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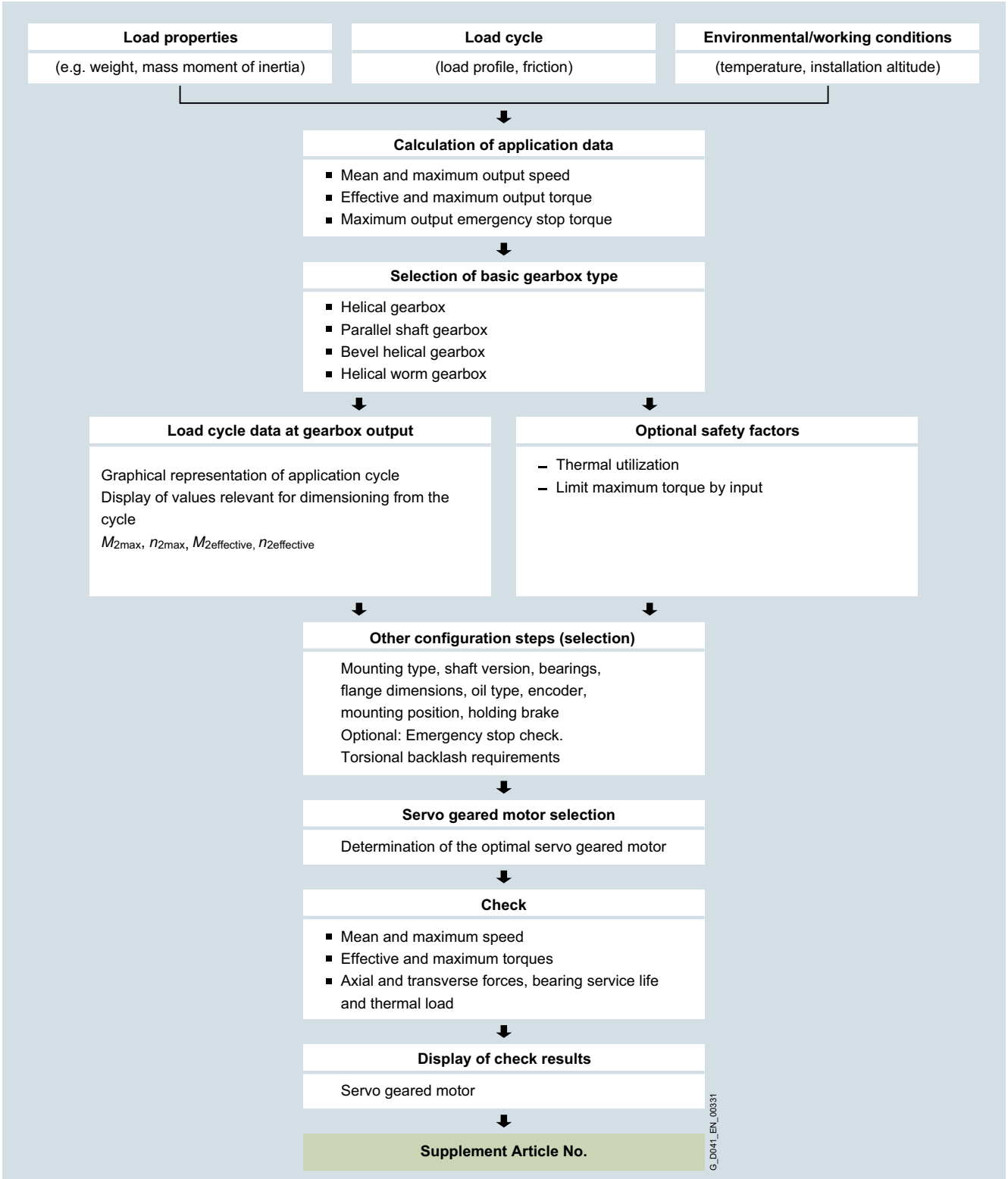
Configuring sequence

Overview

General configuring notes for standard versions are provided in this chapter. The servo geared motor permits individual solutions to be created for a wide range of drive applications. In order to select the correct drive, initially specific data for the application must be known or determined.

The flow diagram schematically shows how to select and dimension a servo geared motor. Use of the SIZER for Siemens Drives engineering tool is recommended for configuring a drive application in detail.
It covers the full range of operations required to configure a complete drive system, from simple single drives to complex multi-axis applications.



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Overview

Important questions pertaining to key aspects of the configuring process can be clarified by means of the checklist.

General

Basic version and load data

Gearbox type: ☐ Helical gearbox ☐ Parallel shaft gearbox ☐ Bevel gearbox ☐ Helical worm gearbox

Max. output speed: _____ rpm **Max. output torque:** _____ Nm

Effective output speed: _____ rpm **Effective output torque:** _____ Nm

Line voltage: _____ V **Cantilever force load:** _____ N

Environmental conditions

Installation altitude: _____ m ☐ Increased environmental stress

Temperature: from _____ to _____ °C Please specify in detail: _____

☐ Normal environmental stress

Brief description of the system: (e.g. sector, conveyor system, etc.)

_____

_____

_____

_____

Gearbox

Mounting and mounting position

Mounting position: ☐ M1 ☐ M2 ☐ M3 ☐ M4 ☐ M5 ☐ M6

Connector position: ☐ Top ☐ Bottom ☐ Left ☐ Right

Mounting type: ☐ Foot-mounted design ☐ Flange-mounted design ☐ Housing flange ☐ Shaft-mounted design

☐ Foot/flange-mounted design

Shafts

Design: ☐ Solid shaft with feather keyway ☐ Hollow shaft with feather keyway ☐ Hollow shaft with shrink disk

☐ Smooth solid shaft ☐ Hollow shaft with splines ☐ SIMOLOC assembly system

Shaft dimensions: (d × l) _____ × _____ mm (depending on gearbox version)

Shaft position: ☐ A ☐ B ☐ Both ends (with right-angle gearbox)

Other requirements: (e.g. axial/radial force)

_____

_____

_____

_____

Motor

Mounted components

Brake: ☐ Holding brake Required holding torque: _____

Encoder: Absolute encoder: ☐ Single-turn ☐ Multi-turn

☐ Resolver

Other requirements:

_____

_____

_____

_____

General options

Surface treatment

Surface protection: ☐ Standard paint finish

☐ Primed with top coat ☐ Primed without top coat ☐ RAL color: _____

Other options:

_____

_____

_____

_____

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Overview

The SIZER for Siemens Drives engineering tool (available free of charge) should be used to configure SIMOTICS S-1FG1 servo geared motors. SIZER guides the user through all the important steps of designing the whole drive system. On completion of the drive configuring process (which covers motors, converters and accessories such as cables and contactors), the tool generates project documentation and a bill of materials that can be exported to SAP. The article numbers generated by SIZER for servo geared motors allow the user to export CAD files, dimensional drawings and 3D views from the DT Configurator.

Servo geared motors and converters

All SIMOTICS S-1FG1 servo geared motors listed in the catalog with

- helical gearbox
- parallel shaft gearbox
- bevel gearbox
- helical worm gearbox

can be configured with the following converter systems in SIZER:

- SINAMICS S110
- SINAMICS S120 AC/AC
- SINAMICS S120 DC/AC

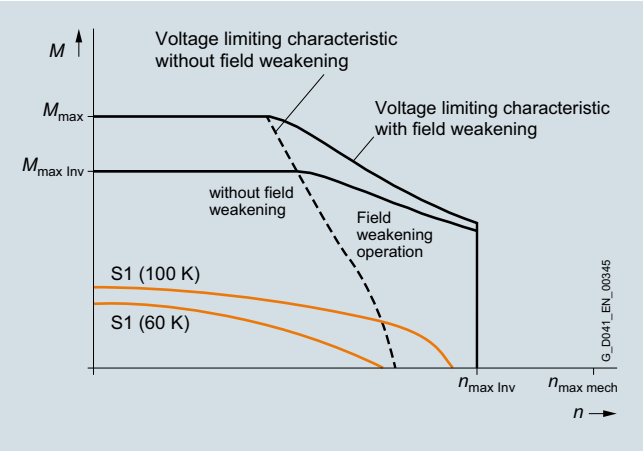
Refer to catalogs D 21.4 and D 31 for further information about converters.

