

Electric motor / gear motor

# Operating manual for electric motor / gear motor

Status : January, 2013



Electric Motor



Spur Gear Motor



Flat Gear Motor

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## 1. General safety information

### 1.1. General

Any work for the transport, storage, installation, commissioning and maintenance may be carried out with the personal protective equipment required for the work.

### 1.2. Explanation of symbols

Signal words:

| Signal word field with signal word                                                                | Meaning                                                                                                             |
|---------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
|  <b>DANGER</b>   | Indicates a hazard with a high degree of risk which leads to death or severe injuries if it is not prevented.       |
|  <b>WARNING</b>  | Indicates a hazard with a medium degree of risk, which can lead to death or severe injuries if it is not prevented. |
|  <b>CAUTION</b> | Indicates a hazard with a low degree of risk which can cause minor or moderate injuries if it is not prevented.     |

Table 1 : Signal words and their meaning

The safety instructions in this operating manual are structured as follows:

| Signal word with illustration                    |
|--------------------------------------------------|
| <b>HAZARD</b><br>➤ Actions to prevent the hazard |

### 1.3. Personnel

Any work for the transport, storage, installation, commissioning and maintenance must only be carried out by qualified specialist personnel. The binding specifications for the qualification of electrically qualified persons and electrically skilled personnel apply as defined in DIN VDE 0105-100.

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### 1.4. **Mechanical hazard**

Transport, assembly, commissioning and decommissioning, as well as maintenance and inspection work must only be carried out using the personal protective equipment required for the respective work, and only by trained specialist personnel while the machine is idle, de-energised and cooled off.

### 1.5. **Thermal hazard**

|                                                                                                                                                                                                                                                                                                                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <b>WARNING</b>                                                                                                                                                                                                                         |
| <b>HOT MACHINE PARTS</b>                                                                                                                                                                                                                                                                                                 |
| <b>Hot machine parts can cause burns in case of skin contact</b>                                                                                                                                                                                                                                                         |
| <ul style="list-style-type: none"> <li>➤ Do not touch hot surfaces!</li> <li>➤ If possible, the manufacturer of the complete machine has to provide suitable touch guards!</li> <li>➤ Wear the personal protective equipment for maintenance or troubleshooting work!</li> <li>➤ Observe the cool-down times!</li> </ul> |

Electric mains must not be in contact with hot surfaces.

### 1.6. **Magnetic hazard**

When using ABM **SINOCHRON®** motors, observe the following:

|                                                                                                                                                                                                                        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <b>DANGER</b>                                                                                                                      |
| <b>MAGNETIC FIELD</b>                                                                                                                                                                                                  |
| <b>Due to the strong magnetic field as well as the associated high magnetic attractive forces, hazards to the health especially to persons with a pacemaker can occur. Severe injuries or death can be the result.</b> |
| <ul style="list-style-type: none"> <li>➤ Any work on the drive is forbidden for persons with a pacemaker!</li> </ul>                                                                                                   |

## Electric motor / gear motor

## 2. General

### 2.1. General instructions

Before working with the drive, carefully read the operating manual. This way, you ensure a risk-free and smooth function of the drive. The instructions of this operating manual must be observed.

Special designs can deviate in technical details! This operating manual and all associated special documentations must be kept in close proximity to the drive.

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### 2.2. Used terms

| Term  | Hereinafter used for                                                                  |
|-------|---------------------------------------------------------------------------------------|
| Motor | Three-phase motor<br>Single-phase motor<br>Gear motor<br>ABM <b>SINOCHRON</b> ® motor |
| Gear  | Spur gear<br>Flat gears<br>Special gears                                              |
| Drive | Motor or gear motor                                                                   |

Table 2 : Used terms

### 2.3. Modification of the product

The drive itself must not be changed. Adjacent constructions by the customer must not obstruct the heat flow by means of convection and heat conduction. A heat input into the drive from the outside is not allowed.

### 2.4. Liability and warranty claims

The drive must only be operated in compliance with the specifications in the operating manual.

In case of property and personal damage caused by improper handling or noncompliance with the safety instructions, any liability and warranty claim expires.

## Electric motor / gear motor

**2.5. Addresses**

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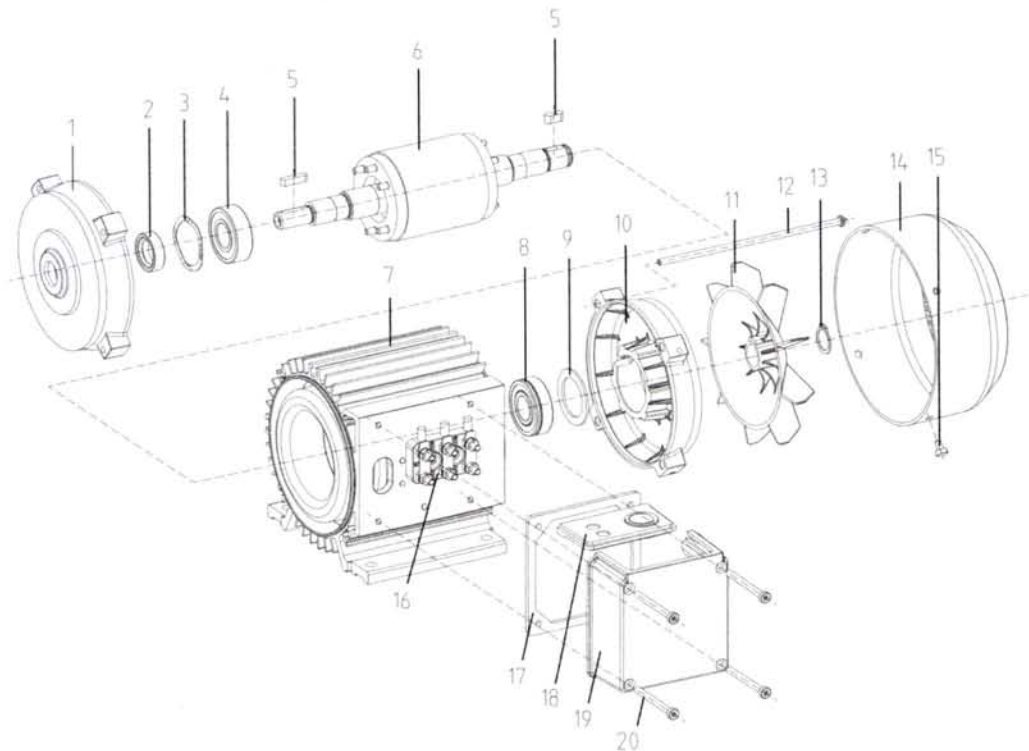
Phone: +86 (0)512 - 8717 1081  
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## Electric motor / gear motor

### 3. Specification

#### 3.1. Construction of the motor (schematic diagram)

Deviations are possible depending on the design.



**Image 1 : Construction of the motor**

- |                           |                     |
|---------------------------|---------------------|
| [1] Bearing plate A-side  | [11] Fan            |
| [2] Shaft seal ring       | [12] Traction screw |
| [3] Ball bearing shim     | [13] Locking ring   |
| [4] Grooved ball bearing  | [14] Fan cowl       |
| [5] Fitting key           | [15] Hexagon screw  |
| [6] Rotor                 | [16] Terminal board |
| [7] Stator                | [17] Seal           |
| [8] Ball bearing          | [18] Slider         |
| [9] Adjusting washer      | [19] Terminal box   |
| [10] Bearing plate B-side | [20] Cylinder screw |

3.2. Name plate

Name plate (Example)

|                                                                                   |  |                                                                                             |  |        |    |               |        |
|-----------------------------------------------------------------------------------|--|---------------------------------------------------------------------------------------------|--|--------|----|---------------|--------|
|  |  | Greiffenberger Antriebstechnik / <a href="http://www.abm—drives.com">www.abm—drives.com</a> |  |        |    |               |        |
|  |  | Mot Nr E130364 0001                                                                         |  |        |    | TNr 191436480 |        |
|                                                                                   |  | VDE0530                                                                                     |  | IKI F  | UT | C             | IP 21  |
| Made in Germany                                                                   |  |                                                                                             |  |        |    |               |        |
| Typ ZFB11SO/TDF230/4DG80MF-4                                                      |  |                                                                                             |  |        |    |               |        |
| S2 - 60min                                                                        |  |                                                                                             |  |        |    |               |        |
| 0,8                                                                               |  | kW                                                                                          |  | 15     |    | V             | 121 Hz |
| $\Delta$                                                                          |  | 46                                                                                          |  | A      |    | cos 0, 82     |        |
| 115 / 3460                                                                        |  |                                                                                             |  |        |    |               | 1/min  |
| BREMSE                                                                            |  | TS 11,5 Nm                                                                                  |  | 24V= V |    | 1,66 A        | CB CA  |

| Abbreviation | Unit  | Designation                                  |
|--------------|-------|----------------------------------------------|
| Mot          |       | D = three-phase motor                        |
|              |       | E = single-phase motor                       |
|              |       | PM = SINOCHRON <sup>®</sup> motor            |
| Nr           |       | Serial number                                |
| TNr          |       | ABM part number                              |
| IKL          |       | Insulation class                             |
| UT           | °C    | Max. allowed ambient temperature             |
| IP           |       | Type of protection                           |
| Typ          |       | ABM type designation                         |
|              |       | Operating mode                               |
|              | kW    | Motor rated power                            |
|              | V     | Motor connection voltage                     |
|              | Hz    | Frequency motor voltage                      |
|              |       | Switching type of the motor (Y / delta)      |
|              | A     | Rated current of the motor                   |
|              |       | Cos-Phi of the motor                         |
|              | 1/min | Rated speed at the motor shaft or gear shaft |
| Brake        | TS    | Nm Braking torque                            |
|              |       | V Brake connection voltage                   |
|              |       | A Rated current of the brake                 |
| CB           | µF    | Operating capacitor for single-phase motors  |
| CA           | µF    | Starting capacitor for single-phase motors   |

