	122	122	122	140				
ADS	77	77	77	122	122	122	140				
L	232	264	367	333	353	396	388				
LS	262	294	367	415	435	478	484				
LB	137	169	272	238	258	301	293				
LBS	167	199	272	320	340	383	389				
XS	70	70	51	45	45	45	50				

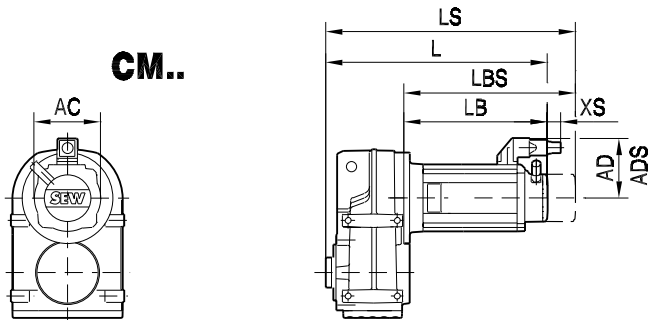


**FAZ27..**  
**DS56..**

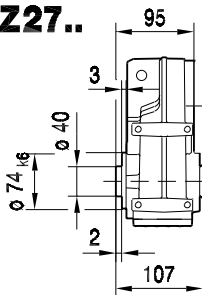
42 038 00 04



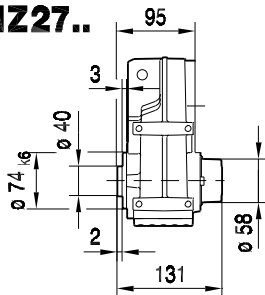
**CM..**



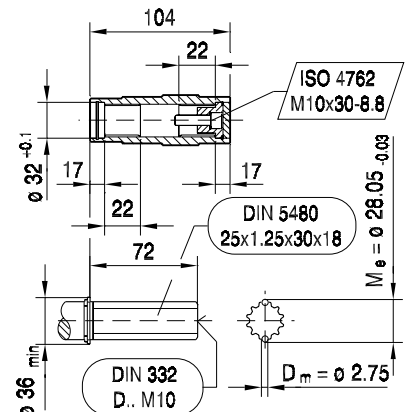
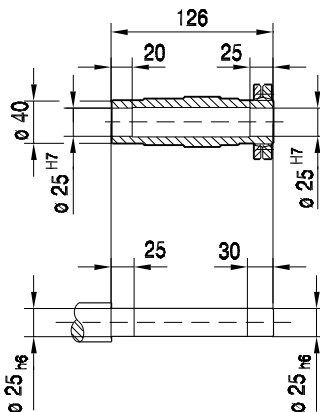
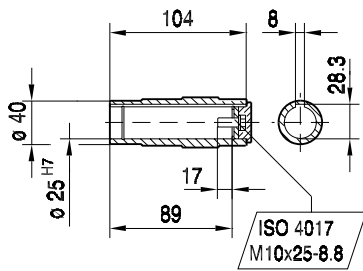
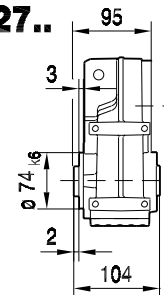
**FAZ27..**



**FHZ27..**



**FVZ27..**

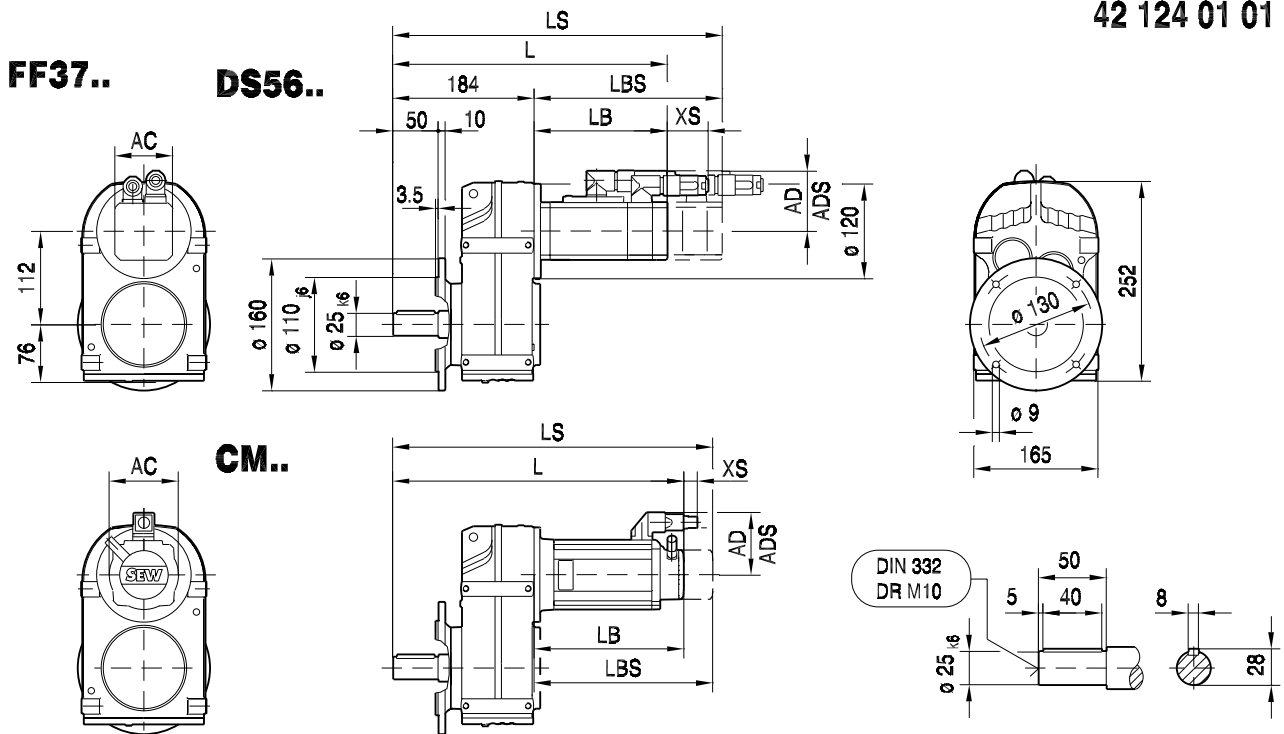


(→ 105)	DS56M	DS56L	DS56H	CM71S	CM71M	CM71L	CM90S			
AC	73	73	73	117	117	117	142			
AD	71	71	77	122	122	122	140			
ADS	77	77	77	122	122	122	140			
L	232	264	367	333	353	396	388			
LS	262	294	367	415	435	478	484			
LB	137	169	272	238	258	301	293			
LBS	167	199	272	320	340	383	389			
XS	70	70	51	45	45	45	50			

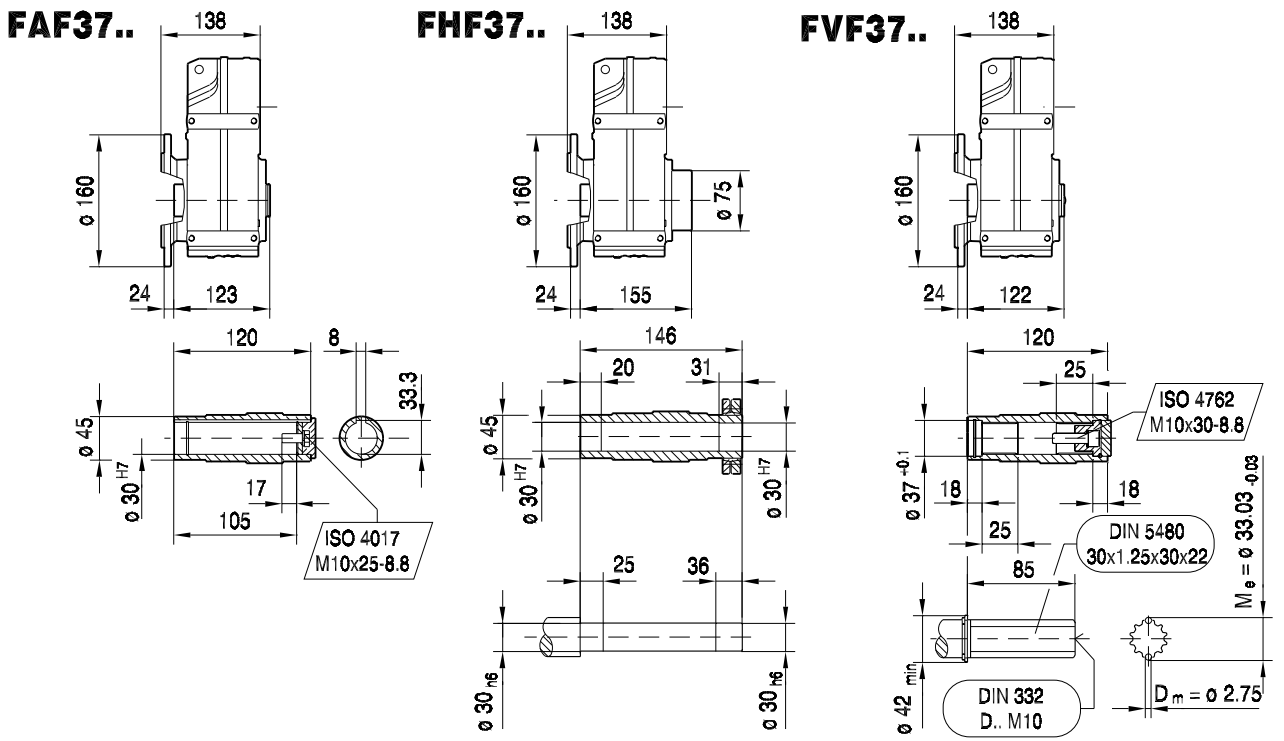




42 124 01 01



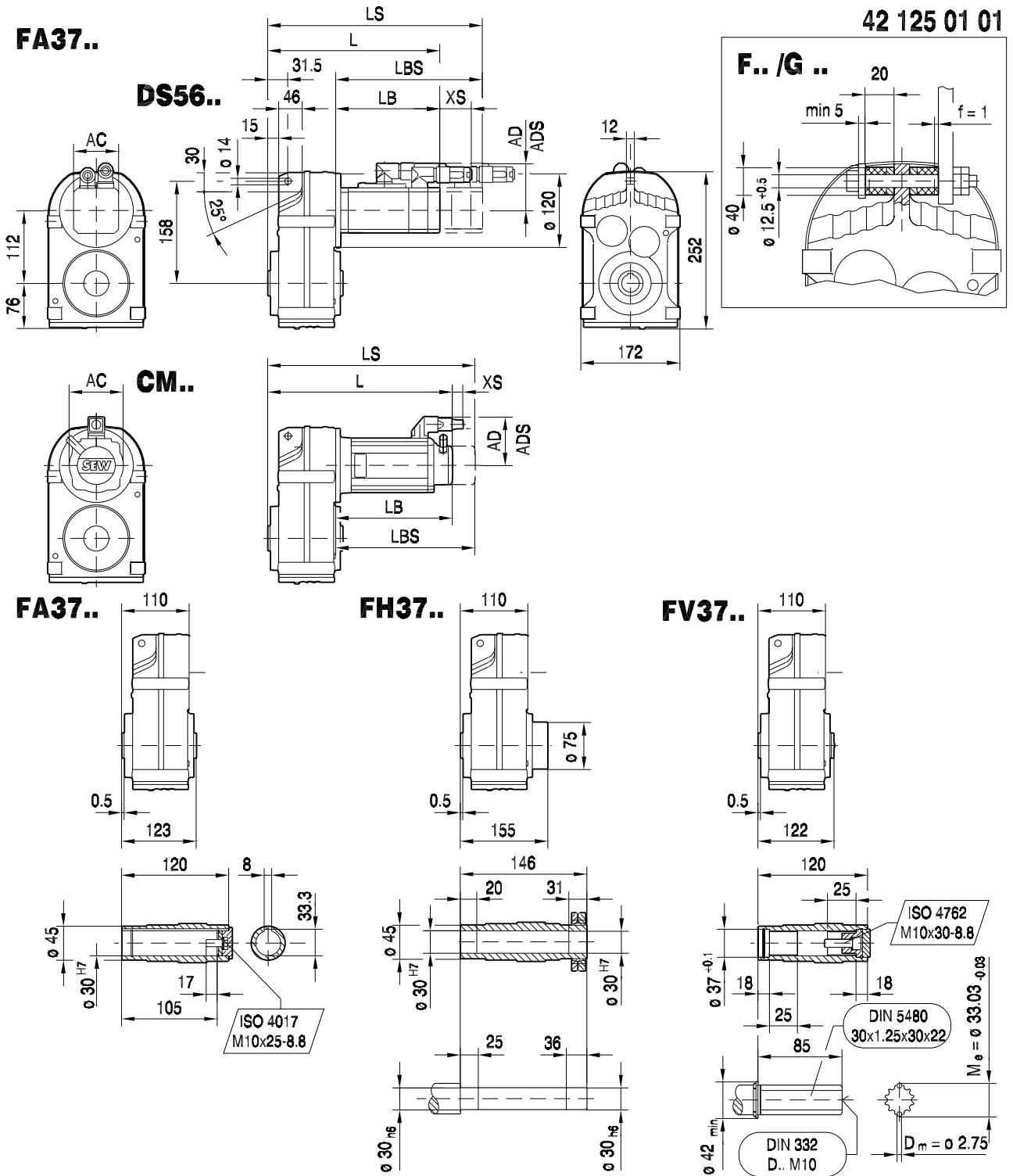
8



(→ 105)	DS56M	DS56L	DS56H	CM71S	CM71M	CM71L	CM90S				
AC	73	73	73	117	117	117	142				
AD	71	71	77	122	122	122	140				
ADS	77	77	77	122	122	122	140				
L	321	353	456	422	442	485	477				
LS	351	383	456	504	524	567	573				
LB	137	169	272	238	258	301	293				
LBS	167	199	272	320	340	383	389				
XS	70	70	51	45	45	45	50				



F..DS/CM..  
F..DS/CM..[mm]

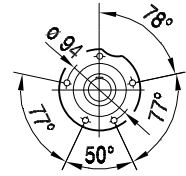
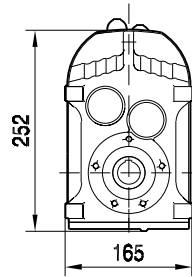
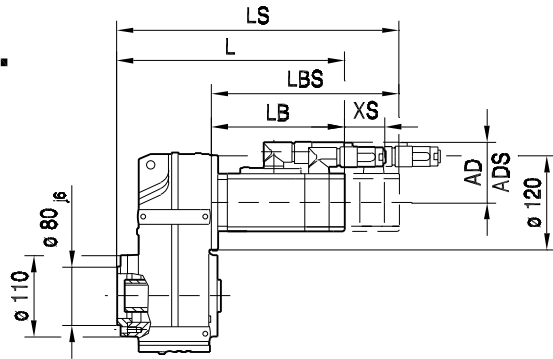
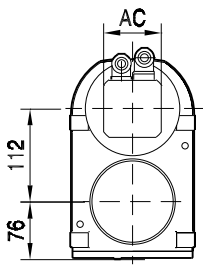


(→ 105)	DS56M	DS56L	DS56H	CM71S	CM71M	CM71L	CM90S				
AC	73	73	73	117	117	117	142				
AD	71	71	77	122	122	122	140				
ADS	77	77	77	122	122	122	140				
L	247	279	382	348	368	411	403				
LS	277	309	382	430	450	493	499				
LB	137	169	272	238	258	301	293				
LBS	167	199	272	320	340	383	389				
XS	70	70	51	45	45	45	50				

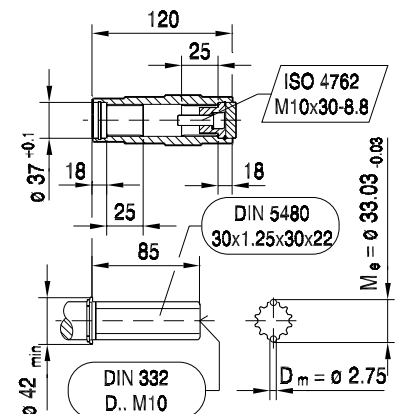
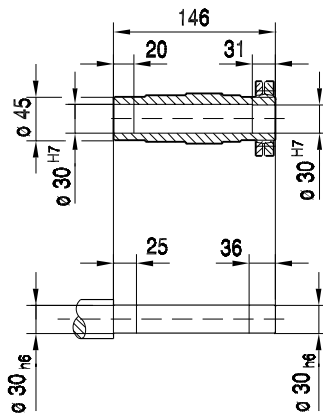
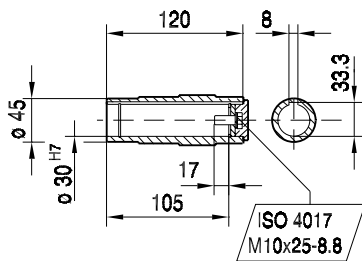
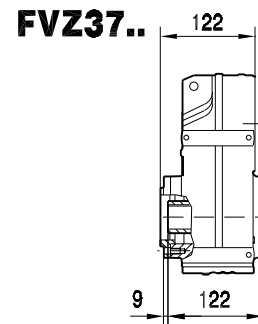
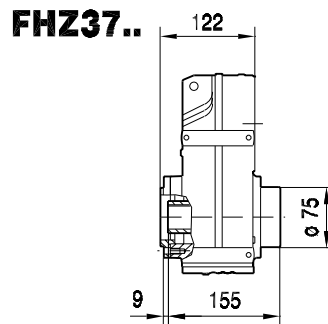
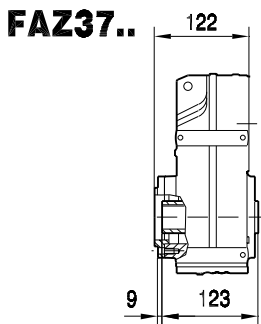
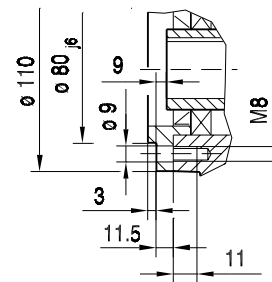
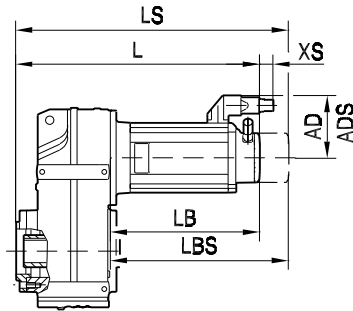
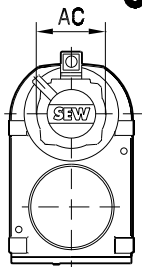


42 039 00 04

**FAZ37.. DS56..**



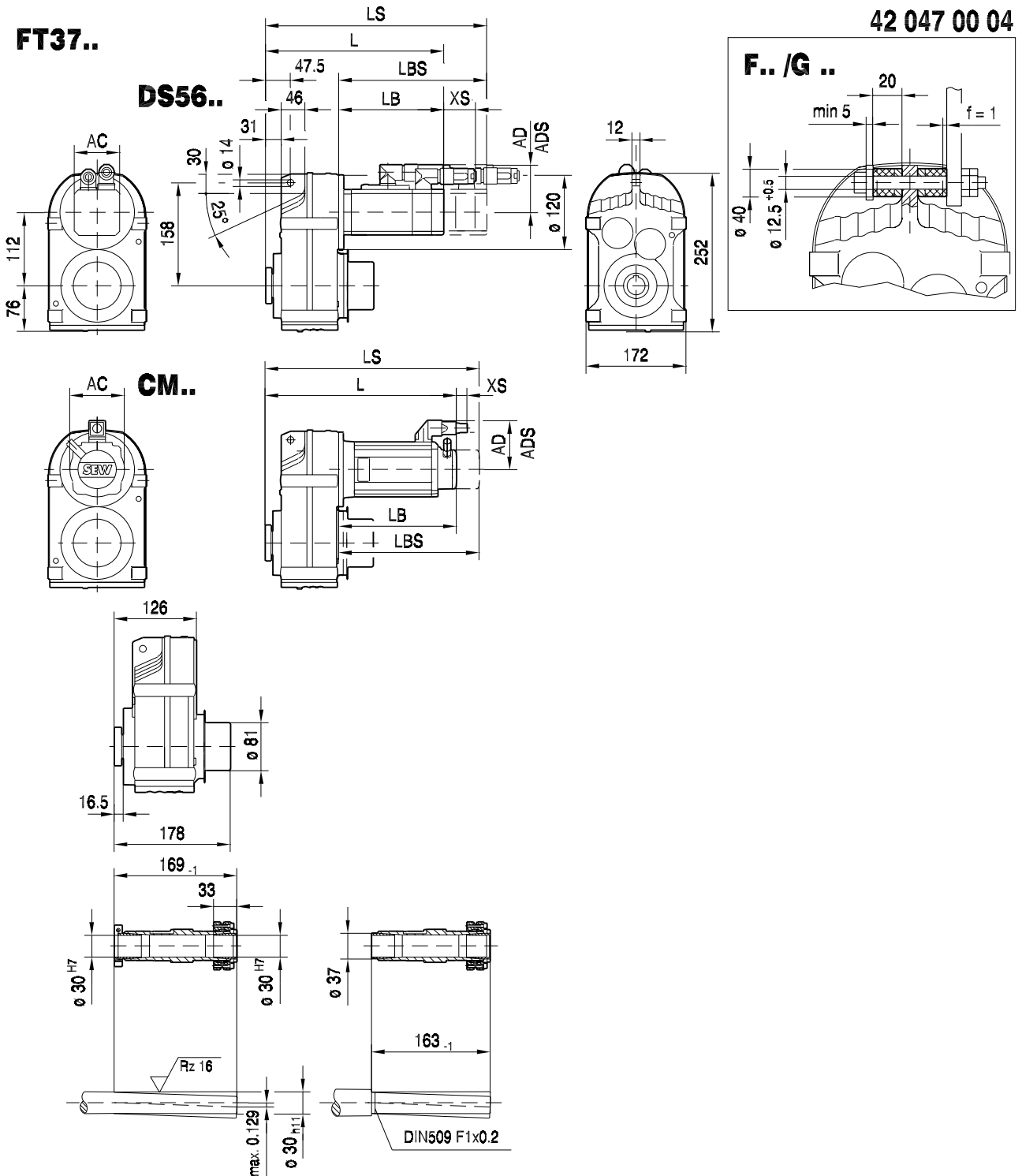
**CM..**



(→ 105)	DS56M	DS56L	DS56H	CM71S	CM71M	CM71L	CM90S				
AC	73	73	73	117	117	117	142				
AD	71	71	77	122	122	122	140				
ADS	77	77	77	122	122	122	140				
L	259	291	394	360	380	423	415				
LS	289	321	394	442	462	505	511				
LB	137	169	272	238	258	301	293				
LBS	167	199	272	320	340	383	389				
XS	70	70	51	45	45	45	50				