Motor operating range

The permissible operating range is restricted by the maximum speed, the rated and maximum torques and the ambient temperature.

The motor temperature increases as a result of winding resistance, speed-dependent core losses and bearing friction. To ensure that the permissible heat loss limit is not exceeded, the permissible torque decreases with increasing speed, starting from static torque M_0.

Each motor has a speed/torque characteristic that takes into account the value of the DC link voltage. With an unregulated infeed, the DC link voltage is determined by the value of the line voltage. With a regulated infeed, the DC link voltage depends on the voltage setting (600 V DC in most cases).



Fundamental curve of the speed/torque characteristic in S1 duty at a temperature rise of 100 K

Design

A load cycle is normally specified for servo applications. This is stated either

- in the form of a speed/torque curve, or a speed characteristic
- is provided with additional information about the moment of inertia and friction.

SIZER provides the same support for the scenarios described above as it does for drives designed for continuous operation. The submenu "Mechanical Systems" in SIZER assists with the design of servo geared motors and applications. The user is required to enter

- traversing curves and
- known data of applications such as hoisting gear or cross cutter.

After all the required data have been entered, SIZER calculates the optimum motor and then checks the properties of the servo geared motor including

- bearing service life,
- oil sump temperature and
- speed and torque limit values (maximum and RMS torque).

The result of this analysis is included in the project documentation.

Installation altitude and ambient temperature

The catalog data refer to an ambient temperature of 40 °C, mounted so that the motors are not thermally insulated and to an installation altitude up to 1000 m above sea level. Values other than those stated above can be taken into account in the SIZER for Siemens Drives engineering tool.

Additional information on the SIZER for Siemens Drives engineering tool is provided in the chapter "Engineering tools".

The SIZER for Siemens Drives engineering tool is available free on the Internet at:

www.siemens.com/sizer

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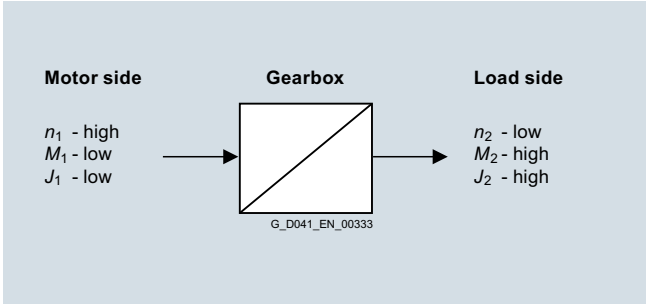
Overview

Gearbox as speed and torque converter



Gear ratio:

$$i = \frac{n_1}{n_2} = \frac{M_2}{M_1 \cdot \eta}$$

Moment of inertia:

$$J_1 = J_2 \left(\frac{n_2}{n_1}\right)^2 = \frac{J_2}{i^2}$$

Formula symbol	Description	Unit
i	Gear ratio	–
η	Gearbox efficiency	–
n_1	Gearbox input speed	rpm
n_2	Gearbox output speed	rpm
M_1	Gearbox input torque	Nm
M_2	Gearbox output torque	Nm
J_1	Moment of inertia of the load referred to the motor shaft	kgm^2
J_2	Moment of inertia of the load referred to the gearbox output	kgm^2
P_{Mot}	Motor output	kW

Standards

Standard	Table of contents
DIN 743	Output shafts
ISO 281, ISO 76	During storage
DIN 7190	Press-fit connection
DIN 6892	Parallel key connection
DIN 3990	Cylindrical gear toothing
DIN 3991	Bevel gear toothing
DIN 3996	Worm gear toothing

Gearbox efficiency

The efficiency of the gearbox is determined in part by the gear teeth, the rolling-contact bearing friction, and the shaft seal friction.

Helical, parallel shaft and bevel gearboxes

SIMOTICS S-1FG1 helical, parallel shaft, and bevel gearboxes have a very high efficiency. Generally, efficiencies of 96 % (2-stage) and 94 % (3-stage) can be assumed. These gearbox types can be operated with energy-efficient motors to create an excellent solution.

Helical worm gearbox

The first stage of the helical worm gearbox is implemented as a helical stage. With the optimally tuned transmission ratios of the worm stage, the best possible overall efficiency is achieved, which is considerably higher than that of worm gearboxes alone.

SIMOTICS S-1FG1 helical worm gearboxes exhibit efficiency levels of between 65 and 90 %.

The high degrees of efficiency ensure that the helical worm gearboxes are not self-locking.

- Running-in period

  The tooth flanks on new helical worm gearboxes will not yet be fully smoothed, meaning that the friction angle will be greater and efficiency lower during the running-in period. The higher the transmission ratio, the more pronounced the effect.

  The running-in process should take approximately 24 hours of operation at full load. In most cases, the catalog values will then be reached.

Efficiency optimization

As a result of the large range of transmission ratios, in many cases, instead of a 3-stage gearbox, a 2-stage gearbox can be used.

This means that the efficiency is improved by approximately 2 % when compared to conventional drives.

Further, the efficiency can be improved by optimizing the mounting position and the input speed.

Losses that occur in gearboxes

- Splashing losses

  Splashing losses depend on the type of oil used and therefore on the mounting position of the gearbox. As a general rule, gearboxes in a horizontal mounting position have the lowest splashing losses. The level of splashing losses depends in particular on the speed of the first gearbox stage.

- Losses through friction

  Friction losses occur at the tooth meshing, in the bearings and at the shaft seal rings.

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Overview (continued)

Required torque

Once the load situation (drive data) has been clarified, the required output torque can be determined.

$$M_2 = \frac{P_{mot} \cdot 9550}{\left(\frac{n_1}{i}\right) \cdot \eta} = \frac{P_{mot} \cdot 9550}{n_2} \cdot \eta$$

Speed at the gearbox input

The gearboxes cover a wide speed range thanks to the large range of transmission ratios.

The gearboxes operate at variable speeds when used in conjunction with SINAMICS frequency converters.

At higher motor speeds above 1500 rpm you will generally experience higher than average noise levels and a lower than average bearing service life. This depends to a large extent on the transmission ratio and gearbox size in question. Furthermore, higher speeds additionally influence the thermal properties and service intervals of the gearbox.

Servo geared motor fastening

Servo geared motors are secured by bolts of grade 8.8 to the customer's installation. When the largest possible motor shaft height is attached to the gearbox and with elevated levels of vibration, further measures need to be taken for flange-mounted servo geared motors.

We recommend that the following possibilities are assessed:

- Selection of a larger output flange
- Use of bolts of grade 10.9
- Use of an anaerobic adhesive to improve the friction lock between the gearbox and the mounting surface

Recommended bolt grade for helical gearboxes in housing flange or flange-mounted design

Helical gearboxes in housing flange design and in flange-mounted design (gearbox types *DZ*/*ZZ* and *DF*/*ZF*) with the smallest available output flanges must be bolted to the mounting surface with bolts of grade 10.9 (see table). Suitable washers must be inserted underneath the bolt head for gearbox sizes *29* and *39*.