Table 3 : Field description at the name plate

## Electric motor / gear motor

### 3.3. Type designation

This documentation applies to ABM drives with the following type designation (example):

ZFB100      /      G200F      /      4D132Mc-4  
 Brake designation      Gear designation      Motor designation

| Type designation brake                       |                                                                                                                                                                                                                                                                                            |                                        |
|----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|
| See operating manual brake                   |                                                                                                                                                                                                                                                                                            |                                        |
| Type designation gear                        |                                                                                                                                                                                                                                                                                            |                                        |
| Gear type                                    | Spur gear                                                                                                                                                                                                                                                                                  | Flat gear                              |
| Designation                                  | G = 2-stage<br>3G = 3-stage<br>GS = special                                                                                                                                                                                                                                                | FG = normal gear<br>FGS = special gear |
| 1. addition                                  | Axle height                                                                                                                                                                                                                                                                                | A = attachment version                 |
| 2. addition                                  | V = reinforced                                                                                                                                                                                                                                                                             | Output torque                          |
| 3. addition                                  | F = flange                                                                                                                                                                                                                                                                                 | F = flange version                     |
| Type designation motor                       |                                                                                                                                                                                                                                                                                            |                                        |
| Casing key                                   | 3 = die-cast case<br>4 = extruded casing<br>- = bearing plate motor                                                                                                                                                                                                                        |                                        |
| Motor type                                   | D = three-phase motor<br>E = single-phase motor<br>PM = Permanent magnet motor                                                                                                                                                                                                             |                                        |
| Variants for single-phase motors             | EK = with operating capacitor<br>EKK = with operating and starting capacitor<br>ERKK = with relay, operating and starting capacitor<br>EWR = with auxiliary resistance phase and relay<br>EZKK = with centrifugal switch, operating and starting capacitor<br>DEK = with Steinmetz circuit |                                        |
| 1. addition                                  | K= flywheel<br>L= bearing plate motor (without casing)<br>B= reinforced coil<br>G= non-ventilated<br>F = flange design                                                                                                                                                                     |                                        |
| 2. addition                                  | Motor size (peak height) and packet length                                                                                                                                                                                                                                                 |                                        |
| 3. addition                                  | Number of pins                                                                                                                                                                                                                                                                             |                                        |
| 4. addition for 1 <sup>st</sup> addition "G" | FL: forced ventilated<br>EL: external ventilation<br>DL: open-circuit ventilated                                                                                                                                                                                                           |                                        |

**Table 4 : type designation ABM drives**

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### 3.4. Standards and guidelines

The motors comply with the following standards:

| Standard          | Title                                                                                                                                                                           |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| IEC / EN 60034-1  | Rotating electrical machines - part 1: Rating and performance                                                                                                                   |
| IEC / EN 60034-5  | Rotating electrical machines - part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) - Classification                         |
| IEC / EN 60034-7  | Rotating electrical machines - part 7: Classification of types of construction and mounting arrangements                                                                        |
| IEC / EN 60034-8  | Rotating electrical machines - part 8: Terminal markings and direction of rotation                                                                                              |
| IEC / EN 60034-9  | Rotating electrical machines - part 9: Noise limits                                                                                                                             |
| IEC / EN 60034-14 | Rotating electrical machines - part 14: Mechanical vibration of certain machines with shaft heights 56 mm and higher - Measurement, evaluation and limits of vibration severity |
| IEC / EN 60204-1  | Safety of machinery - Electrical equipment of machines - part 1: General requirements                                                                                           |

**Table 5 : Standards**

If the products fall within their scope, the following guidelines and directives apply:

| Number                 | Abbreviated designation           |
|------------------------|-----------------------------------|
| 2006/95/EC             | Low-Voltage Directive             |
| 2009/125/EC            | Ecodesign Directive               |
| 2011/65/EU             | RoHS directive                    |
| Directive EC 640/2009  | Implementing directive 2005/32/EC |
| Directive EC 1907/2006 | REACH                             |

**Table 6 : Guidelines**

Asynchronous motor at sinusoidal mains are considered as electromagnetically passive components because they neither cause faults nor are they error-prone. According to chapter 1 paragraph 1 section 3 of the EMC directive (2004/108/EC), they are therefore excluded from the scope of this directive.

3.5. CE conformity

EU-Declaration of Conformity

Document-No./ Month . Year
 

01E

/

01

.

2013

Hereby we declare for the following product

|                                                        |                                                                                                                                                                                                                  |
|--------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Electric motors of the series<br><b>D... E... PM..</b> | <ul style="list-style-type: none"> <li>• poss. in combination with the frame size</li> <li>• poss. in combination with the number of poles</li> <li>• poss. in combination with additional components</li> </ul> |
|--------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

are in conformity with the essential requirements, which are defined in the following directives:

DIRECTIVE 2006/95/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 12 December 2006 on the harmonisation of the laws of Member States relating to electrical equipment designed for use within certain voltage limits – in short: **Low Voltage Directive**

DIRECTIVE 2011/65/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment – in short: **RoHS-Directive**

DIRECTIVE 2009/125/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products – in short: **Ecodesign Directive** \*

\* where the products fall under the scope of the directive

Relevant harmonised standards used or references to the specifications in relation to which conformity is declared:

| Reference                                          | Date                     | Title                                                                                                                                                                                                   |
|----------------------------------------------------|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Harmonised standard for the Low Voltage Directive: |                          |                                                                                                                                                                                                         |
| EN 60204-1 +A1                                     | 2009-06<br>2009-02       | Safety of machinery. Electrical equipment of machines. General requirements                                                                                                                             |
| EN 60034<br>All relevant parts                     | Diverse                  | Rotating electrical machines                                                                                                                                                                            |
| Harmonised standard for the RoHS-Richtlinie:       |                          |                                                                                                                                                                                                         |
| EN 50581                                           | 2012                     | Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances                                                                |
| Implementing measure for the Ecodesign Directive:  |                          |                                                                                                                                                                                                         |
| EG 640/2009 + Corr.                                | 2009-07-22<br>2009-07-23 | COMMISSION REGULATION (EC) No 640/2009 of 22 July 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to <u>ecodesign</u> requirements for electric motors |
| Additional technical specifications applied:       |                          |                                                                                                                                                                                                         |
| EN ISO 12100                                       | 2010-11                  | Safety of machinery. General principles for design. Risk assessment and risk reduction                                                                                                                  |

This declaration is given for the manufacturer **ABM Greiffenberger Antriebstechnik GmbH**, Friedenfelser Str. 24, 95615 Marktrechwitz by CEO Robert Lacknermeier

Marktrechwitz, 15.01.2013  
 Place, Date

  
 Legal Signature

This declaration is in accordance with the above mentioned specified standards and directives. It does not include a guarantee of characteristics.

Additional information:
 

1. This declaration is valid for all specimens which are manufactured according the current production drawings – which are component of the technical documents.
2. Asynchronous motors connected to sinusoidal power supply systems are considered to be electromagnetically passive components since the neither cause electromagnetic disturbance no rare affected by such disturbance. According to chapter 1 Article 1(3) of the EMC Directive (2004/108/EG), they are thus excluded from the scope of the Directive.

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### 3.6. *Intended use*

The drives serve the generation of a rotary movement and are intended for commercial plants.

| Ambient conditions   | Requirement                                            |
|----------------------|--------------------------------------------------------|
| Ambient temperatures | -15° up to +40 °C                                      |
| Installation height  | ≤ 1000 m above sea level                               |
| Humidity             | Up to 50% (at +40°)<br>Up to 90% (at room temperature) |

**Table 7 : Operating conditions according to EN 60034-1 or EN 60204-1**

The use in explosive areas is forbidden.

An overload can cause damages to the drive. The maximum shaft load allowed for your gear is specified in Annex B.

In order to prevent an overheating of the drive, it must be ensured that sufficient space is available for the unobstructed ventilation. The fan cowls must not be covered. When using several drives in close proximity, it must be ensured that it is possible to prevent a suction of warm exhaust air.

The technical data on the name plate must be observed. The documentation must be complied with. For applications in which the failure of a gear or motor could cause a danger to persons, corresponding safety precautions must be provided.

The motor is no independently functional machine and it is intended for the integration into another machine. The commissioning is prohibited until it has been determined that the machine complies with the regulations of the EC directives.

### 3.7. *Optional modules*

If your drive is equipped with a brake, please observe the supplementary operating manual. This manual will also specify the  $B_{10d}$  characteristics pursuant to EN ISO 13849-1.

The safety characteristics for the variant with rotary encoder are specified in Annex E.

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### 4. Preparation of the drives for operation

#### 4.1. *Shipment and packaging*

The motor is delivered with suitable packaging. The outer packaging is taken back.

##### **Incoming control:**

- Check the completeness on the basis of the delivery note!

##### **Is the packaging damaged?**

- Check the delivery for damages (visual inspection)!

##### **In case of complaints**

If the delivery was damaged during transport:

- Contact the forwarding agent immediately!
- Keep the packaging (due to a possible inspection by the forwarding agent, or for the return of the goods)!

##### **Packaging for the return of the goods**

- Pack the motor shockproof.