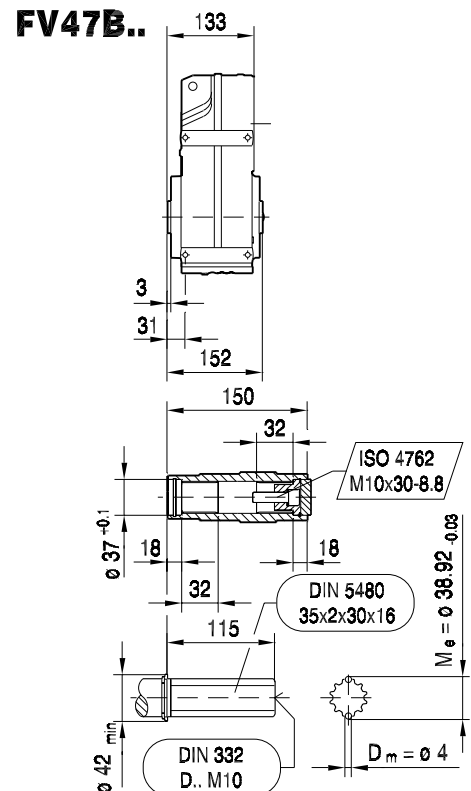
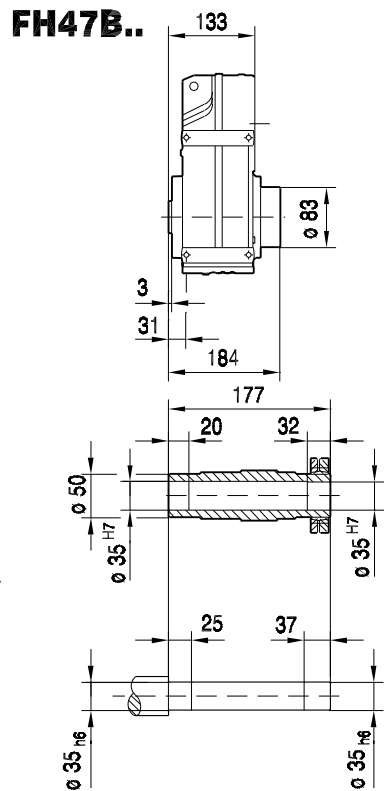
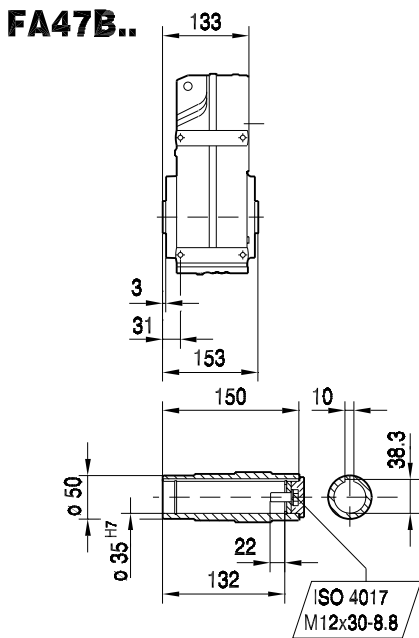
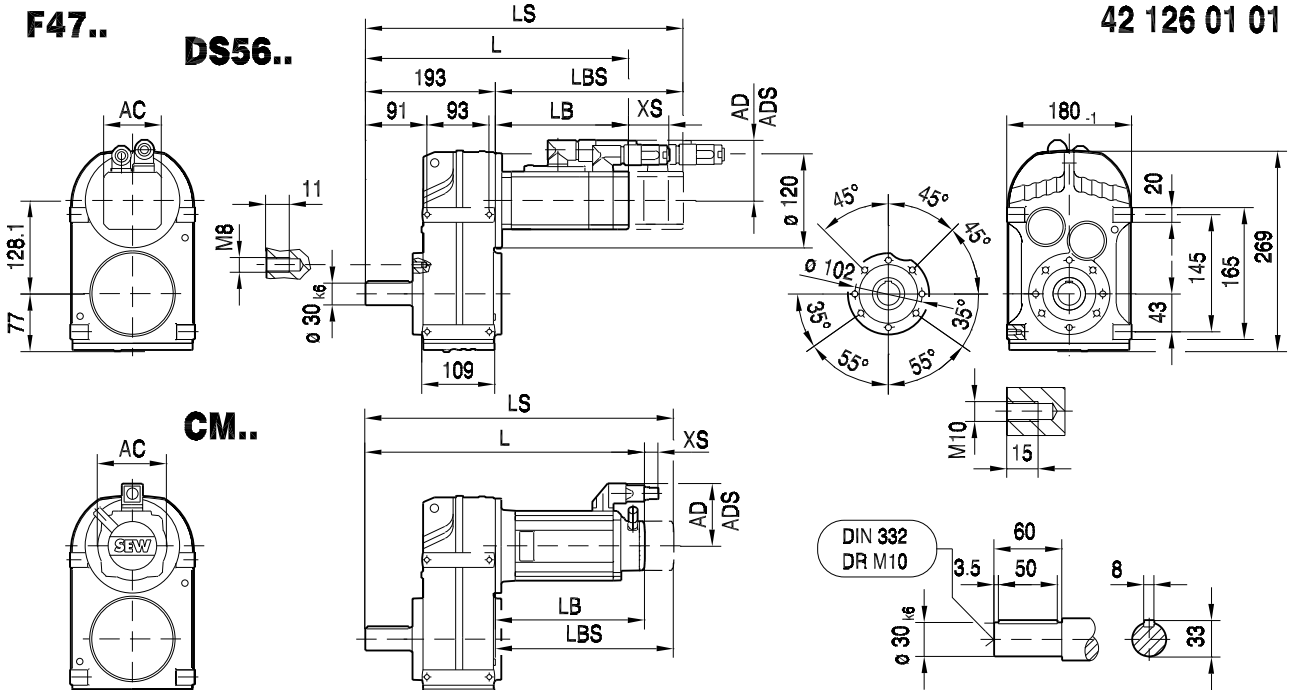
F..DS/CM..  
F..DS/CM..[mm]



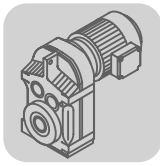
(→ 105)	DS56M	DS56L	DS56H	CM71S	CM71M	CM71L				
AC	73	73	73	117	117	117				
AD	71	71	77	122	122	122				
ADS	77	77	77	122	122	122				
L	263	295	398	364	384	427				
LS	293	325	398	446	466	509				
LB	137	169	272	238	258	301				
LBS	167	199	272	320	340	383				
XS	70	70	51	45	45	45				



42 126 01 01



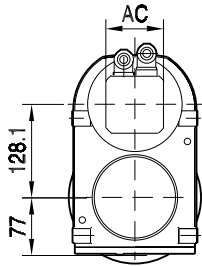
(→ 105)	DS56M	DS56L	DS56H	CM71S	CM71M	CM71L	CM90S				
AC	73	73	73	117	117	117	142				
AD	71	71	77	122	122	122	140				
ADS	77	77	77	122	122	122	140				
L	330	362	465	431	451	494	486				
LS	360	392	465	513	533	576	582				
LB	137	169	272	238	258	301	293				
LBS	167	199	272	320	340	383	389				
XS	70	70	51	45	45	45	50				



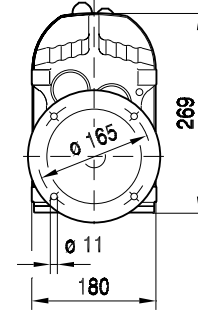
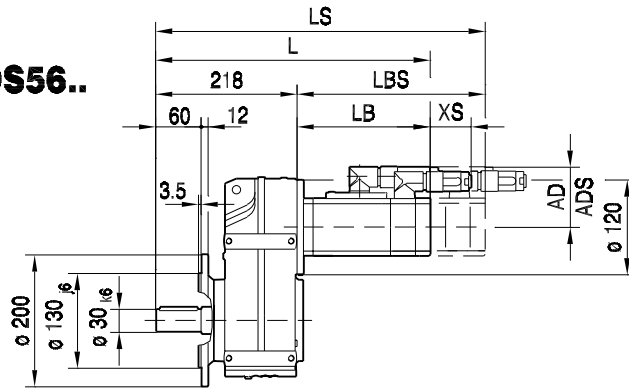
F..DS/CM..  
F..DS/CM..[mm]

42 127 01 01

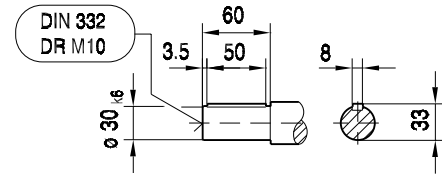
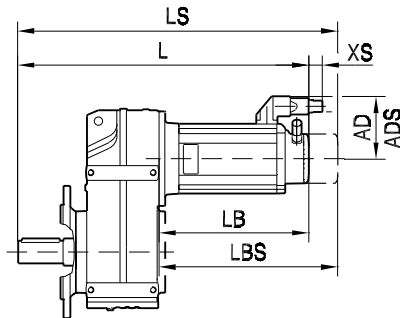
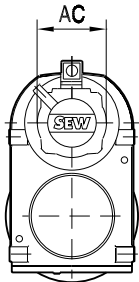
FF47..



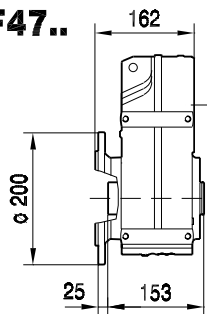
DS56..



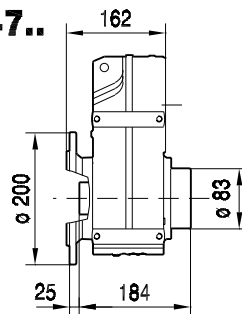
CM..



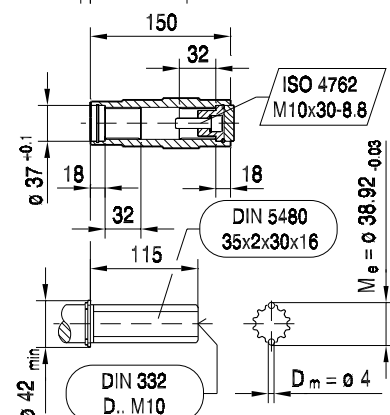
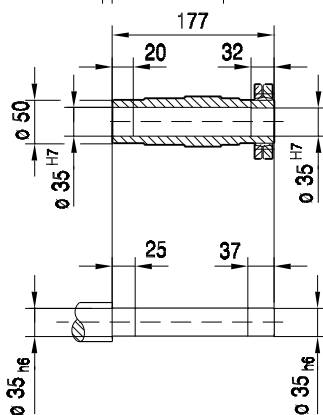
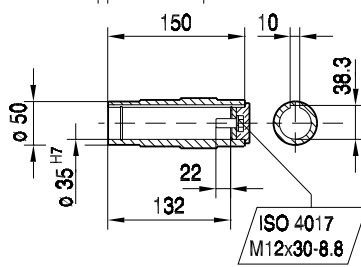
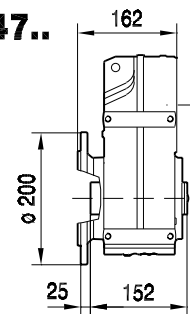
FAF47..



FHF47..



FVF47..



(→ 105)	DS56M	DS56L	DS56H	CM71S	CM71M	CM71L	CM90S				
AC	73	73	73	117	117	117	142				
AD	71	71	77	122	122	122	140				
ADS	77	77	77	122	122	122	140				
L	355	387	490	456	476	519	511				
LS	385	417	490	538	558	601	607				
LB	137	169	272	238	258	301	293				
LBS	167	199	272	320	340	383	389				
XS	70	70	51	45	45	45	50				

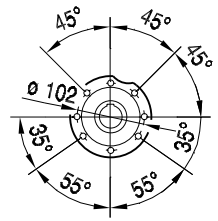
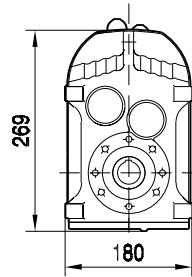
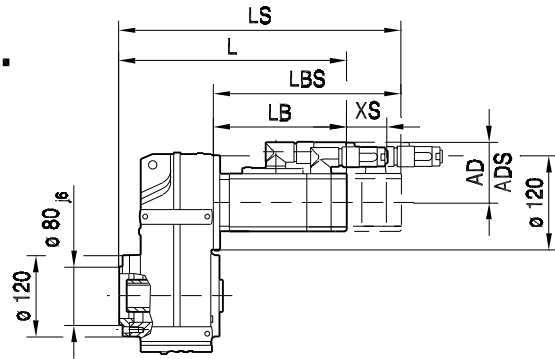
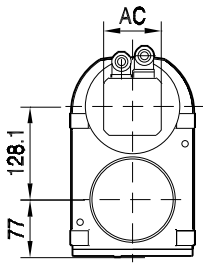




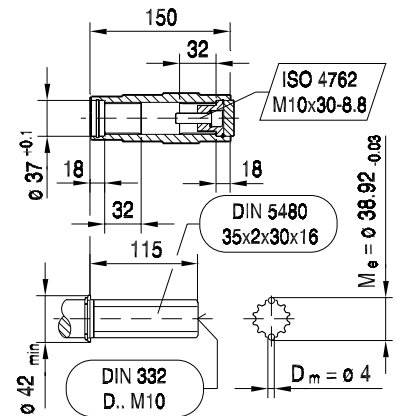
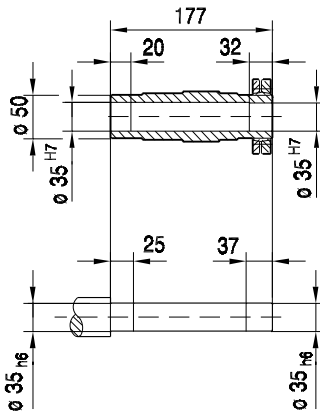
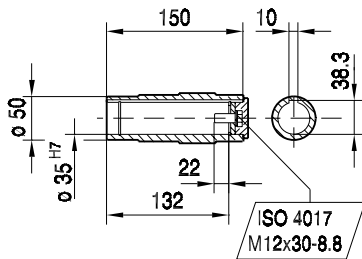
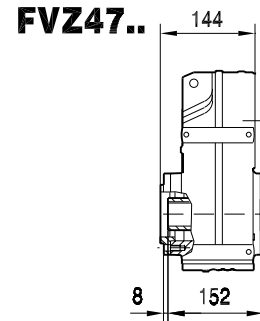
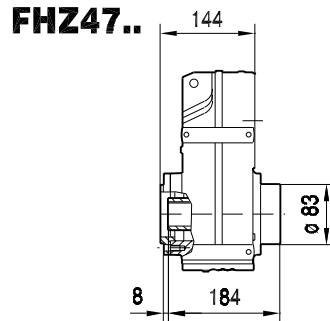
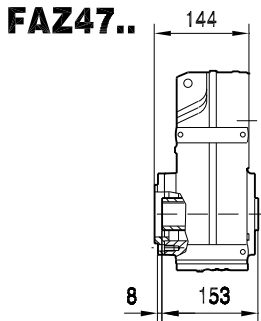
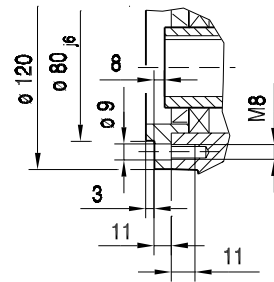
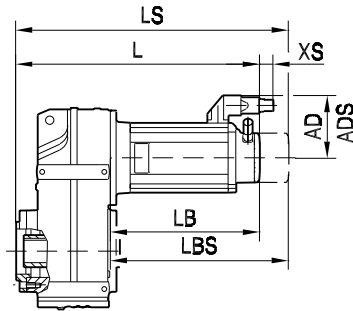
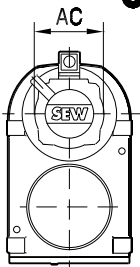
F..DS/CM..  
F..DS/CM..[mm]

42 040 00 04

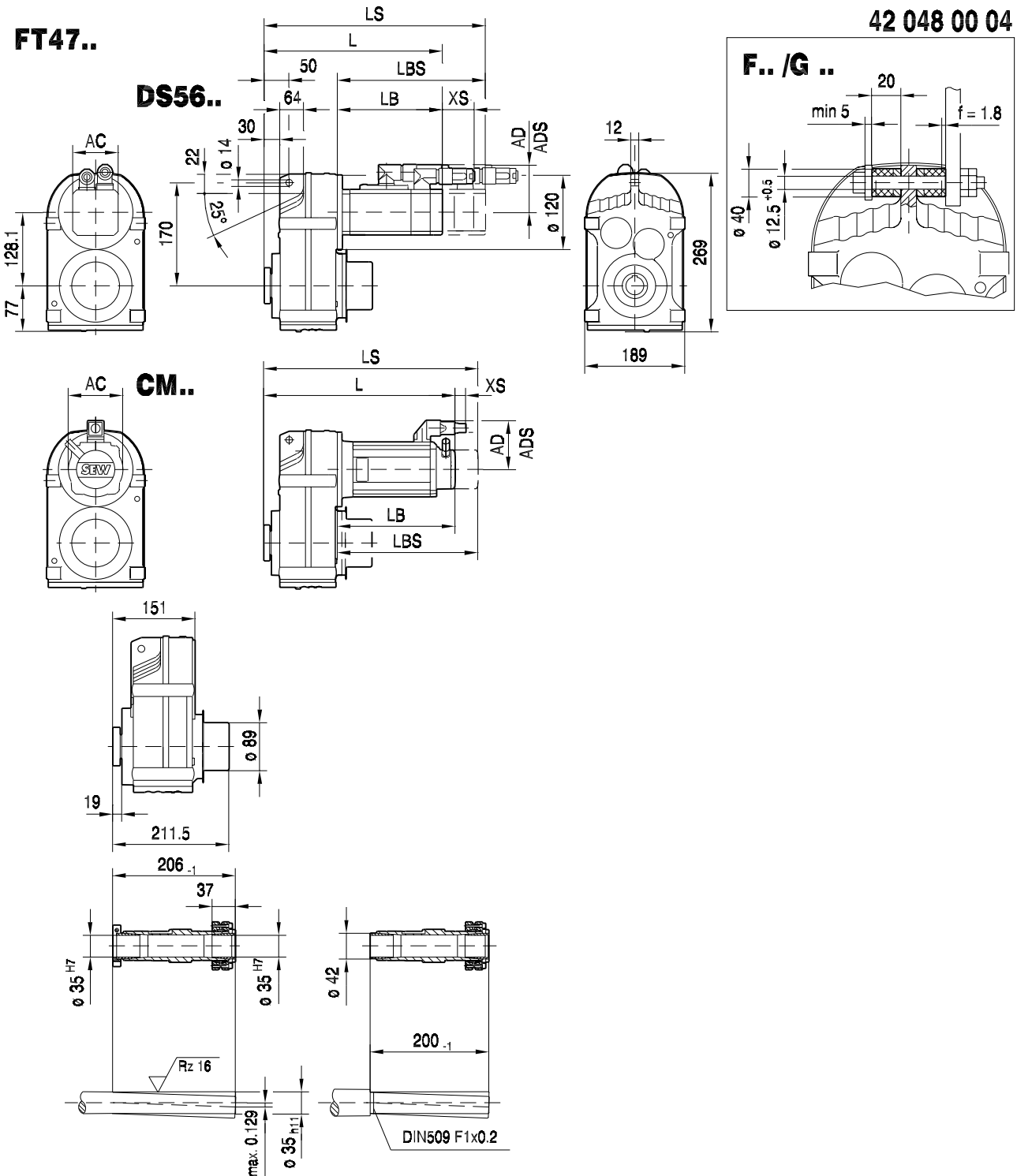
**FAZ47.. DS56..**



**CM..**



(→ 105)	DS56M	DS56L	DS56H	CM71S	CM71M	CM71L	CM90S				
AC	73	73	73	117	117	117	142				
AD	71	71	77	122	122	122	140				
ADS	77	77	77	122	122	122	140				
L	281	313	416	382	402	445	437				
LS	311	343	416	464	484	527	533				
LB	137	169	272	238	258	301	293				
LBS	167	199	272	320	340	383	389				
XS	70	70	51	45	45	45	50				

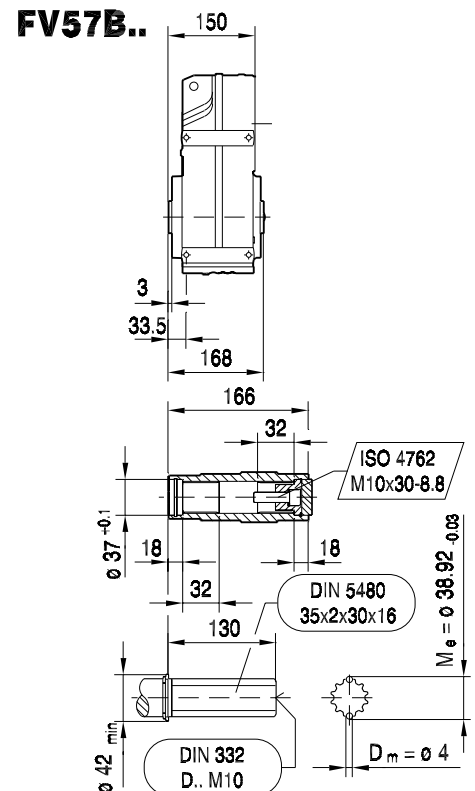
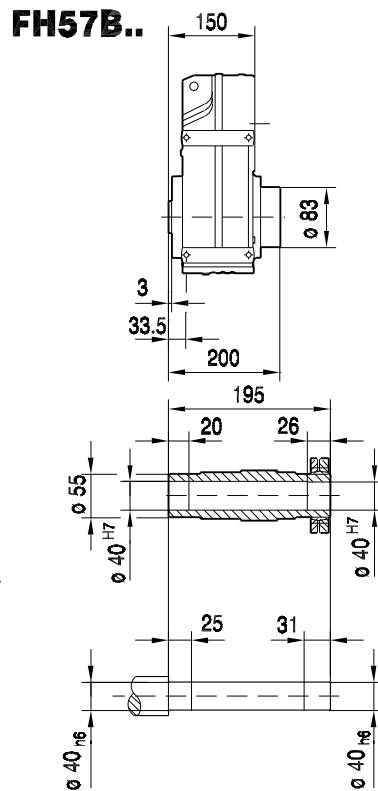
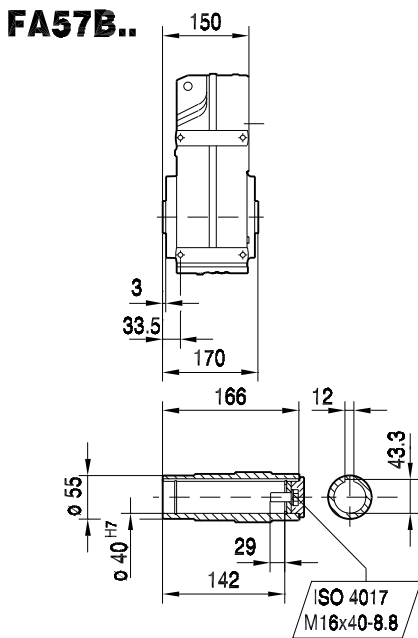
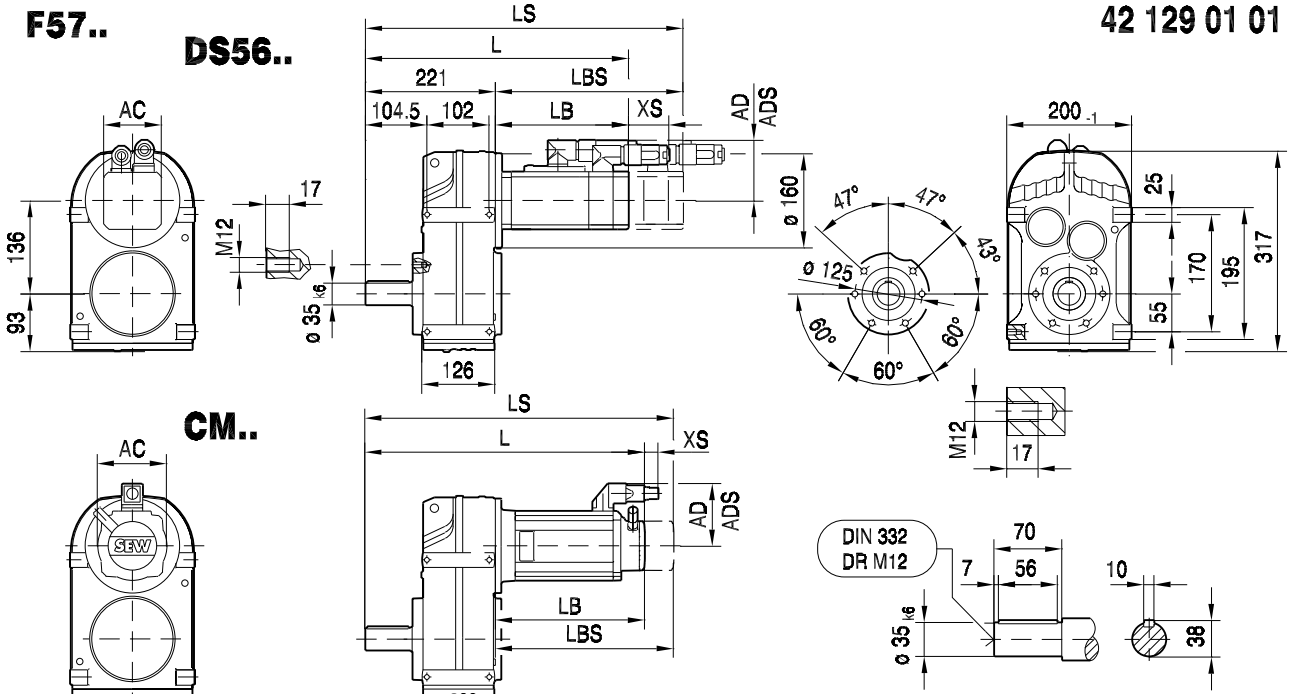


