Gear units and geared motors for passenger transportation

Brochure · September 2008

CAVEX

SIEMENS

Catalogs

MOTOX Geared Motors D 87.1

E86060-K5287-A111-A2-7600

Low-Voltage Motors D 81.1
Squirrel-Cage Motors

E86060-K5581-A111-A2-7600

SINAMICS G110/SINAMICS G120 D 11.1
Inverter Chassis Units
SINAMICS G120D
Distributed Frequency Inverter

E86060-K5511-A111-A5-7600

SINAMICS G130 D 11
Drive Converter Chassis Units
SINAMICS G150
Drive Converter Cabinet Units

E86060-K5511-A101-A4-7600

MICROMASTER DA 51.2
MICROMASTER 420/430/440
Inverters
0.12 kW to 250 kW

E86060-K5151-A121-A6-7600

MICROMASTER/COMBIMASTER DA 51.3
MICROMASTER 411 Inverters
COMBIMASTER 411
Distributed Drive Solutions

E86060-K5251-A131-A2-7600

Industrial Communication IK PI
Part 5:
ET 200 Distributed I/O
ET 200S FC Frequency Converter

E86060-K6710-A101-B6-7600

AC NEMA & IEC Motors D81.2
Further details available U.S./
on the Internet at: Canada

Only PDF
http://www.sea.siemens.com/motors

MOTOX Konfigurator MOTOX
MOTOX Configurator
Information/Configuration
(CD)

E86060-D5203-A100-A2-X100

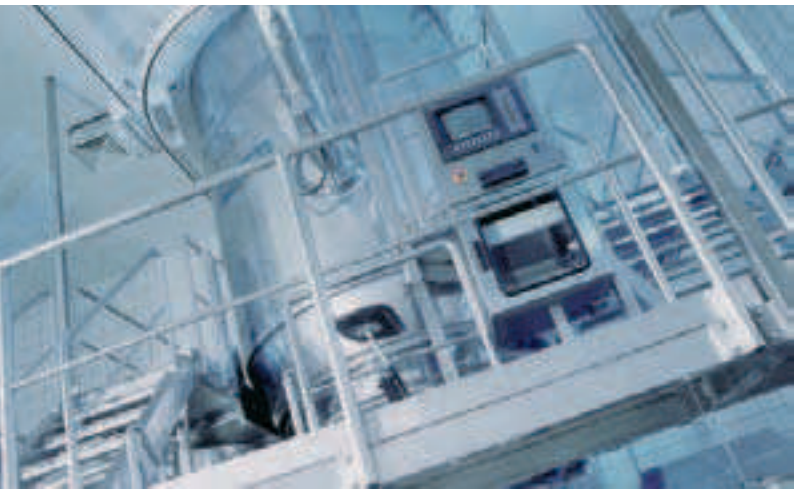
Additional documentation

You will find all information material, such as brochures, catalogs, manuals and operating instructions for standard drive systems up-to-date on the Internet at the address:

http://www.siemens.com/gearedmotors

You can order the listed documentation or download it in common file formats (PDF, ZIP).

Contents



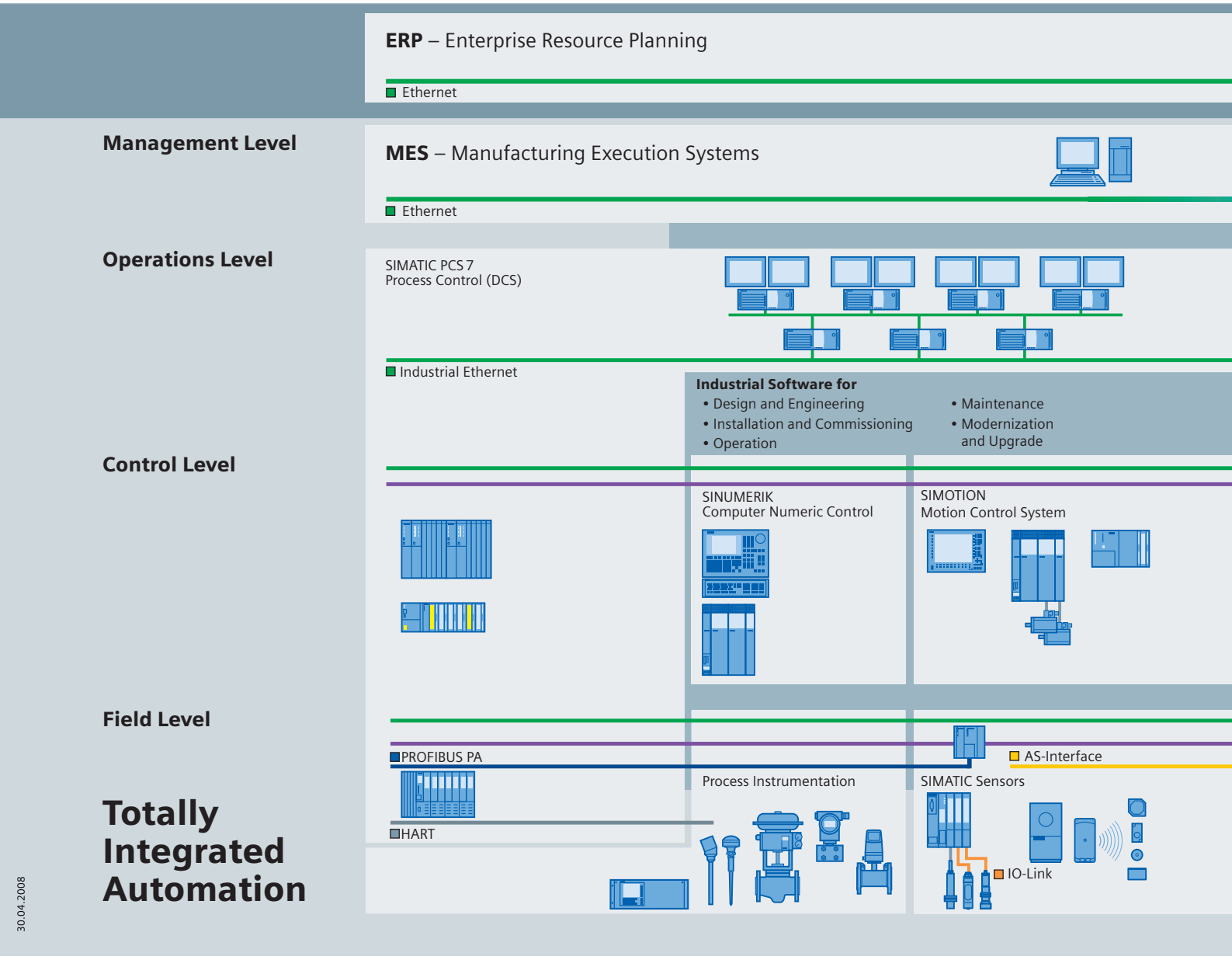
Answers for Industry.

Siemens Industry answers the challenges in the manufacturing and the process industry as well as in the building automation business. Our drive and automation solutions based on Totally Integrated Automation (TIA) and Totally Integrated Power (TIP) are employed in all kinds of industry. In the manufacturing and the process industry. In industrial as well as in functional buildings.

Siemens offers automation, drive, and low-voltage switching technology as well as industrial software from standard products up to entire industry solutions. The industry software enables our industry customers to optimize the entire value chain – from product design and development through manufacture and sales up to after-sales service. Our electrical and mechanical components offer integrated technologies for the entire drive train – from couplings to gear units, from motors to control and drive solutions for all engineering industries. Our technology platform TIP offers robust solutions for power distribution.

The high quality of our products sets industry-wide benchmarks. High environmental aims are part of our eco-management, and we implement these aims consistently. Right from product design, possible effects on the environment are examined. Hence many of our products and systems are RoHS compliant (Restriction of Hazardous Substances). As a matter of course, our production sites are certified according to DIN EN ISO 14001, but to us, environmental protection also means most efficient utilization of valuable resources. The best example are our energy-efficient drives with energy savings up to 60 %.