#### 4.2. *Transport and storage*

During transport, motors (from size 100) and all gear motors must only be suspended at the provided lifting eyes. Do not attach additional loads to the motor. Only use suitable **lifting means**. Improper execution, unsuitable or damaged devices and tools can cause injuries and/or property damage.

 **DANGER**

**FALLING OBJECTS**

**In case of improper transport, the drive could detach from the transport and lifting gear. Falling objects can cause severe injuries.**

- Staying underneath the drive during transport is forbidden!
- Ensure secure fastening!

## Electric motor / gear motor

The following points must be observed for the storage:

- Storage in installation position, protect the drive against falling
- Slightly lubricate blank casing surfaces and shafts
- Store in dry, dust-free rooms
- Temperature without considerable fluctuations between -25°C and +55°C
- Relative humidity less than 60%
- No direct sunlight or UV light
- No aggressive, corrosive materials (contaminated air, ozone, gases, solvents, acids, lye, salts, radioactivity etc.) in the surroundings
- No shocks and vibrations.

### 4.3. **Mechanical installation**

The mechanical connection of the electric motor has to be carried out by a specialist. Only carry out work at the drive when it is switched off and secured against restart.

Before the installation, check the installation situation. Shearing and crushing points must be avoided when handling the drive.

Also observe the following when using ABM **SINOCHRON**® motors:

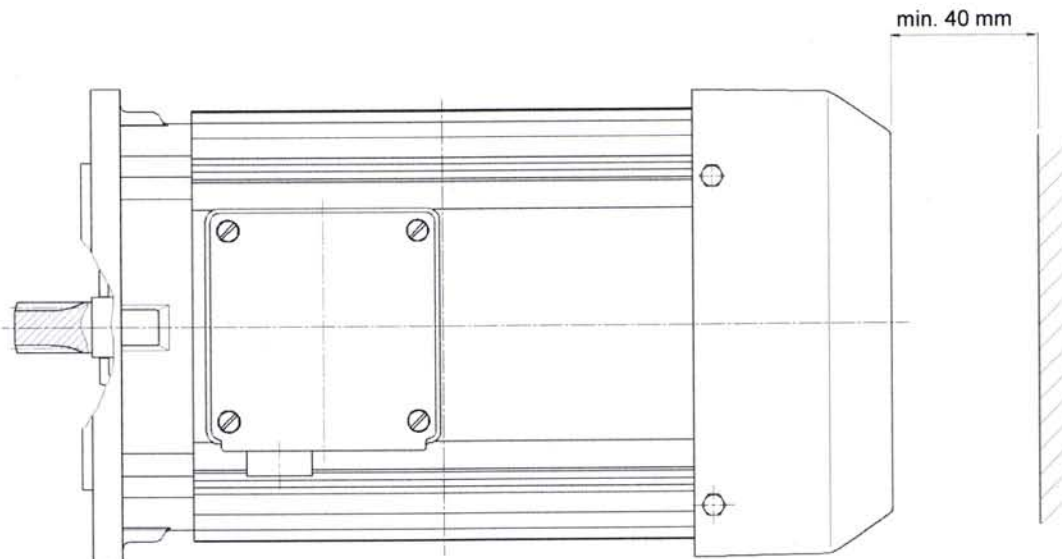
|                                                                                                                                                              |                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
|                                                                           | <b>CAUTION</b> |
| <b>MAGNETIC FIELD</b>                                                                                                                                        |                |
| <b>Due to the magnetic forces, injuries can be caused by attracted tools</b>                                                                                 |                |
| <ul style="list-style-type: none"><li>➤ Hold on to the tools tightly!</li><li>➤ Bring them closer to the motor slowly!</li><li>➤ Wear work gloves!</li></ul> |                |

## Electric motor / gear motor

### Assembly

The following must be observed during assembly:

- Mount the drive on an even, vibration-free locating surface. All fastening bases and flanges must rest flush in order to prevent bracings of the motor casing or gear casing.
- Ensure a free cooling air supply. The distance between motor air inlet and walls, components etc. must be at least 40 mm.



**Image 2 : Minimum distance from the fan cowl**

- The airflow direction is from the B-side towards the A-side. The escaping exhaust air must not be sucked in again immediately. The air inlets and outlets must be kept free from dirt.
- Ensure that existing condensate bores are located at the lowest point of the motor. Protect them against contaminations. If required, remove the plastic sealing plugs (if available).
- Remove the rust protection coating from the shaft ends. When removing the rust protection, no solvents may penetrate into the bearings.
- Mount the transmission element to the motor / gearbox drive shaft.
- The cylindrical shaft ends are equipped with a centring device whose thread enables the fitting of the transmission element. Always use suitable devices for the fitting and removal. Avoid vibrations and shocks during assembly. In case of a force effect, the bearings will be damaged.
- Only use elastic couplings. Rigid couplings require a precise alignment of the shafts.

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- When using transmission elements which cause radial and axial shaft loads during operation, observe the allowed loads. If not specified in the data sheet, the specifications are stipulated in Annex B.


**DANGER**

**MOVING PARTS**

**Rotating parts can cause injuries**

- Equip the transmission elements with a safety device!
- Observe the design guidelines of "DIN EN ISO 12100" and the safety distances pursuant to "DIN EN ISO 13857"!

- Product-specific characteristics must be observed when selecting add-on components (fixtures) and for the later use of the complete machine:

### Balancing

Only for the assembly of the drive element onto the motor shaft:

Ensure the correct balancing type of the drive element according to the balancing type of the motor shaft (F- or H-balancing). The shafts are balanced according to DIN ISO 1940-1. The marking is indicated on the Name plate behind the product number.

| Marking | Balancing type                 |
|---------|--------------------------------|
| F       | Balanced with full fitting key |
| H       | Balanced with half fitting key |

**Table 8 : Balancing type**

Couplings, pulleys, gear wheels etc. must be balanced on an even shaft without fitting key (other balancing types only after previous agreement).

## Electric motor / gear motor

### Alignment

In coupling operation, align the shafts axially and radially against each other.

Fit dial gauges.

Measure at four measuring points, which are each offset by 90°, while rotating **both** coupling halves at the same time.

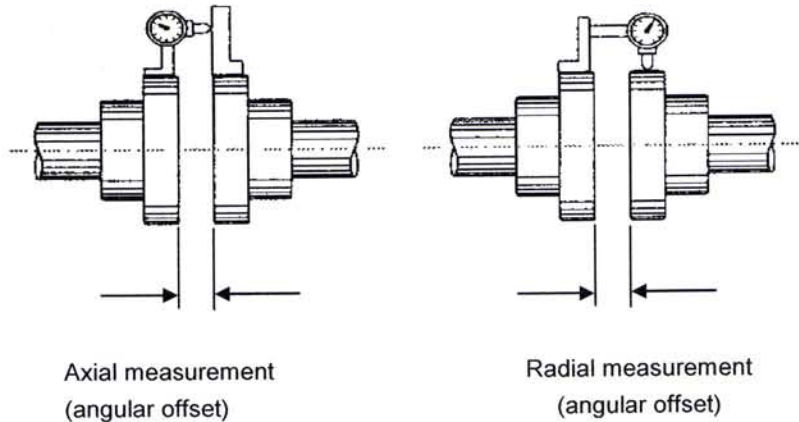
Check the alignment at **operating temperature**.

### Axial measurement

- Balance the discrepancy by placing sheet metal plates underneath.
- Do not exceed remaining inaccuracies of 0.03 mm, based on a measuring circle of 200 mm.

### Radial measurement

- Balance differences by displacement or by placing sheet metal plates underneath.
- Do not exceed remaining inaccuracies of 0.03 mm, based on a measuring circle of 200 mm.
- Carry out the adjustment of the axial air between the coupling halves according to the specifications of the coupling manufacturer.



**Image 3 : Measurement of angular offset**

#### 4.4. Electrical installation

 **DANGER**

**ELECTRIC SHOCK**

**Electrical parts are energized with hazardous voltage. When touching these parts you will get an electric shock. Death or severe injuries are the result.**

- Any work for electrical installations must only be carried out by qualified specialists!
- Connecting work must only be carried out in de-energized condition!

- Compare the mains voltage and mains frequency with the data on the rating plate. The allowed mains voltage fluctuation is  $\pm 10\%$ .
- Adjust the cross-sections of the connecting cables to the nominal current pursuant to the regulations.
- Connect and arrange the connection terminals according to the connection plan on the inside of the terminal box.
- Ensure that all connections including ground wire are tightly screwed.
- In order to avoid a tensile load of the terminals, mount the connection cables strain-relieved.
- No foreign matters, dirt or humidity may enter the terminal box.
- In order to ensure the type of protection when closing the terminal box, use the original seals.
- Only use screw connections and locking screws made of insulating material for the bushing bores at the plastic terminal box.
- Close unused cable entries in a dust- and waterproof manner.

#### **4.5. Commissioning**

- Before commissioning, ensure that the drive is undamaged and non-choked. Ensure the proper installation of the safety devices.
- In order to check the rotational direction, switch the properly connected motor in uncoupled condition "On/Off" for a short time.
- In order to avoid inadmissible switching current and torque jerks, the switching from Y- to delta start-up may only be effected is the starting current of the Y-step has decayed.
- Connect integrated temperature sensors (PTC thermistor or bimetal temperature sensor) to the control device. If a continuity test of the temperature sensors is required, this must be carried out with a measuring bridge (max. 5 V).
- During the test run under maximum load, the gear must be checked for:
  - 4.1.1. Unusual noises such as milling, knocking or grinding noises
  - 4.1.2. Unusual vibrations, oscillations and movements
  - 4.1.3. Generation of steam and smokeThe drive must be shut down and ABM must be contacted if an abnormality was determined during the aforementioned check tests.
- After the test run, the gear must be checked for leaks.