(→ 105)	DS56M	DS56L	DS56H	CM71S	CM71M	CM71L				
AC	73	73	73	117	117	117				
AD	71	71	77	122	122	122				
ADS	77	77	77	122	122	122				
L	288	320	423	389	409	452				
LS	318	350	423	471	491	534				
LB	137	169	272	238	258	301				
LBS	167	199	272	320	340	383				
XS	70	70	51	45	45	45				



F..DS/CM..  
F..DS/CM..[mm]

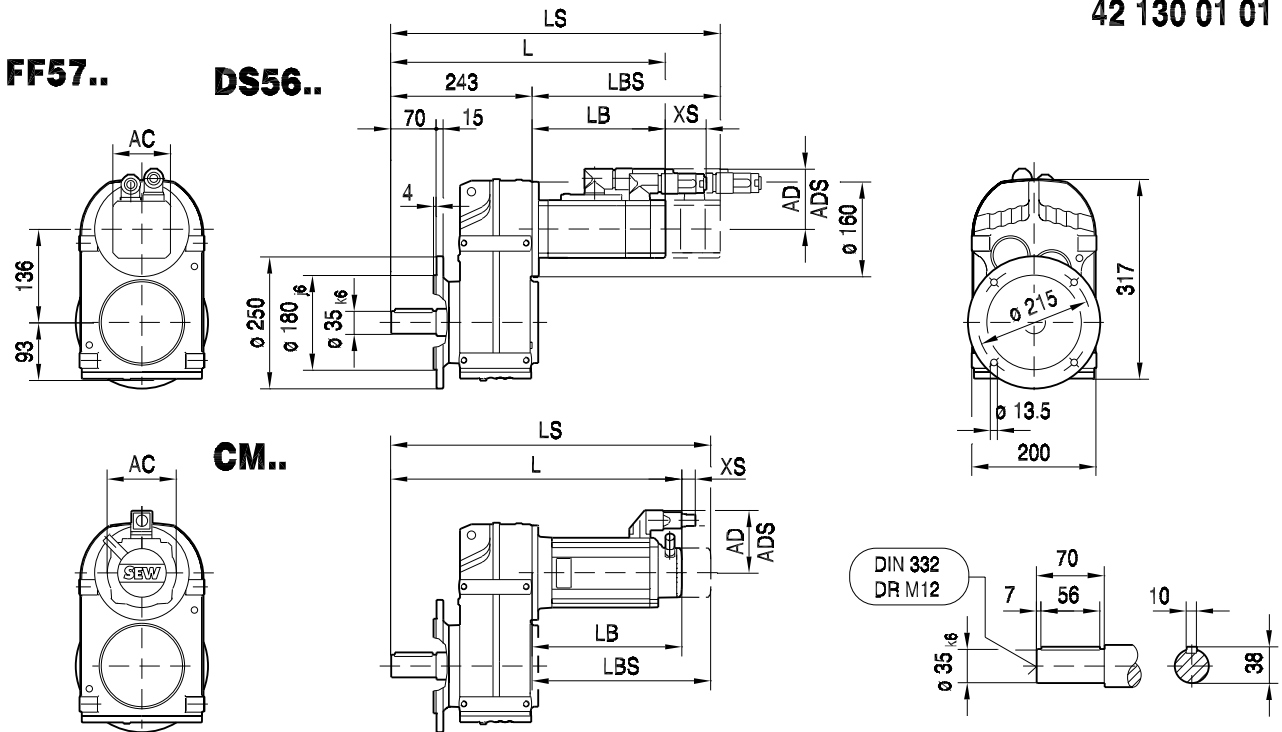
42 129 01 01



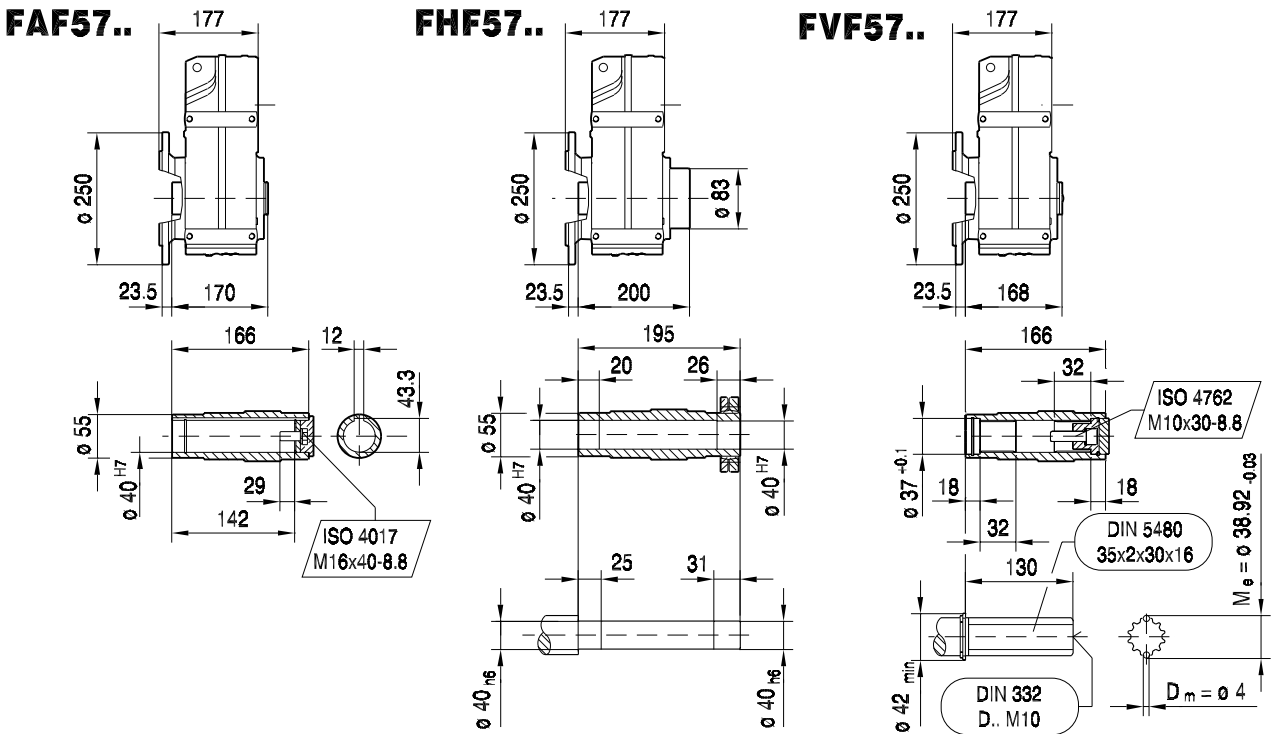
(→ 105)	DS56H	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L	CM112S			
AC	73	117	117	117	142	142	142	186			
AD	77	122	122	122	140	140	140	162			
ADS	77	122	122	122	140	140	140	162			
L	487	453	473	513	505	532	590	545			
LS	487	535	555	595	601	628	686	635			
LB	266	232	252	292	284	311	369	324			
LBS	266	314	334	374	380	407	465	414			
XS	51	45	45	45	50	50	50	36			



42 130 01 01



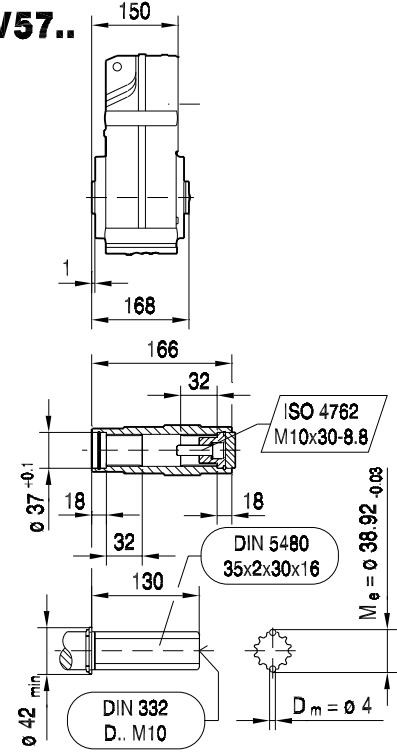
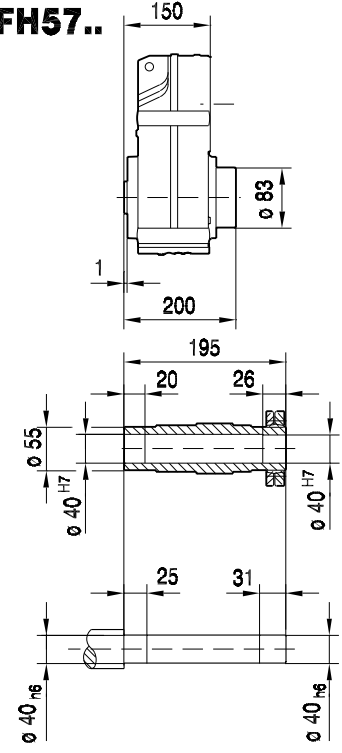
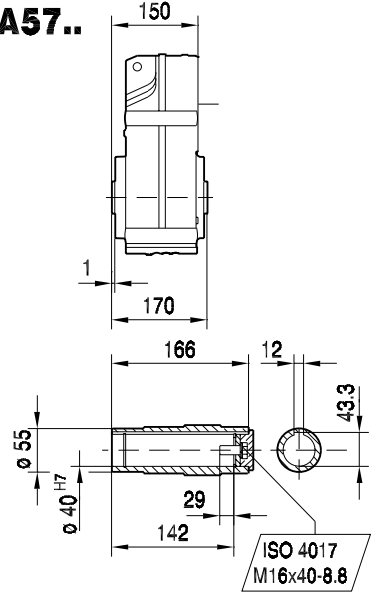
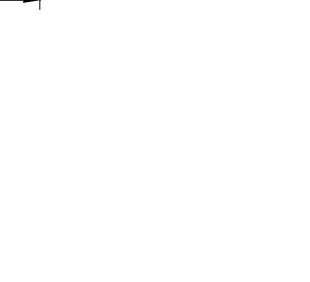
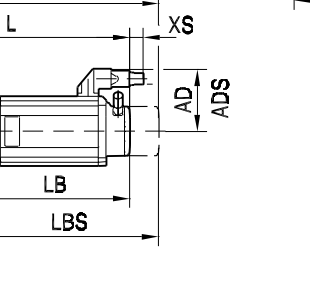
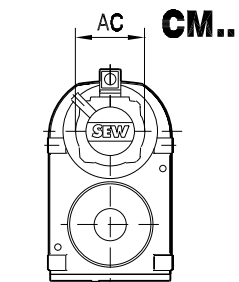
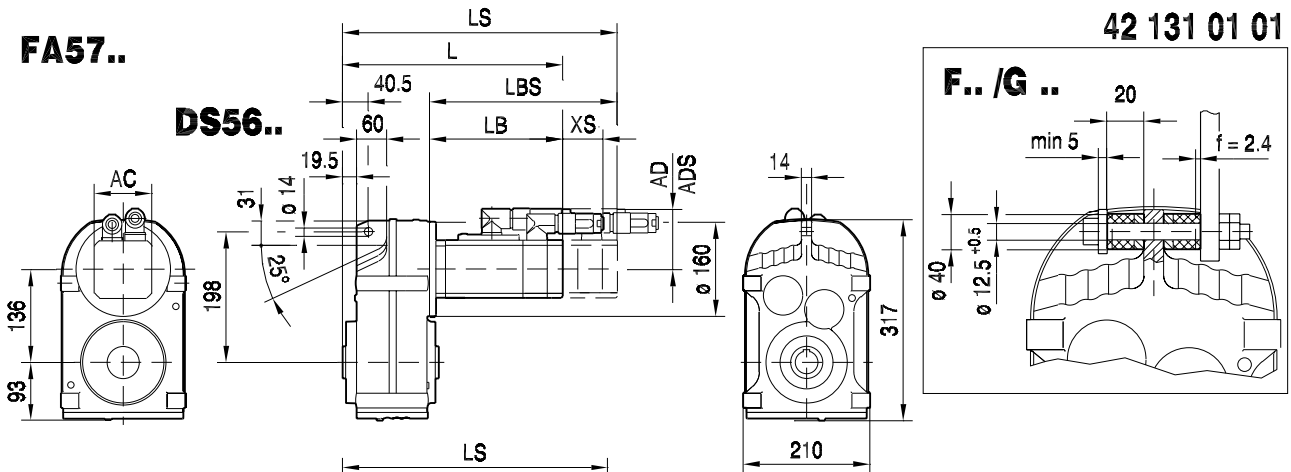
8



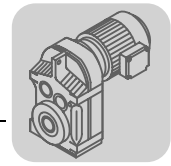
(→ 105)	DS56H	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L	CM112S			
AC	73	117	117	117	142	142	142	186			
AD	77	122	122	122	140	140	140	162			
ADS	77	122	122	122	140	140	140	162			
L	509	475	495	535	527	554	612	567			
LS	509	557	577	617	623	650	708	657			
LB	266	232	252	292	284	311	369	324			
LBS	266	314	334	374	380	407	465	414			
XS	51	45	45	45	50	50	50	36			



F..DS/CM..  
F..DS/CM..[mm]

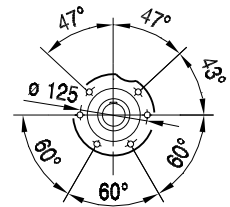
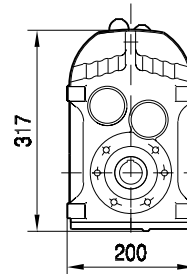
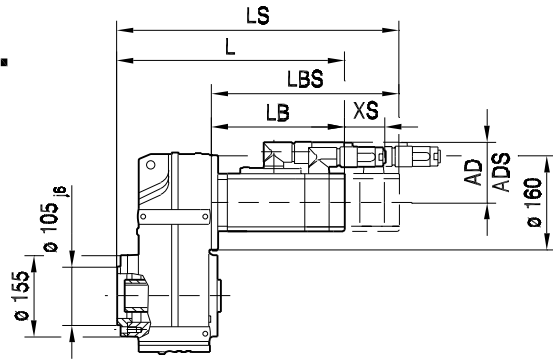
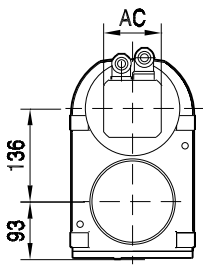


(→ 105)	DS56H	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L	CM112S			
AC	73	117	117	117	142	142	142	186			
AD	77	122	122	122	140	140	140	162			
ADS	77	122	122	122	140	140	140	162			
L	416	382	402	442	434	461	519	474			
LS	416	464	484	524	530	557	615	564			
LB	266	232	252	292	284	311	369	324			
LBS	266	314	334	374	380	407	465	414			
XS	51	45	45	45	50	50	50	36			

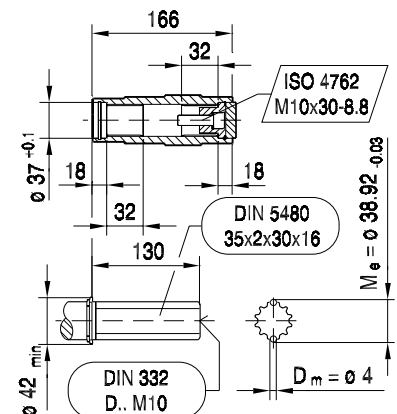
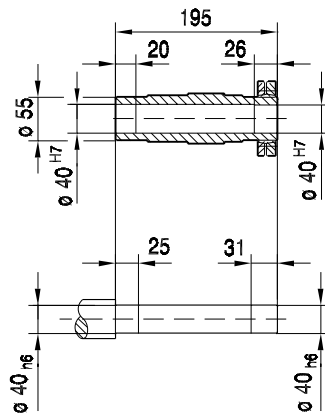
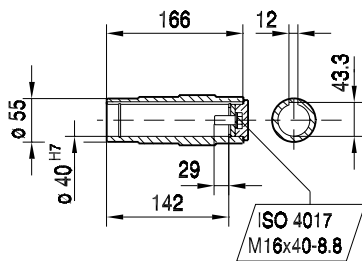
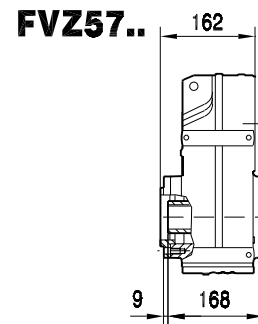
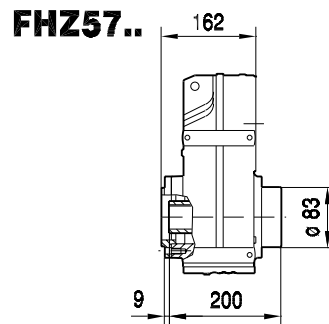
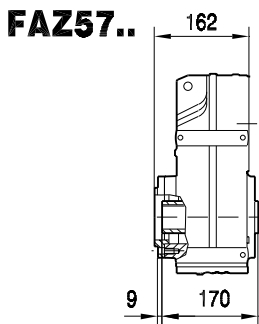
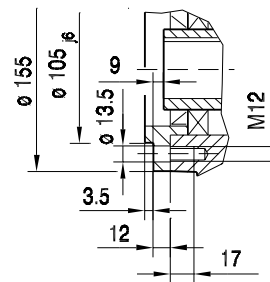
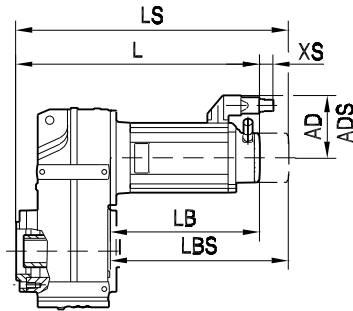
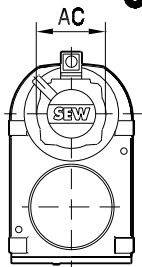


**FAZ57.. DS56..**

42 041 00 04



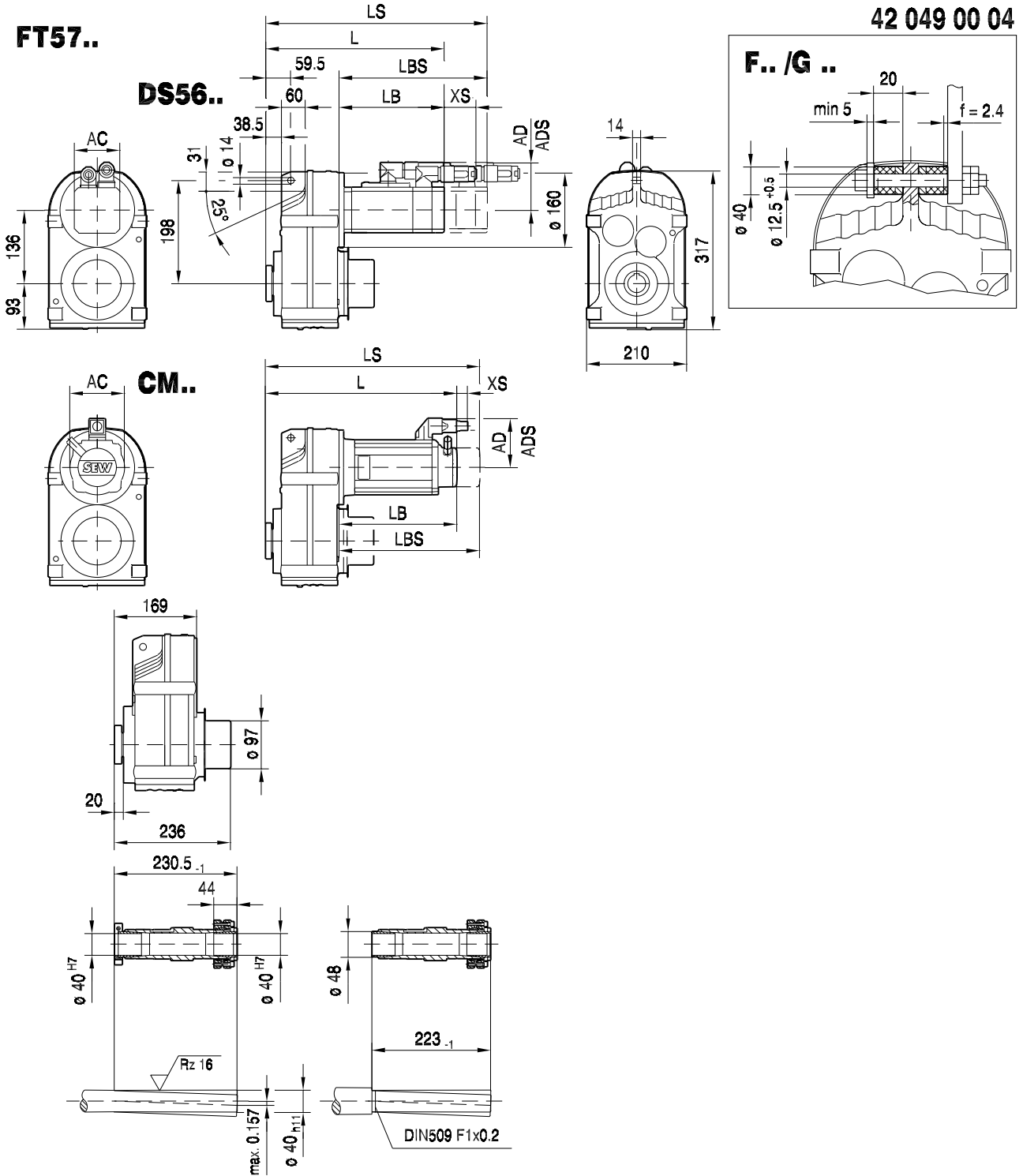
**CM..**



(→ 105)	DS56H	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L	CM112S			
AC	73	117	117	117	142	142	142	186			
AD	77	122	122	122	140	140	140	162			
ADS	77	122	122	122	140	140	140	162			
L	428	394	414	454	446	473	531	486			
LS	428	476	496	536	542	569	627	576			
LB	266	232	252	292	284	311	369	324			
LBS	266	314	334	374	380	407	465	414			
XS	51	45	45	45	50	50	50	36			