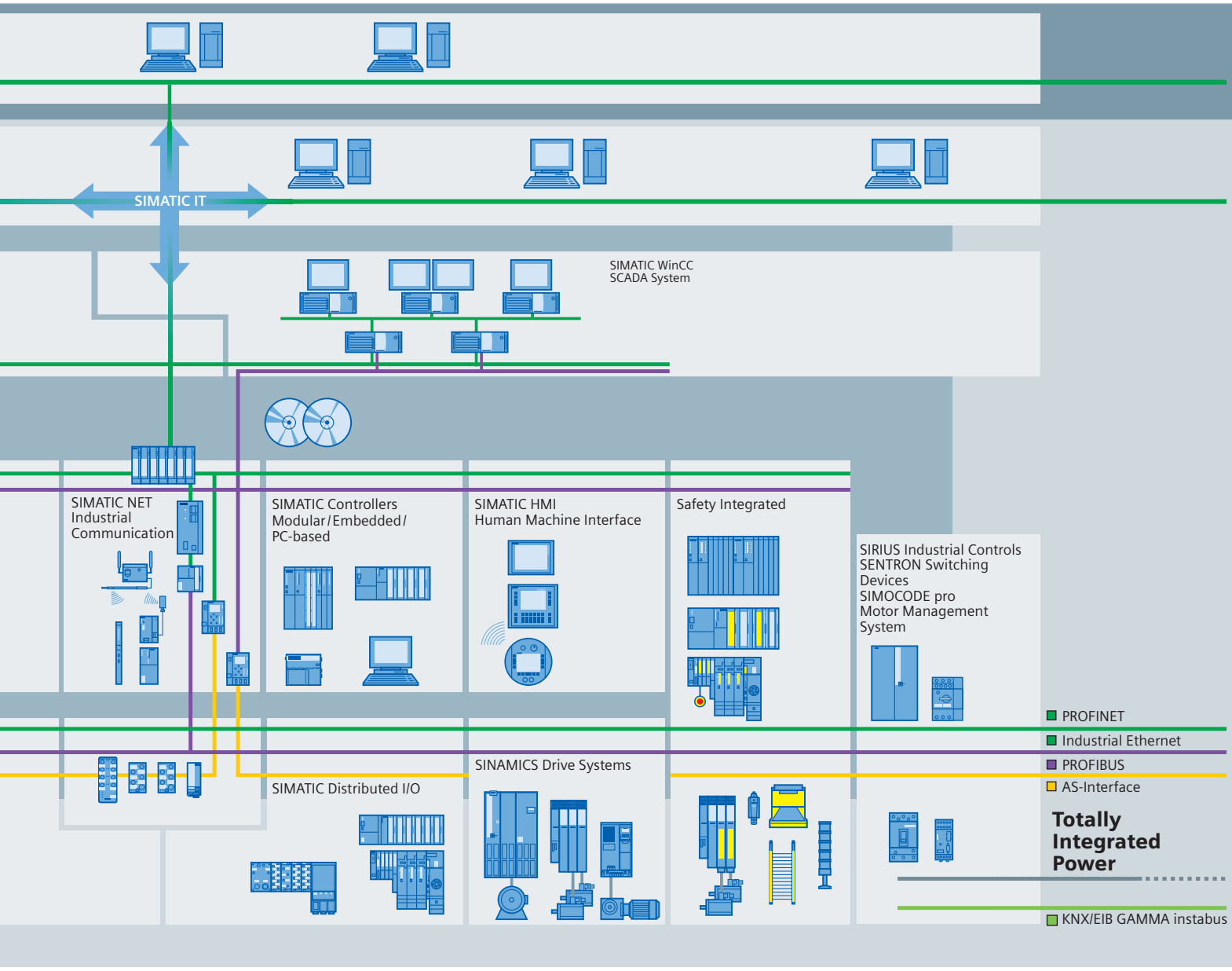
Check out the opportunities our automation and drive solutions provide. And discover how you can sustainably enhance your competitive edge with us.



Setting standards in productivity and competitiveness.

Totally Integrated Automation.

Thanks to Totally Integrated Automation (TIA), Siemens is the only provider of an integrated basis for implementation of customized automation solutions – in all industries from inbound to outbound.



TIA is characterized by its unique continuity.

It provides maximum transparency at all levels with reduced interfacing requirements – covering the field level, production control level, up to the corporate management level. With TIA you also profit throughout the complete life cycle of your plant – starting with the initial planning steps through operation up to modernization, where we offer a high measure of investment security resulting from continuity in the further development of our products and from reducing the number of interfaces to a minimum.

The unique continuity is already a defined characteristic at the development stage of our products and systems.

The result: maximum interoperability – covering the controller, HMI, drives, up to the process control system. This reduces the complexity of the automation solution in your plant. You will experience this, for example, in the engineering phase of the automation solution in the form of reduced time requirements and cost, or during operation using the continuous diagnostics facilities of Totally Integrated Automation for increasing the availability of your plant..

Introduction

Optimum drives for passenger transportation

Escalators, moving ramps or moving walkways – passenger transportation installations in stores, metro stations or airports facilitate everyday life. The applications used here make heavy demands on electromechanical drives.

Passenger transportation: heavy demands made on drive systems:

- Long operational life
- High breaking load and high safety against breakage on the entire drive
- Complete solution, comprising gear unit, motor and brake
- Compact dimensions, designed as right-angle or coaxial geared motor, depending on the application
- Suitable ratio of the gear unit for the application
- High efficiency or system damping or optimum synthesis of efficiency and system damping

Our offer: optimum drives for passenger transportation

We, Siemens Geared Motor GmbH, offer a wide range of different products to suit your application.

As well as CAVEX worm geared and worm helical geared motors specially developed for the transportation of passengers, standard geared motors from the CAVEX and MOTOX ranges (helical geared motors) can also be used.

Our products meet the highest standards of quality, reliability and future viability.

Your benefit: a wide product range and our expert knowledge

We offer a comprehensive product range with a wide variety of mounting positions, ratios and sizes, from which you can choose the solution best suited for your requirements.

You can use mechanical gear units and electromechanical drives for applications in escalators, moving ramps and moving walkways which were specially developed or adapted for these requirements. The design of the electromechanical drive consists of a motor, a brake and a gear unit, so that you have a completely ready-to-fit drive at your disposal.
If required, you can also optimally fit the gear units into your design environment individually.

The large selection of sizes offers you, for example, an operational life of 146 000 or 290 000 hours and a high breaking load for the steady state. This helps you optimize costs and reduce maintenance budget.

Our products are available worldwide. Due to Siemens AG's international sales organization with its regional sales offices you always get through to a contact quickly.

When planning projects, you can rely on the experience gained from the successful realization of numerous applications. Production facilities are located at our works in Tübingen, Germany, and Tianjin, China. Expert knowledge and experience gained over many years are thus concentrated.

Area of application

Applications

Our drives specially developed for passenger transportation as well as modified standard drives can be used in many areas of passenger transportation.

The wide range of applications includes:

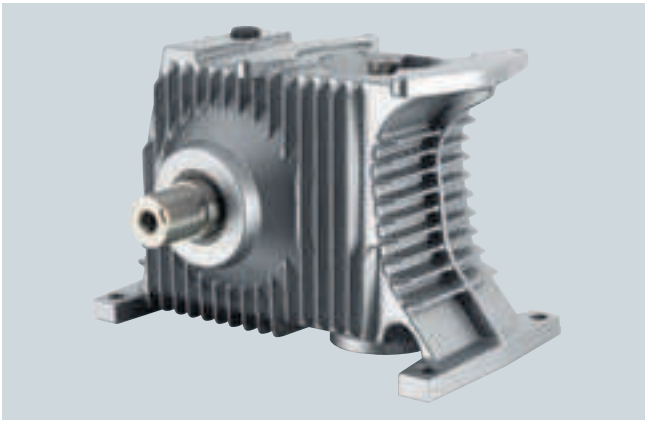
- escalators
- moving ramps
- moving walkways

On request we can also offer you special solutions for elevators, for example, the CG45 elevator drive.

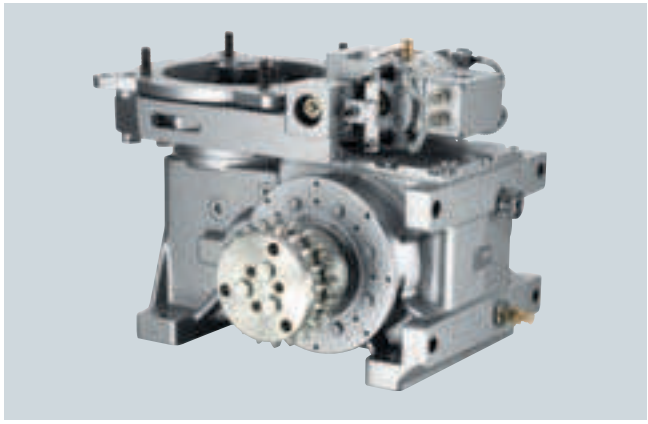
Our drives for commercial and public escalators are used all over the world for moving ramps and moving walkways in numerous department stores, shopping centers, railway stations, airports and metro stations.

You will find our drives powering escalators in metro stations in Montreal, Toronto, Paris, Marseille, Algiers, Dehli, Hong Kong, Beijing, Nanjing and Guangzhou.

Product overview



CAVEX CRW160 worm gear unit



CAVEX CG26 worm helical gear unit

Our product range for passenger transportation comprises both CAVEX worm geared and worm helical geared motors and worm geared motors from our CAVEX standard range as well as helical geared motors from the MOTOX gear unit range. The single-stage worm gear units offer you maximum system damping capacity.

You can achieve an optimum compromise between system damping and efficiency by using our two-stage worm helical gear units.
For maximum efficiency there are our two-stage helical geared motors of the MOTOX modular range.
For our complete range of MOTOX geared motors, see the "MOTOX D 87.1 Geared Motors" catalog.