#### **4.6. Commissioning after longer downtimes**

- After longer downtimes (longer than 1 year), check the screw connections and bearings before the commissioning.
- Ensure that cooling airways, especially the openings of the fan cowls, are free from contaminations
- Before commissioning, replace the lubricant in the gear.
- Measure the insulation resistance. The maximum discharge current of the coil against the casing at 1500 V test voltage for the motors in supplied condition is 10 mA. The measurement must be carried out by a correspondingly qualified employee.

## Electric motor / gear motor

## 5. Operation

### 5.1. Safety instructions

|  <b>DANGER</b> |                                                                                                                              |
|-------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| <b>MOVING PARTS</b>                                                                             |                                                                                                                              |
| <b>Rotating parts can cause injuries</b>                                                        |                                                                                                                              |
| ➤                                                                                               | Never reach into moving parts and keep foreign materials away from these parts!                                              |
| ➤                                                                                               | Safety devices must be provided by the manufacturer of the complete machine and must not be removed or put out of operation! |
| ➤                                                                                               | Observe the safety distance!                                                                                                 |

During operation, motor surfaces must not be touched. The surfaces at the drives can become very hot. If required, provide a touch guard!

|  <b>WARNING</b> |                              |
|--------------------------------------------------------------------------------------------------|------------------------------|
| <b>HOT MACHINE PARTS</b>                                                                         |                              |
| <b>Hot machine parts can cause burns in case of skin contact</b>                                 |                              |
| ➤                                                                                                | Do not touch hot surfaces!   |
| ➤                                                                                                | Observe the cool-down times! |

Carry out regular checks during the operation, depending on the operating conditions. In doing so, pay special attention to:

- Unusual or excessive noise or temperature generation,
- Loose fixing elements,
- The condition of the electric mains,
- Stronger vibrations,
- Changes in the rotational speed,
- Problems with the heat removal due to depositions on the drive system.

In case of faults, contact the maintenance personnel immediately.

## Electric motor / gear motor

### 5.2. Error diagnosis and fault removal

 **DANGER**

**ELECTRIC SHOCK**

**Electric parts**

**Electrical parts are energized with hazardous voltage. When touching these parts you will get an electric shock. Death or severe injuries are the result.**

- Any repair work must only be carried out by qualified specialists!
- Connecting work must only be carried out in de-energized condition!

| Fault                                                        | Possible cause                                                                          | Remedy                                                                                                                                       |
|--------------------------------------------------------------|-----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| Motor does not start                                         | Fuse has blown                                                                          | Replace the fuse                                                                                                                             |
|                                                              | Motor protection has tripped                                                            | Check the motor protection for correct adjustment, readjust if necessary                                                                     |
|                                                              | Motor protection does not switch, error in the control                                  | Check the control of the motor protection, remove error                                                                                      |
|                                                              | Power supply interrupted                                                                | Check connections, adjust if necessary                                                                                                       |
|                                                              | Counter torque of the load is too big                                                   | Check load and reduce if necessary (check application)                                                                                       |
|                                                              | Voltage or frequency deviate severely from the target value, at least when switching on | Provide better mains conditions; check the cross-section of the supply line                                                                  |
|                                                              | Coil defective                                                                          | Repair by manufacturer                                                                                                                       |
| Motor does not start in Y-connection but in delta connection | Rotor streaks                                                                           | Repair by manufacturer                                                                                                                       |
|                                                              | Drive blocked                                                                           | Check components for free movement; remove foreign materials from the motor, if necessary                                                    |
|                                                              | Torque in Y-connection not sufficient                                                   | Unless the delta starting current is too high, switch on directly; otherwise you need a larger motor or special equipment after consultation |

# Electric motor / gear motor

| Fault                                                              | Possible cause                                    | Remedy                                                                     |
|--------------------------------------------------------------------|---------------------------------------------------|----------------------------------------------------------------------------|
|                                                                    | Contact error on the Y-delta connection           | Remove the error                                                           |
| Blow when switching on                                             | Motor coupling defective                          | Replace elastomer gear rim,                                                |
|                                                                    | Gear fixture loose                                | Re-tighten the motor and gear fixture screws                               |
|                                                                    | Rubber element defective                          | Replace rubber element                                                     |
| Wrong rotational direction                                         | Motor connected incorrectly                       | Interchange the two phases                                                 |
| Gearbox drive shaft does not rotate although the motor is rotating | Breakage in the gear                              | Contact ABM-Service                                                        |
|                                                                    | Motor coupling defective                          | Contact ABM-Service                                                        |
|                                                                    | Shrink disc slips through                         | Contact ABM-Service                                                        |
| Motor hums and has a high power consumption                        | Coil defective                                    | Repair by manufacturer                                                     |
|                                                                    | Rotor streaks                                     | Repair by manufacturer                                                     |
| Running noises                                                     | Foreign materials inside the motor                | Cleaning of the interior, possibly by the manufacturer                     |
|                                                                    | Bearing damage                                    | Installation of new grooved ball bearings, possible repair by manufacturer |
|                                                                    | Gearing damage                                    | Contact ABM-Service                                                        |
|                                                                    | Oil deficiency                                    | Contact ABM-Service                                                        |
|                                                                    | Vibrations                                        | Remove cause, balance if necessary                                         |
| Motor gets too hot                                                 | Motor switched in delta instead of Y, as intended | Correct the switching                                                      |
|                                                                    | Overload of the drive                             | Check load and reduce if necessary                                         |
|                                                                    | Insufficient cooling air, cooling airways blocked | Ensure free inlet and outlet of the supply air                             |

## Electric motor / gear motor

| Fault                                 | Possible cause                                                                                                                                                                                                                                  | Remedy                           |
|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| Motor gets too hot                    | Cooling air is preheated                                                                                                                                                                                                                        | Provide fresh air                |
|                                       | Ambient temperature too high                                                                                                                                                                                                                    | Provide fresh air                |
|                                       | Heat removal impaired due to deposits                                                                                                                                                                                                           | Clean the surface of the drives  |
|                                       | Power supply deviates from the rated motor voltage by more than 5%. Higher voltage is particularly unfavourable for multi-pin motors because for these motors, the no-load current is already close to the nominal current at a normal voltage. | Provide the correct power supply |
| Gear gets too warm                    | Unfavourable installation conditions                                                                                                                                                                                                            | Contact ABM-Service              |
|                                       | Gear damage                                                                                                                                                                                                                                     | Contact ABM-Service              |
| Oil escapes from the gear or motor    | Seal defective                                                                                                                                                                                                                                  | Contact ABM-Service              |
| Oil escapes from pressure ventilation | Incorrect oil level                                                                                                                                                                                                                             | Oil change                       |
|                                       | Dirty oil                                                                                                                                                                                                                                       | Oil change                       |

**Table 9 : Error diagnosis**

Electric motor / gear motor

## 6. Maintenance

### 6.1. Safety instructions

|  <b>DANGER</b>                                                                  |                                                                                                      |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| <b>ELECTRIC SHOCK</b>                                                                                                                                            |                                                                                                      |
| <b>Electrical parts are energized with hazardous voltage. When touching these parts you will get an electric shock. Death or severe injuries are the result.</b> |                                                                                                      |
| ➤                                                                                                                                                                | Any maintenance work must only be carried out by qualified specialists!                              |
| ➤                                                                                                                                                                | Maintenance work must only be carried out if the system is de-energised and secured against restart! |

|  <b>WARNING</b> |                              |
|--------------------------------------------------------------------------------------------------|------------------------------|
| <b>HOT MACHINE PARTS</b>                                                                         |                              |
| <b>Hot machine parts can cause burns in case of skin contact</b>                                 |                              |
| ➤                                                                                                | Do not touch hot surfaces!   |
| ➤                                                                                                | Observe the cool-down times! |

Please also observe the following when using ABM **SINOCHRON®** motors:

|  <b>CAUTION</b> |                                        |
|----------------------------------------------------------------------------------------------------|----------------------------------------|
| <b>MAGNETIC FIELD</b>                                                                              |                                        |
| <b>Due to the magnetic forces, injuries can be caused by attracted tools</b>                       |                                        |
| ➤                                                                                                  | Hold on to the tools tightly!          |
| ➤                                                                                                  | Bring them closer to the motor slowly! |
| ➤                                                                                                  | Wear work gloves!                      |

Please also ensure that no foreign materials reach the inside of the motor during repair work.

## Electric motor / gear motor

### 6.2. Maintenance

 **WARNING**

**FUMES**

**Chemical cleaning agents can be corrosive or develop hazardous fumes. Breathing difficulties, irritation or poisoning can be the result.**

- Use the personal protective equipment!
- Observe the warning notices of the cleaning agent producer!