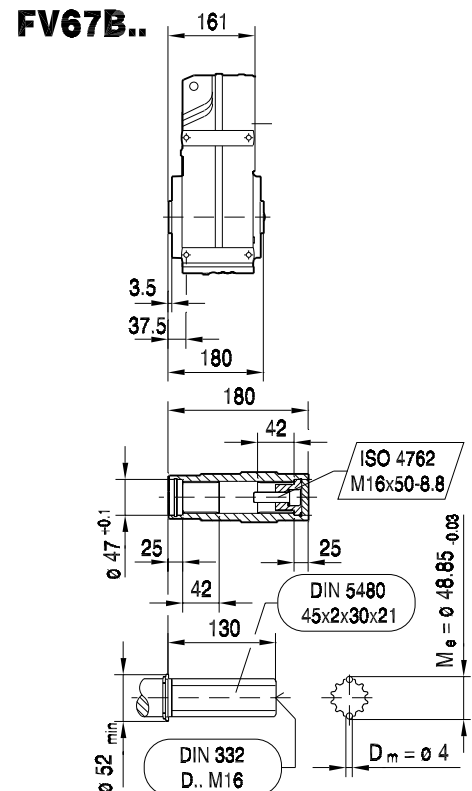
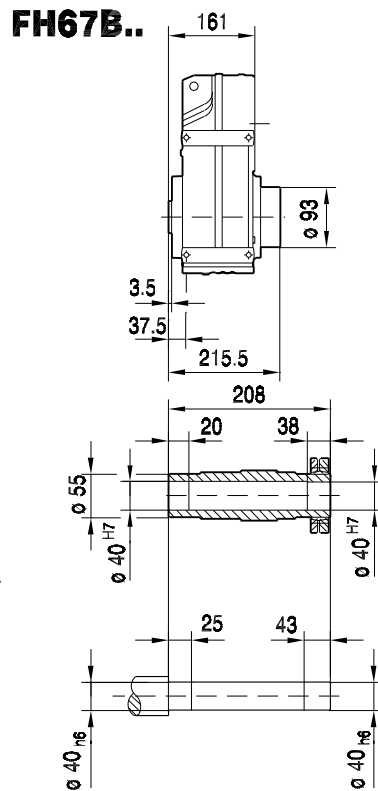
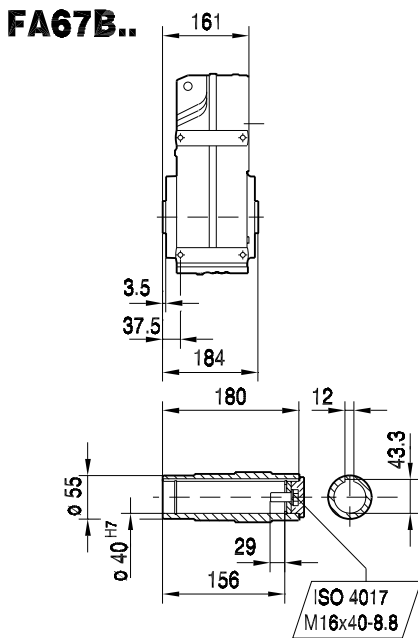
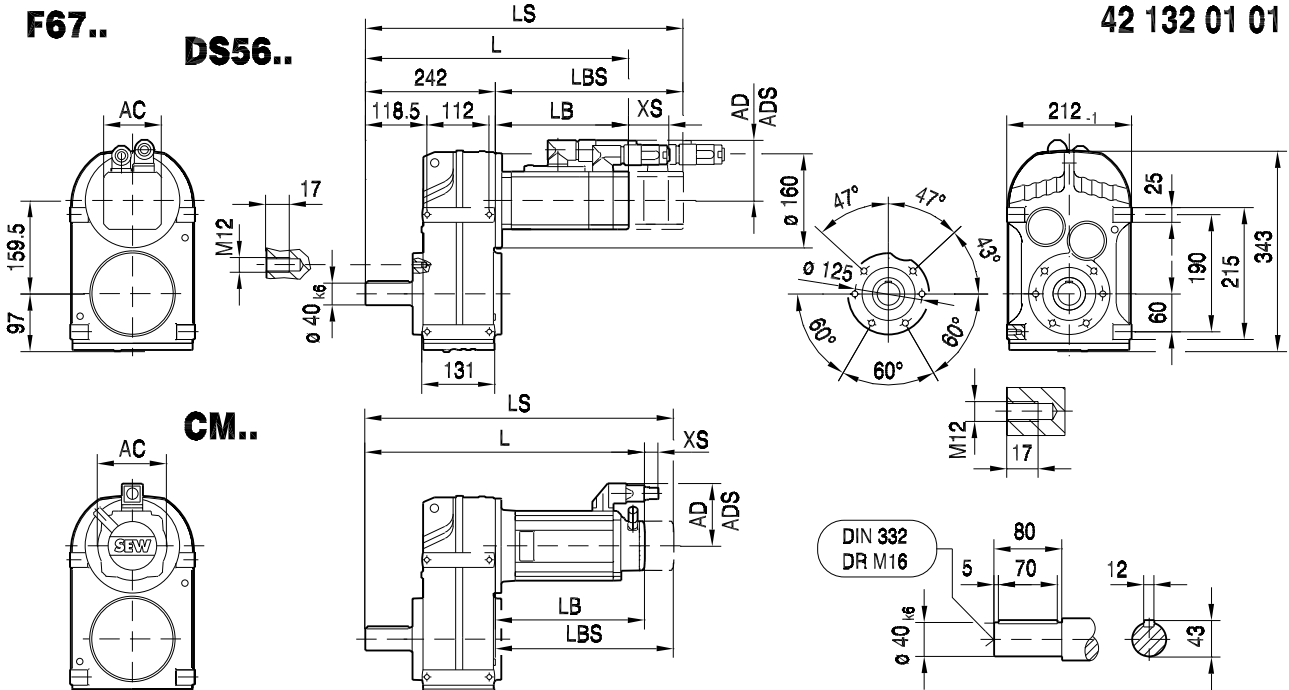
F..DS/CM..  
F..DS/CM..[mm]



(→ 105)	DS56H	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L			
AC	73	117	117	117	142	142	142			
AD	77	122	122	122	140	140	140			
ADS	77	122	122	122	140	140	140			
L	435	401	421	461	453	480	538			
LS	435	483	503	543	549	576	634			
LB	266	232	252	292	284	311	369			
LBS	266	314	334	374	380	407	465			
XS	51	45	45	45	50	50	50			

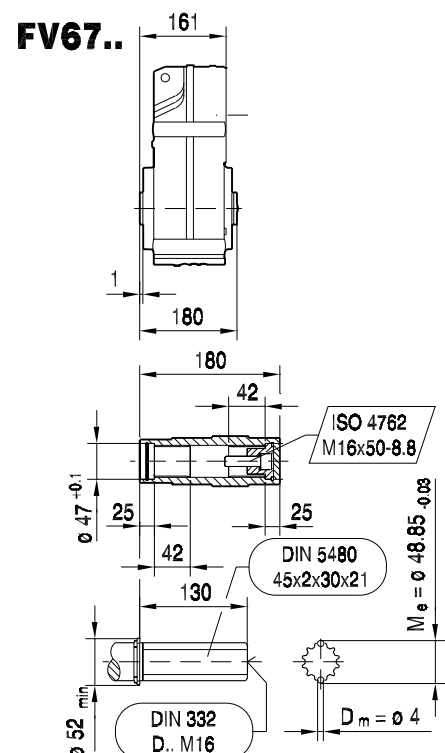
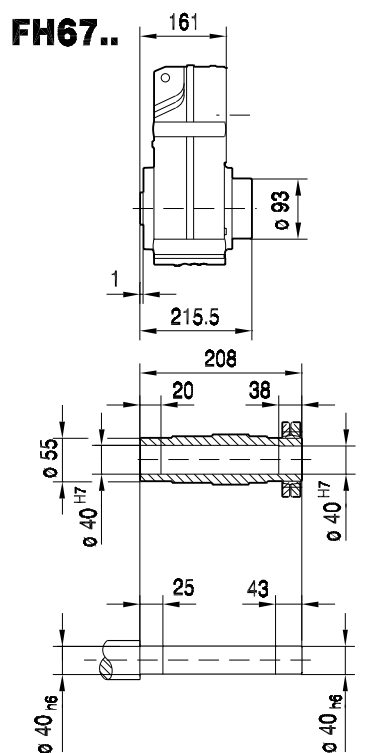
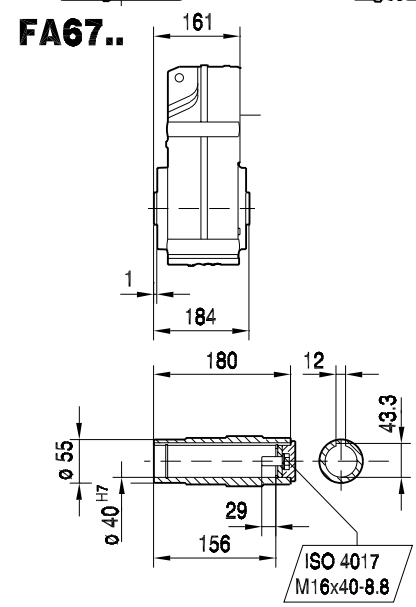
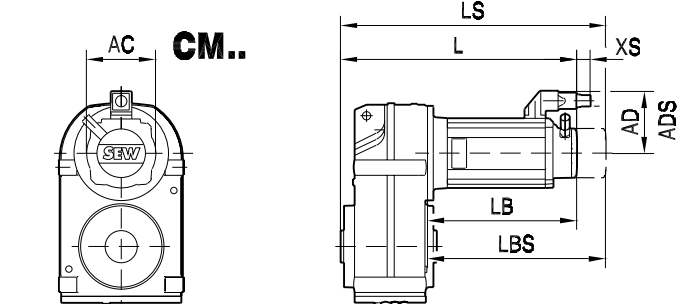
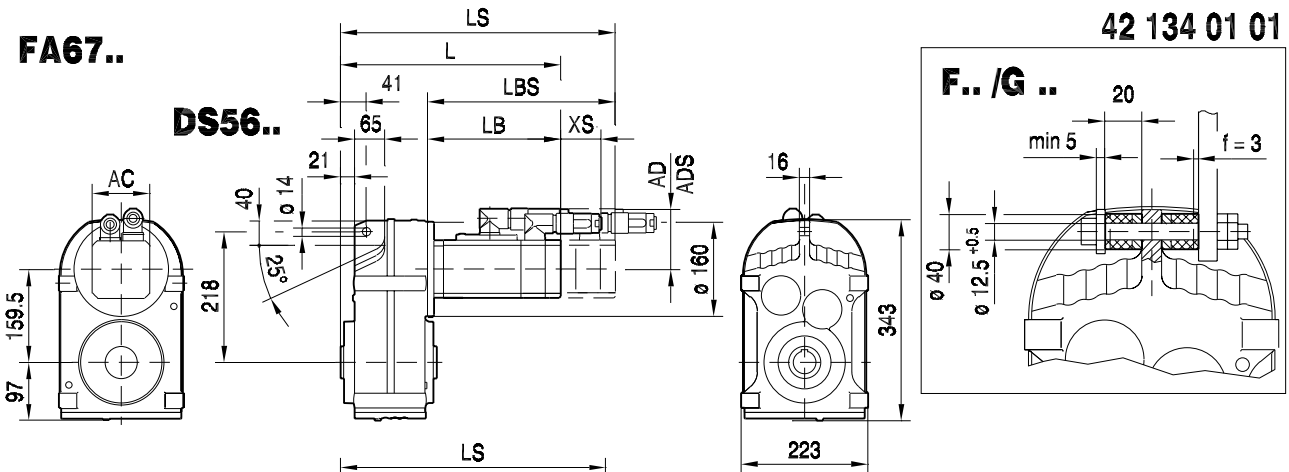
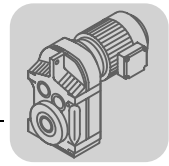


42 132 01 01



(→ 105)	DS56H	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L	CM112S	CM112M		
AC	73	117	117	117	142	142	142	186	186		
AD	77	122	122	122	140	140	140	162	162		
ADS	77	122	122	122	140	140	140	162	162		
L	508	474	494	534	526	553	611	566	590		
LS	508	556	576	616	622	649	707	656	680		
LB	266	232	252	292	284	311	369	324	348		
LBS	266	314	334	374	380	407	465	414	438		
XS	51	45	45	45	50	50	50	36	36		





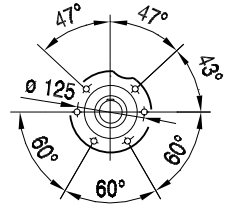
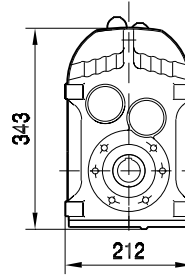
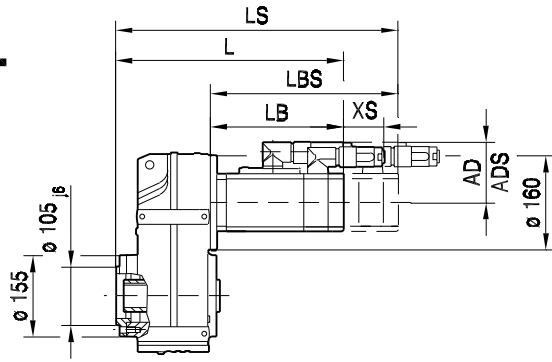
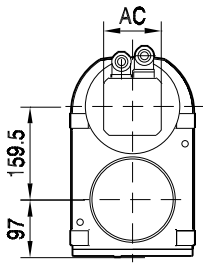
(→ 105)	DS56H	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L	CM112S	CM112M		
AC	73	117	117	117	142	142	142	186	186		
AD	77	122	122	122	140	140	140	162	162		
ADS	77	122	122	122	140	140	140	162	162		
L	427	393	413	453	445	472	530	485	509		
LS	427	475	495	535	541	568	626	575	599		
LB	266	232	252	292	284	311	369	324	348		
LBS	266	314	334	374	380	407	465	414	438		
XS	51	45	45	45	50	50	50	36	36		



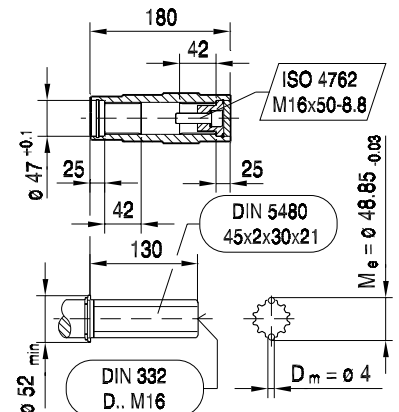
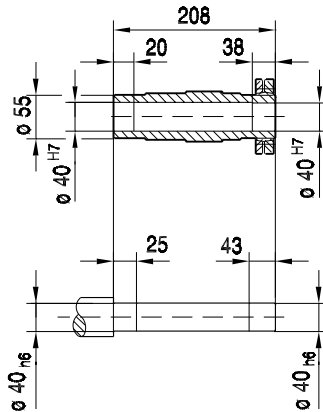
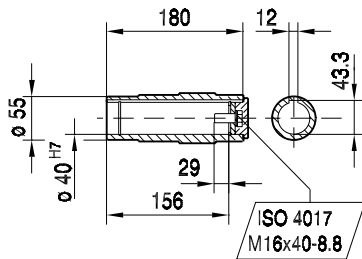
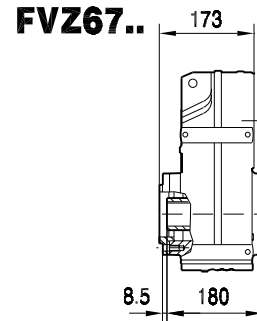
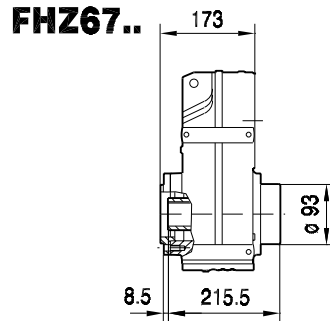
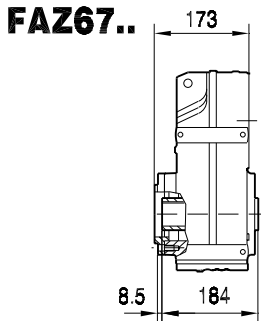
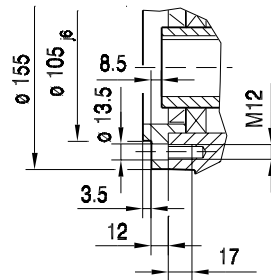
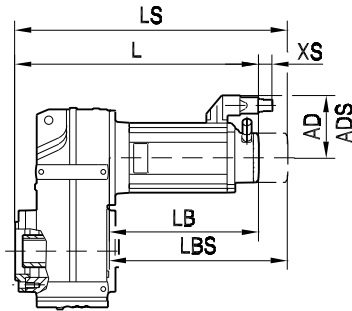
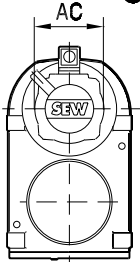
F..DS/CM..  
F..DS/CM..[mm]

42 042 00 04

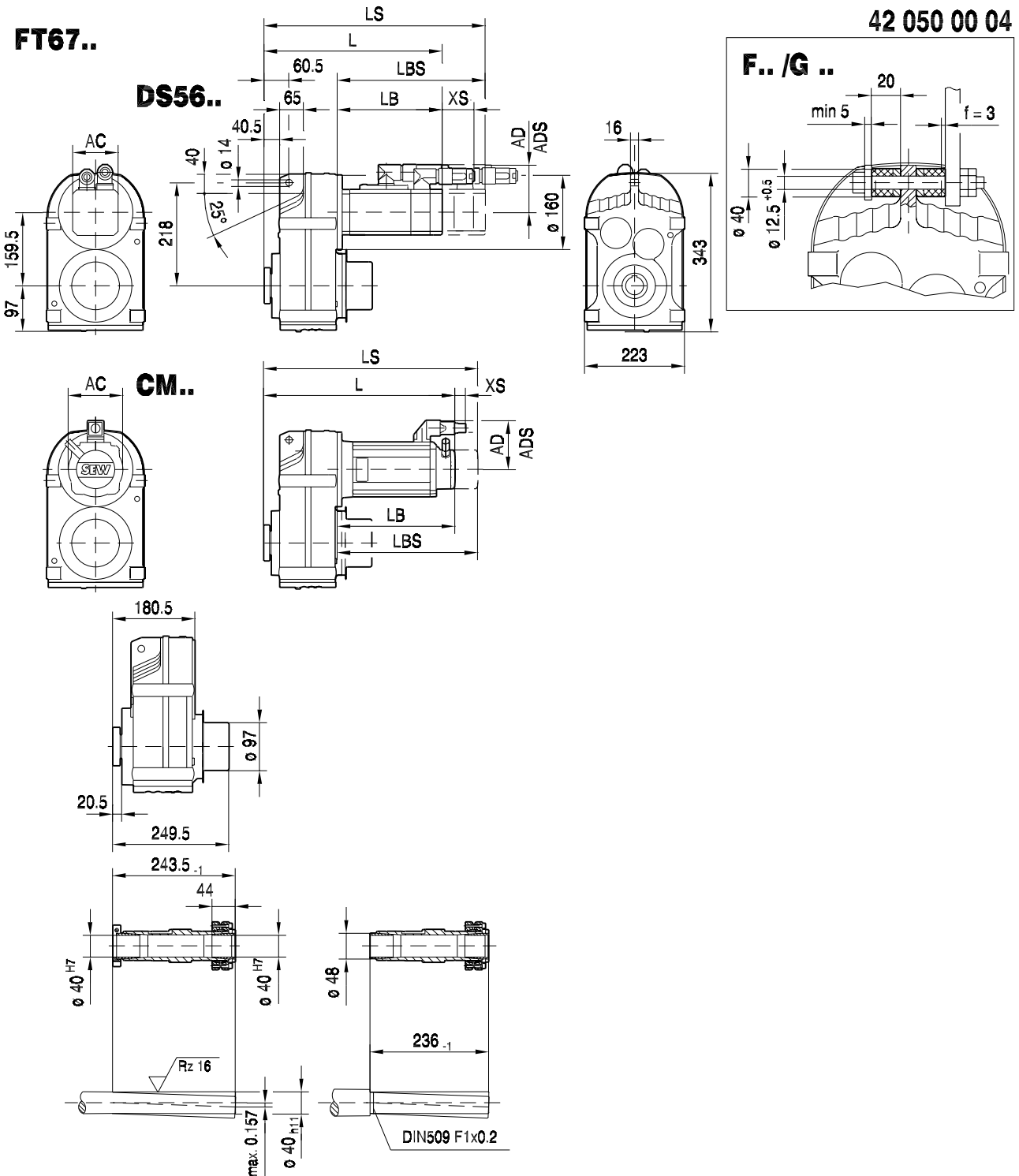
**FAZ67.. DS56..**



**CM..**



(→ 105)	DS56H	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L	CM112S	CM112M		
AC	73	117	117	117	142	142	142	186	186		
AD	77	122	122	122	140	140	140	162	162		
ADS	77	122	122	122	140	140	140	162	162		
L	439	405	425	465	457	484	542	497	521		
LS	439	487	507	547	553	580	638	587	611		
LB	266	232	252	292	284	311	369	324	348		
LBS	266	314	334	374	380	407	465	414	438		
XS	51	45	45	45	50	50	50	36	36		



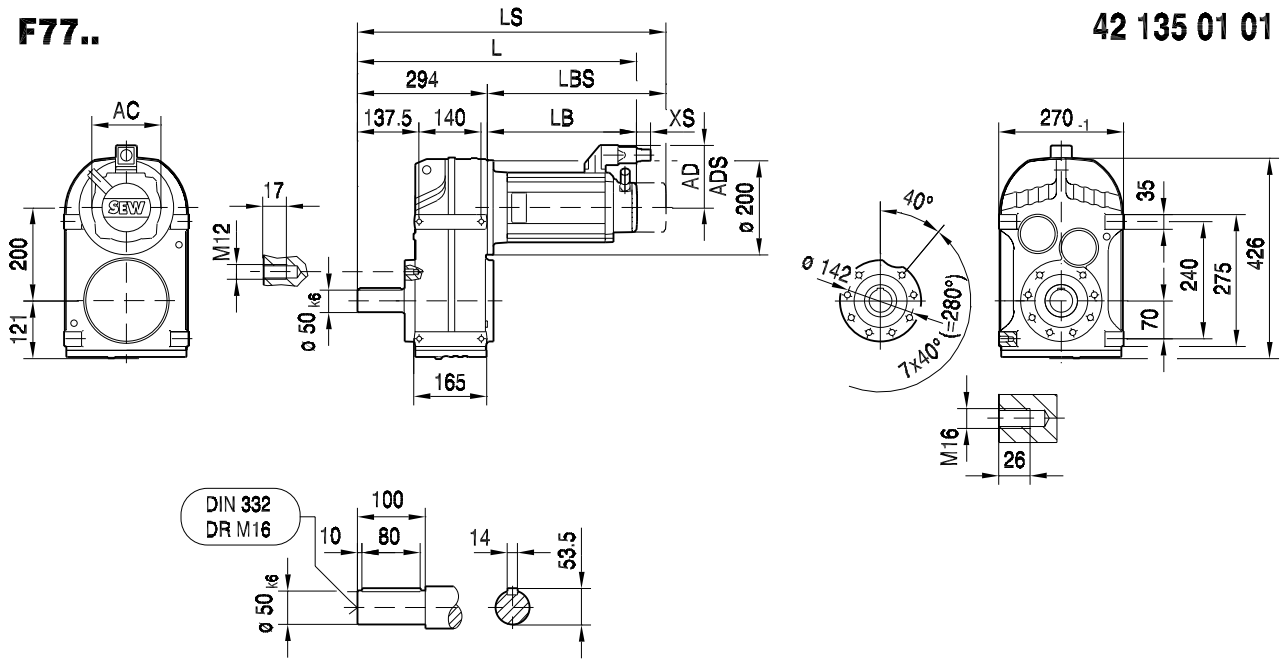
(→ 105)	DS56H	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L	CM112S	CM112M		
AC	73	117	117	117	142	142	142	186	186		
AD	77	122	122	122	140	140	140	162	162		
ADS	77	122	122	122	140	140	140	162	162		
L	446	412	432	472	465	492	550	505	529		
LS	446	494	514	554	560	587	645	595	619		
LB	266	232	252	292	284	311	369	324	348		
LBS	266	314	334	374	380	407	465	414	438		
XS	51	45	45	45	50	50	50	36	36		



F..DS/CM..  
F..DS/CM..[mm]