Gear type	CAVEX worm gear units			CAVEX worm helical gear units	MOTOX helical gear units
Gear unit type	**CG35**	**CRW160/ CRW180**	**CUW**	**CG26**	**Z**
Requirement					
Right-angle gear units	✓	✓	✓	✓	
Coaxial gear units					✓
Maximum system damping	✓	✓	✓		
Maximum efficiency					✓
High system damping and high efficiency				✓	
Low material use	✓	✓	✓		
Rise height:					
• low	✓	✓			
• medium				✓	✓
• high			✓	✓ [1)]	

[1)] With dual arrangement

Guideline for drive selection

How to achieve the right drive for your application:

Step 1	**Application-specific requirements of the drive**
Determining the type of gear unit	See product overview, page 10
Step 2	**Technical requirements of the drive**
Determining the load data of the drive	See checklist and information on gear unit selection, page 12
Step 3	**Detailed design of the drive**
Detailed definition of the boundary conditions of the application	Our experienced project planners would be pleased to assist you.
Step 4	**Requesting quotations**
Formal request for quotation	
Step 5	**Quotation preparation**
	You can obtain a quotation for your drive from the regional sales office responsible for your area

Information on gear unit selection

The product overview will help you with the initial selection of the gear unit suitable for your application.

The ratio and size of the drive are determined essentially by the output torque, the output speed, the runtime in hours and the breaking load. Equally important is the specification of the ambient temperature at the place of installation of the drive (see checklist for gear unit selection, page 12).

The motor can be determined by taking into account line frequency and line voltage as well as the parameters set out in the checklist. For the design of the brake and the additional moment of inertia, the data on the braking torque and the reduced moment of inertia on the motor shaft must be added.

Information on breaking load for CG35, CRW160, CRW180 and CG26 gear units can be found in the section Output torque for safety against breakage (see page 19).

The runtime for the toothing can be calculated from the output torque and the speed. Diagrams for this are shown in the section Gearing load capacity (see page 16).

The output torque T_2 as a decisive design parameter can be calculated from, for example, the service classification of the system.

With the aid of the service classification it is possible to estimate the maximum output torque during movement and the temperature pattern of the gear unit.

Checklist for gear unit selection

	Designation	Value	Unit
Necessary data on the gear unit			
Output torque	T_2		Nm
Output speed	n_2		rpm
Runtime	L		h
Breaking load with safety factor 1	T_{2break}		Nm
Ambient temperature	Θ		°C
Optional data			
Motor			
• Line voltage	U		V
• Line frequency	f		Hz
Brake			
• Braking torque on the motor shaft or the drive shaft of the gear unit	T_{1brake}		Nm
Moment of inertia			
• Reduced moment of inertia on the motor shaft	J		kgm²

Example for output torque calculation T_2 on the basis of a service classification

The operating behavior of the escalator in a metro station is supposed as a starting point.

The high load with the output torque T_2 = 2000 Nm for the time 0.5 h represents the rush hour. With an average load at average metro train transportation capacity we assume an output torque of T_2 = 1000 Nm for a period of 1.5 h

The third period with an output torque of T_2 = 500 Nm represents the operating condition with the lowest partial load. During this time only few passengers use the metro trains.

$$T_2 = \sqrt[3]{\frac{0.5\text{ h}}{3.0\text{ h}}(2000\text{ Nm})^3 + \frac{1.5\text{ h}}{3.0\text{ h}}(1000\text{ Nm})^3 + \frac{1.0\text{ h}}{3.0\text{ h}}(500\text{ Nm})^3}$$

T_2 = 1233 Nm

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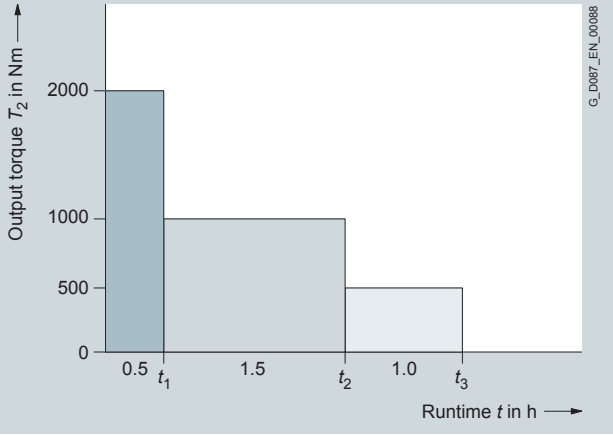
The output torque of T_2 as a comparative value can be calculated as a cubic mean value from the service classification shown in the diagram.

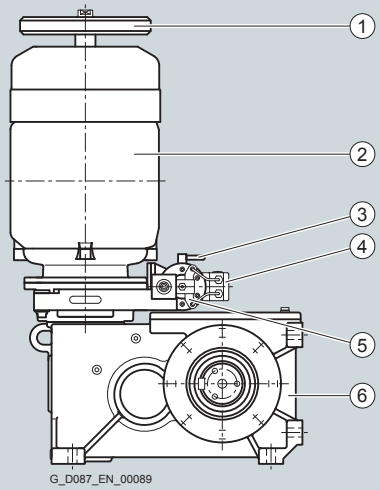
Depending on the application, a time division into more than three sections is possible.



Design and function

Design of CG26 geared motor

1 Flywheel
2 Motor
3 Manual release
4 Brake
5 Brake magnet
6 Gear unit



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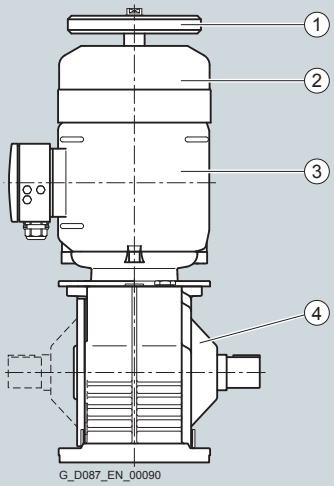
Design of CRW geared motor

1 Flywheel
2 Brake
3 Motor
4 Gear unit



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We offer CAVEX solutions developed for passenger transportation as complete drive sets. The motor is fitted directly to the gear unit; the brake is located on the motor shaft or the worm shaft.

The single-stage worm gear units in the CAVEX standard range are also available as a drive set. Gear unit, motor and brake are then generally mounted on a frame. These, too, offer you maximum system damping.

In addition, we offer MOTOX helical gear units as a complete drive. For applications in the escalator, moving ramp and moving walkway sector slight modifications are made. The brake is fitted to the motor shaft.

For further information on our complete range of MOTOX geared motors, see the "MOTOX Geared Motors D 87.1" catalog.

Gear units

Where the technology and application of worm gear and helical gear sets are concerned, you profit from the many years of experience gained by our company. We have been supplying gear units with gear sets of this kind for general industrial applications since 1950 and for the passenger transportation sector since 1985.

We calculate the worm toothing according to DIN 3996, the latest method of proving load-bearing capacity. The bronze used for the worm gear rim has been optimized with regard to maximum frictional wear load capacity combined with high tooth root strength. The steel worm shaft toothing is case-hardened and ground. The high load capacity for wear is achieved by great hardness and low tooth flank roughness.

The helical gear toothing is calculated according to DIN 3990. Steel is used for the helical gears. The toothing is case-hardened and ground. The high flank load capacity, scoring load capacity and tooth root strength is achieved by optimization of the geometry and production process.

The synthetic oil polyglycol is used as a lubricant. We select lubricants to minimize wear abrasion and to maximize the efficiency of the worm gearing.

Brake

On type CG26 geared motors the brake is integrated into the bell housing and fitted between the motor and the gear unit. On type CG35 and CRW160 geared motors and MOTOX helical geared motors the brake is attached to the ND side of the motor.

Electric single-circuit or electric dual-circuit brakes are normally used as brakes. The single-circuit brake is designed as a disk brake, while the dual-circuit brake employs the principle of the drum brake. The dual-circuit brake is optionally also available as a disk brake.

The brake is switched and released against spring action electromagnetically. If the electric power fails, the brake is switched automatically. This enables the passenger transportation equipment to be braked and securely held while stationary.

The brake can be released manually with the hand lever.

The braking torque T_{1brake} is set to your order specifications, when the drive is delivered. The braking torque for setting up the system can be easily adjusted on the brake from outside.

Data on possible drum-brake braking torques for type CG26 gear units apply only to the design of the brake. For the complete output the braking torque must be specified in accordance with the required breaking load, the safety for the breaking load and the ratio of the gear unit.

Gear unit type	Braking torque	Control voltage
	T_{1brake} Nm	V
CG26-100	≤ 160	AC or DC /
CG26-112	≤ 520	220 V or 110 V
CG26-135	≤ 520	
CG26-170	≤ 1000	

When designing the brake, a duty cycle of 100 % is provided for. For an escalator operating time of, for example, 20 hours a day the brake is completely released for the entire operating time. The solenoid switch is suitably dimensioned for this.

For diagnosis of the mechanical control function of the brake and the wear limit of the friction lining sensors may be optionally installed. The sensor signals can be processed electronically with a suitable control system.

Motor

In the case of MOTOX helical geared motors the motor is fitted directly to the gear unit.