 **CAUTION**

**DUST**

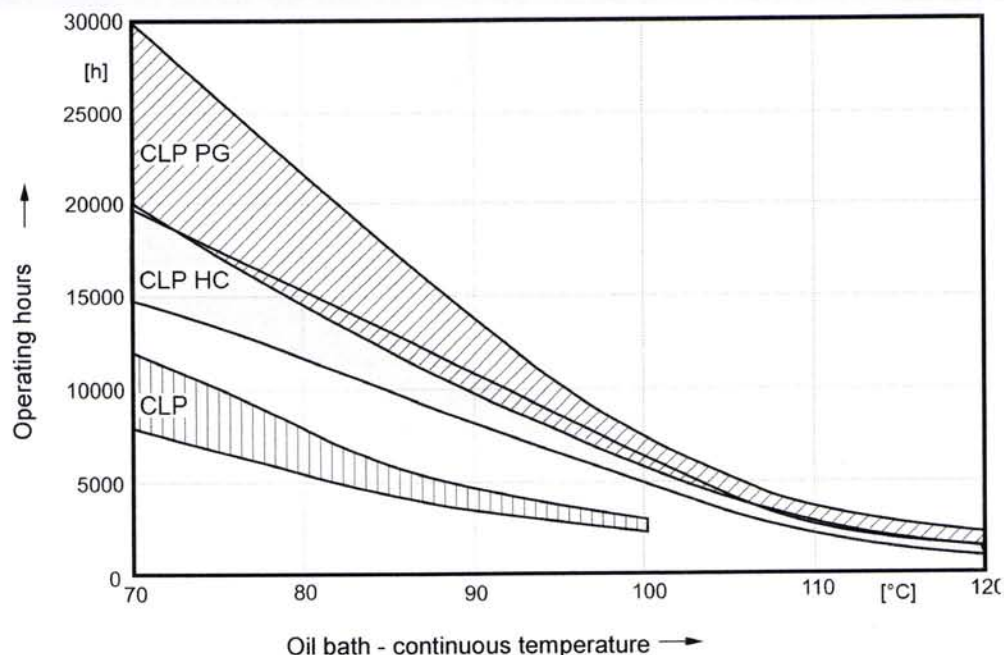
**When cleaning with compressed air or steam jet, dirt particles can be raised and inhaled, or they can reach into the eyes**

- Use the personal protective equipment!
- Ensure proper extraction!

| Maintenance intervals                                 | Maintenance work                                                                                                                                                                                                                         |
|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Maintenance work for the machine operator:</b>     |                                                                                                                                                                                                                                          |
| Regularly                                             | Depending on the dirt, clean the motor regularly along the entire cooling airway.                                                                                                                                                        |
| <b>Maintenance work for specialist personnel:</b>     |                                                                                                                                                                                                                                          |
| Every 3000 operating hours, at least every six months | <ul style="list-style-type: none"> <li>• Check oil level</li> <li>• Visual check for leakages</li> <li>• Check the coupling</li> <li>• Re-lubricate</li> <li>• Check the gear for abnormal running noises and / or vibrations</li> </ul> |
| Every 3 years                                         | <ul style="list-style-type: none"> <li>• Oil change (for mineral oil)</li> </ul>                                                                                                                                                         |
| Every 5 years                                         | <ul style="list-style-type: none"> <li>• Oil change (for synthetic oil)</li> </ul>                                                                                                                                                       |

**Table 10 : Maintenance work**

## Electric motor / gear motor



**Image 4 : Oil change interval for normal operating conditions**

We recommend shortened change intervals in case of particularly difficult operating conditions such as high humidity, aggressive environment, severe temperature fluctuations, etc.

Our gear motors are delivered ready-to-use. The first lubricant filling ex works lasts for approx. 10,000 operating hours for oil filling, for grease filling approx. 8,000 operating hours.

For quantity and type of the lubricant, please see Annex C. In doing so, observe the instructions in your data sheet. When changing the lubricant, the gear must be cleaned thoroughly.

⚠
**DANGER**

**HOT OIL**

**In case of contact with hot oil, there is a risk of scalding**

- Open the discharge carefully!
- Wear the personal protective equipment!

Ensure that no dirt reaches the inside of the gear when changing the lubricant. Remove bypassing oil immediately using an oil binding agent.

## Electric motor / gear motor

**6.3. Spare parts**

We expressly point out that spare and equipment parts, which were not delivered by ABM, were also not tested and approved by ABM.

The installation and / or use of such products could therefore have a negative impact on the constructive properties of your drive. The liability of the manufacturer is excluded for damages arising from the use of non-original spare parts and non-original equipment.

Request a separate spare parts drawing and list for your drive.

## Electric motor / gear motor

## 7. Decommissioning and disposal

### 7.1. Decommissioning

- First, remove the electrical connections

 **DANGER**

**ELECTRIC SHOCK**  
**Electrical parts are energized with hazardous voltage. When touching these parts you will get an electric shock. Death or severe injuries are the result.**  

- Any electrical work for the decommissioning must only be carried out by qualified specialists!
- Electrical work must only be carried out if the system is de-energised and secured against restart!

- For gear with oil filling: remove the lubricant
- Remove the drive from the machine
- Transport the drive to the work station prepared for the disassembly. Observe the Instruction in the chapter "Transport"
- Protect the drive and the components against falling when disassembling

 **DANGER**

**FALLING OBJECTS**  
**Falling objects can cause severe injuries.**  

- Ensure secure fastening!

## 7.2. *Recycling and disposal*

Divide the components into the following category for recycling:

- Electronic scrap
- Iron scrap
- Aluminium
- Non-ferrous metal such as motor coil
- Insulation material, cables
- Permanent magnets (for ABM **SINOCHRON®** motor)

Divide the auxiliary materials into the following category for recycling:

- Oil
- Grease
- Anticorrosive agents

The permanent magnets must be demagnetised before the disposal. This prevents hazards which are caused by the permanent magnets during and after the disposal. Permanent magnets are demagnetized by heating up.

Dispose of the components in compliance with the national and local regulations.

## Electric motor / gear motor

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# Electric motor / gear motor

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## Electric motor / gear motor

### Annex

## A Constructions

### A1 Electric motors

The constructions of the ABM electric motors comply with the standardization regulations DIN EN 60034-7.

Terminal box position:

The illustrations (image A-1 and A-2) show the terminal box position A, B, C and D.

If no specification is made upon order placement, the motor is delivered in terminal box position A. Terminal box positions B, C and D are delivered upon customer request.

The cable inlet can only be rotated by 90° for terminal boxes made of plastic. It is only partly possible for aluminium boxes (request).

Foot design:

Example for terminal box position and cable inlet

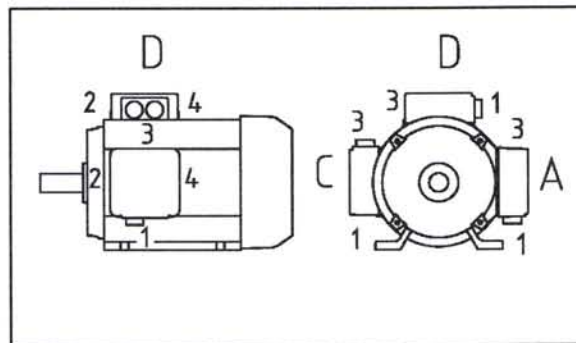


Image 5 : Terminal box position, foot design

Flange design:

Example for terminal box position and cable inlet

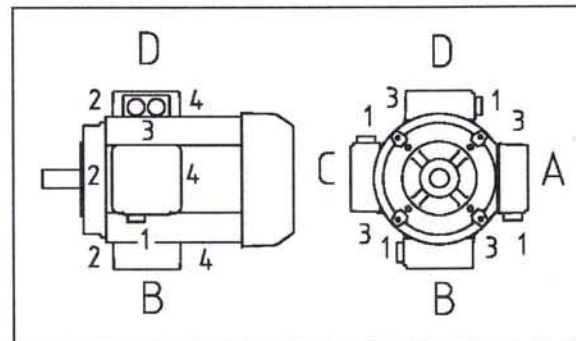


Image 6 : Terminal box position, flange design

Electric motor / gear motor

Constructions with horizontal shaft arrangement

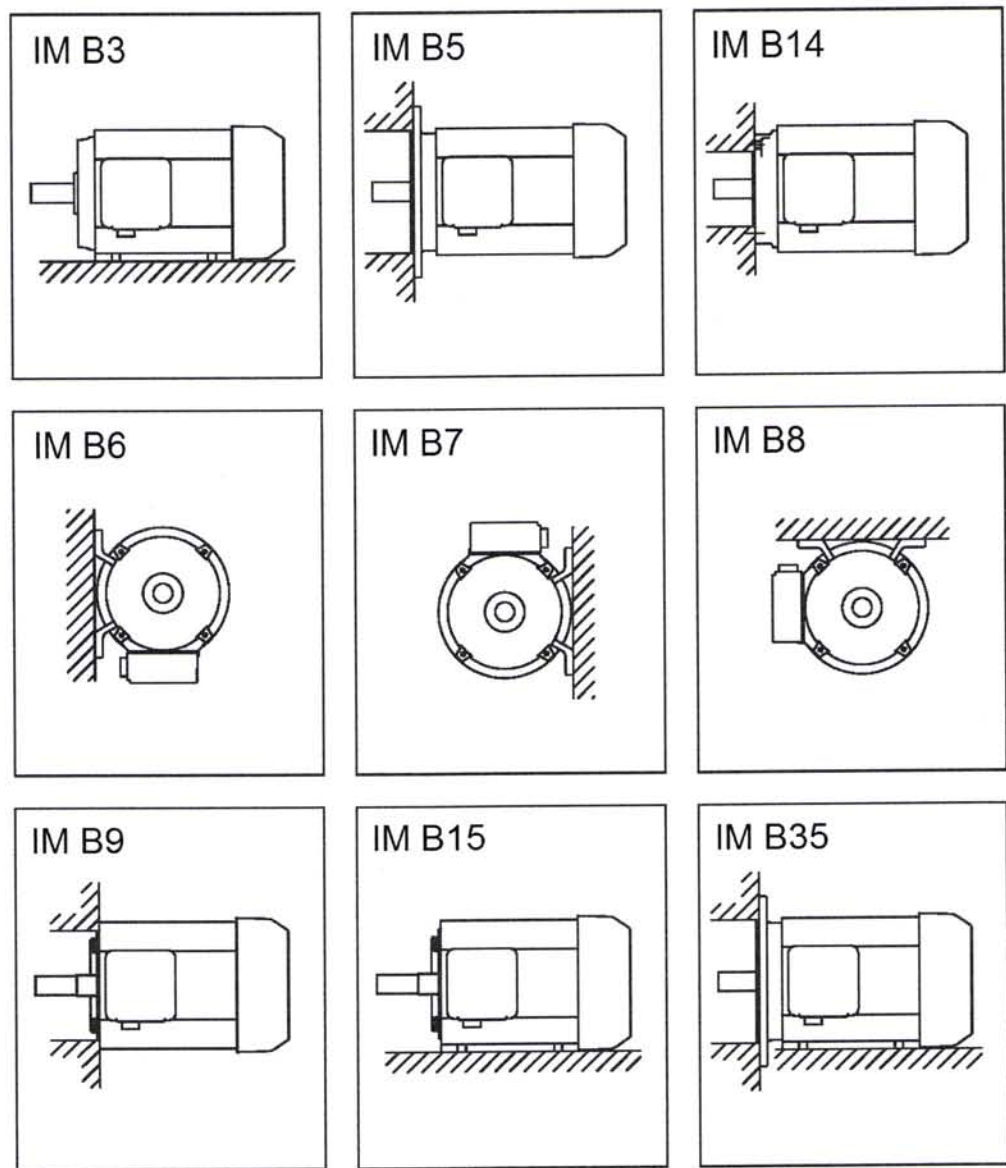


Image 7 : Constructions electric motors with horizontal shaft arrangement

# Electric motor / gear motor

## Constructions with vertical shaft arrangement

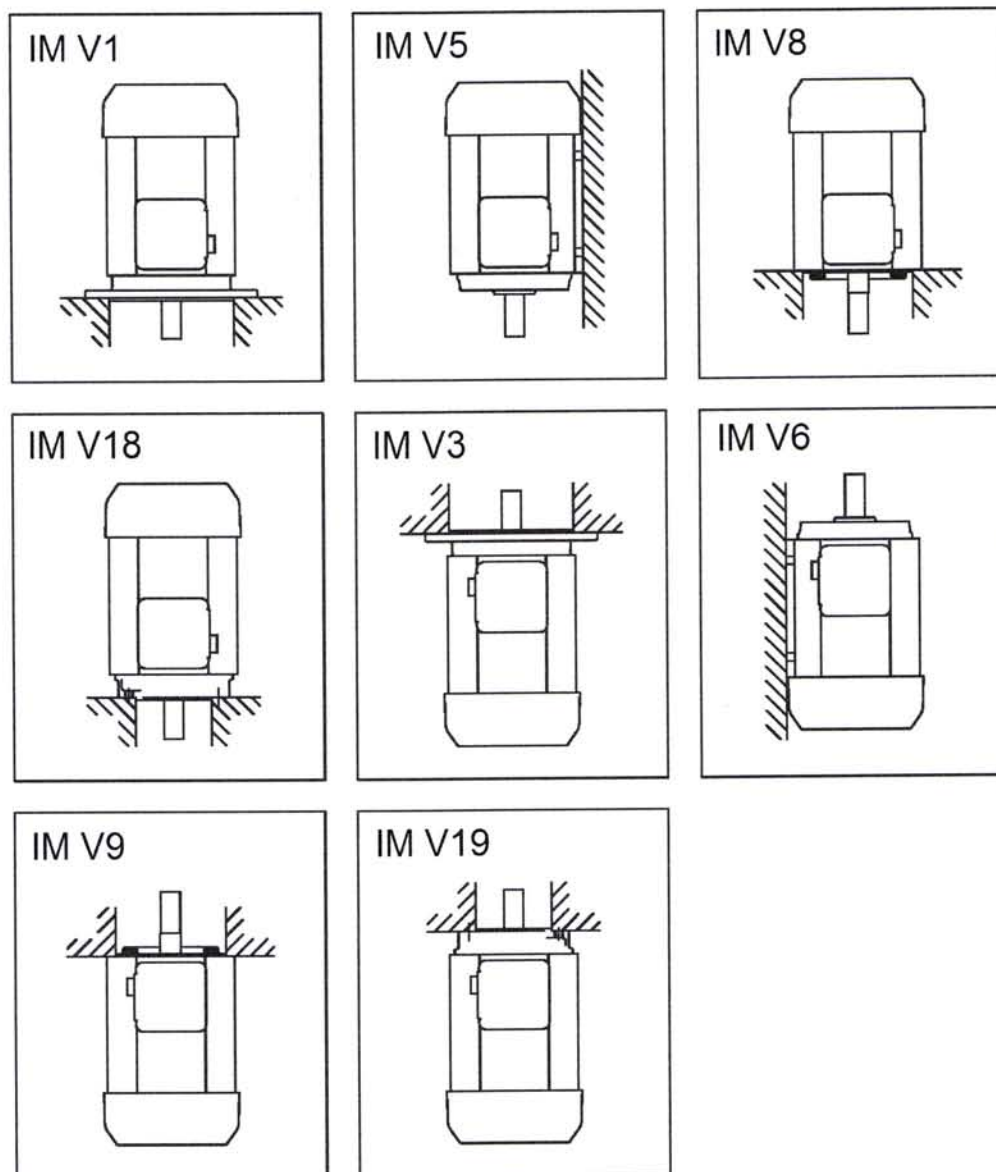


Image 8 : Constructions electric motors with vertical shaft arrangement

# Electric motor / gear motor

## A2      *Spur gear motors*

For the constructions of the ABM electric motors, see A1, image 7

- Marking:
-  = Oil fill plug
  -  = Oil level check plug
  -  = Oil drain plug

### Constructions with horizontal shaft arrangement

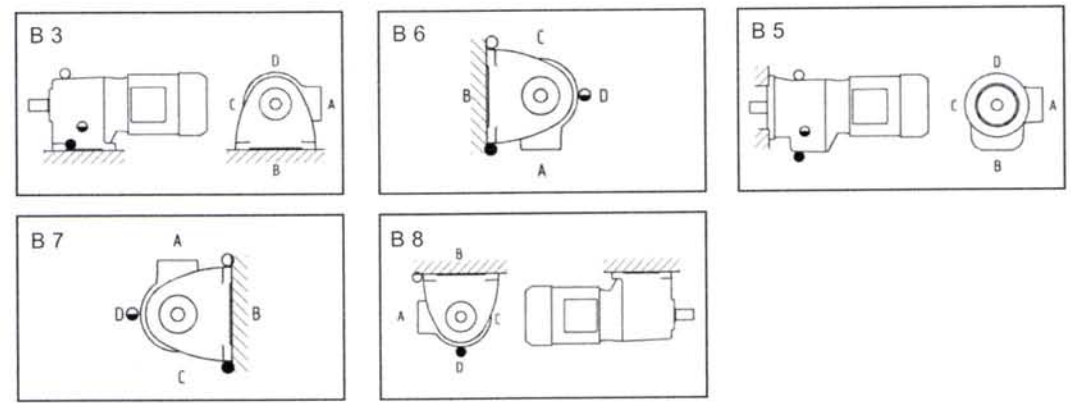


Image 9 : Constructions spur gear motors with horizontal shaft arrangement

### Constructions with vertical shaft arrangement

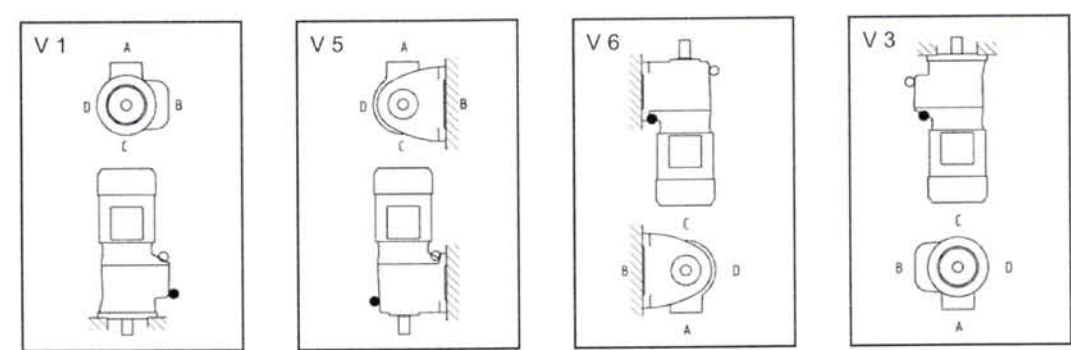


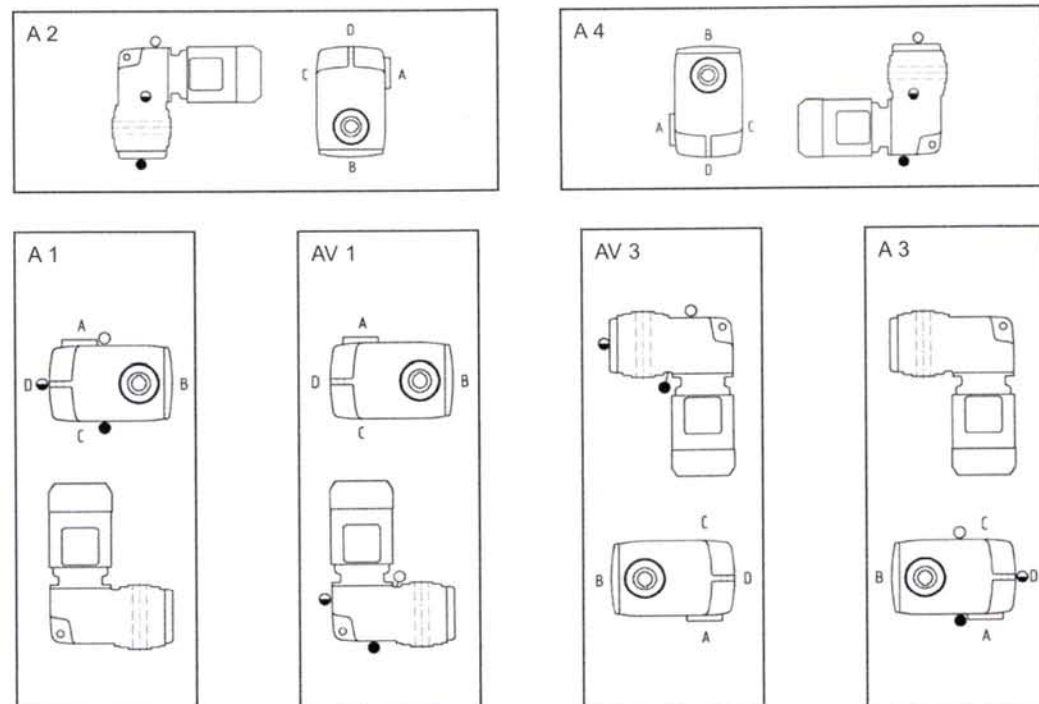
Image 10 : Constructions spur gear motors with vertical shaft arrangement

# Electric motor / gear motor

## A3 Flat gear motors

For the constructions of the ABM electric motors, see A1, image 7

The illustration shows the standard design. The shown constructions are also valid for flange and journal shaft design.



**Image 11 : Constructions of flat gear motors**

The oil drain plug is always located at the bottom and corresponds to the installation position of the gears.

## Electric motor / gear motor

### B Allowed radial forces

#### B1 Electric motors

The data refer to the centre of the standard shaft end at the drive side, for operation with 50 Hz

| Design size | Fr [N] |       |       |       |
|-------------|--------|-------|-------|-------|
|             | 2-pin  | 4-pin | 6-pin | 8-pin |
| 56          | 230    | 270   | 310   | -     |
| 63          | 230    | 300   | 350   | 380   |
| 71          | 260    | 320   | 370   | 400   |
| 80          | 350    | 450   | 520   | 560   |
| 90          | 550    | 750   | 860   | 920   |
| 100         | 770    | 950   | 1090  | 1170  |
| 112         | 900    | 1110  | 1270  | 1360  |
| 132         | 1140   | 1400  | -     | -     |
| 160         | -      | 2500  | 2800  | 3100  |

**Table 11 : Allowed radial forces for electric motors**

# Electric motor / gear motor

## B2 Spur gear motors

Radial forces refer to the centre of the short shaft end. Valid for 90°. Axial forces traction or pressure at level towards the output shaft. If radial and axial forces occur simultaneously, please check back.

For normal bearing:

| Gear |    | Motor output in kW |       |       |       |       |       |       |       |      |
|------|----|--------------------|-------|-------|-------|-------|-------|-------|-------|------|
|      |    | 0.12               | 0.18  | 0.25  | 0.37  | 0.55  | 0.75  | 1.1   | 1.5   |      |