Helical gearbox in		Flange	Strength class of bolt/nut
Housing flange design	Flange-mounted design		
DZ/*ZZ29*	*DF*/*ZF29*	A120	**10.9** [1]
DZ/*ZZ39*	*DF*/*ZF39*	A120	**10.9** [1]
DZ/*ZZ49*	*DF*/*ZF49*	A140	**10.9**
DZ/*ZZ59*	*DF*/*ZF59*	A160	**10.9**
DZ/*ZZ69*	*DF*/*ZF69*	A200	**10.9**
DZ/*ZZ79*	*DF*/*ZF79*	A250	**10.9**
DZ/*ZZ89*	*DF*/*ZF89*	A300	**10.9**
DZ/*ZZ109*	*DF*/*ZF109*	A350	**10.9**
DZ/*ZZ129*	*DF*/*ZF129*	A350	**10.9**

Recommended bolt grade for parallel shaft gearboxes and bevel gearboxes in flange-mounted design

Parallel shaft gearboxes (gearbox types *FF*/*FAF*) and bevel gearboxes (gearbox types *KF*/*KAF*) in combination with larger servomotors must be bolted to the mounting surface with bolts of grade 10.9 (see table).

Parallel shaft gearbox	Bevel gearbox	Flange	Motor shaft height				
			36	48	63	80	100
in flange-mounted design			Strength class of bolt/nut				
F.F/*F.AF39*	*K.F*/*KAF39*	A160	**8.8**	**8.8**	**10.9**	**10.9**	–
F.F/*F.AF49*	*K.F*/*KAF49*	A200	**8.8**	**8.8**	**8.8**	**8.8**	**10.9**
F.F/*F.AF69*	*K.F*/*KAF69*	A250	**8.8**	**8.8**	**8.8**	**8.8**	**8.8**
F.F/*F.AF79*	*K.F*/*KAF79*	A250	**8.8**	**8.8**	**8.8**	**8.8**	**8.8**
F.F/*F.AF189*	*K.F*/*KAF89*	A300	–	–	**8.8**	**8.8**	**8.8**
F.F/*F.AF109*	*K.F*/*KAF109*	A350	–	–	**8.8**	**8.8**	**8.8**
F.F/*F.AF129*	*K.F*/*KAF129*	A450	–	–	–	**8.8**	**8.8**
–	*K.F*/*KAF149*	A450	–	–	–	–	**8.8**

Shaft load and bearing service life

Existing radial force

The radial forces either come from the driven machine or they are caused by the transmission elements.

The existing radial force F_{Rexist} at the output shaft is obtained as follows:

- The required geared motor output torque M_2
- Average diameter of the mounted transmission element d_0
- Transmission element type, e.g. sprocket wheel

The transmission element type determines the additional factor C (see table).

$$F_{Rexist} = 2000 \cdot \frac{M_2}{d_0} \cdot C$$

Additional factor C for the transmission element type

Transmission element	Explanation	Additional factor C
Toothed wheel	> 17 teeth	**1.00**
	≤ 17 teeth	**1.15**
Sprocket wheel	≥ 20 teeth	**1.00**
	14 … 19 teeth	**1.25**
	≤ 13 teeth	**1.40**
Toothed belts	Preloading force	**1.50**
V-belts	Preloading force	**2.00**
Flat belts	Preloading force	**2.50**

[1] Use suitable washers underneath the bolt head.

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Overview (continued)

Permissible radial force

The permissible radial force F_{R2} is determined by the required bearing service life, among other things. The nominal service life L_{h10} is determined in accordance with ISO 281. Normally, calculating the nominal bearing service life is completely adequate.

The selection tables specify the permissible radial force F_{R2} for the output shafts of foot-mounted gearboxes with solid shaft. These table values refer to the force application point at the center of the shaft extension and are minimum values, which apply under the most unfavorable conditions (force application angle, mounting position, direction of rotation).

Note:
2-stage and 3-stage servo bevel geared motors (gearbox types *B* and *K*) in mounting position M1 with foot mounting on the face side:
A maximum of 50 % of the radial force F_{R2} specified in the tables is permissible.

2-stage and 3-stage servo helical geared motors (gearbox types *ZB* and *DB*) in foot/flange-mounted design:
For torque transmission via the flange surface, a maximum of 50 % of the radial force F_{R2} specified in the tables is permissible.

Permissible axial force

If no radial force is present, then max. 50 % of the permissible radial force can be applied as a permissible axial force F_{ax} (tension or compression).

Higher permissible radial and axial force

The permissible radial force load can be increased, taking the force application angle α and the direction of rotation into account.

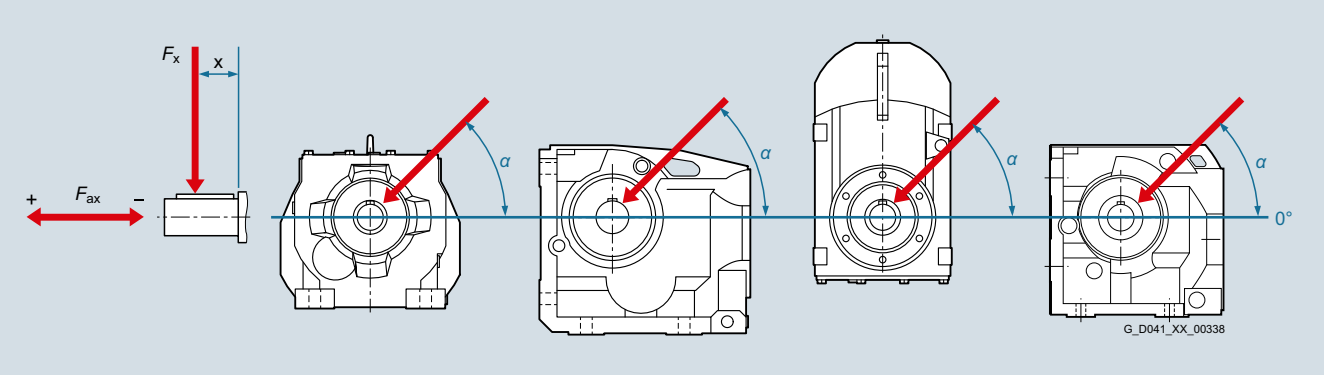
The gearboxes can be supplied with the standard design or with reinforced output shaft bearings. The reinforced bearings allow higher radial and combined forces (radial and axial) to be absorbed.

If higher radial or axial forces or combined loads comprising radial and axial forces occur, then please consult Siemens.

Formula symbols and units for existing radial force, permissible radial and axial forces and bearing service life

Formula symbol	Description	Unit
C	Additional factor for radial force calculation	–
d_0	Average diameter of the mounted transmission element	mm
F_{ax}	Permissible axial force for foot-mounted gearbox	N
F_{Rexist}	Existing radial force from the mounted transmission element	N
F_{R2}	Permissible radial force at the center of shaft extension (l/2)	N
F_x	Permissible radial force from out of center force application point	N
M_2	Servo geared motor output torque	Nm
α	Force application angle	°
x	Distance from the shaft shoulder up to the point where force is applied	mm
L_{h10}	Nominal service life	h
L_{na}	Modified service life	h

Definition of the point of application of radial and axial forces



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Overview (continued)

Radial force conversion for out of center force application point

If the force is not applied at the center of the shaft extension, the permissible radial force must be converted using the following formula.

The lower value of F_{xperm1} (bearing service life) and F_{xperm2} (strength) is the permissible radial force. The calculation is applicable without axial force.