**F77..**

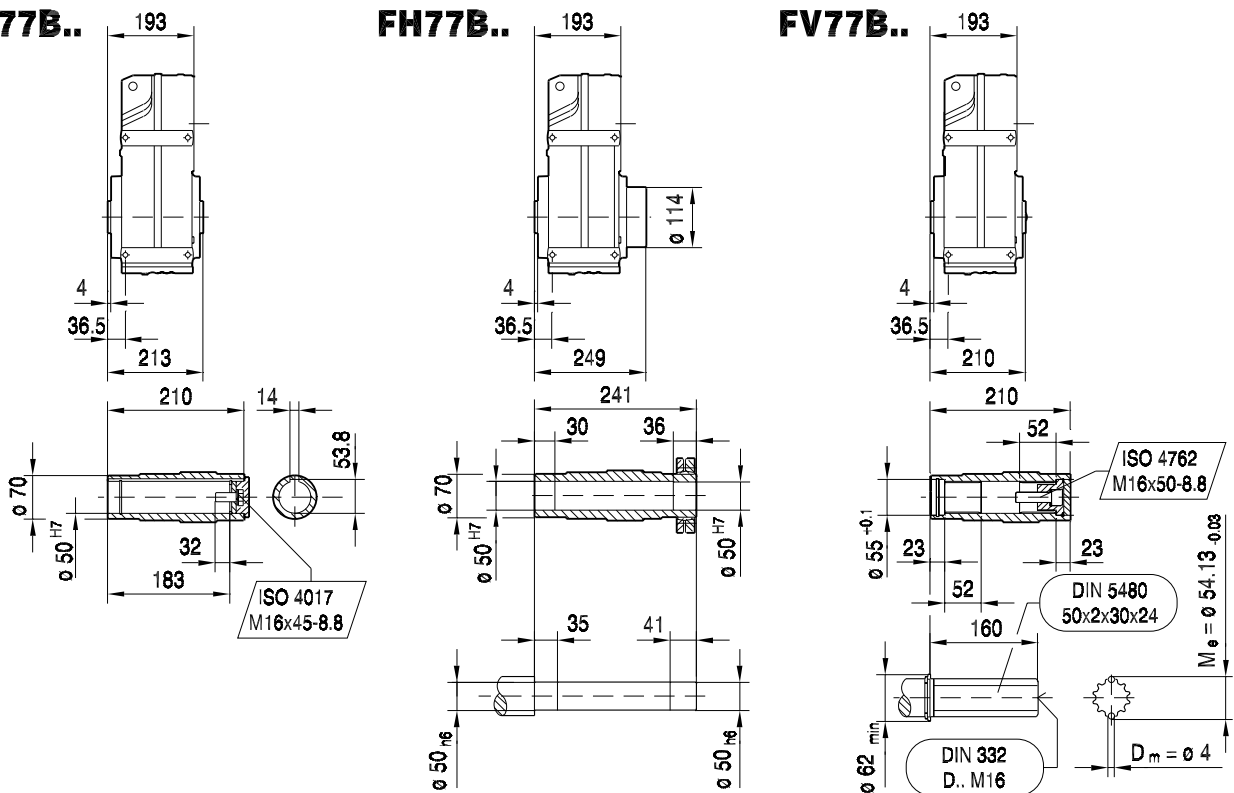
42 135 01 01



**FA77B..**

**FH77B..**

**FV77B..**

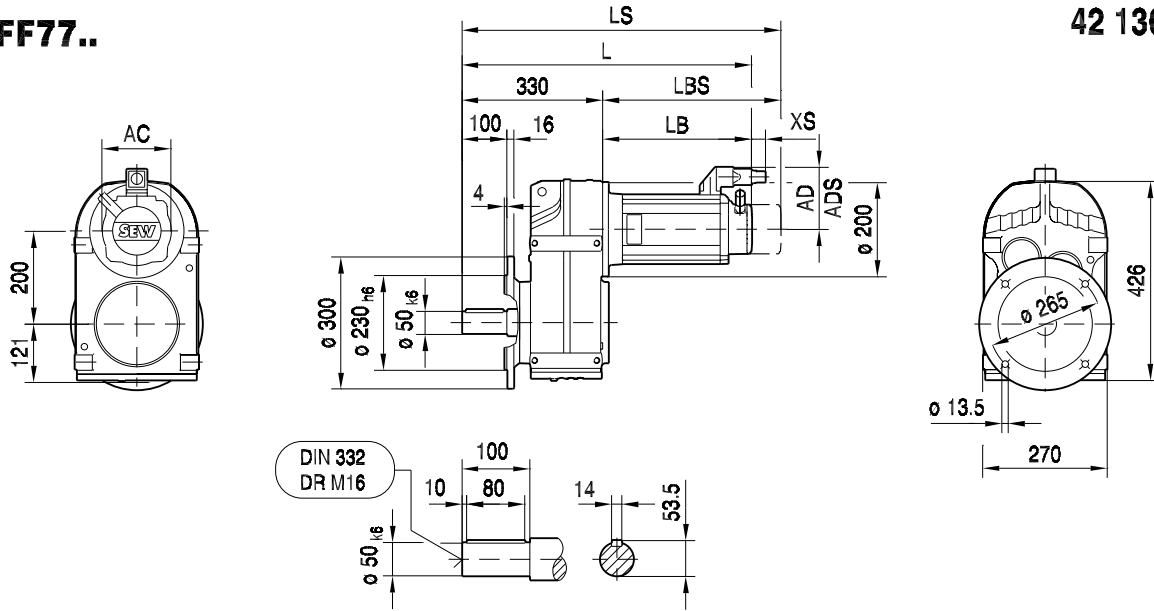


(→ 105)	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L	CM112S	CM112M	CM112L		
AC	117	117	117	142	142	142	186	186	186		
AD	122	122	122	140	140	140	162	162	162		
ADS	122	122	122	140	140	140	162	162	162		
L	520	540	579	570	597	651	606	633	695		
LS	602	622	661	666	693	747	696	723	785		
LB	226	246	285	276	303	357	312	339	401		
LBS	308	328	367	372	399	453	402	429	491		
XS	45	45	45	50	50	50	36	36	36		



**FF77..**

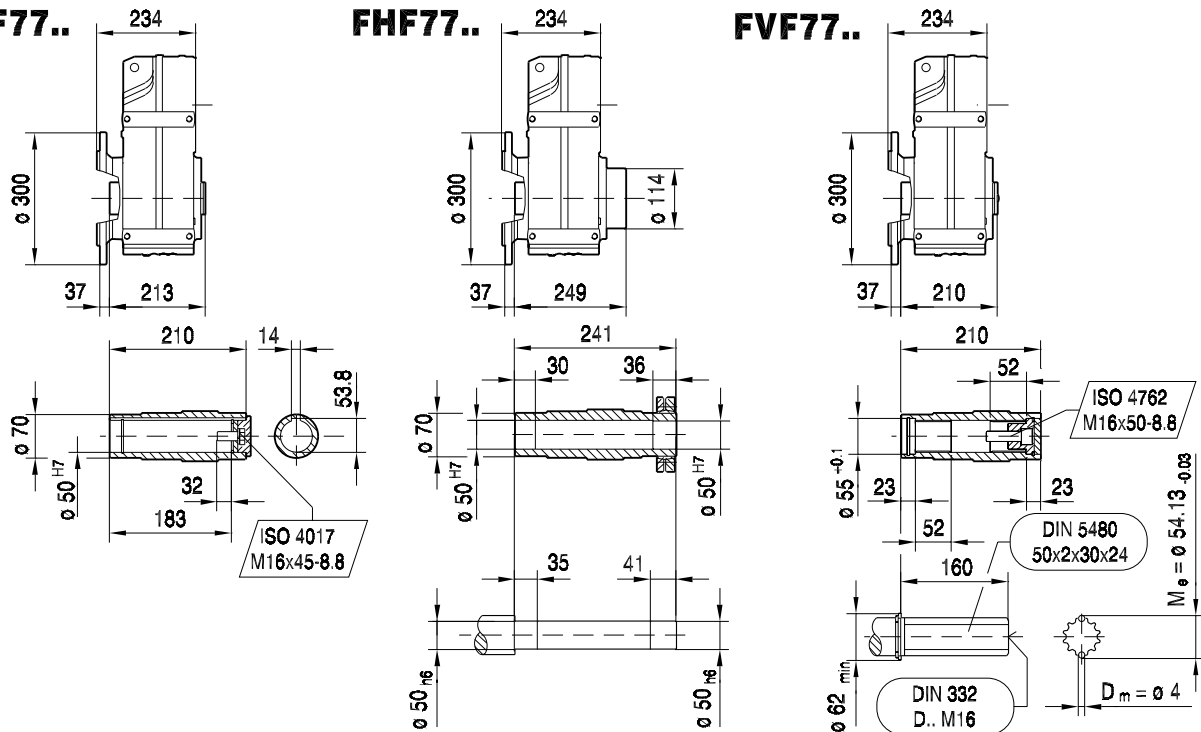
42 136 01 01



**FAF77..**

**FHF77..**

**FVF77..**

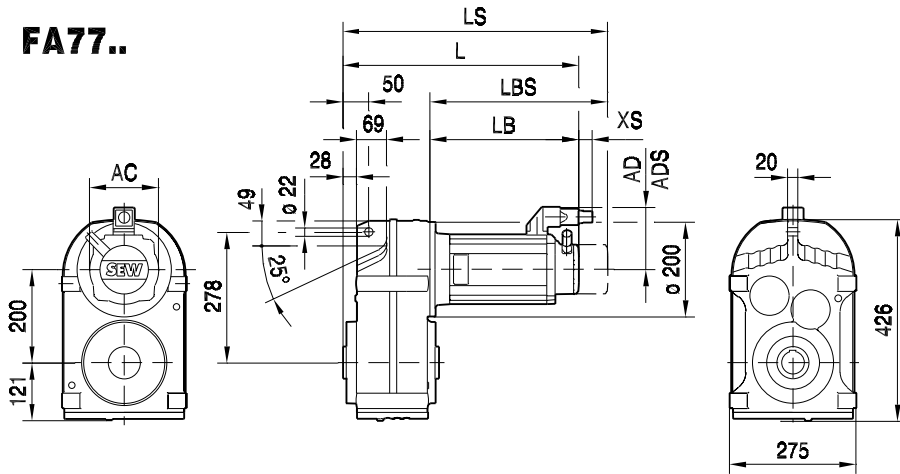


(→ 105)	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L	CM112S	CM112M	CM112L		
AC	117	117	117	142	142	142	186	186	186		
AD	122	122	122	140	140	140	162	162	162		
ADS	122	122	122	140	140	140	162	162	162		
L	556	576	615	606	633	687	642	669	731		
LS	638	658	697	702	729	783	732	759	821		
LB	226	246	285	276	303	357	312	339	401		
LBS	308	328	367	372	399	453	402	429	491		
XS	45	45	45	50	50	50	36	36	36		

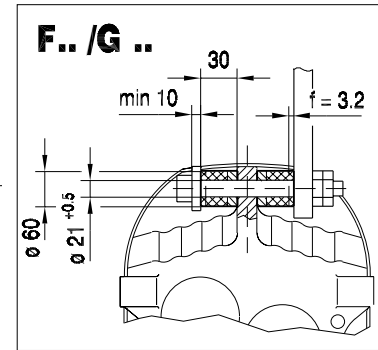


**F..DS/CM..**  
F..DS/CM..[mm]

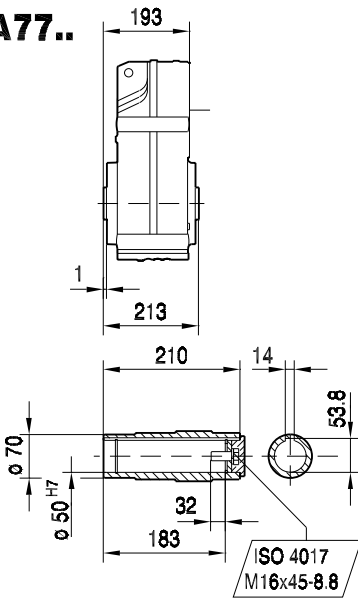
**FA77..**



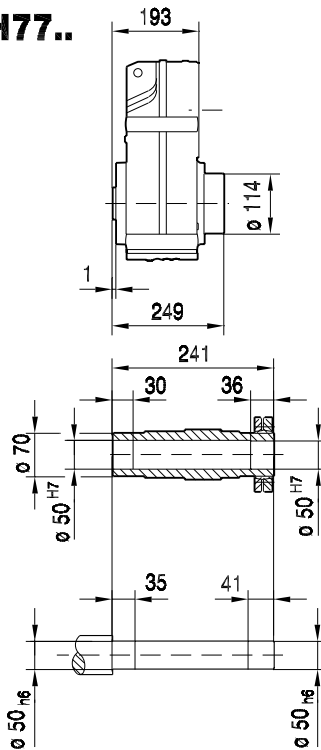
42 137 01 01



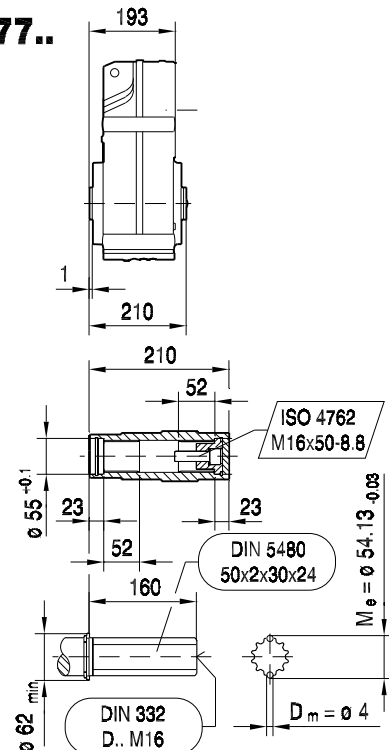
**FA77..**



**FH77..**



**FV77..**

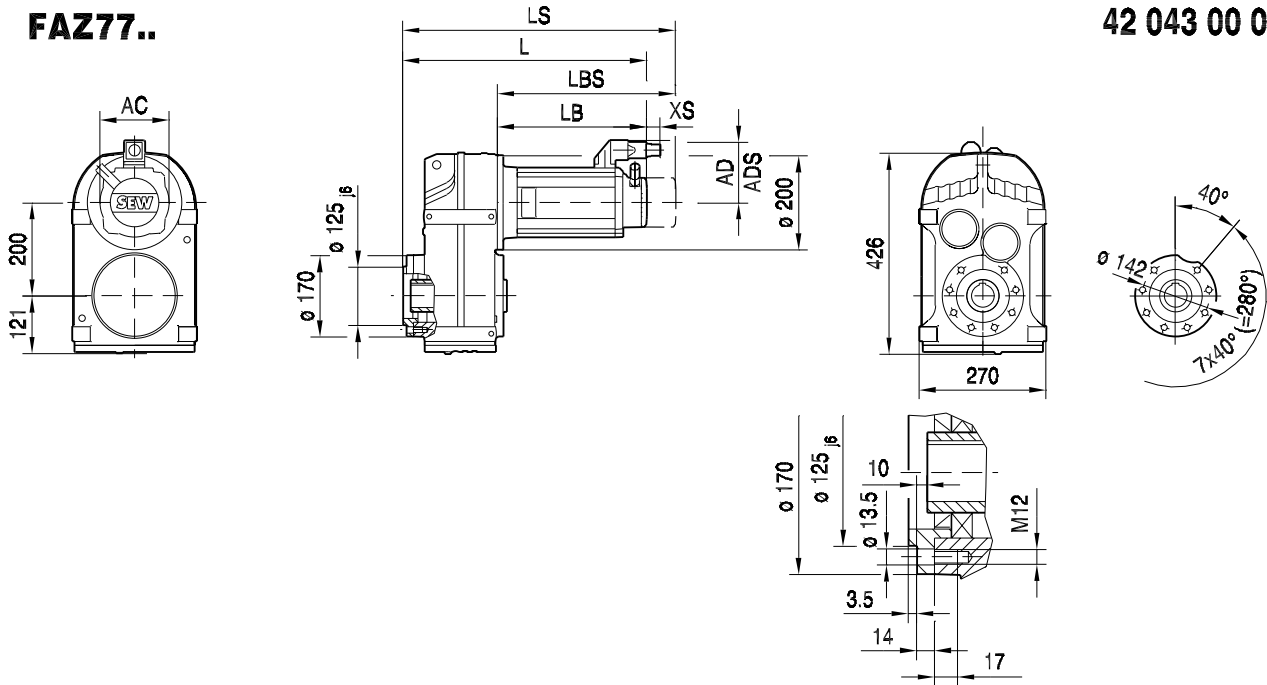


(→ 105)	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L	CM112S	CM112M	CM112L		
AC	117	117	117	142	142	142	186	186	186		
AD	122	122	122	140	140	140	162	162	162		
ADS	122	122	122	140	140	140	162	162	162		
L	419	439	478	469	496	550	505	532	594		
LS	501	521	560	565	592	646	595	622	684		
LB	226	246	285	276	303	357	312	339	401		
LBS	308	328	367	372	399	453	402	429	491		
XS	45	45	45	50	50	50	36	36	36		

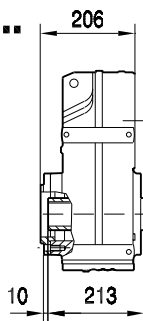


**FAZ77..**

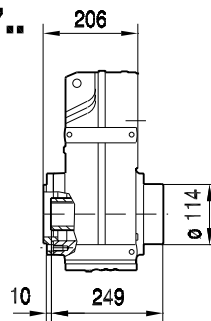
42 043 00 04



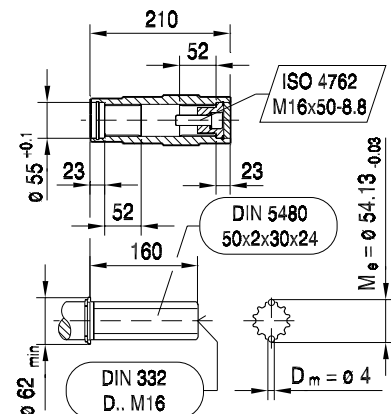
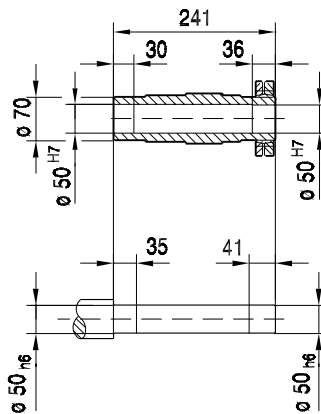
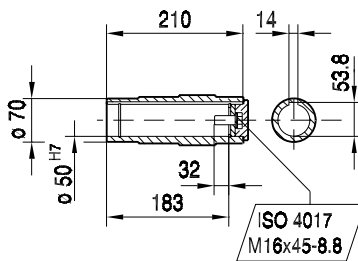
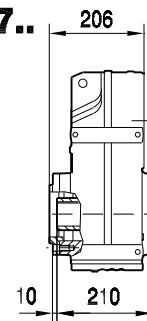
**FAZ77..**



**FHZ77..**



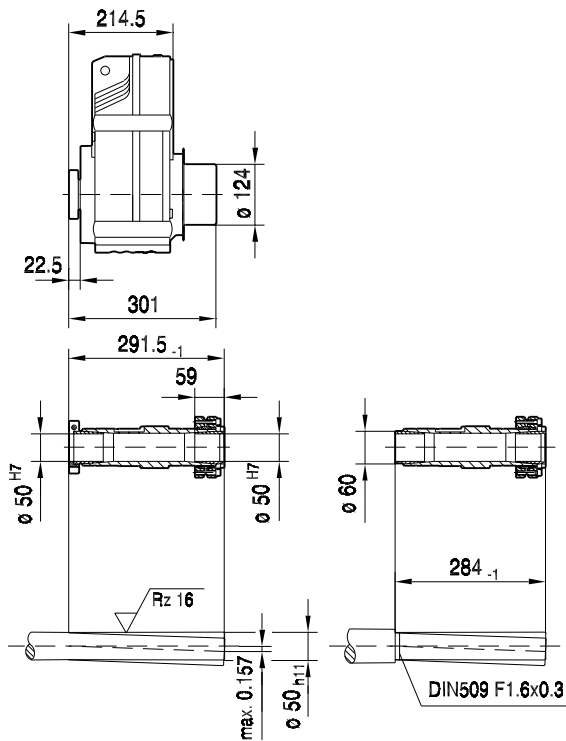
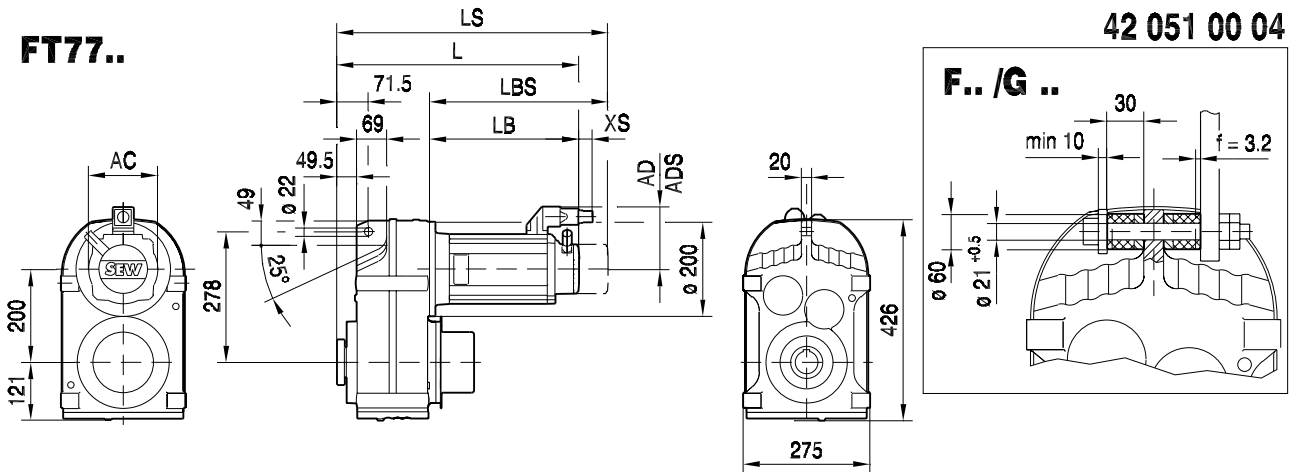
**FVZ77..**



(→ 105)	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L	CM112S	CM112M	CM112L		
AC	117	117	117	142	142	142	186	186	186		
AD	122	122	122	140	140	140	162	162	162		
ADS	122	122	122	140	140	140	162	162	162		
L	432	452	491	482	509	563	518	545	607		
LS	514	534	573	578	605	659	608	635	697		
LB	226	246	285	276	303	357	312	339	401		
LBS	308	328	367	372	399	453	402	429	491		
XS	45	45	45	50	50	50	36	36	36		



F..DS/CM..  
F..DS/CM..[mm]

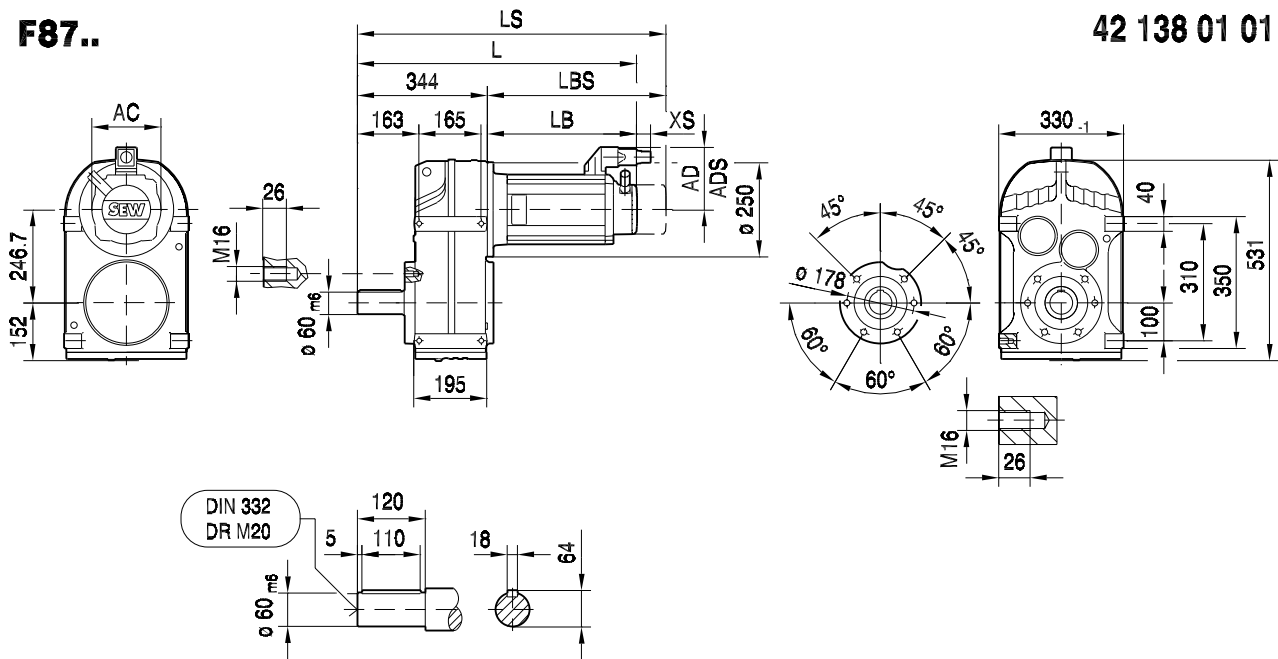


(→ 105)	CM71S	CM71M	CM71L	CM90S	CM90M	CM90L	CM112S	CM112M	CM112L		
AC	117	117	117	142	142	142	186	186	186		
AD	122	122	122	140	140	140	162	162	162		
ADS	122	122	122	140	140	140	162	162	162		
L	440	460	499	491	518	572	527	554	616		
LS	522	542	581	586	613	667	617	644	706		
LB	226	246	285	276	303	357	312	339	401		
LBS	308	328	367	372	399	453	402	429	491		
XS	45	45	45	50	50	50	36	36	36		