| G71  | Fr | 700                | 700   | 700   | 700   | 600   | 500   | -     | -     |      |
|      | Fa | 500                | 500   | 500   | 500   | 400   | 300   | -     | -     |      |
| G80  | Fr | 1600               | 1400  | 1400  | 1400  | 1100  | 1100  | 1100  | 1000  |      |
|      | Fa | 1000               | 1000  | 1000  | 1000  | 1000  | 1000  | 1000  | 1000  |      |
| G90  | Fr | 3000               | 3000  | 3000  | 2500  | 2000  | 2000  | 1500  | 1500  |      |
|      | Fa | 2500               | 2500  | 2500  | 2000  | 2000  | 2000  | 1500  | 1500  |      |
| G100 | Fr | 3000               | 3000  | 3000  | 2800  | 2000  | 2000  | 2000  | 1500  |      |
|      | Fa | 2500               | 2500  | 2500  | 2000  | 2000  | 2000  | 1500  | 1500  |      |
| G112 | Fr | 4500               | 4500  | 4500  | 4500  | 4000  | 4000  | 3000  | 2500  |      |
|      | Fa | 3500               | 3500  | 3500  | 3500  | 2500  | 2500  | 2000  | 2000  |      |
| G132 | Fr | 8000               | 8000  | 8000  | 8000  | 7000  | 7000  | 6000  | 5000  |      |
|      | Fa | 5000               | 5000  | 5000  | 5000  | 4000  | 4000  | 3000  | 3000  |      |
| G160 | Fr | 10000              | 10000 | 10000 | 10000 | 10000 | 10000 | 7500  | 7000  |      |
|      | Fa | 7000               | 7000  | 7000  | 7000  | 7000  | 7000  | 5500  | 4500  |      |
| G180 | Fr | 17500              | 17500 | 17500 | 17500 | 17500 | 17500 | 15000 | 13000 |      |
|      | Fa | 10000              | 10000 | 10000 | 10000 | 10000 | 10000 | 9000  | 8000  |      |
| Gear |    | Motor output in kW |       |       |       |       |       |       |       |      |
|      |    | 2.2                | 3.0   | 4.0   | 5.5   | 7.5   | 11.0  | 15.0  | 18.5  | 22.0 |
| G90  | Fr | 1000               | 1000  | -     | -     | -     | -     | -     | -     | -    |
|      | Fa | 1000               | 1000  | -     | -     | -     | -     | -     | -     | -    |
| G100 | Fr | 1500               | 1000  | 1000  | -     | -     | -     | -     | -     | -    |
|      | Fa | 1500               | 1000  | 1000  | -     | -     | -     | -     | -     | -    |
| G112 | Fr | 2000               | 2000  | 1500  | 1500  | -     | -     | -     | -     | -    |
|      | Fa | 2000               | 1500  | 1500  | 1500  | -     | -     | -     | -     | -    |
| G132 | Fr | 5000               | 4000  | 3500  | 3000  | 3000  | -     | -     | -     | -    |
|      | Fa | 2500               | 2000  | 2000  | 1500  | 1500  | -     | -     | -     | -    |
| G160 | Fr | 6000               | 5000  | 4000  | 4000  | 3000  | 2000  | 1500  | -     | -    |
|      | Fa | 3500               | 3000  | 2500  | 2000  | 1500  | 1000  | 1000  | -     | -    |
| G180 | Fr | 12000              | 10000 | 9000  | 8000  | 7000  | 5500  | 4500  | 4000  | 3000 |
|      | Fa | 8000               | 8000  | 8000  | 7000  | 6000  | 3000  | 2500  | 2000  | 1500 |

Table 12 : Permissible forces for spur gear motors (standard bearing)