Permissible radial force according to the bearing service life:

$$F_{xperm1} = F_{R2} \cdot \frac{y}{(z + x)}$$

Permissible radial force according to the shaft strength:

$$F_{xperm2} = \frac{a}{(b + x)}$$

Gearbox constants for calculating the radial force:

Gearbox size	Constants					
	y	z	a	b	d	l
	mm	mm	kNmm	mm	mm	mm
Helical gearboxes Z and D						
29	104	79	137	12	25	50
39	116	91	109	0	25	50
49	138	108	260	15	30	60
59	143.5	108.5	414	19	35	70
69	169	134	385	0	35	70
79	172.5	132.5	536	0	40	80
89	212.5	162.5	929	0	50	100
109	250	190	1212	0	60	120
129	297	227	2051	0	70	140
Parallel shaft gearbox F						
29	108.5	83.5	159	0	25	50
39	123.5	98.5	146	0	25	50
49	154.5	124.5	239	0	30	60
69	175	140	378	0	35	70
79	191	151	544	0	40	80
89	226	176	884	0	50	100
109	256	196	1500	0	60	120
129	324	254	2625	0	70	140
Bevel gearbox B						
29	117	97	83	0	20	40
39	143.5	113.5	209	0	30	60
49	175	140	392	0	35	70
Bevel gearbox K						
39	123.5	98.5	152	0	25	50
49	154.5	124.5	235	0	30	60
69	175	140	378	0	35	70
79	191	151	556	0	40	80
89	226	176	916	0	50	100
109	256	196	1470	0	60	120
129	324	254	2800	0	70	140
149	385	300	5525	0	90	170
Helical worm gearbox C						
29	117.5	97.5	84	0	20	40
39	123.5	98.5	157	0	25	50
49	154.5	124.5	236	0	30	60
69	171.5	136.5	410	0	35	70
89	220.0	175.0	736	0	45	90

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Overview (continued)

Permissible torque for SIMOLOC assembly system

It is important to note that the maximum permissible torque is dependent on the selected machine shaft diameter.

Diameter of customer's shaft	Gearbox size					
	29	39	49	69	79	89
	Max. permissible torque M2 Nm					
Metric shafts						
25	150					
30		290				
35			480			
40				600	1000	
50						1750
Imperial shafts						
1"	150					
1.1875"		290				
1.25"		290				
1.375"			480			
1.4375"			480			
1.5"					1000	
1.625"				600	1000	
2"						1750

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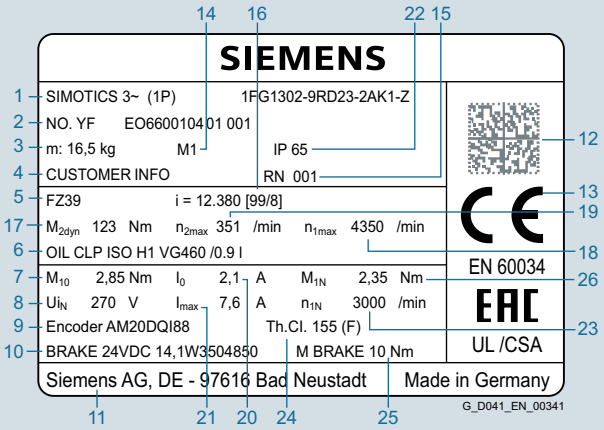
Overview

Rating plate data (type plate)

The rating plate (type plate) shows the technical specifications for the supplied motor. A second rating plate is supplied as a separate accessory with the servo geared motor, and can be used for documentation purposes.

Example of rating plate:



1 Product name, three-phase motor, Article No. (without order codes)
2 Factory number (Ident No., production number)
3 Total weight [kg]
4 Customer specifications for Y84
5 Gearbox type
6 Gearbox oil/gearbox oil quantity [l]
7 Permanent static torque [Nm]
8 Induced voltage [V]
9 Encoder type
10 Brake type
11 Manufacturer's address, country of origin
12 Barcode - serial number + Article No. (without order codes)
13 Certifications; EN 60034/UL/CE/EAC/CSA
14 Mounting position
15 Revision number
16 Gear ratio, number of teeth
17 Maximum output torque during short-time duty [Nm]
18 Max. permissible speed input side during short-time duty [rpm]
19 Max. permissible speed output side during short-time duty [rpm]
20 Stall current [A]
21 Maximum current [A]
22 Degree of protection
23 Rated speed of motor (irrespective of gearbox) [rpm]
24 Temperature class
25 Braking torque (only for spring-operated brake) [Nm]
26 Rated torque

Ambient temperature and installation altitude

Unrestricted operation: –15 °C to +40 °C, dependent on oil type.

All of the catalog data refer to an ambient temperature of 40 °C, mounted so that the motors are not thermally insulated and an installation altitude up to 1000 m above sea level.

Under conditions other than those specified above (ambient temperature > 40 °C or installation altitude > 1000 m above sea level), the permissible torque/power must be determined using the factors from the following table.

The S1 characteristic must be shifted in parallel depending on the result of the factors applied. When the servo geared motor is configured with the SIZER for Siemens Drives engineering tool, the appropriate factors are applied automatically.

This results in a maximum torque of the motor of:

$M_{perm} = M_{rated} \cdot k_{HT}$

Formula symbol	Description	Unit
P_{perm}	Permissible motor power	kW
P_{rated}	Rated motor power	kW
k_{HT}	Factor for non-standard ambient temperature and installation altitude	–
M_{perm}	Permissible motor torque	Nm
M_{rated}	Rated motor torque	Nm

Factors to reduce the torque/power (derating):

Installation altitude	Ambient temperature				
	< 30 °C	30 … 40 °C	45 °C	50 °C	55° C
	Factor for non-standard ambient temperature and installation altitude				
m	k_{HT}				
1000	1.07	1.00	0.96	0.92	0.87
1500	1.04	0.97	0.93	0.89	0.84
2000	1.00	0.94	0.90	0.86	0.82
2500	0.96	0.90	0.86	0.83	0.78
3000	0.92	0.86	0.82	0.79	0.75
3500	0.88	0.82	0.79	0.75	0.71
4000	0.82	0.77	0.74	0.71	0.67

Cooling and ventilation

For naturally-cooled motors, the heat loss is dissipated through thermal conduction, radiation and natural convection.
To ensure sufficient cooling, a minimum clearance of 100 mm to adjacent components must be observed on 3 sides.

Encoders

For motors with integrated DRIVE-CLiQ interface, the encoder signal is converted and transferred via DRIVE-CLiQ to the SINAMICS S converter. The DRIVE-CLiQ interface simplifies the commissioning and diagnostics through the electronic type plate that contains the encoder and motor data.

The encoder types absolute encoder and resolver are uniformly connected with a MOTION-CONNECT DRIVE-CLiQ cable.
For further information about encoders, please refer to chapter "Technical definitions for servomotors".

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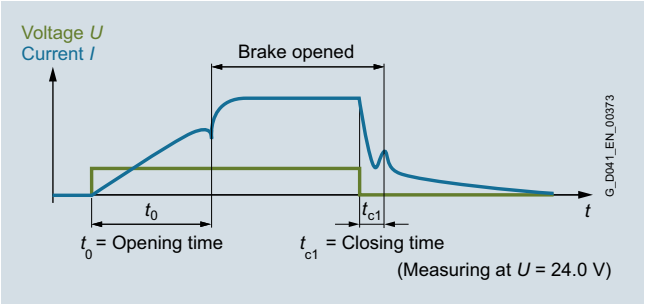
Overview (continued)

Holding brakes

Many drives need a holding brake with an emergency stop function for safety reasons or to meet process requirements.

The permanent-magnet and spring-operated brakes used for SIMOTICS S-1FG1 servo geared motors function according to the quiescent current principle. The rated voltage of the holding brake is 24 V DC ± 10 % Voltages outside this tolerance range can cause faults. A manual brake release mechanism and an air gap check are optionally available for spring-operated brakes.