**F87..**

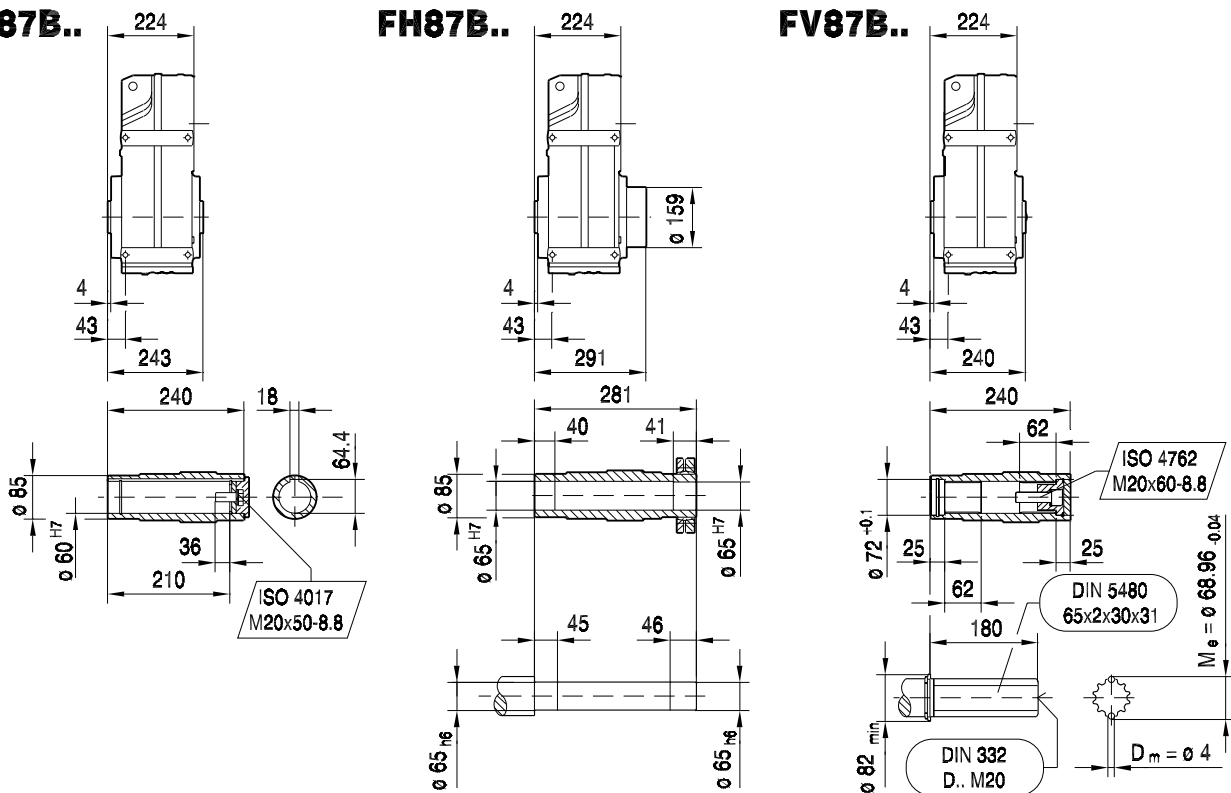
42 138 01 01



**FA87B..**

**FH87B..**

**FV87B..**



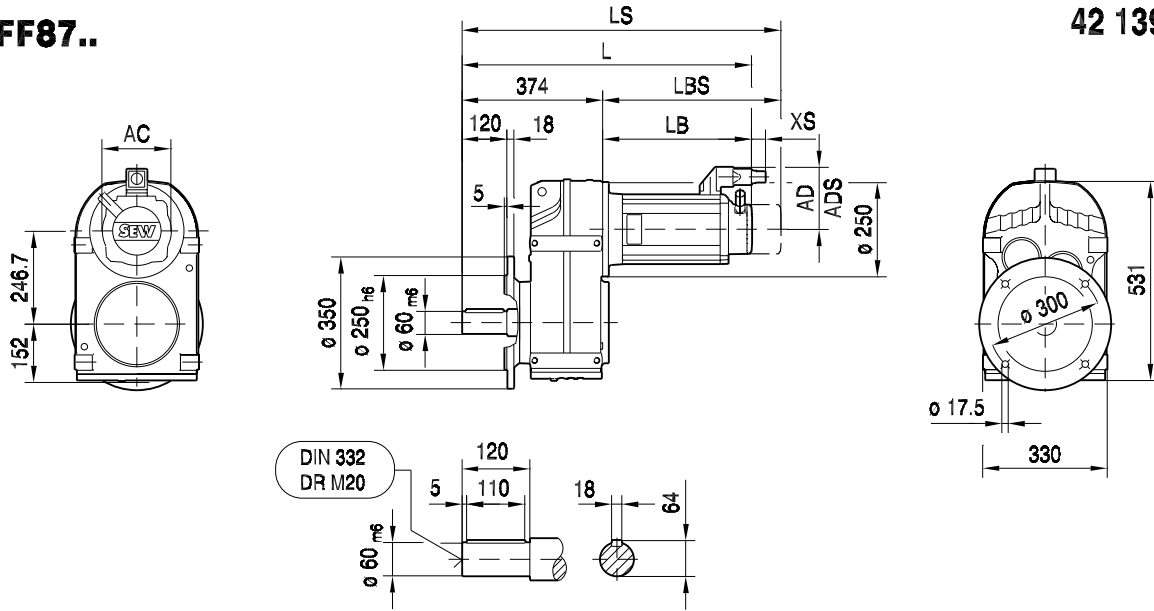
(→ 105)	CM90S	CM90M	CM90L	CM112S	CM112M	CM112L	CM112H			
AC	142	142	142	186	186	186	186			
AD	140	140	140	162	162	162	162			
ADS	140	140	140	162	162	162	162			
L	616	643	697	651	678	740	870			
LS	712	739	793	741	768	830	935			
LB	272	299	353	307	334	396	526			
LBS	368	395	449	397	424	486	591			
XS	50	50	50	36	36	36	36			



F..DS/CM..  
F..DS/CM..[mm]

**FF87..**

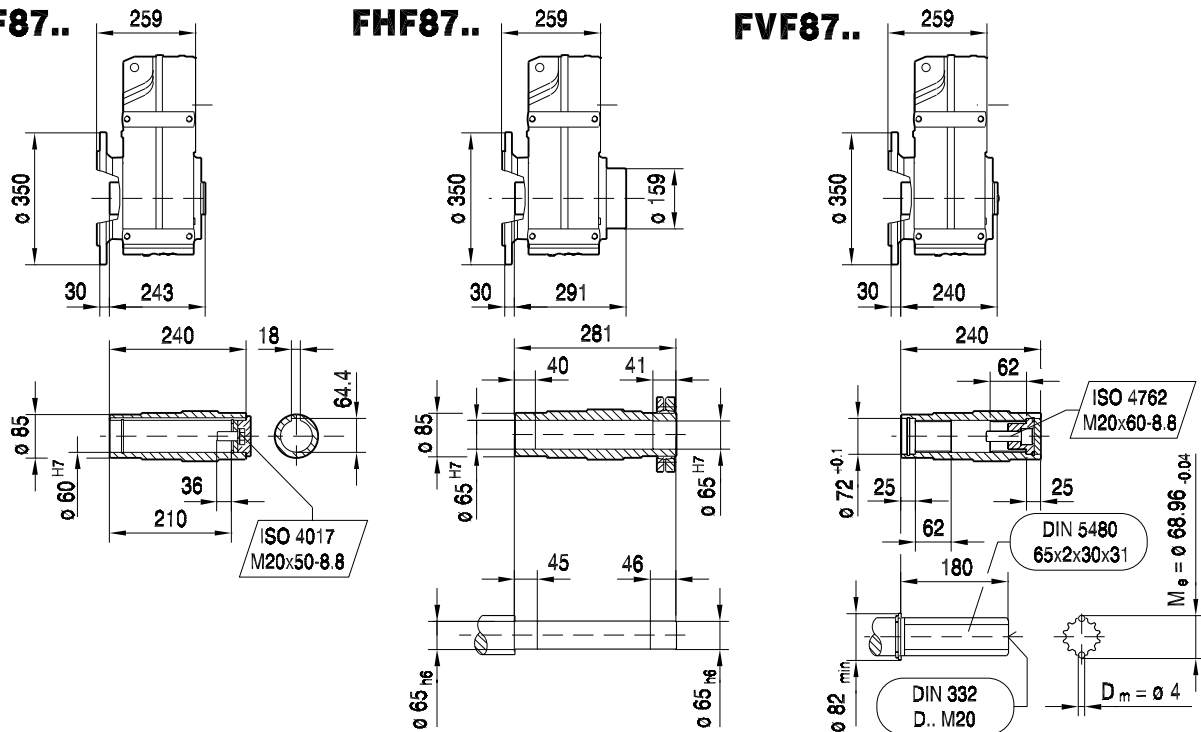
42 139 01 01



**FAF87..**

**FHF87..**

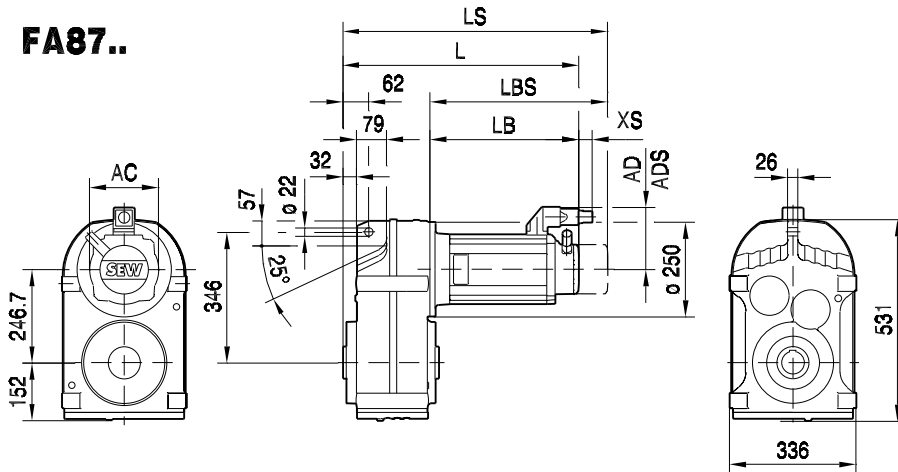
**FVF87..**



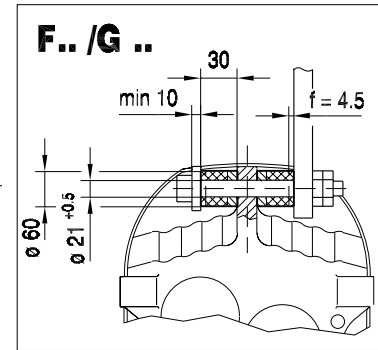
(→ 105)	CM90S	CM90M	CM90L	CM112S	CM112M	CM112L	CM112H			
AC	142	142	142	186	186	186	186			
AD	140	140	140	162	162	162	162			
ADS	140	140	140	162	162	162	162			
L	646	673	727	681	708	770	900			
LS	742	769	823	771	798	860	965			
LB	272	299	353	307	334	396	526			
LBS	368	395	449	397	424	486	591			
XS	50	50	50	36	36	36	36			



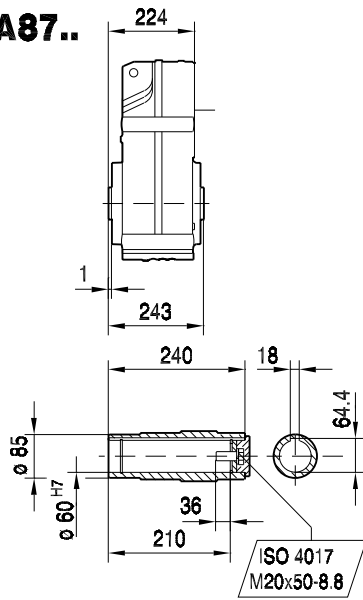
**FA87..**



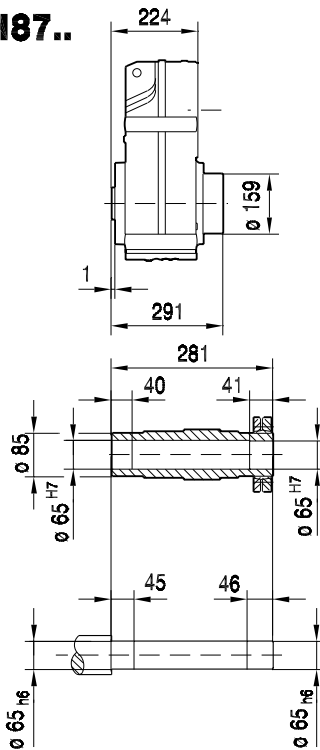
42 140 01 01



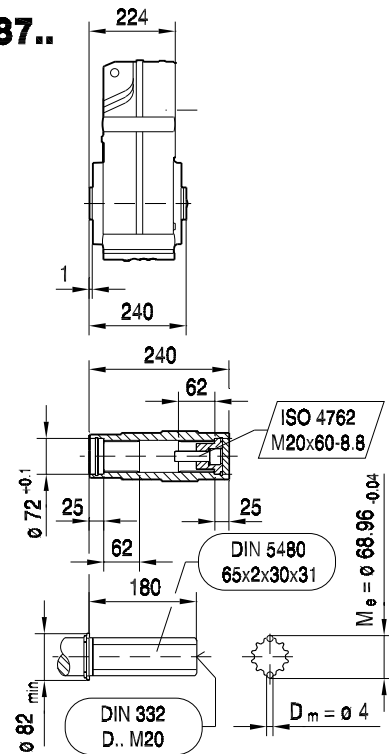
**FA87..**



**FH87..**



**FV87..**



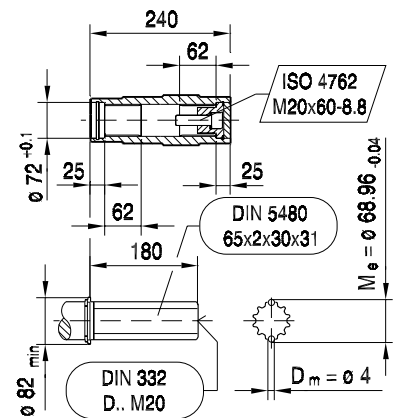
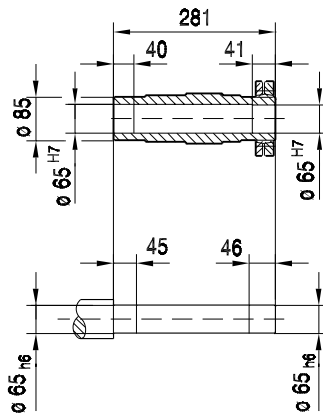
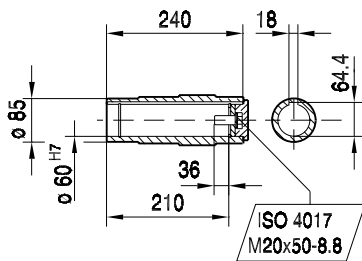
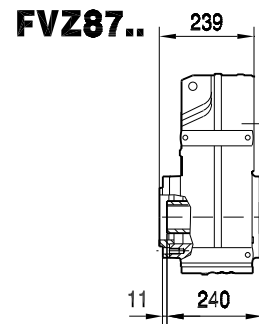
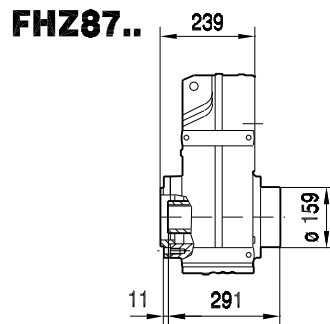
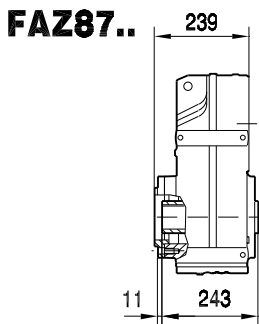
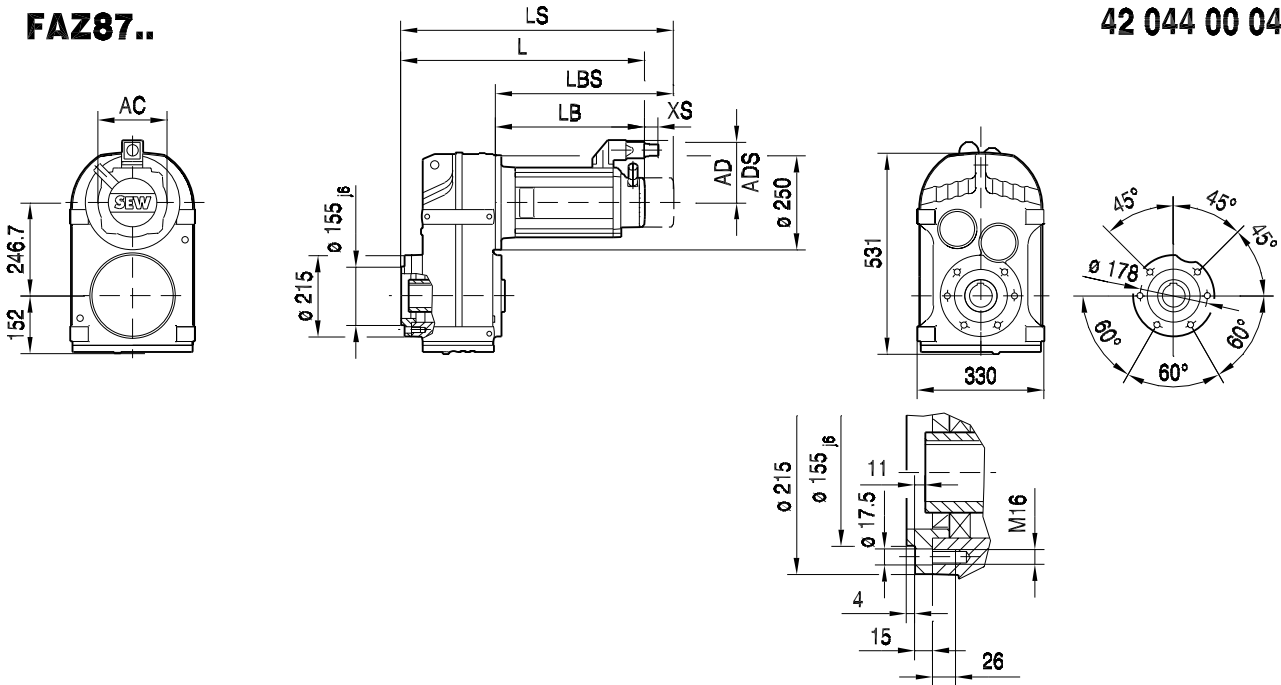
(→ 105)	CM90S	CM90M	CM90L	CM112S	CM112M	CM112L	CM112H			
AC	142	142	142	186	186	186	186			
AD	140	140	140	162	162	162	162			
ADS	140	140	140	162	162	162	162			
L	496	523	577	531	558	620	750			
LS	592	619	673	621	648	710	815			
LB	272	299	353	307	334	396	526			
LBS	368	395	449	397	424	486	591			
XS	50	50	50	36	36	36	36			



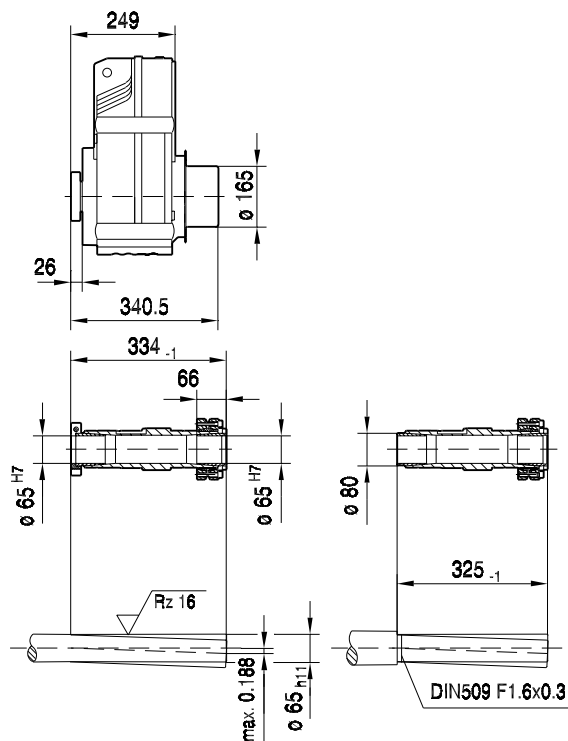
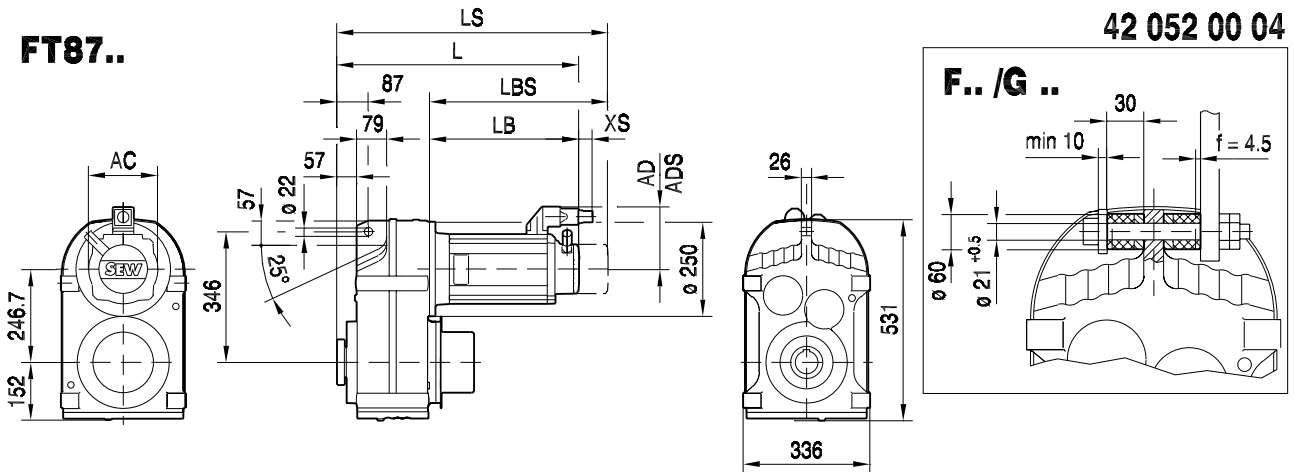
F..DS/CM..  
F..DS/CM..[mm]

**FAZ87..**

42 044 00 04



(→ 105)	CM90S	CM90M	CM90L	CM112S	CM112M	CM112L	CM112H			
AC	142	142	142	186	186	186	186			
AD	140	140	140	162	162	162	162			
ADS	140	140	140	162	162	162	162			
L	511	538	592	546	573	635	765			
LS	607	634	688	636	663	725	830			
LB	272	299	353	307	334	396	526			
LBS	368	395	449	397	424	486	591			
XS	50	50	50	36	36	36	36			



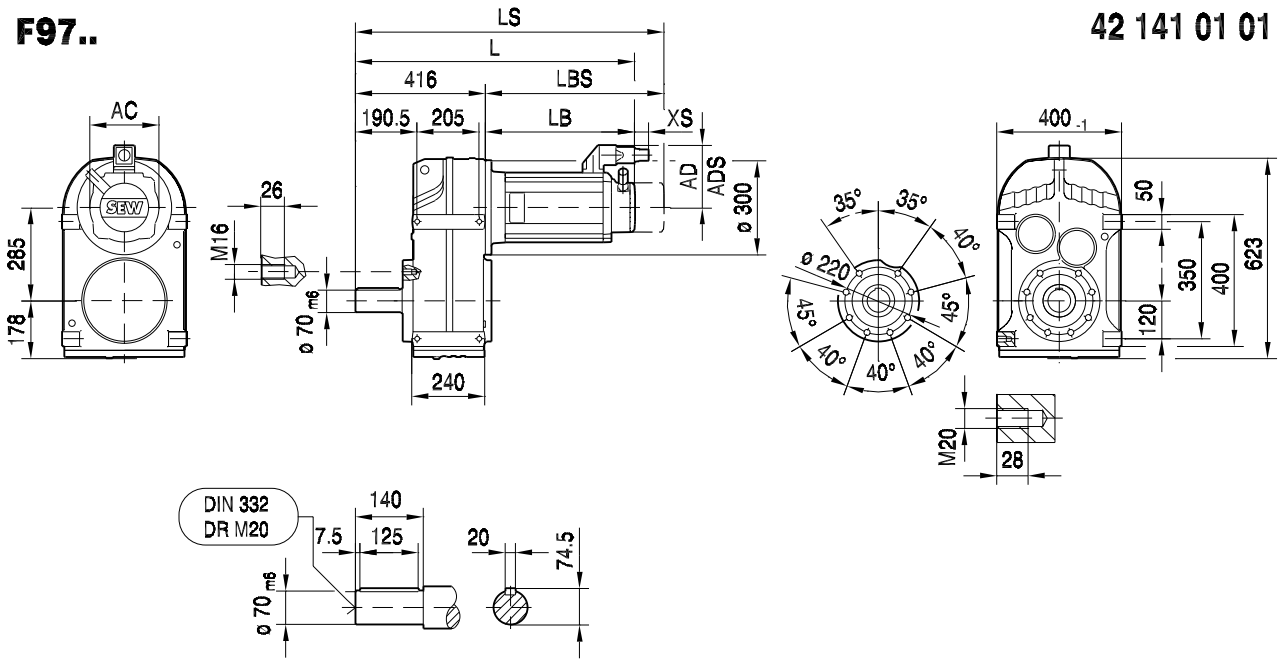
(→ 105)	CM90S	CM90M	CM90L	CM112S	CM112M	CM112L	CM112H			
AC	142	142	142	186	186	186	186			
AD	140	140	140	162	162	162	162			
ADS	140	140	140	162	162	162	162			
L	521	548	602	556	583	645	775			
LS	617	644	698	646	673	735	840			
LB	272	299	353	307	334	396	526			
LBS	368	395	449	397	424	486	591			
XS	50	50	50	36	36	36	36			



F..DS/CM..  
F..DS/CM..[mm]

F97..