CAVEX type CG35, CRW160 and CRW180 worm gear units are fitted with a flange surface on the gear unit housing, to which the motor is attached.

In the case of CAVEX type CG26 worm helical gear units the motors are connected to the gear unit housing via a bell housing. The connection dimensions of the bell housing on the motor side conform to the IEC standard.

In the case of CAVEX type CUW worm gear units the motor can be fitted both to a coupling bell housing and the machine frame. The connection dimensions of the coupling bell housing conform to the IEC standard. For further information, see the "CAVEX K88 Worm Gear Units" catalog, Edition 2005-2.

On CG35, CRW160, CRW180, CG26 and CUW gear units the motor shaft and gear unit drive shaft are connected by a flexible coupling. Type N-EUPEX, RUPEX and BIPEX couplings from the Siemens product range can be used for this.

For detailed information on the couplings mentioned above, see Siemens' "FLENDER MD 10.1 Standard Couplings" catalog.

General assignment of motor output to the gear units

The motor outputs stated in the table below apply to a drive speed n_1 of 1000 rpm and an ambient temperature of 40 °C. When selecting the gear unit and the motor the specific application data must also be taken into consideration (see checklist for gear unit selection, page 12).

The reduced moment of inertia of the drive set as a whole is determined mainly by the moment of inertia of the motor rotor. The reduced moment of inertia of the gear unit is very small by comparison. For adaptation to the reduced moment of inertia necessary for the application the moment of inertia of the additional flywheel is varied accordingly. The flywheel is generally fitted to the ND shaft end of the motor.

In the case of drive sets with CAVEX Type CUW worm gear units mounted directly on the machine frame the position of the flywheel can be varied.

Gear unit type	Rated motor output P_{1N} kW		Drive speed n_1 rpm
CG35	7.5		1000
CRW160	15		
CRW180	22		
CG26-100	7.5	ratio-dependent	
CG26-112	15	ratio-dependent	
CG26-135	22	ratio-dependent	
CG26-170	37	ratio-dependent	

Technical data

Gearing load capacity

The runtime of the worm toothing is calculated mainly from the output torque T_2 and the input speed n_1. The characteristic curves show the permissible runtime of the toothing as a function of the output torque T_2 at a constant input speed n_1.

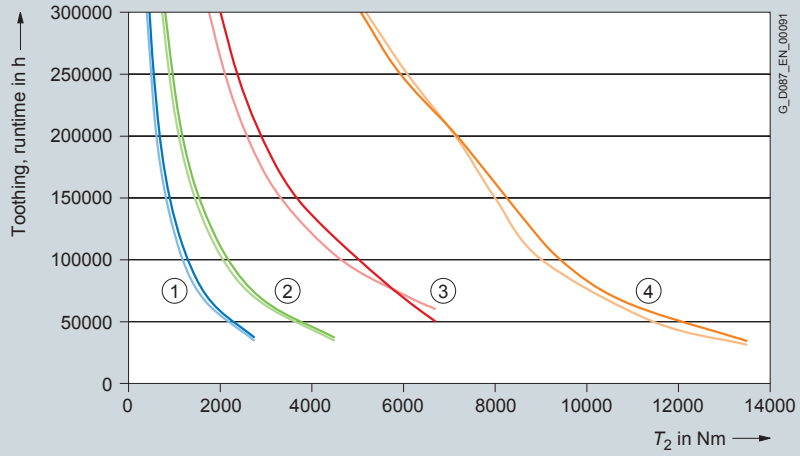
The worm toothing is assessed to DIN 3996 and takes into consideration wear abrasion and pitting as decisive operational limits.

The data apply with an ambient temperature of 40 °C on the gear unit with free convection and lubrication with synthetic oil of viscosity class ISO VG 460.

At a high output torque T_2, during short runtimes (see service classification, page 12), and high input speed n_1 the temperature pattern on the gear unit must be monitored. This requirement is assessed as part of detailed project planning.

Gearing load capacity on CG26 worm gear units

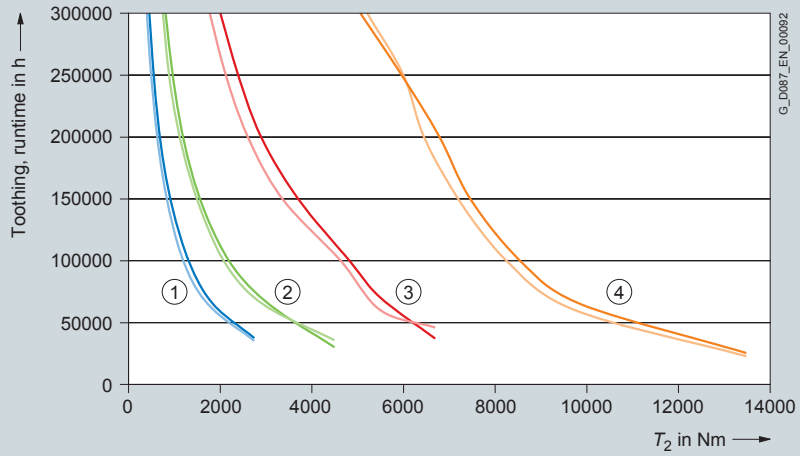
Runtime of the toothing at an input speed of n_1 = 1000 rpm^{-1}



1 CG26-100
i = 18.8; 26.4
2 CG26-112
i = 19; 25.9
3 CG26-135
i = 19; 26
4 CG26-170
i = 17.9; 25.3

Synthetic oil ISO 460
Ambient temperature 40 °C

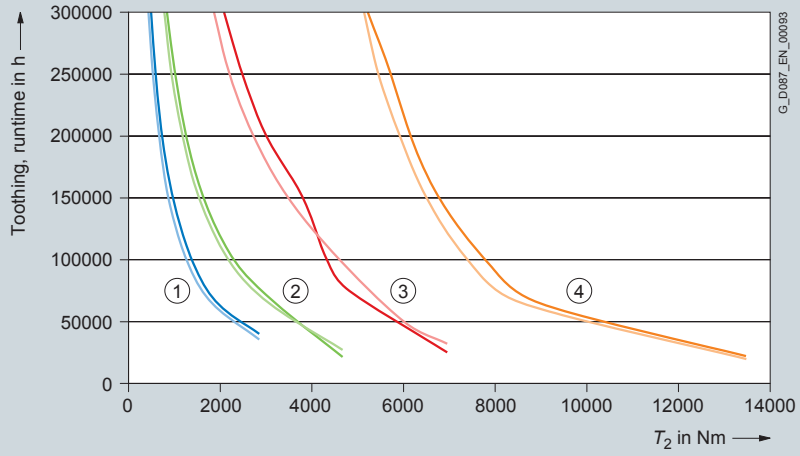
Runtime of the toothing at an input speed of n_1 = 1200 rpm^{-1}