Opening and closing times for holding brakes

Permanent-magnet brakes

- Standard holding brake – order code **N23**
- Holding brake with increased braking torque – order code **N24**

The magnetic field produced by the permanent magnet of the brake exerts a tension on the brake anchor plate, i.e. in a condition of zero current, the brake is closed and the motor shaft thereby stopped.

When the rated voltage of 24 V DC ± 10 % is applied to the brake, current flows through the coil and produces a counter-field that cancels the pull of the permanent magnet, causing the brake to release.

In the event of emergency stops or power failures, approximately 2000 braking operations can be performed with the maximum operating energy without causing excessive wear on the holding brake.

Condition:
maximum external moment of inertia = moment of inertia of motor and n_{max} type-specific.

The holding brake is not a working brake for braking the rotating motor.

Motor Motor shaft height	Type	Holding torque M_{4Br}	Dynamic braking torque M_{1Br}	Direct current	Opening time with varistor t_0	Closing time with varistor t_{c1}	Maximum operating energy per brake operation
		Nm	Nm	A	ms	ms	J
Standard holding brake for SIMOTICS S-1FG1 servo geared motors (order code N23)							
36	1FG1..-..C..	1.9	1	0.3	50	30	40
48	1FG1..-..D..	4.0	3	0.5	70	30	150
63	1FG1..-..E..	13	8.5	0.8	100	50	380
80	1FG1..-..F..	22	11	0.9	200	60	1400
100	1FG1..-..G0.	23	11	1.0	300	70	3380
100	1FG1..-..G1. 1FG1..-..G3. 1FG1..-..G5.	43	25	1.0	300	70	3380
Holding brake with increased braking torque for SIMOTICS S-1FG1 servo geared motors (order code N24)							
36	1FG1..-..C..	3	1.5	0.3	60	25	30
48	1FG1..-..D..	8	5	0.6	90	30	270
63	1FG1..-..E..	18	11	0.8	150	50	880
80	1FG1..-..F..	48	25	1.0	220	65	1900
100	1FG1..-..G..	85	35	1.6	250	70	5300

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Overview (continued)

Spring-operated brake

These brakes are electromagnetic units. An electromagnetic field is used to release the brake which is applied using spring force. They operate in accordance with the quiescent current principle, i.e. when no current is flowing, the spring-operated brake brakes and holds the drive. When power is applied to the brake, it is released and the drive is free to rotate.

In the event of a power failure or an emergency stop, the drive is braked from its current speed down to standstill.

The holding brake is not a working brake for braking the rotating motor.

The use of a spring-operated brake increases the overall length of the motor relative to motor versions without a brake,
by 48 mm with motor shaft height 80 and
by 62 mm with motor shaft height 100.

Motor Motor shaft height	Type	Order code	Holding torque M_{4Br}	Rated braking torque M_{2Br}	Direct current	Opening time with varistor t_0	Closing time with varistor t_{c1}	Maximum operating energy per brake operation	Total operating energy
			Nm	Nm	A	ms	ms	J	kJ
80	1FG1..-..F	**N30**	8	11	1.6	150 (55)	150 (130)	2800	5600
		N31	11	15		200 (60)	140 (100)		5600
		N32	15	22		250 (80)	120 (80)		5600
		N33	20	30		350 (100)	110 (75)		5600
		N34	30	40		500 (140)	80 (45)		4200
100	1FG1..-..G	**N30**	19	25	1.6	300 (115)	200 (130)	6500 (13000)[1]	13000
		N31	23	32		370 (130)	180 (110)		13000
		N32	34	50		500 (150)	130 (80)		13000
		N33	41	62		640 (190)	110 (65)		13000
		N34	50	80		700 (220)	100 (60)		10000

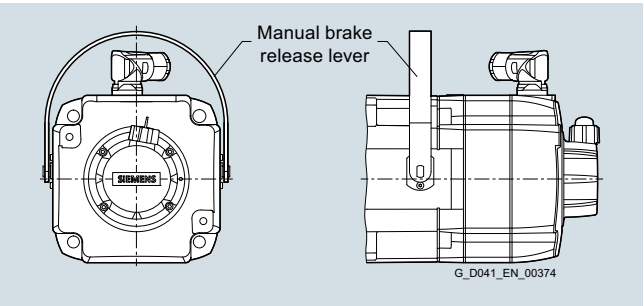
Total operating energy
When the brake operates above the total operating energy limit, it can suffer wear that will cause it to malfunction.

Switching times
The opening and closing times are calculated on the basis of the life cycle and total wear of the brake and should be taken into account when the system is configured.

The values stated in parentheses are the values for new brakes calculated according to DIN VDE 0580.

Manual brake release - order code **K82**

A manual brake release can be ordered as an option for servo geared motors with spring-operated brake. This release disengages the brake. When the manual brake release lever is pushed towards the NDE, the spring-operated brake is mechanically released and disengaged. The position of the manual brake release lever is always identical to the position of the connector.



Spring-operated brake with manual brake release lever

Mechanical air gap check - order code **C05**

The servo geared motor can be ordered with an optional opening through which a mechanical air gap check can be carried out to assess the level of wear on the spring-operated brake.

Inspection of the brake is limited to a check of the air gap in the spring-operated brake in order to determine the degree of wear on the friction disk.

To perform this check, the brake module must be opened electro-magnetically when the motor is at a standstill. The plug over the opening must be removed so that the gap between the armature and the friction disk can be measured by means of a feeler gauge through the opening.

If the maximum air gap measures s_{max}, the brake is no longer operationally reliable and must be replaced. Wear adjustment is not possible.

[1] Braking operations with maximum operating energy up to 13000 J are permissible. In order to protect the brake against excessive wear, however, only three consecutive braking operations and only 50 in total are permitted.

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Overview (continued)

Degrees of protection

Degrees of protection of electric motors are specified by a code comprising two numbers:

First code number	Brief description	Second code number	Brief description
6	The machine is dust-tight	**5**	The motor is protected against jets of water

The first code number of the degree of protection indicates the degree to which an enclosure provides protection against contact and the ingress of foreign bodies.

The second code number indicates the protection that an enclosure offers regarding the ingress of water. The degree of protection designation in accordance with EN 60034-5 and IEC 60034-5 is made using the letters "IP" and two digits.

IP = International Protection

The motors are supplied in IP65 to standard IEC 60034-5. They can be installed in dusty or humid environments.

The degree of protection only refers to the motor. When selecting higher degrees of protection, the equipment on the gearbox side should be taken into account (seals, vents). The shaft output at the gearbox must be protected against contamination/water jets.

Protection against water alone is not sufficient for fluids that contain oil or aggressive substances or for penetrative fluids. In these cases, the servo geared motors must be protected by suitable covers.

Noise emission

The noise emitted by SIMOTICS S-1FG1 servo geared motors in operation from 0 speed up to rated speed can reach the following enveloping surface sound pressure level *L*p(A):

Sound pressure level:

Motor type	Motor shaft height	Sound pressure level L_{pA} (1m) in accordance with EN ISO 1680, max. (tolerance +3) up to Rated motor speed n_{1rated}
1FG1 . . . - . . C 1FG1 . . . - . . D	36 48	65 dB(A)
1FG1 . . . - . . E	63	70 dB(A)
1FG1 . . . - . . F 1FG1 . . . - . . G	80 100	75 dB(A)

The servo geared motors are certified for a wide range of installation and operating conditions. These conditions, such as rigid or vibration-isolated foundation design, influence noise emission, sometimes significantly.