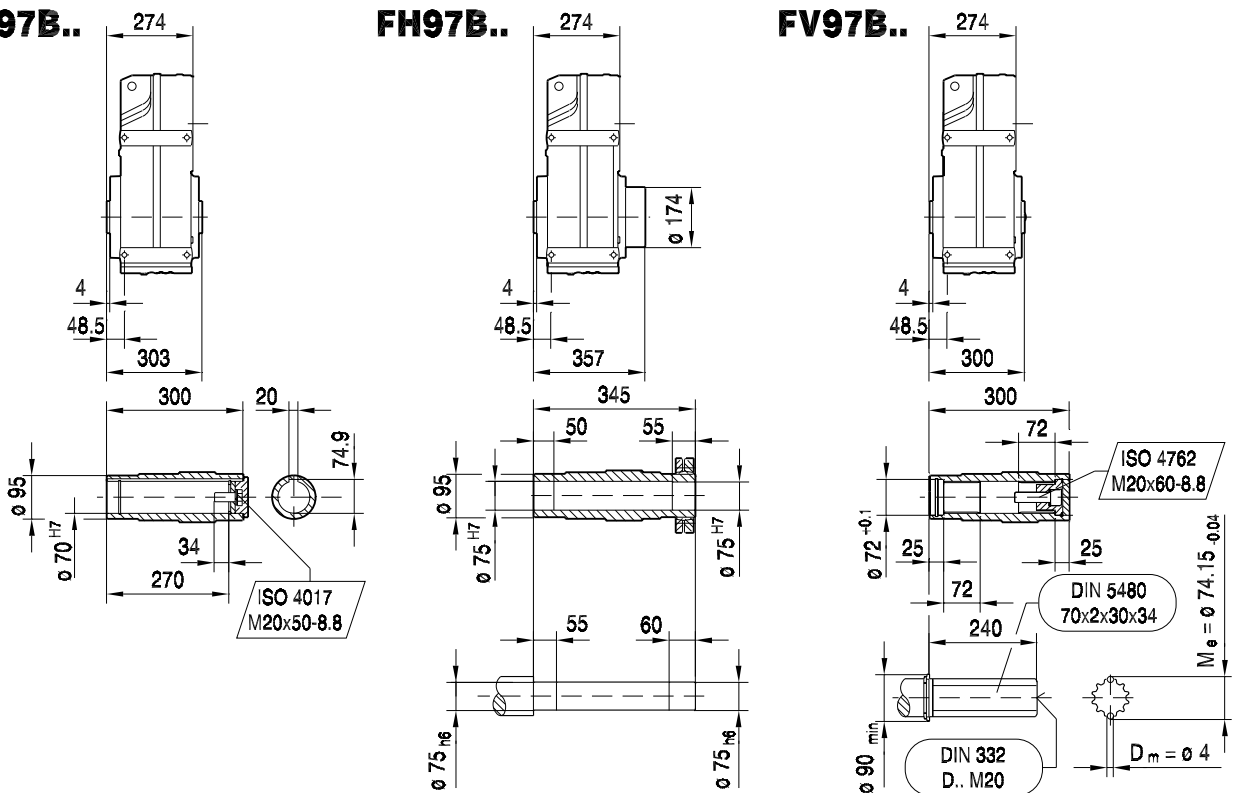
42 141 01 01



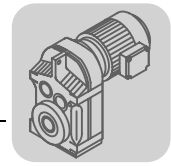
FA97B..

FH97B..

FV97B..

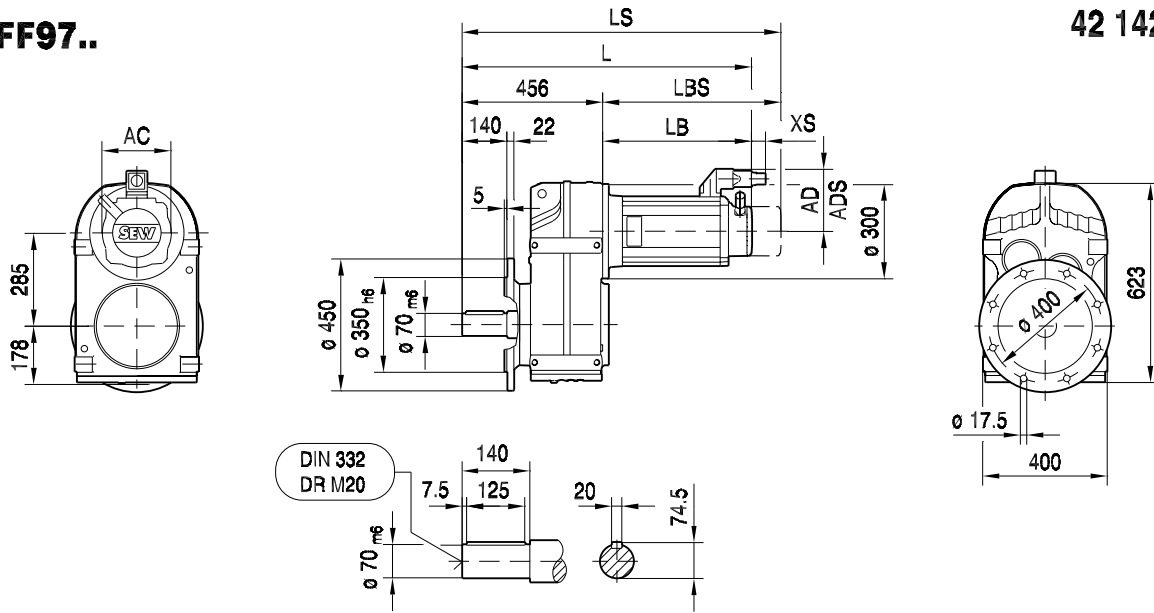


(→ 105)	CM90S	CM90M	CM90L	CM112S	CM112M	CM112L	CM112H				
AC	142	142	142	186	186	186	186				
AD	140	140	140	162	162	162	162				
ADS	140	140	140	162	162	162	162				
L	682	709	763	718	745	807	937				
LS	778	805	859	808	835	897	1002				
LB	266	293	347	302	329	391	521				
LBS	362	389	443	392	419	481	586				
XS	50	50	50	36	36	36	36				



**FF97..**

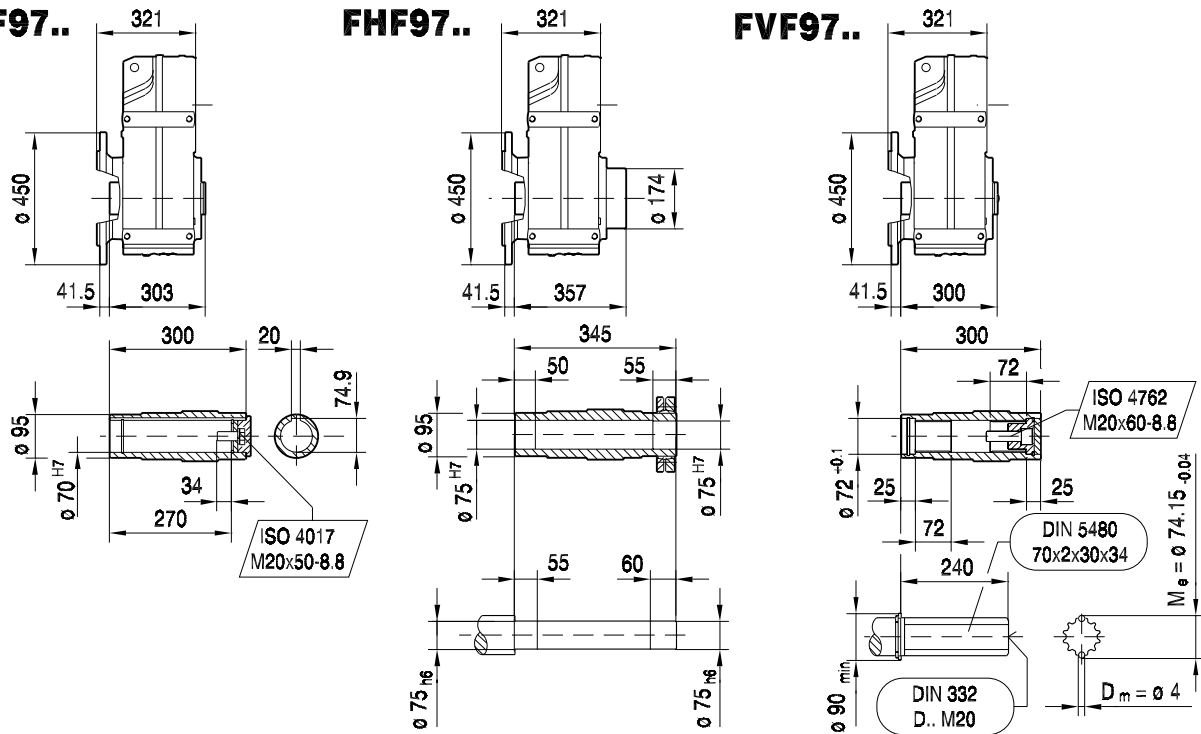
42 142 01 01



**FAF97..**

**FHF97..**

**FVF97..**

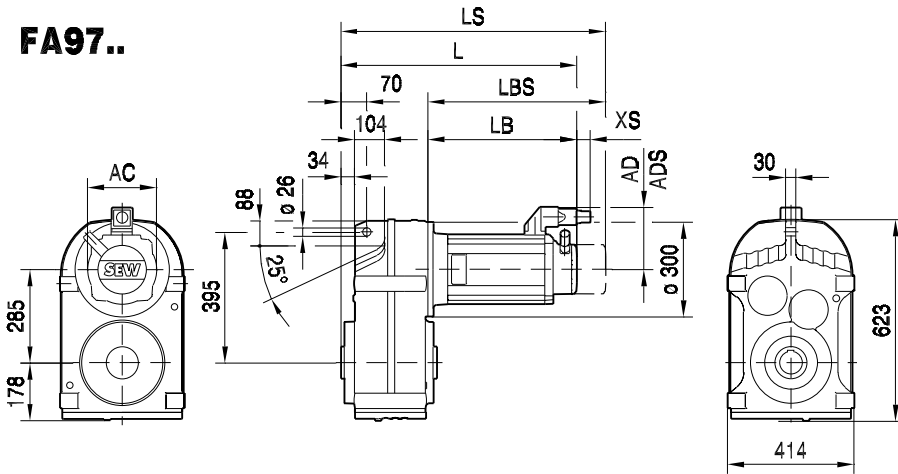


(→ 105)	CM90S	CM90M	CM90L	CM112S	CM112M	CM112L	CM112H			
AC	142	142	142	186	186	186	186			
AD	140	140	140	162	162	162	162			
ADS	140	140	140	162	162	162	162			
L	722	749	803	758	785	847	977			
LS	818	845	899	848	875	937	1042			
LB	266	293	347	302	329	391	521			
LBS	362	389	443	392	419	481	586			
XS	50	50	50	36	36	36	36			

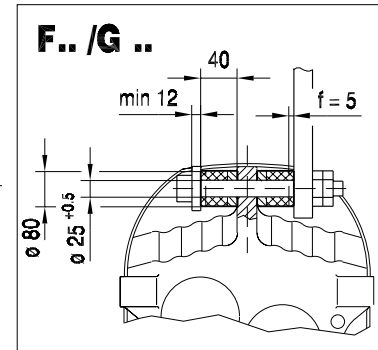


F..DS/CM..  
F..DS/CM..[mm]

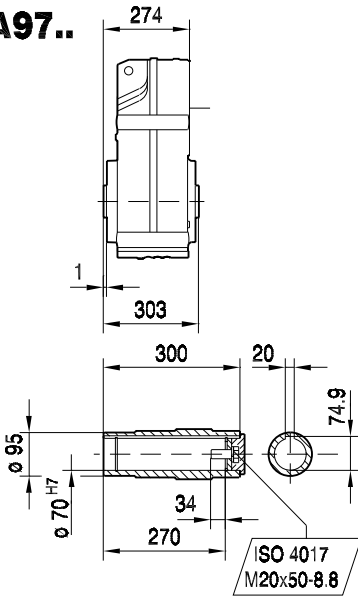
FA97..



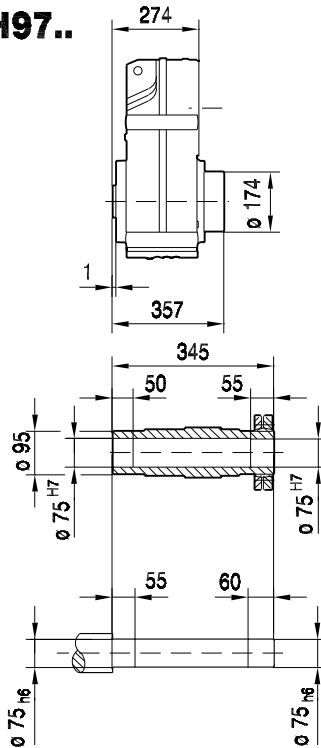
42 143 01 01



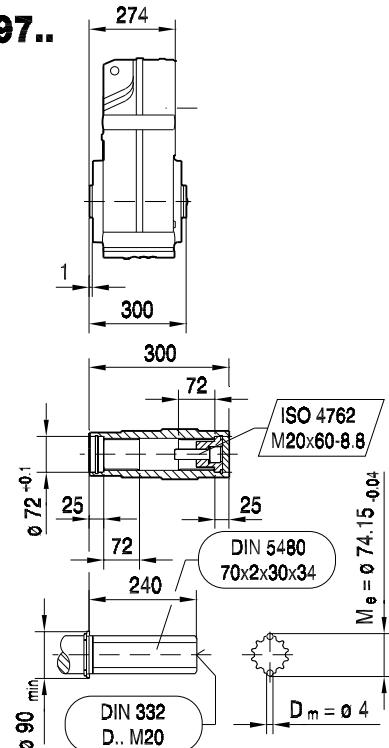
FA97..



FH97..



FV97..

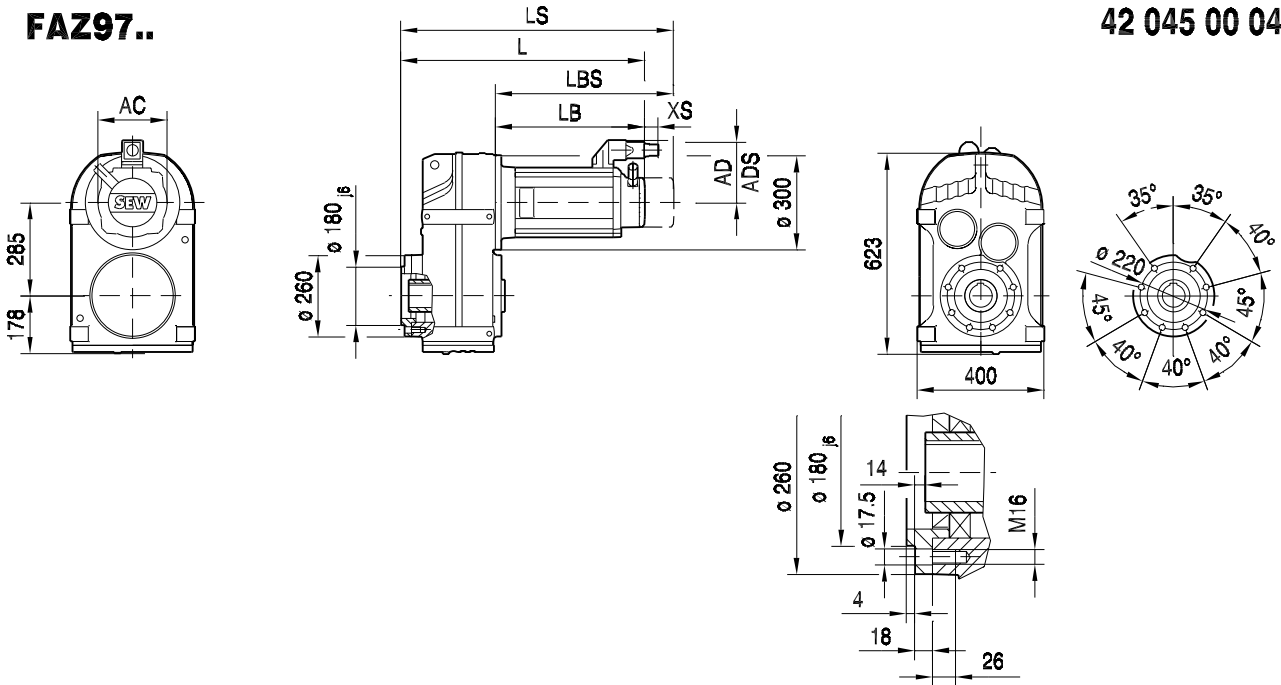


(→ 105)	CM90S	CM90M	CM90L	CM112S	CM112M	CM112L	CM112H			
AC	142	142	142	186	186	186	186			
AD	140	140	140	162	162	162	162			
ADS	140	140	140	162	162	162	162			
L	540	567	621	576	603	665	795			
LS	636	663	717	666	693	755	860			
LB	266	293	347	302	329	391	521			
LBS	362	389	443	392	419	481	586			
XS	50	50	50	36	36	36	36			

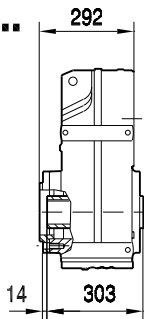


**FAZ97..**

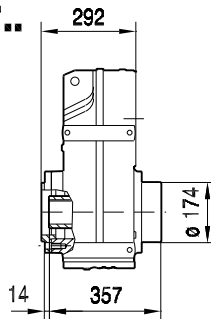
42 045 00 04



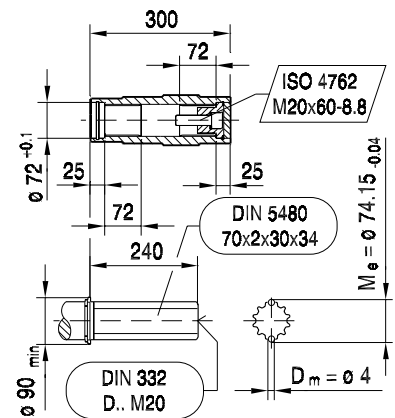
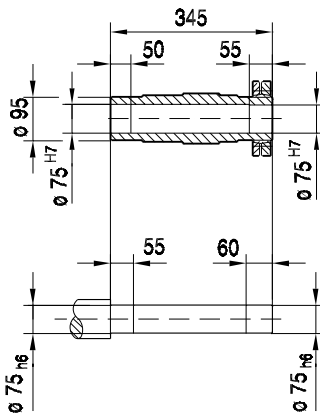
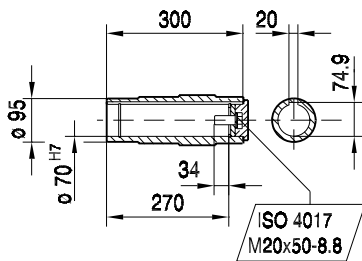
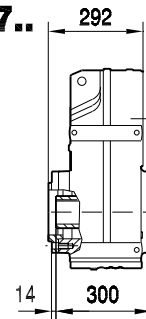
**FAZ97..**



**FHZ97..**



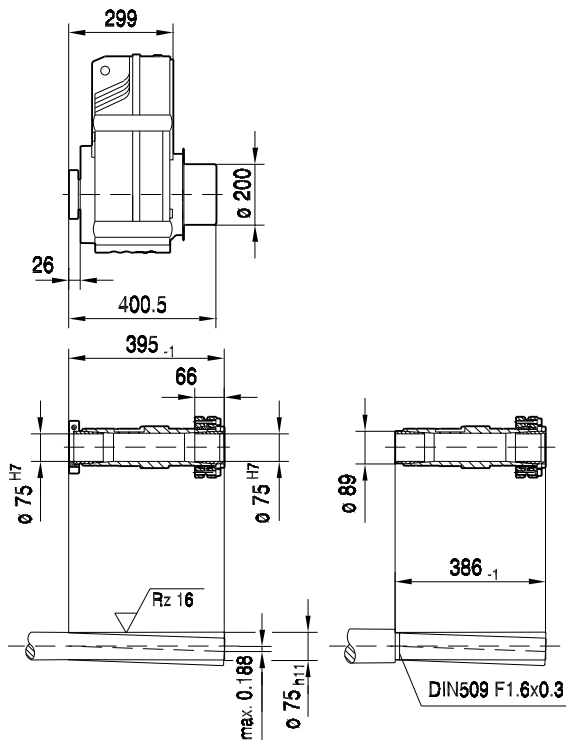
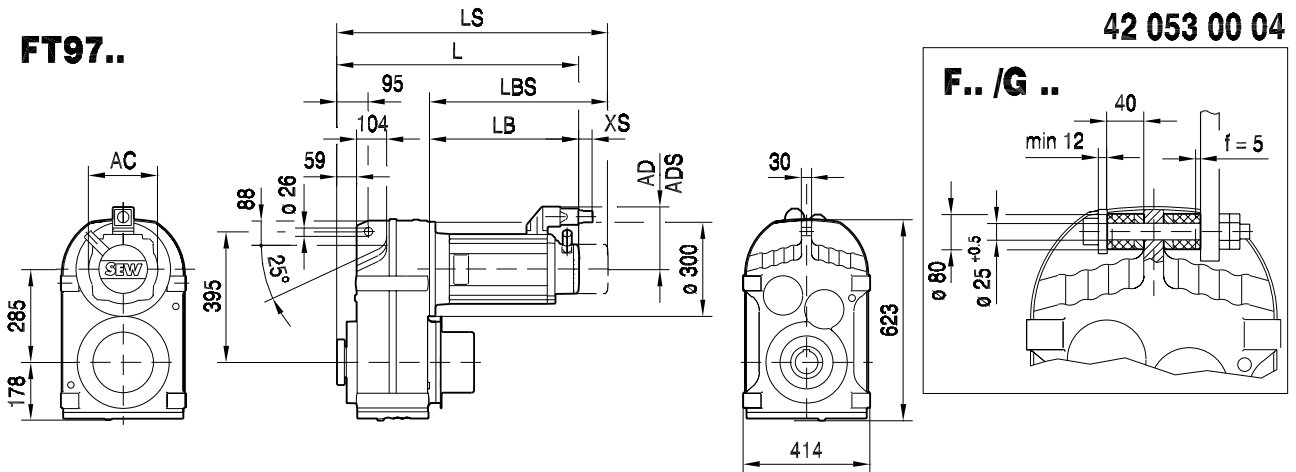
**FVZ97..**