1 CG26-100
i = 18.8; 26.4
2 CG26-112
i = 19; 25.9
3 CG26-135
i = 19; 26
4 CG26-170
i = 17.9; 25.3

Synthetic oil ISO 460
Ambient temperature 40 °C

Runtime of the toothing at an input speed of n_1 = 1500 rpm^{-1}

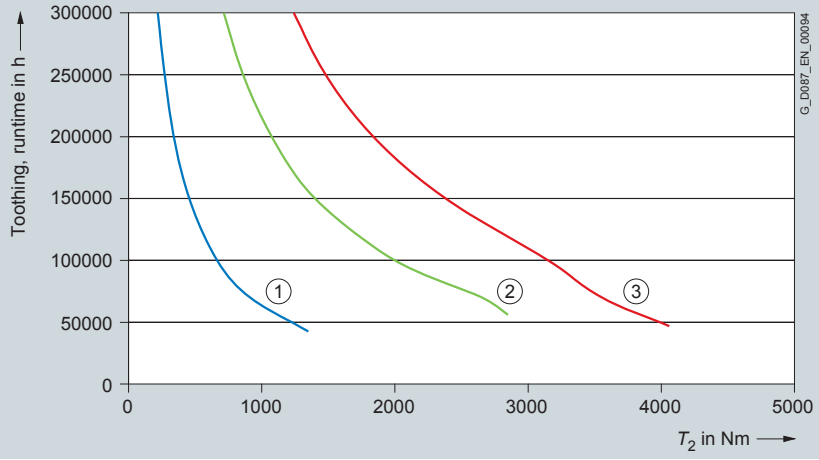


1 CG26-100
i = 18.8; 26.4
2 CG26-112
i = 19; 25.9
3 CG26-135
i = 19; 26
4 CG26-170
i = 17.9; 25.3

Synthetic oil ISO 460
Ambient temperature 40 °C

Gearing load capacity on CG35, CRW160 and CRW180 worm gear units

Runtime of the toothing at an input speed of n_1 = 1000 rpm^{-1}

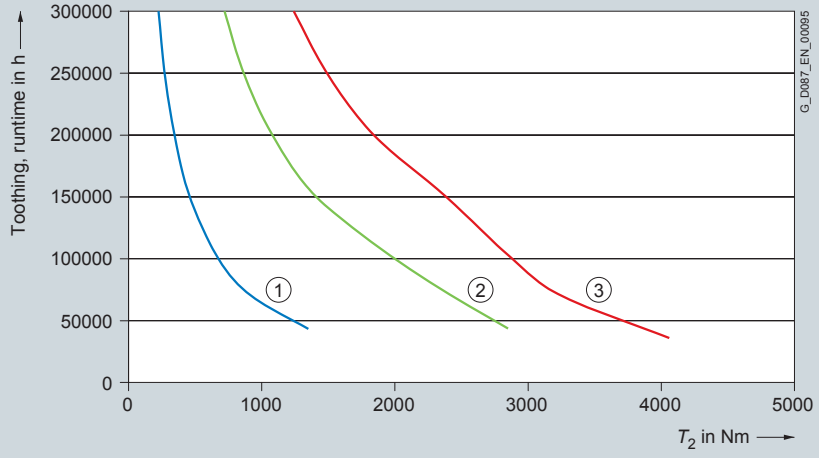


1 CG35
2 CRW160
3 CRW180

i = 24.5

Synthetic oil ISO 460
Ambient temperature 40 °C

Runtime of the toothing at an input speed of n_1 = 1200 rpm^{-1}

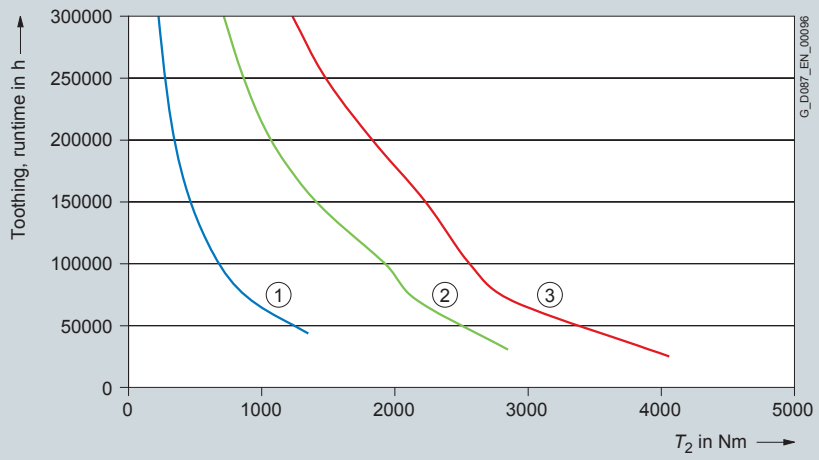


1 CG35
2 CRW160
3 CRW180

i = 24.5

Synthetic oil ISO 460
Ambient temperature 40 °C

Runtime of the toothing at an input speed of n_1 = 1500 rpm^{-1}



1 CG35
2 CRW160
3 CRW180

i = 24.5

Synthetic oil ISO 460
Ambient temperature 40 °C

Output torque for safety against breaking

The maximum possible output torque to breakage T_{2break} is an essential criterion for selecting the drive.

The values listed here apply under the following conditions:

- The escalator, moving ramp or moving walkway is stationary.
- Load application on the output shaft of the gear unit is assumed to be quasi-static.
- The escalator gear units are fitted in accordance with the operating instructions.

Operating instructions

Gear unit type	Operating instructions	
	Short designation	Title
CG35	BA 6603	CAVEX type CG35, CRW160, CRW180 escalator gear units
CRW160		
CRW180		
CG26	BA 6802	CAVEX type CG26 escalator gear units

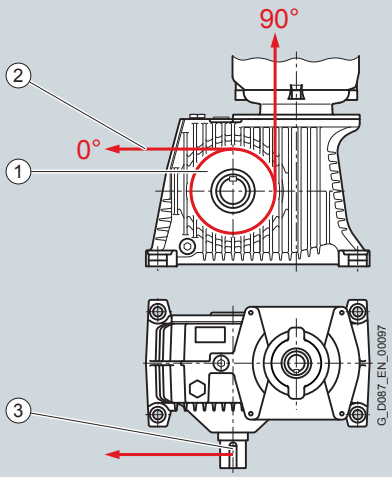
Maximum possible output torque to breakage T_{2break} with safety factor 1

Gear unit type	Ratio	T_{2break} with safety factor 1 Nm
CG35	i = 24.5	7500
CRW160	i = 24.5	15500
CRW180	i = 24.5	22000
CG26-100	i = 18.8; 26.4; 33; 40.1	13770
CG26-112	i = 19; 25.9; 31.4; 39.3	22563
CG26-135	i = 19; 26; 32.5; 40.7	35000
CG26-170	i = 17.9; 25.3; 32.6; 39.6	67626

The data for the maximum possible output torque T_{2break} apply under the limiting conditions shown in the following drawings.

Output torque for safety against breaking

CG35, CRW160, CRW180 single-stage worm gear units

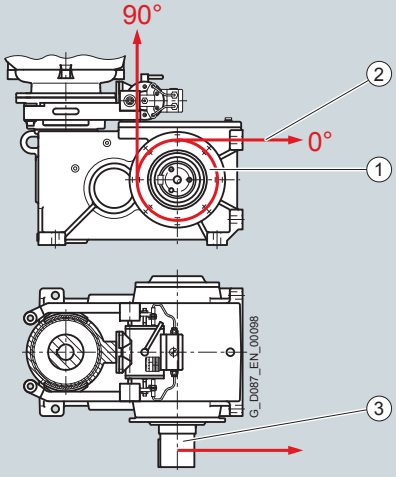


(1) Radius of chain sprocket
r = 100 mm for CG35
r = 120 mm for CRW160
r = 140 mm for CRW180

(2) Direction of force between 0° and 90°

(3) Force application on the output shaft in the journal center

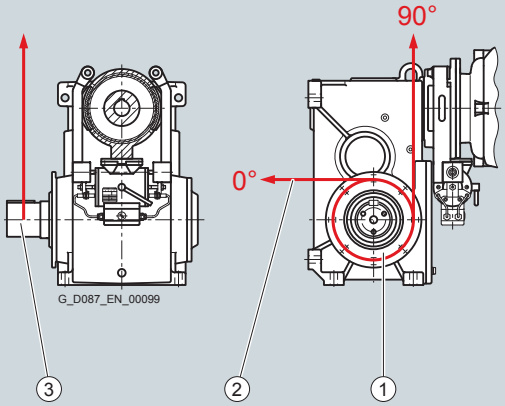
CG26 two-stage worm helical gear units



(1) Radius of chain sprocket
r = 120 mm for CG26-100, 112
r = 140 mm for CG26-135
r = 160 mm for CG26-179

(2) Direction of force between 0° and 90°

(3) Force application on the output shaft in the journal center



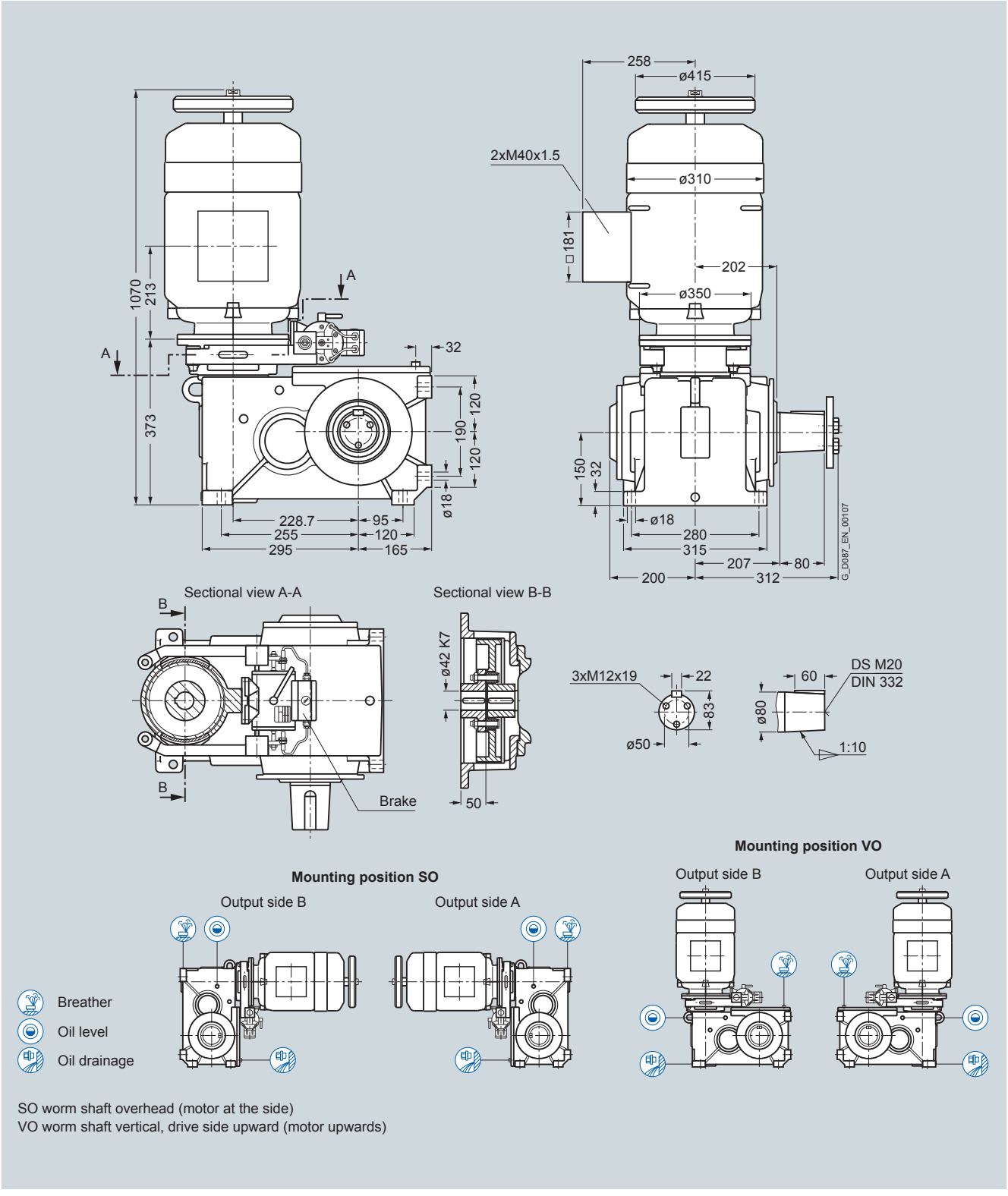
(1) Radius of chain sprocket
r = 120 mm for CG26-100, 112
r = 140 mm for CG26-135
r = 160 mm for CG26-179