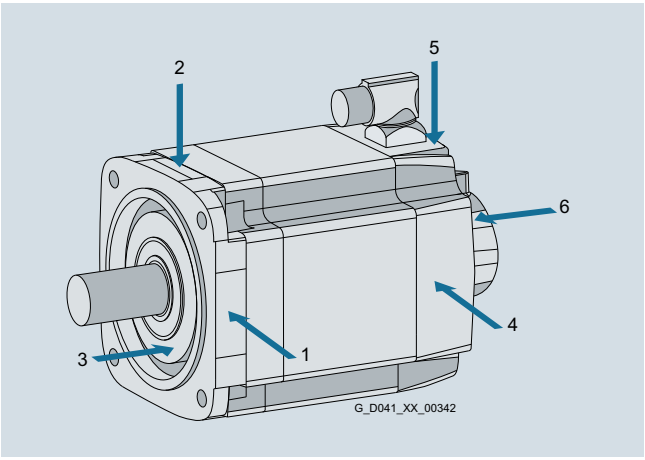
Vibratory load

For perfect function and to comply with the motor specification (particularly the bearing service life) the vibration values specified in the following table must not be exceeded.

Vibration values:

		Vibration value
Vibration velocity according to ISO 10816	V_{rms}	Max. 4.5 mm/s
Axial vibration acceleration	$a_{peak\ axial}$	25 m/s^2
Radial vibration acceleration	$a_{peak\ radial}$	50 m/s^2

The measurement points 1 to 5 should be selected in accordance with ISO 10816-1 Paragraph 3.2. The vibration values must not exceed the specified limits at any measurement point.



The vibration acceleration must be evaluated in a frequency band of 10 to 2000 Hz.
The maximum peak value in the time range is assessed.

To evaluate the vibration velocity, the measuring equipment must fulfill the requirements of ISO 2954.

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Overview (continued)

Servo geared motors with hollow shaft in shaft-mounted design (torque arm)

Servo parallel shaft geared motors 2-/3-stage

Gearbox type *F.AD*

The rubber buffers (supplied loose) are used to flexibly support the gearbox on the housing plate provided. When mounting, the rubber buffer must be pretensioned to the dimension specified in the dimensional drawing.

The elastomer used for support is manufactured out of natural rubber of grade 70° ± 5 Shore A.

The rubber buffers are suitable for all mounting positions and can withstand temperatures of between -40 °C and +80 °C.

The dimensions of the torque arm can be seen in the dimensional drawings.

Servo bevel and servo helical worm geared motors 2-stage

Gearbox types *BAD* and *CAD*

The torque arm can be screwed to the gearbox housing at various positions.

The elastomer used for support is manufactured out of natural rubber of grade 60° Shore A.

The flexible bushing is suitable for all mounting positions and can withstand temperatures of between -40 °C and +80 °C.

When ordered, the torque arm is supplied loose.

Servo bevel geared motors 3-stage

Gearbox type *KAD*

The torque arm of 3-stage bevel gearboxes is mounted on the underside of the housing. The flexible bushing is used to flexibly support the gearbox on the torque arm.

The elastomer used for support is manufactured out of natural rubber of grade 60° Shore A.

The flexible bushing is suitable for all mounting positions and can withstand temperatures of between -40 °C and +80 °C.

The dimensions of the torque arm can be seen in the dimensional drawings.

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Overview (continued)

SIMOLOC assembly system

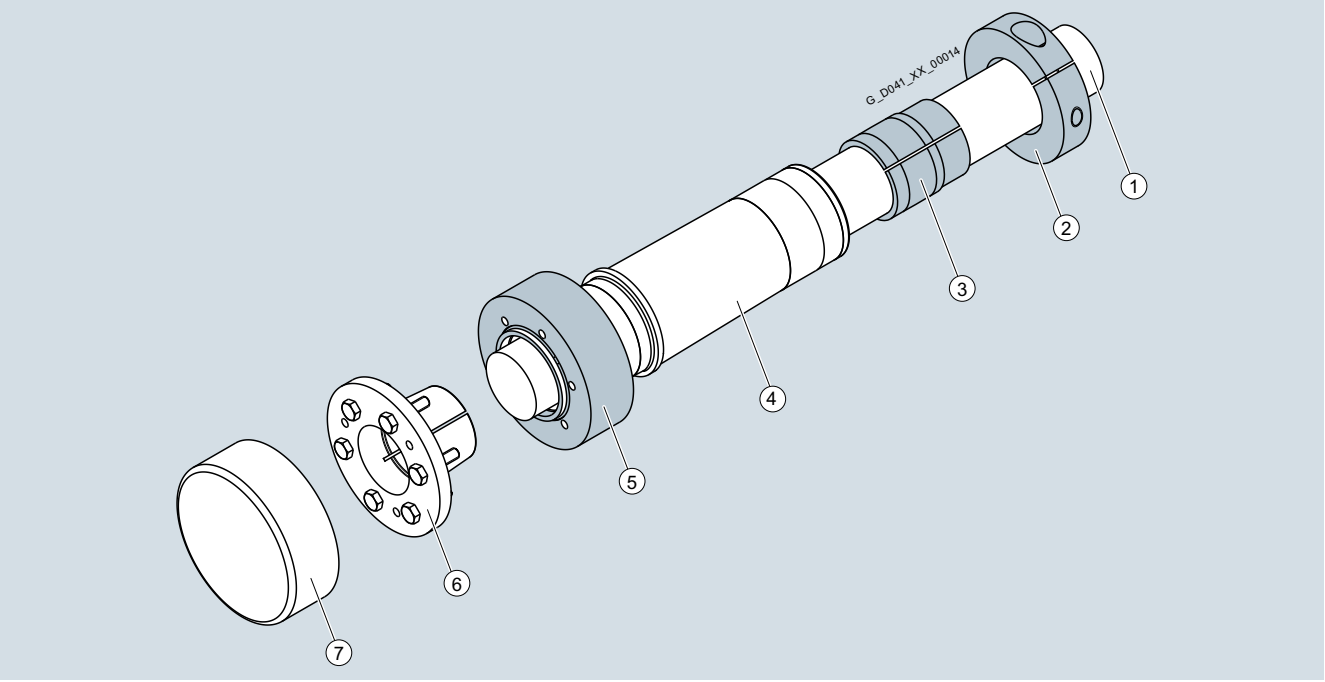
The new SIMOLOC assembly system has been designed to provide a friction-locked connection between the motor shaft made of drawn shaft material of grade h11 or lower and the hollow shaft in the gearbox.

The SIMOLOC assembly system offers a low-cost, easy-to-fit alternative to conventional shaft connections such as hollow shaft with a feather key, hollow shaft with shrink disk or hollow shaft with spline.

It is compatible with the shaft-mounted designs of the parallel shaft, bevel and helical worm gearboxes.

Several diameters are available for each gearbox size.

Components of the SIMOLOC assembly system



SIMOLOC assembly system

① Machine shaft
② Clamping ring
③ Bronze bushing
④ Hollow shaft of gearbox
⑤ V-ring
⑥ Taper bushing
⑦ Rotating protection cover

Scope of supply

The gearbox is shipped with a SIMOLOC hollow shaft. The diameter-specific components are supplied as a separate assembly kit. The unit is supplied with pre-assembled rotating protection cover. The non-rotating protection cover can be ordered as an option.

Benefits

Cost reduction

- The input shaft of the motor can be made of low-cost, drawn shaft material of grade h11 or lower.
- The shaft is cheaper to machine because there is no need to machine the shaft seat and a keyway is not required.

Quick and easy mounting

- Easy to mount and dismantle thanks to adequate clearance between the motor shaft and hollow shaft. The press fit is not made until the taper bushing is inserted.
- The press fit prevents the formation of fretting corrosion. The taper bushing can be removed easily in order to separate the press-fit connection.
- No tight fits need to be overcome when the gearbox is pushed onto the motor shaft.

Variability

- Quick adjustment of the gearbox to different motor shaft diameters is possible by replacement of the taper and bronze bushings.
- Easy conversion from metric to inch dimensions and vice versa.