(→ 105)	CM90S	CM90M	CM90L	CM112S	CM112M	CM112L	CM112H			
AC	142	142	142	186	186	186	186			
AD	140	140	140	162	162	162	162			
ADS	140	140	140	162	162	162	162			
L	558	585	639	594	621	683	813			
LS	654	681	735	684	711	773	878			
LB	266	293	347	302	329	391	521			
LBS	362	389	443	392	419	481	586			
XS	50	50	50	36	36	36	36			



**F..DS/CM..**  
**F..DS/CM..[mm]**

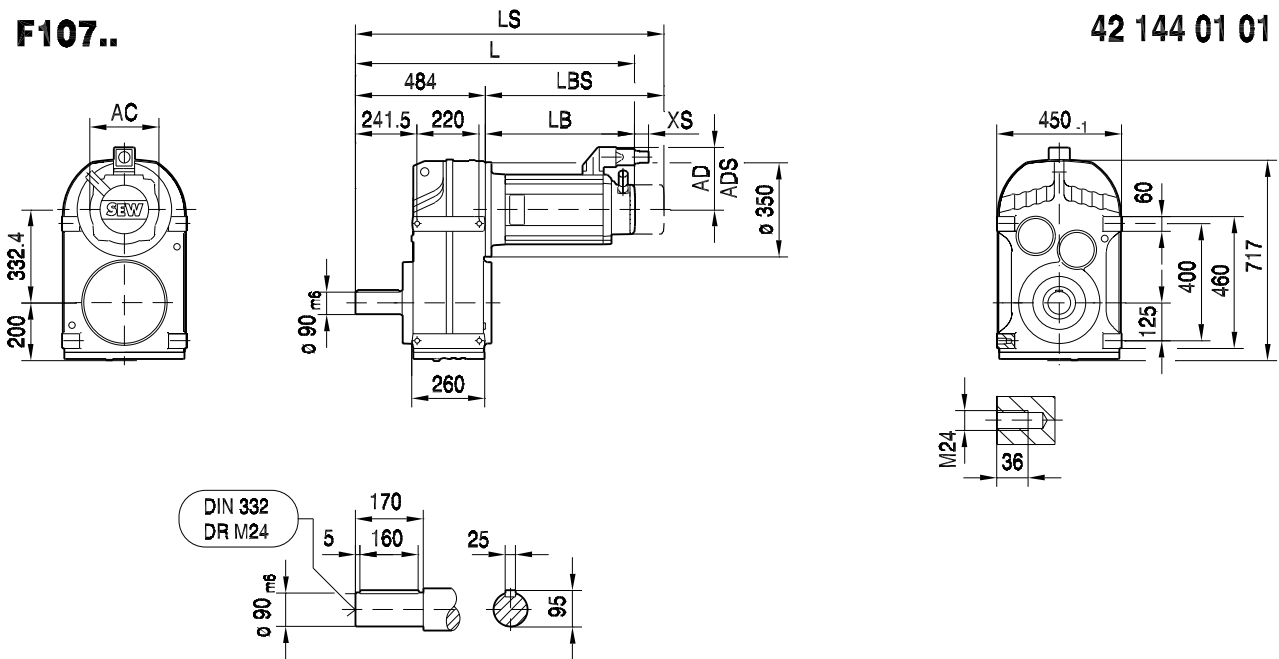


(→ 105)	CM90S	CM90M	CM90L	CM112S	CM112M	CM112L	CM112H			
AC	142	142	142	186	186	186	186			
AD	140	140	140	162	162	162	162			
ADS	140	140	140	162	162	162	162			
L	565	592	646	601	628	690	820			
LS	661	688	742	691	718	780	885			
LB	266	293	347	302	329	391	521			
LBS	362	389	443	392	419	481	586			
XS	50	50	50	36	36	36	36			



**F107..**

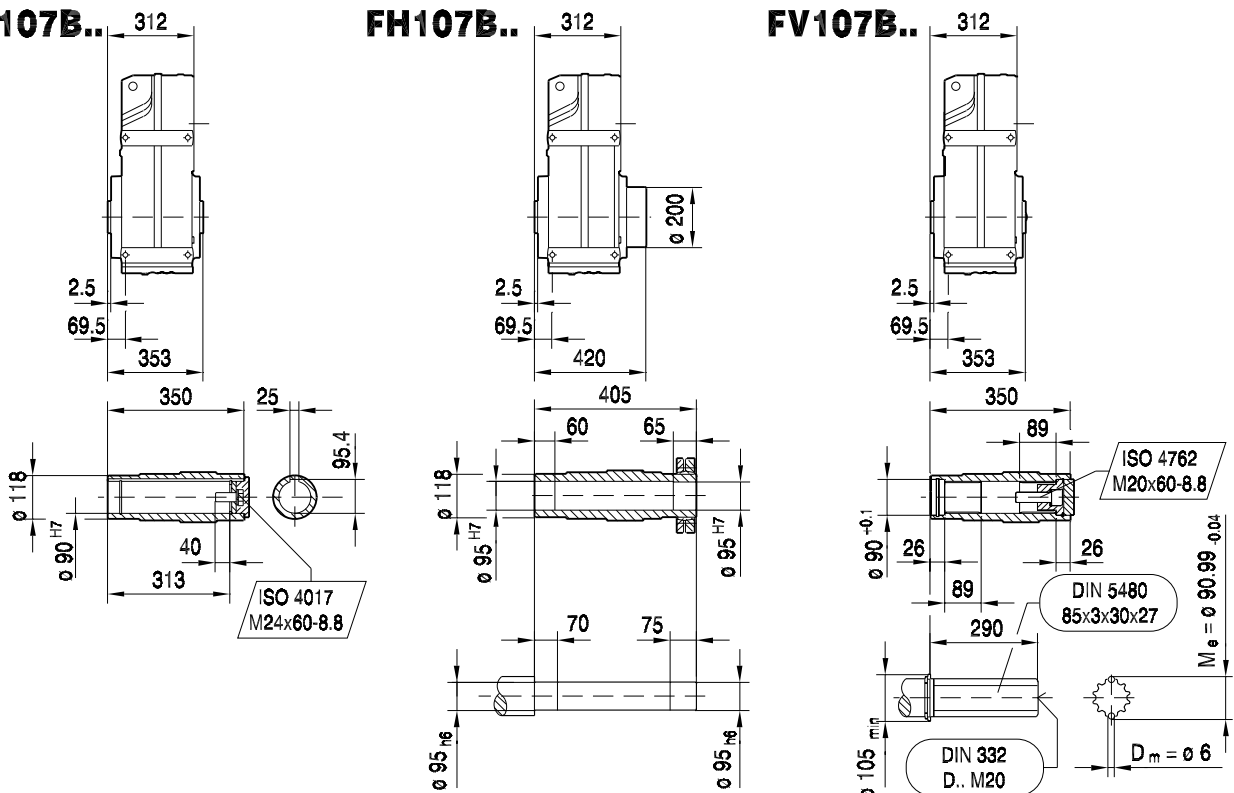
42 144 01 01



**FA107B..**

**FH107B..**

**FV107B..**



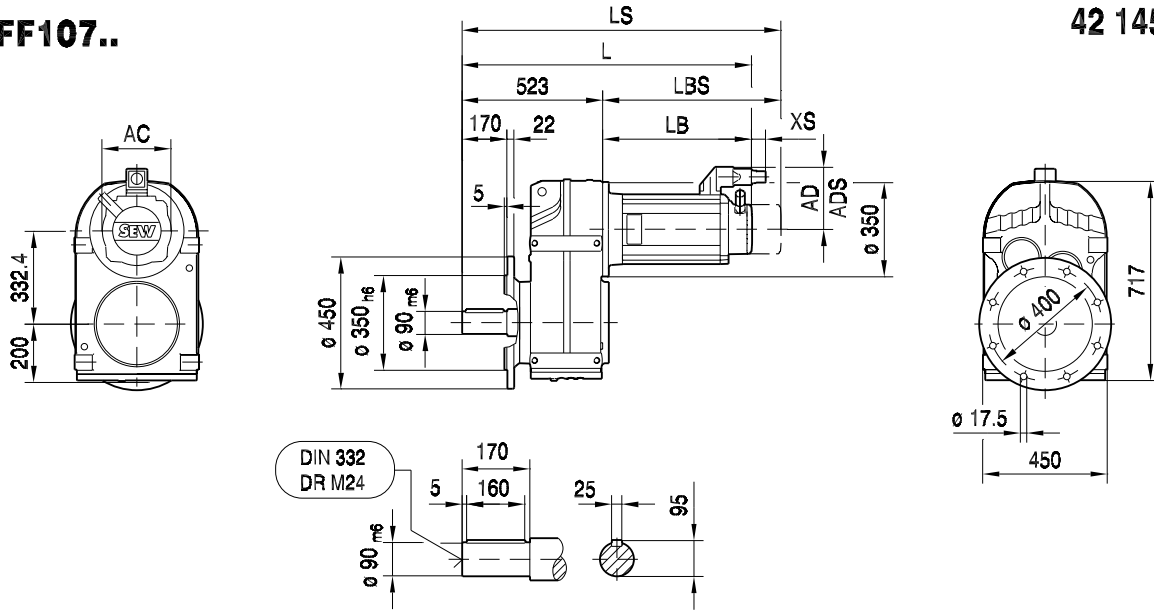
(→ 105)	CM112S	CM112M	CM112L	CM112H					
AC	186	186	186	186					
AD	162	162	162	162					
ADS	162	162	162	162					
L	780	807	869	999					
LS	870	897	959	1064					
LB	296	323	385	515					
LBS	386	413	475	580					
XS	36	36	36	36					



F..DS/CM..  
F..DS/CM..[mm]

**FF107..**

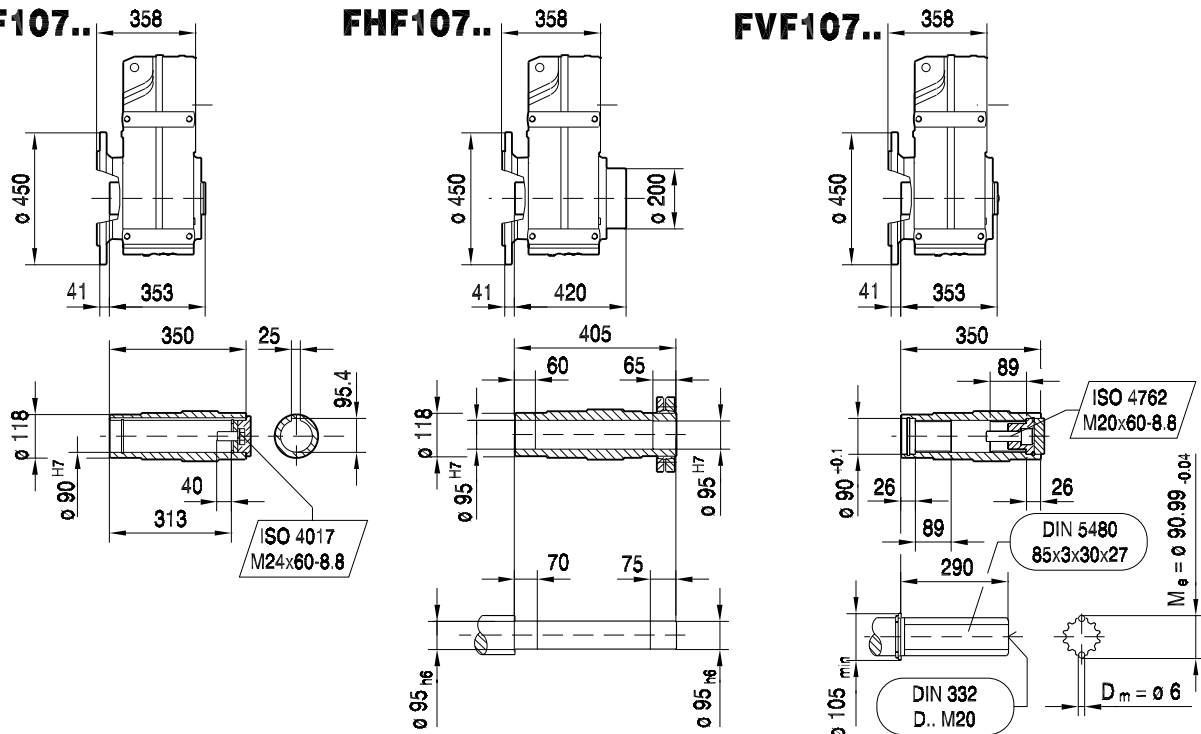
42 145 01 01



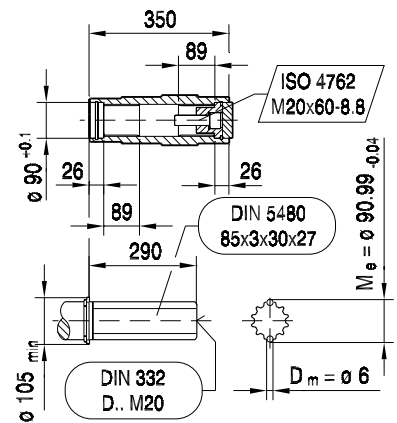
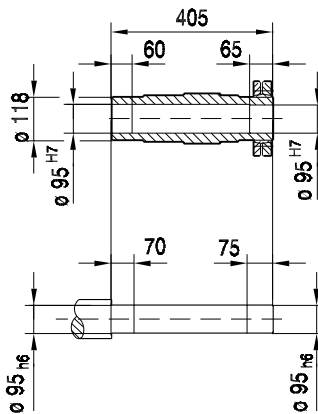
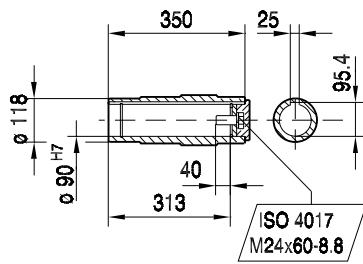
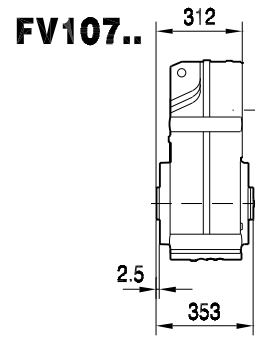
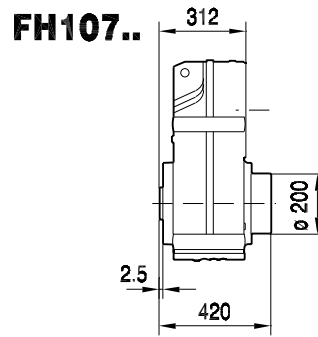
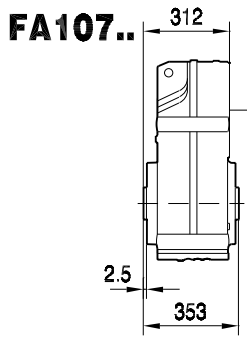
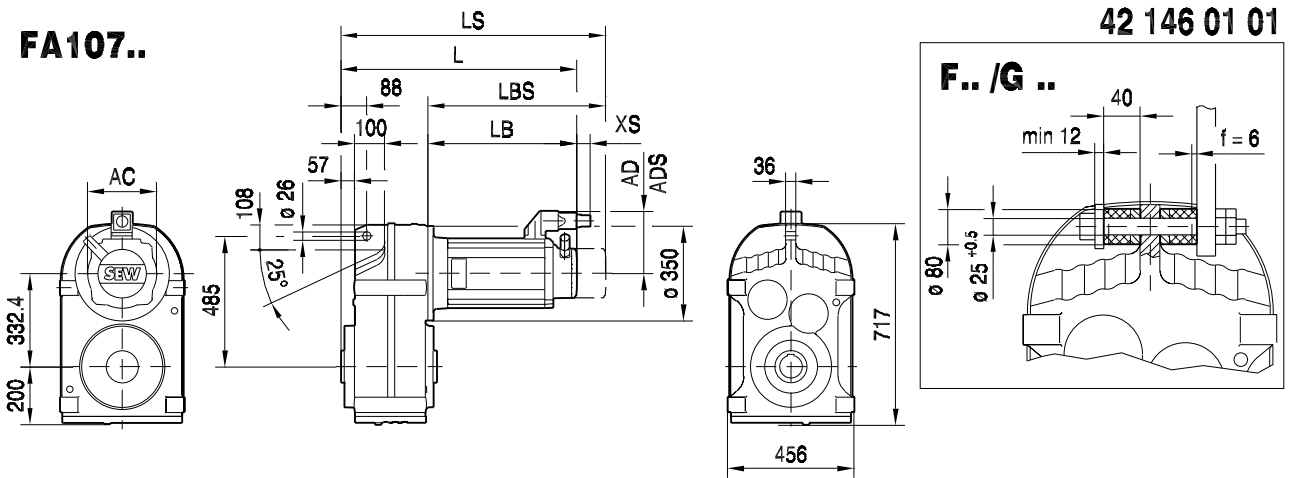
**FAF107..**

**FHF107..**

**FVF107..**



(→ 105)	CM112S	CM112M	CM112L	CM112H					
AC	186	186	186	186					
AD	162	162	162	162					
ADS	162	162	162	162					
L	819	846	908	1038					
LS	909	936	998	1103					
LB	296	323	385	515					
LBS	386	413	475	580					
XS	36	36	36	36					



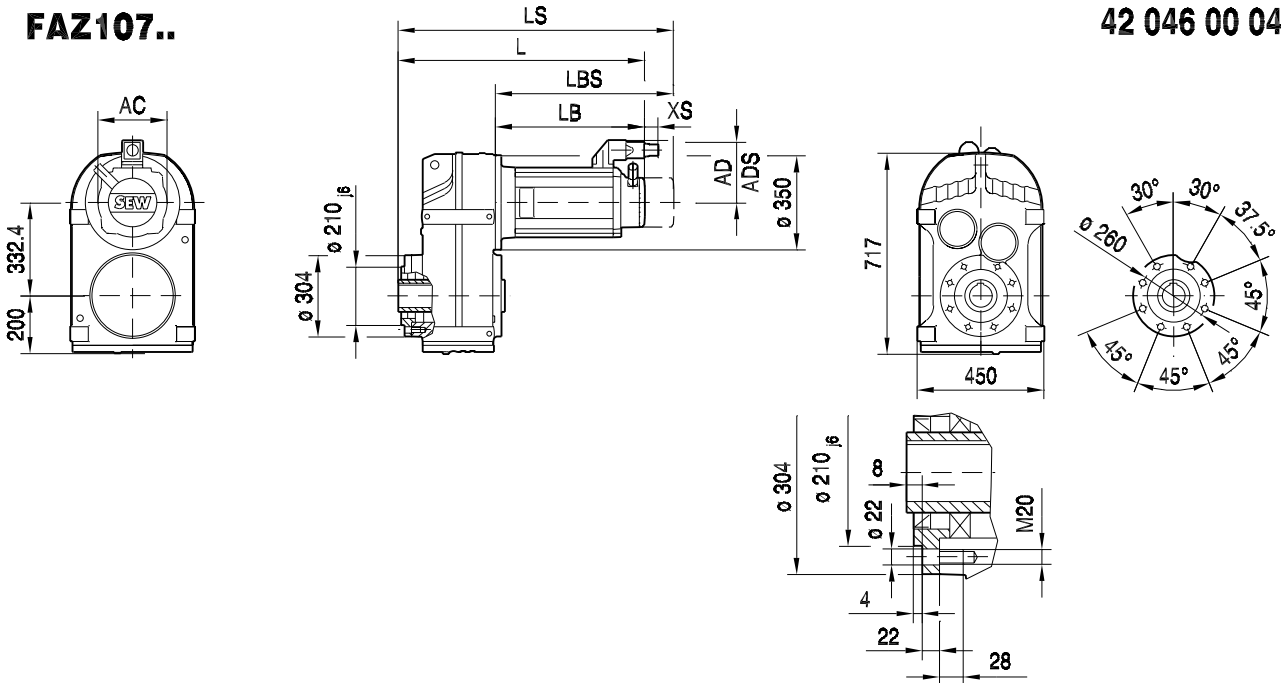
(→ 105)	CM112S	CM112M	CM112L	CM112H						
AC	186	186	186	186						
AD	162	162	162	162						
ADS	162	162	162	162						
L	608	635	697	827						
LS	698	725	787	892						
LB	296	323	385	515						
LBS	386	413	475	580						
XS	36	36	36	36						



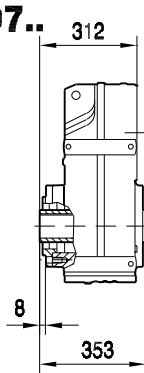
F..DS/CM..  
F..DS/CM..[mm]

42 046 00 04

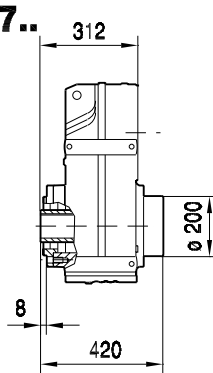
**FAZ107..**



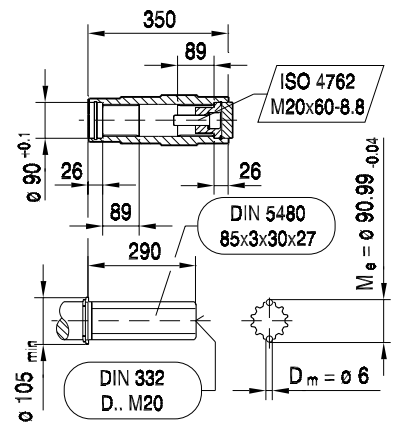
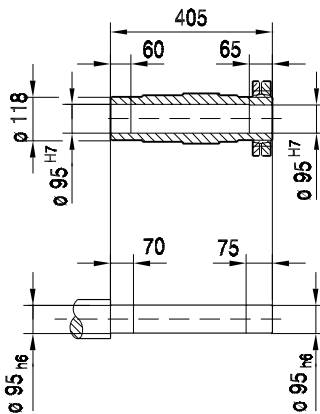
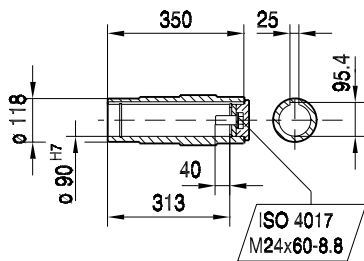
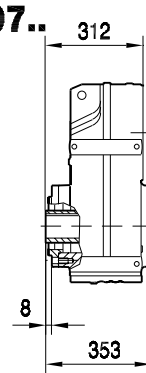
**FAZ107..**



**FHZ107..**



**FVZ107..**



(→ 105)	CM112S	CM112M	CM112L	CM112H						
AC	186	186	186	186						
AD	162	162	162	162						
ADS	162	162	162	162f						
L	608	635	697	827						
LS	698	725	787	892						
LB	296	323	385	515						
LBS	386	413	475	580						
XS	36	36	36	36						