(2) Direction of force between 0° and 90°

(3) Force application on the output shaft in the journal center

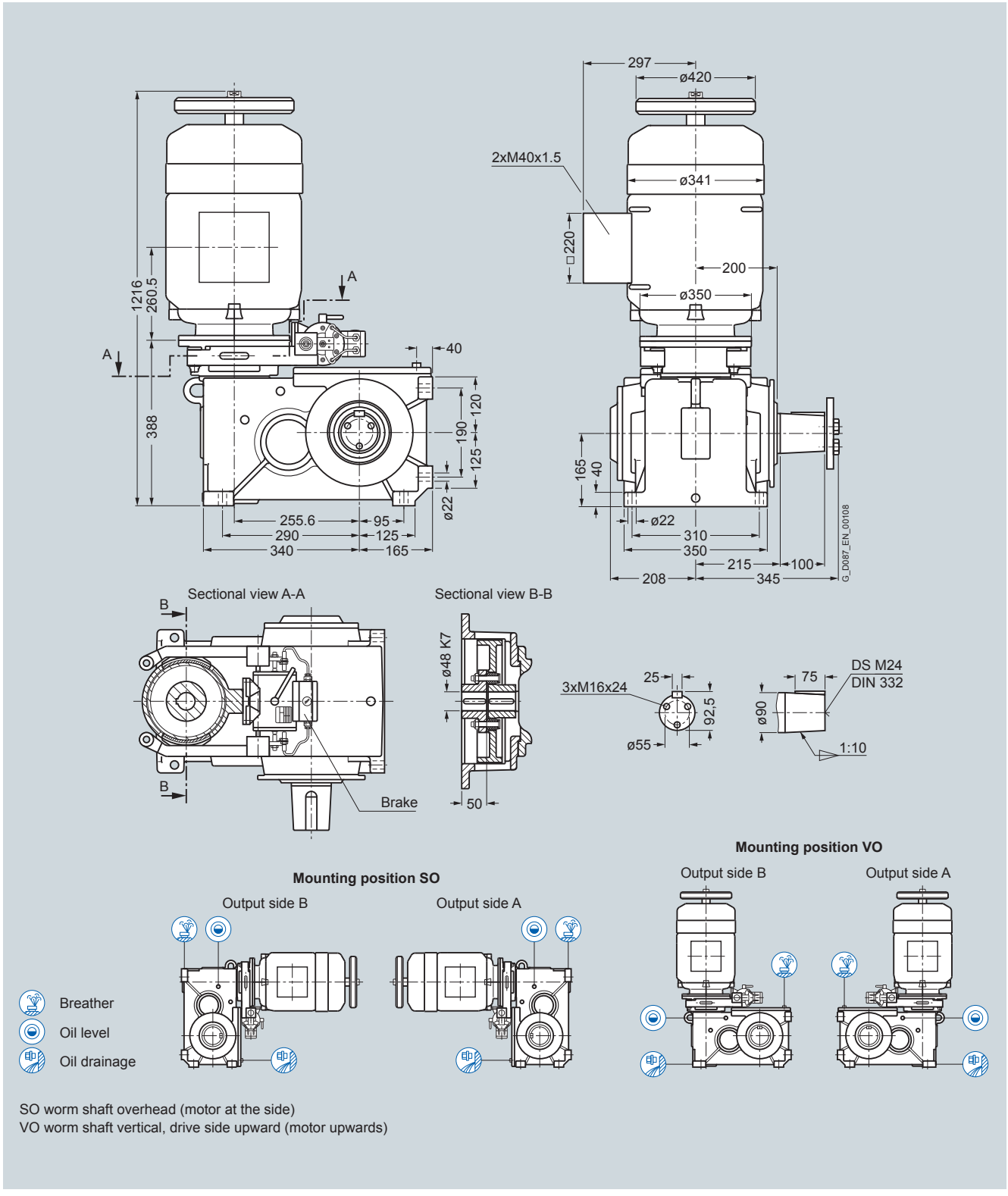
Dimensional drawings

CG26-100-ARGA160MB-06 worm helical geared motor



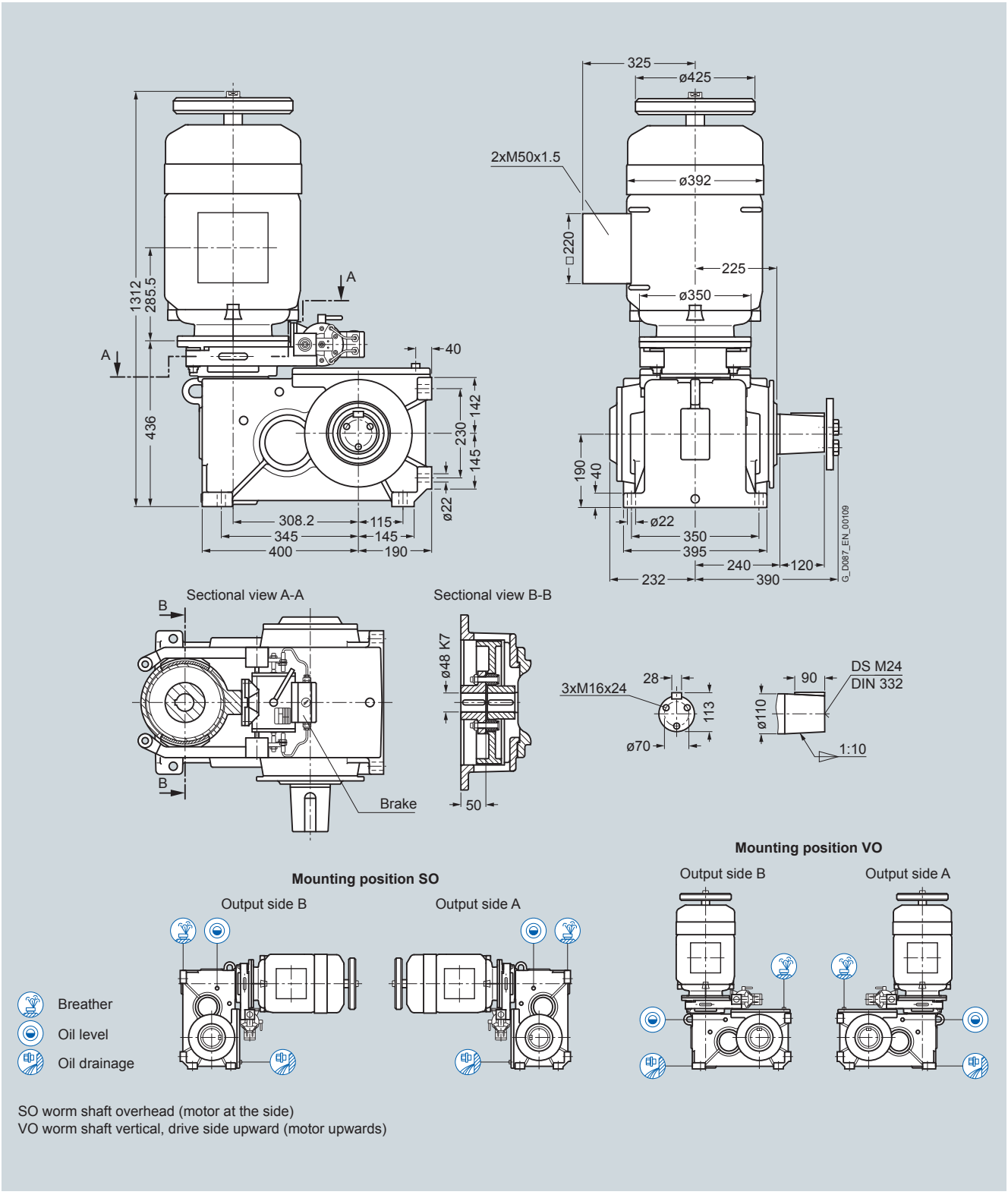
SO worm shaft overhead (motor at the side)
VO worm shaft vertical, drive side upward (motor upwards)