Available diameters

The SIMOLOC assembly system can be supplied for shaft-mounted designs. 2 metric versions and 2 to 4 inch versions are available for all gearbox sizes.

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Overview (continued)

Hollow shaft cover

Sealing cap

The bore of the hollow shaft is sealed using a plastic sealing cap.

Gearboxes with hollow shaft and shrink disk have a rotating protective cap.

The dimensions of the rotating protection cover can be seen in the dimensional drawings provided in the chapters for selection of servo geared motors.

For safety reasons, stationary protection covers may be required.

Protection cover

For gearbox sizes 29 to 149, a stationary protection cover for the hollow shaft and hollow shaft with shrink disk can be selected.

The dimensions of the protection cover can be seen in the separate dimensional drawing provided in the chapters for selection of servo geared motors.

Lubrication

The gearboxes are filled in the factory with a high-quality lubricant.
Lubricants permitted for the various gearbox types and applications are listed in the lubricant table under heading "Sealing and lubrication" in the chapter Options.

Other oils from various lubricant manufacturers that have been approved by Siemens can be found on the Internet in the Service and Support pages in the List of approved and recommended gear lubricants T 7300:

https://support.industry.siemens.com/cs/ww/en/view/44231658

Note:
For ambient conditions with a high air humidity and salt-laden atmosphere, we recommend that only mineral or PAO oils are used.

Oil quantities

The lubricant quantity depends on the gearbox type, size and mounting position. The corresponding oil quantities are specified in the operating instructions and on the rating plate of the geared motor.

Roller bearing greases for gearboxes and motors

The roller bearings of gearboxes and motors are lubricated in the factory with a roller bearing grease that is coordinated with the selected application area. The quantity of grease between the rolling elements and the space in front of the bearing depends on the operating conditions and the gearbox mounting position. For operation in the selected application areas, it is not necessary to relubricate the roller bearings.

We recommend that the grease filling of the roller bearings is also changed when the oil or shaft sealing rings are replaced.

Other greases approved by Siemens supplied by different lubricant manufacturers are specified in the List of approved and recommended gearbox lubricants T 7300.

https://support.industry.siemens.com/cs/ww/en/view/44231658

Sealing

The standard models of gearbox are supplied with high-quality radial shaft sealing rings with dust protection lips. This sealing system is reliable for a wide range of applications.

Special application areas and environmental conditions require special radial shaft sealing rings and materials, which are coordinated with the particular gearbox oil and environment. This coordinated sealing system ensures that the plant is highly reliable and available.

When compared to standard sealing systems, the maintenance intervals can be extended. This therefore reduces maintenance costs.

The standard models of gearbox can be used in the range from -20 °C to +40 °C. Additional oils for lower or higher ambient temperatures are available for selection.

Please inquire regarding geared motors outside the temperature range from -20 °C to +40 °C, as the suitability of the components used for the respective application must be checked.

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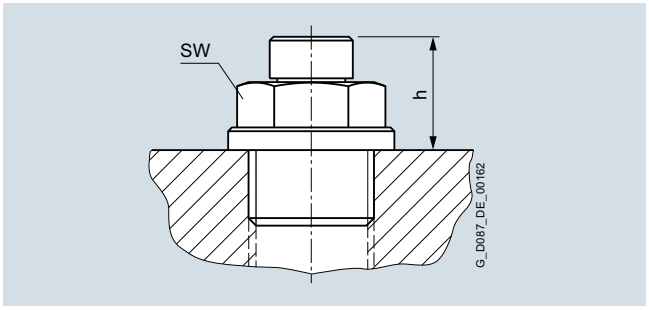
Overview (continued)

Pressure breather valve

Gearboxes from size 39 are supplied with an installed pressure breather valve; this is suitable for both indoors and outdoors use.

Gearbox size 29 can be operated in mounting positions M1, M3, M5 and M6 without requiring a pressure breather valve. For mounting positions M2 and M4, they are equipped with a pressure breather valve.

Technical specifications for pressure breather valve



Pressure breather valve

Gearbox type	Gearbox size	Width across flats	Thread	Dimensions h
		Width SW		mm
Helical gearboxes *Z* and *D*	29, 39	12	G 1/8 A	15
	49, 59, 69, 79	13	G 1/4 A	15
	89, 109, 129	17	G 3/8 A	15
Parallel shaft gearbox *F*	29, 39	12	G 1/8 A	15
	49, 69, 79	13	G 1/4 A	15
	89, 109, 129	17	G 3/8 A	15
Bevel gearbox *B*	29, 39	12	G 1/8 A	15
	49	13	G 1/4 A	15
Bevel gearbox *K*	39	12	G 1/8 A	15
	49, 69, 79, 89	13	G 1/4 A	15
	109, 129	17	G 3/8 A	15
	149	24	G 3/4 A	18
Helical worm gearbox *C*	29, 39	12	G 1/8 A	15
	49, 69, 89	13	G 1/4 A	15

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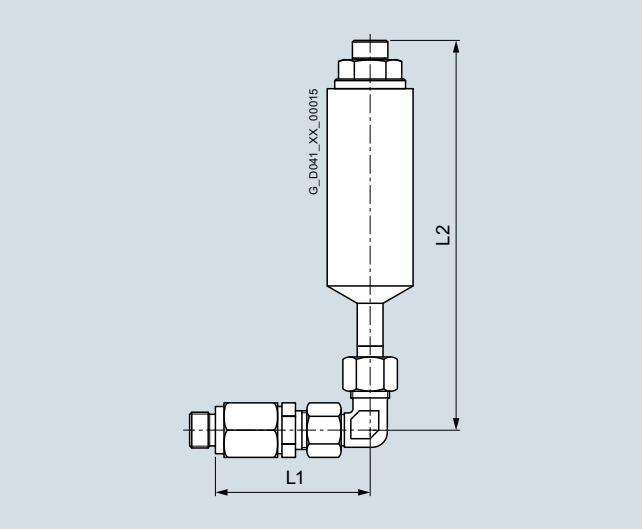
Overview (continued)

Oil expansion unit

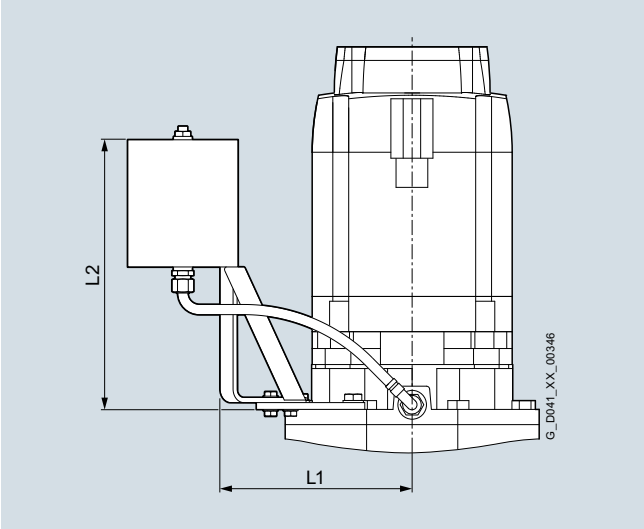
The oil expansion unit increases the expansion space for the lubricant. For certain types of construction and at high operating temperatures, this avoids lubricant escapes.

The oil expansion unit is supplied as a mounting kit, and can be mounted onto the geared motor vertically or at an angle.