CG26-112-ARGA180LB-06 worm helical geared motor



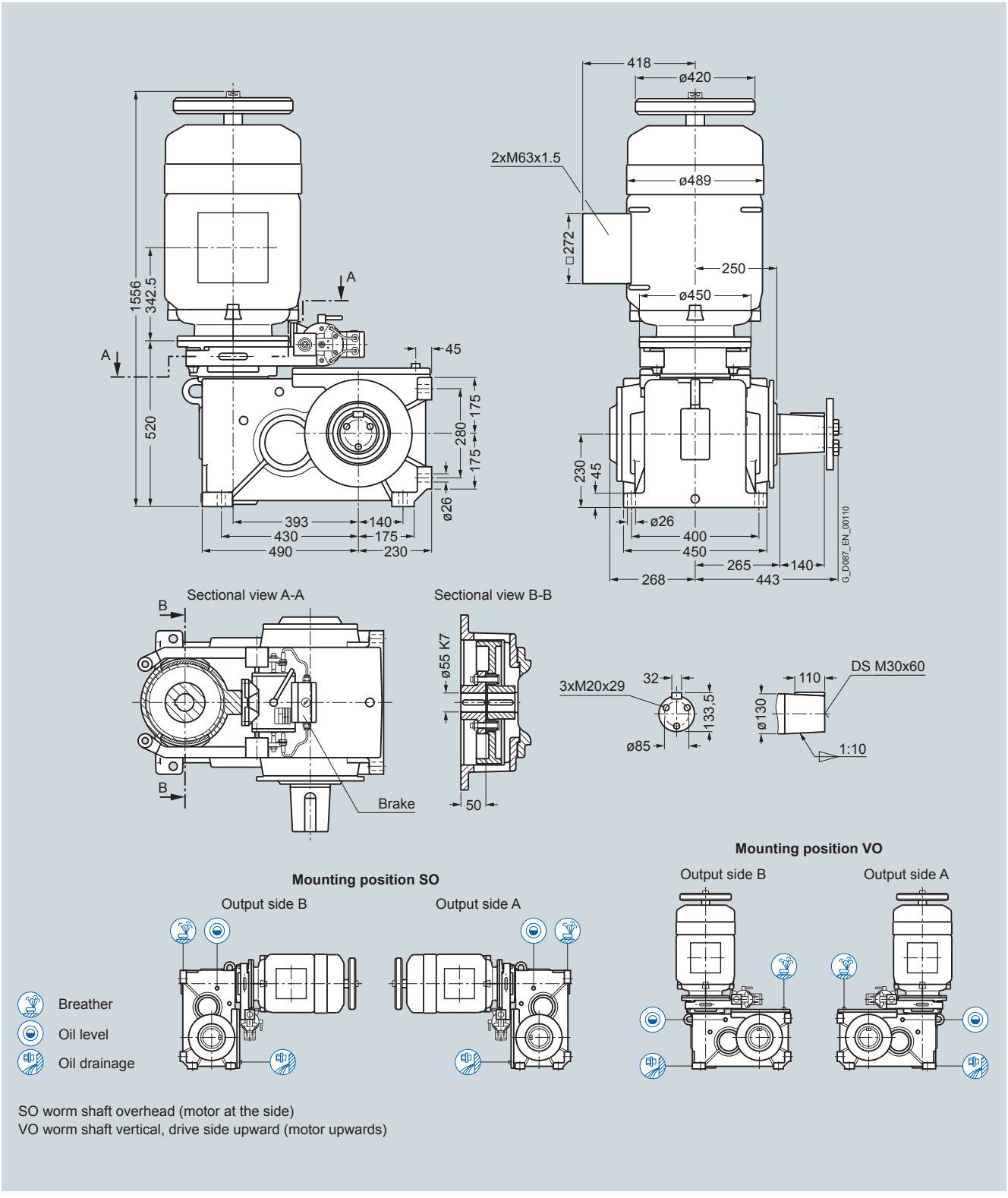
SO worm shaft overhead (motor at the side)
VO worm shaft vertical, drive side upward (motor upwards)

CG26-135-ARGA200LD-06 worm helical geared motor



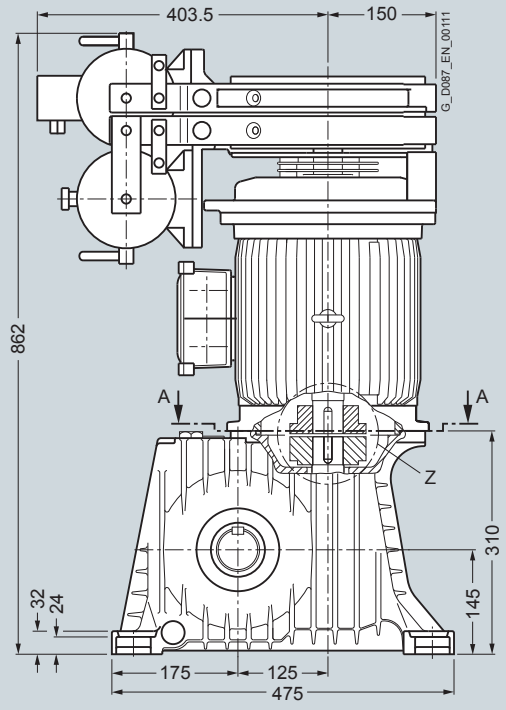
SO worm shaft overhead (motor at the side)
VO worm shaft vertical, drive side upward (motor upwards)

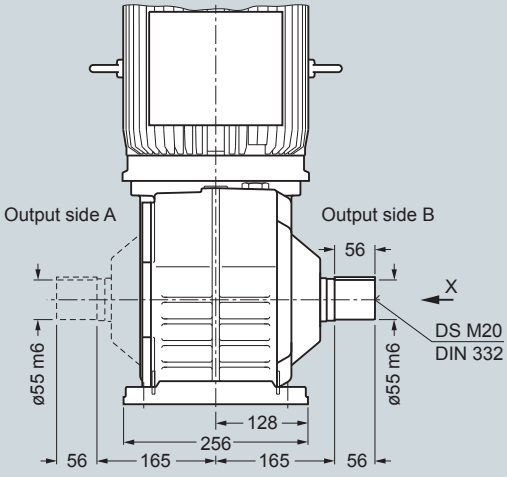
CG26-170-ARGA250ME-06 worm helical geared motor

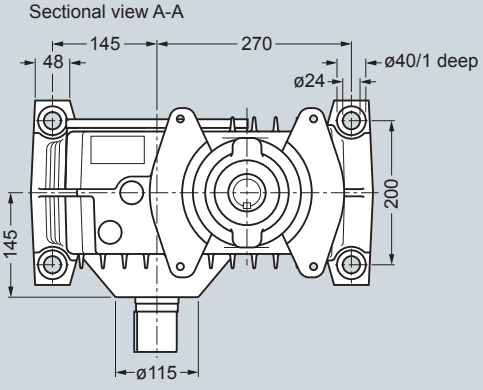


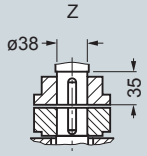
SO worm shaft overhead (motor at the side)
VO worm shaft vertical, drive side upward (motor upwards)

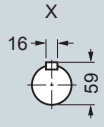
CG35-FBB160S/6 worm geared motor



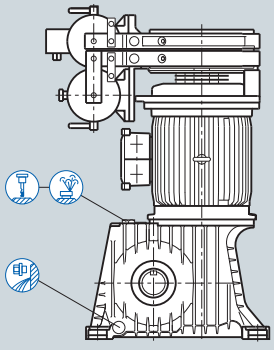


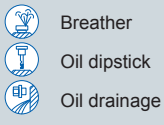






Mounting position VO



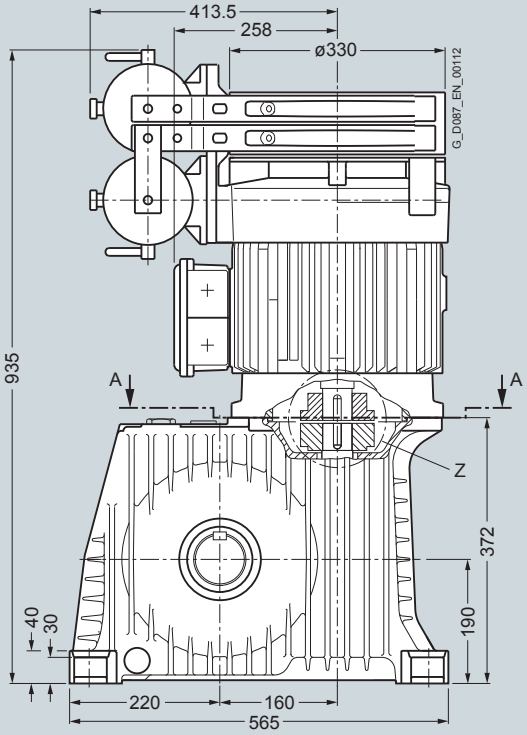


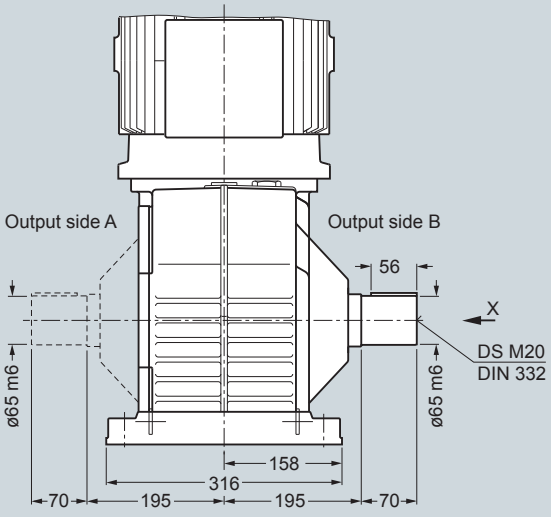
VO worm shaft vertical, drive side upward (motor upwards)