Technical specifications for oil expansion unit



Oil expansion unit type 1



Oil expansion unit type 2

Gearbox type	Gearbox size	Motor shaft height	Oil expansion unit	Width across flats	Thread	Dimension L1	Dimension L2
			Type	SW		mm	mm
Parallel shaft gearbox *F*	*39*	36 ... 80	1	19/22	G1/8A	62.5	155
	49	63 ... 80	1	19/22	G1/4A	42	155
	69	80 ... 100	1	19/22	G1/4A	42	155
	79	100	1	19/22	G1/4A	42	155
	89	100	1	22	G3/8A	42	154
	129	100	2	–	G3/8A	442	334
Bevel gearbox *B*	*29*	36 ... 80	1	19/22	G1/8A	62.5	155
	39	36 ... 80	1	19/22	G1/8A	62.5	155
	49	63 ... 100	1	19/22	G1/4A	42	155
Bevel gearbox *K*	*39*	36 ... 80	1	19/22	G1/8A	62.5	155
	69	80 ... 100	1	19/22	G1/4A	42	155
	79	63 ... 100	1	19/22	G1/4A	42	155
	89	63 ... 100	1	19/22	G1/4A	42	155
	109	100	1	22	G3/8A	42	154
	129	80 ... 100	2	–	G3/8A	442	334
	149	100	2	–	G3/8A	465	334
Helical worm gearbox *C*	*69*	63 ... 100	1	19/22	G1/4A	42	155
	89	100	1	19/22	G1/4A	42	155

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Overview (continued)

Oil drain

Magnetic oil drain screw

For gearboxes from gearbox size 39, a magnetic oil drain screw is available that is inserted in the oil drain hole. This serves to collect any metal particles in the gearbox oil.

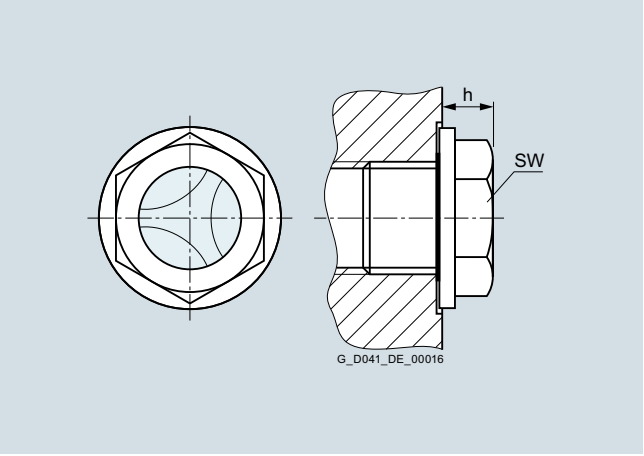
Oil sight glass

With gearboxes from gearbox size 49, the oil level is checked using the oil level checking screw.

The version with "Oil sight glass" is not possible for angled mounting positions.

The oil sight glass is fitted with a reflector for visual monitoring.

Technical specifications of oil sight glass



Oil sight glass

Gearbox type	Gearbox size	Width across flats SW	Thread	Dimension h
		mm		mm
Helical gearboxes *Z* and *D*	49 … 79	16	G 1/4 A	10
	89 … 129	19	G 3/8 A	9
Parallel shaft gearbox *F*	49 … 79	16	G 1/4 A	10
	89 … 129	19	G 3/8 A	9
Bevel gearbox *B*	49	16	G 1/4 A	10
Bevel gearbox *K*	49 … 89	16	G 1/4 A	10
	109, 129	19	G 3/8 A	9
	149	24	G 3/4 A	10
Helical worm gearbox *C*	49 … 89	16	G 1/4 A	10

Reduced-backlash version

Gearboxes with low torsional backlash are required for high-precision positioning tasks. A minimal torsional backlash also has a favorable effect on torque spikes during startup and on load switching in the drive train.

The torsional backlash of a geared motor depends on several factors. The total torsional backlash is primarily influenced by circumferential backlash, bearing clearance and shaft-hub connections.

SIMOTICS S-1FG1 servo geared motors with helical, parallel shaft and bevel gearboxes in sizes 29 to 89 are also available in reduced-backlash version in addition to the standard version. Thanks to the overall concept and the plug-on pinion system, motors with lower torsional backlash values can be supplied.

To ensure that the entire driven machine can be designed with minimum possible backlash, it is advisable to use the output shaft with shrink disk connection or with smooth shafts (without feather key). In this case, only backlash-free power transmission elements should be used.

The specified torsional backlash in minutes of the angle [’] is based on the maximum rotation angle of the output shaft (no load, max. 1 % of rated output torque) with stationary input shaft.

For the exact values, refer to the torque tables. If no values are specified in the tables, this means that a reduced-backlash version is not available for the specific version.

The dimensions of the reduced-backlash gearboxes are identical to those of the standard versions.

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2

Overview (continued)

Increased chemical resistance

Order code **N16**

SIMOTICS S-1FG1 servo geared motors are available in a version with increased chemical resistance. The relevant order code is **N16**.

Additional properties:

- Four-coat paint system
- Nickel-plated connectors
- Stainless steel pressure breather valve

Applications

SIMOTICS S-1FG1 servo geared motors with option "Increased chemical resistance" are designed for operation in food processing environments.
The paint system of these servo geared motors is resistant to numerous common cleaners and disinfectants.

Note:

The resistance of the paint to the cleaners and disinfectants used has been verified by a material resistance test by ECOLAB Deutschland GmbH.

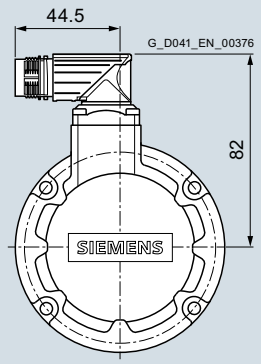
The certificate can be found on the Internet at https://support.industry.siemens.com/cs/ww/en/view/58657336.

Resistance of the connectors is achieved with a nickel-plated surface. Test the resistance of the entire system comprising the servo geared motor, connections and cables before use.

Connection system:

On motors with order code **N16**, the power/brake and signal connectors are nickel-plated.
Regarding the signal plug, motors with DRIVE-CLiQ interface differ from the standard motor version in the following respects:

- The motor is 5 mm longer and has the same overall length as a motor without DRIVE-CLiQ interface.
- The connector is a rotatable angle plug, see illustration
- The height of the interfering contour relative to the motor center is 82 mm, see illustration
- A non-standard signal cable is required



DRIVE-CLiQ signal cables with M17 motor-side rotary plug for SIMOTICS S-1FG1 servo geared motors with order code **N16**

	6FX ■ 002-2D ■ ■ ■ -....
MOTION CONNECT 500 – for predominantly fixed cable installation.	5
MOTION CONNECT 800PLUS – meets requirements for use in cable carriers	8
SPEED CONNECT – quick-release lock version	C
Full thread – conventional screw lock	D
Cable end:	
• DRIVE-CLiQ connector RJ45, IP20 – e.g. for the connection between motor and SINAMICS S120 converter	4 0
• DRIVE-CLiQ connector RJ45, IP67 – e.g. for the connection between motor and hub or between motor and cabinet lead-through	4 8
• DRIVE-CLiQ rotary plug M17, IP67 (contact pins) – extension between motor and above-stated signal cables	4 4

Limited validity for 1FG1 servo geared motors:

The order code **N16** can be ordered for the following versions:

- Encoder for SINAMICS S120 with DRIVE-CLiQ interface AM20DQI (1FG1…-.R…-….) –
  Absolute encoder 20 bit + 12 bit multi-turn with DRIVE-CLiQ interface
- Housing flange design and flange-mounted design (1FG1…-…..-.F.., 1FG1…-…..-.H..)

The following versions cannot be combined with the order code **N16**:

- Hollow shaft designs
- Torque arm
- Double-sided shaft –
  with **9** at the 8th position of the Article No. and order code **H5A**
- Paint options with order codes **K23** and **K24**
- Manual release with spring-operated brake -
  Order code **K82**