Output side A / right-hand version:
Viewed from the worm shaft, the output side is on the right.

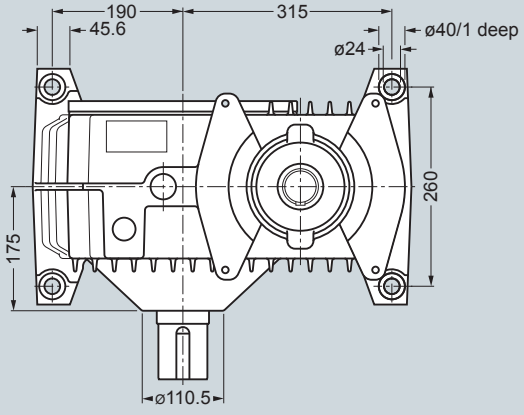
Output side B / Left-hand version:
Viewed from the worm shaft, the output side is on the left.

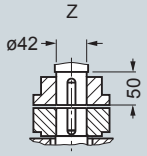
CRW160-FBB160S/6 worm geared motor

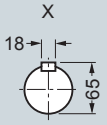




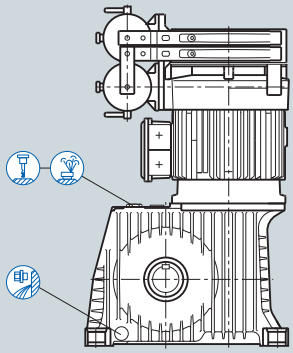
Sectional view A-A







Mounting position VO

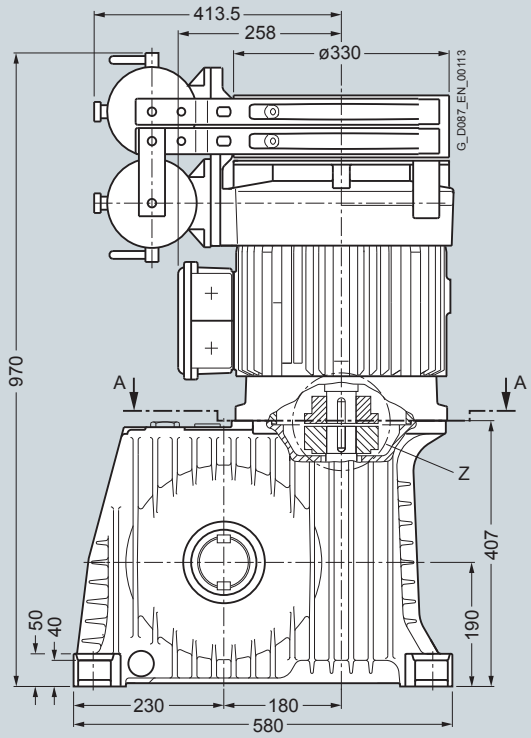


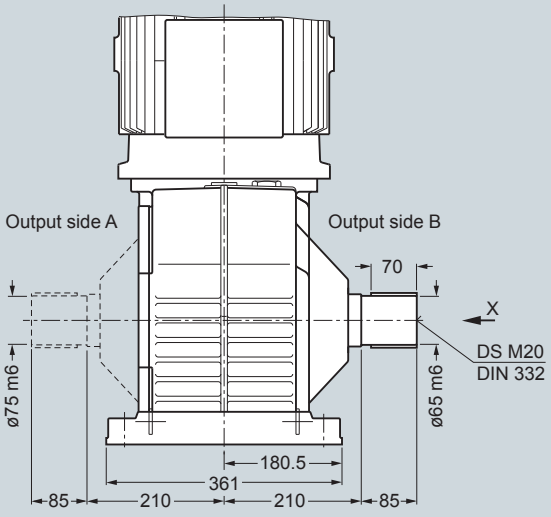
VO worm shaft vertical, drive side upward (motor upwards)

Output side A / right-hand version:
Viewed from the worm shaft, the output side is on the right.

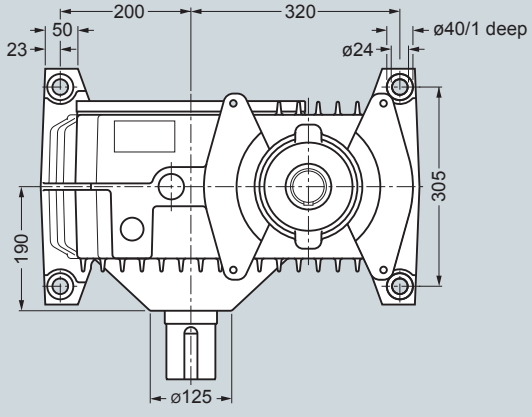
Output side B / Left-hand version:
Viewed from the worm shaft, the output side is on the left.

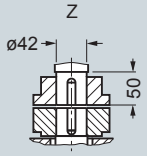
CRW180-FBB160S/6 worm geared motor

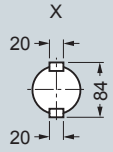




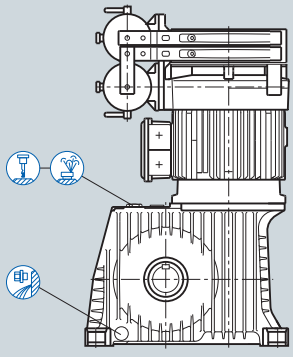
Sectional view A-A

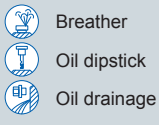






Mounting position VO

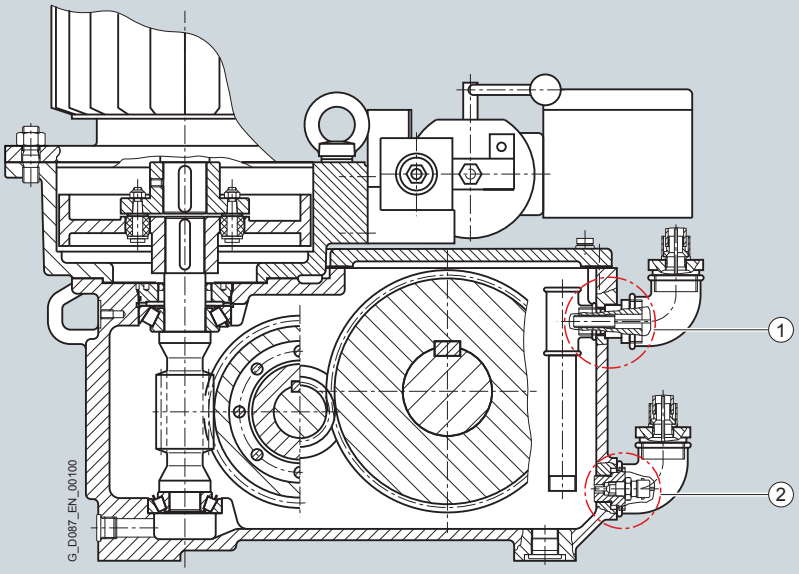




VO worm shaft vertical, drive side upward (motor upwards)
Output side A / right-hand version:
Viewed from the worm shaft, the output side is on the right.
Output side B / Left-hand version:
Viewed from the worm shaft, the output side is on the left.

Options

Oil-level and temperature monitoring on the CG26 gear unit



1 Oil-level monitoring (capacitive sensor)
2 Temperature monitoring (PT100)

Oil-level monitoring

On request gear units can be fitted with an electric oil-level monitoring system. The oil level is determined by the use of a capacitive sensor.

Temperature monitoring

On request a temperature monitoring system can also be fitted. The temperature of the oil sump is monitored by a type PT100 temperature sensor. Temperature monitoring is also possible while the drive is running.

Monitoring of system vibration

As a further option, the gear unit housing can be prepared for fitting an acceleration sensor for monitoring the system vibration.

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