# Electric motor / gear motor

## For reinforced bearing (possible from G90):

| Gear |    | Motor output in kW |       |       |       |       |       |       |       |       |
|------|----|--------------------|-------|-------|-------|-------|-------|-------|-------|-------|
|      |    | 0.12               | 0.18  | 0.25  | 0.37  | 0.55  | 0.75  | 1.1   | 1.5   |       |
| G90  | Fr | 3000               | 3000  | 3000  | 3000  | 3000  | 2500  | 2500  | 2500  |       |
|      | Fa | 3000               | 3000  | 3000  | 3000  | 3000  | 2500  | 2500  | 2500  |       |
| G100 | Fr | 3200               | 3200  | 3200  | 3200  | 3200  | 3000  | 3000  | 3000  |       |
|      | Fa | 3000               | 3000  | 3000  | 3000  | 3000  | 3000  | 2500  | 2500  |       |
| G112 | Fr | 6000               | 6000  | 6000  | 6000  | 5000  | 5000  | 4000  | 4000  |       |
|      | Fa | 5000               | 5000  | 5000  | 5000  | 4000  | 4000  | 3000  | 3000  |       |
| G132 | Fr | 9000               | 9000  | 9000  | 9000  | 9000  | 8000  | 7000  | 6000  |       |
|      | Fa | 7000               | 7000  | 7000  | 7000  | 7000  | 7000  | 6000  | 5000  |       |
| G160 | Fr | 12500              | 12500 | 12500 | 12500 | 12500 | 12500 | 12500 | 11000 |       |
|      | Fa | 10000              | 10000 | 10000 | 10000 | 10000 | 10000 | 10000 | 9000  |       |
| G180 | Fr | 24000              | 24000 | 24000 | 24000 | 24000 | 24000 | 22000 | 20000 |       |
|      | Fa | 15000              | 15000 | 15000 | 15000 | 15000 | 15000 | 14000 | 12000 |       |
| G200 | Fr | 27000              | 27000 | 27000 | 27000 | 27000 | 27000 | 25000 | 23000 |       |
|      | Fa | 18000              | 18000 | 18000 | 18000 | 18000 | 18000 | 16000 | 14000 |       |
| G225 | Fr | 30000              | 30000 | 30000 | 30000 | 30000 | 30000 | 30000 | 30000 |       |
|      | Fa | 20000              | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 |       |
| Gear |    | Motor output in kW |       |       |       |       |       |       |       |       |
|      |    | 2.2                | 3.0   | 4.0   | 5.5   | 7.5   | 11.0  | 15.0  | 18.5  | 22.0  |
| G90  | Fr | 2500               | 2000  | -     | -     | -     | -     | -     | -     | -     |
|      | Fa | 2500               | 2000  | -     | -     | -     | -     | -     | -     | -     |
| G100 | Fr | 3000               | 2500  | 2000  | -     | -     | -     | -     | -     | -     |
|      | Fa | 2500               | 2000  | 2000  | -     | -     | -     | -     | -     | -     |
| G112 | Fr | 3000               | 3000  | 3000  | 3000  | -     | -     | -     | -     | -     |
|      | Fa | 3000               | 2000  | 2000  | 2000  | -     | -     | -     | -     | -     |
| G132 | Fr | 6000               | 5000  | 4000  | 3500  | 3000  | -     | -     | -     | -     |
|      | Fa | 5000               | 4000  | 3000  | 2500  | 2500  | -     | -     | -     | -     |
| G160 | Fr | 10000              | 9000  | 7000  | 6000  | 5000  | 4000  | 3000  | -     | -     |
|      | Fa | 8000               | 7000  | 5000  | 5000  | 4000  | 3500  | 3000  | -     | -     |
| G180 | Fr | 18000              | 15000 | 12000 | 12000 | 10000 | 9500  | 8000  | 7000  | 6000  |
|      | Fa | 10000              | 10000 | 9000  | 8000  | 7000  | 6000  | 5000  | 5000  | 4000  |
| G200 | Fr | 21000              | 17000 | 14000 | 13000 | 12000 | 11000 | 10000 | 9000  | 8000  |
|      | Fa | 13000              | 13000 | 12000 | 11000 | 10000 | 9000  | 8000  | 6000  | 5000  |
| G225 | Fr | 30000              | 27000 | 25000 | 22000 | 20000 | 19000 | 18000 | 17000 | 15000 |
|      | Fa | 20000              | 17000 | 15000 | 12000 | 10000 | 9000  | 8000  | 7000  | 5000  |

Table 13 : Permissible forces for spur gear motors (reinforced bearing, up to G225)

B3 Flat gear motors

The permissible radial force is stated based on the nominal service life for normal running conditions of the hollow shaft bearing according to DIN ISO 281. Fr is dependent on the output torque T<sub>2</sub> [Nm], on the output speed n<sub>2</sub> [min<sup>-1</sup>], and on the distance x [mm]. The calculation applies to the least favourable force application angle and is dependent on the rotational directions. Fr is applied on the non-motor side.

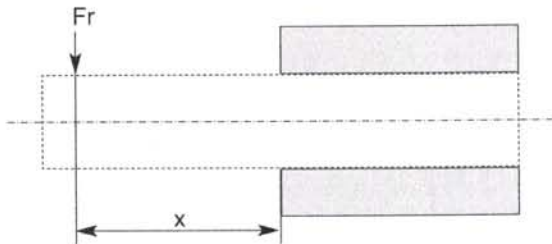


Image 12 : Radial force and distance X

The calculation of Fr is only valid for n<sub>2</sub> > 9 min<sup>-1</sup>.

$$Fr = \frac{K_1 \cdot \frac{1}{\sqrt[3]{n_2}} - K_2 \cdot T_2}{x + K_3} \text{ (N)}$$

| Gear type           | K <sub>1</sub>        | K <sub>2</sub> | K <sub>3</sub> |
|---------------------|-----------------------|----------------|----------------|
| FGA53               | 6.9 * 10 <sup>5</sup> | 600            | 61.5           |
| FGA103              | 9.8 * 10 <sup>5</sup> | 644,5          | 68             |
| FGA252 / FGA253     | 2.4 * 10 <sup>6</sup> | 1259           | 111.5          |
| FGA422 / FGA424.3   | 2.3 * 10 <sup>6</sup> | 908            | 94             |
| FGA423 / FGA424.4   | 2.3 * 10 <sup>6</sup> | 540            | 94             |
| FGA453              | 2,3 * 10 <sup>6</sup> | 908            | 94             |
| FGA952 / FGA954.3   | 5.9 * 10 <sup>6</sup> | 900            | 131.5          |
| FGA1353 / FGA1354.3 | 5.9 * 10 <sup>6</sup> | 490            | 131.5          |

Table 14 : Factors for the calculation of the radial force for the flat gear

# Electric motor / gear motor

## C Lubrication

### C1 Lubricant amounts

#### Spur gear with horizontal shaft arrangement

| Type      |                | Construction                          |             |           |                                  |             |           |                                 |             |           |
|-----------|----------------|---------------------------------------|-------------|-----------|----------------------------------|-------------|-----------|---------------------------------|-------------|-----------|
|           |                | Foot B3, B6, B7<br>Oil filling in cm³ |             |           | Foot B8<br>Grease filling in cm³ |             |           | Flange B5<br>Oil filling in cm³ |             |           |
| Two-stage | Three-stage    | Two-stage                             | Three-stage |           | Two-stage                        | Three-stage |           | Two-stage                       | Three-stage |           |
|           |                |                                       | Main stage  | Pre-stage |                                  | Main stage  | Pre-stage |                                 | Main stage  | Pre-stage |
| G 71      |                | 100                                   |             |           | 80                               |             |           | 100                             |             |           |
| G 80      |                | 130                                   |             |           | 100                              |             |           | 140                             |             |           |
| G 90      | 3 - G90 / 71   | 200                                   | 200         | 60        | 160                              | 160         | 50        | 180                             | 180         | 60        |
| G 100     | 3 - G100 / 71  | 280                                   | 280         | 100       | 220                              | 220         | 80        | 250                             | 250         | 100       |
| G 112     | 3 - G112 / 80  | 400                                   | 400         | 100       | 320                              | 320         | 80        | 400                             | 400         | 100       |
| G 132     | 3 - G132 / 90  | 600                                   | 600         | 160       | 480                              | 480         | 120       | 550                             | 550         | 160       |
| G 160     | 3 - G160 / 100 | 1000                                  | 1000        | 250       | 800                              | 800         | 200       | 800                             | 800         | 250       |
| G 180     | 3 - G180 / 100 | 1400                                  | 1400        | 250       | 1100                             | 1100        | 200       | 1200                            | 1200        | 250       |
| G 200     | 3 - G200 / 132 | 2100                                  | 2100        | 450       | 1600                             | 1600        | 350       | 1800                            | 1800        | 450       |
| G 225     | 3 - G225 / 132 | 3000                                  | 3000        | 450       | 2400                             | 2400        | 350       | 2500                            | 2500        | 450       |

Table 15 : Lubricant amounts for spur gears (1)

#### Spur gears with vertical shaft arrangement

| Type       |                | Construction                             |             |           |                                  |            |           |
|------------|----------------|------------------------------------------|-------------|-----------|----------------------------------|------------|-----------|
|            |                | Foot B3, B6, B7<br>Grease filling in cm³ |             |           | Foot B8<br>Grease filling in cm³ |            |           |
|            |                | Two-stage                                | Three-stage | Two-stage | Three-stage                      |            |           |
| Main stage | Pre-stage      |                                          |             |           | Two-stage                        | Main stage | Pre-stage |
| G 71       |                | 100                                      |             |           | 100                              |            |           |
| G 80       |                | 230                                      |             |           | 230                              |            |           |
| G 90       | 3 - G90 / 71   | 340                                      | 340         | 100       | 340                              | 340        | 100       |
| G 100      | 3 - G100 / 71  | 420                                      | 420         | 150       | 420                              | 420        | 150       |
| G 112      | 3 - G112 / 80  | 800                                      | 800         | 150       | 800                              | 800        | 150       |
| G 132      | 3 - G132 / 90  | 1000                                     | 1000        | 200       | 1100                             | 1100       | 200       |
| G 160      | 3 - G160 / 100 | 1600                                     | 1600        | 270       | 1700                             | 1700       | 270       |
| G 180      | 3 - G180 / 100 | 2100                                     | 2100        | 270       | 2500                             | 2500       | 270       |
| G 200      | 3 - G200 / 132 | 3200                                     | 3200        | 650       | 3500                             | 3500       | 650       |
| G 225      | 3 - G225 / 132 | 4800                                     | 4800        | 650       | 5000                             | 5000       | 650       |

Table 16 : Lubricant amounts for spur gears (2)

# Electric motor / gear motor

## Flat gears

| Type                                 | Construction |            |      |            |      |            |      |            |      |            |      |            |
|--------------------------------------|--------------|------------|------|------------|------|------------|------|------------|------|------------|------|------------|
|                                      | A1           |            | A2   |            | A3   |            | A4   |            | AV1  |            | AV3  |            |
|                                      | Oil          | Grea<br>se | Oil  | Grea<br>se | Oil  | Grea<br>se | Oil  | Grea<br>se | Oil  | Grea<br>se | Oil  | Grea<br>se |
| FG 103★                              | 400          | 450        | 400  | 450        | 400  | 450        | 400  | 450        | 400  | 450        | 400  | 450        |
| FG422                                | 900          | 1100       | 1000 | 1200       | 900  | 1100       | 800  | 1000       | 900  | 1100       | 1100 | 1300       |
| FG423                                | 900          | 1100       | 1000 | 1200       | 900  | 1100       | 800  | 1000       | 900  | 1100       | 1100 | 1300       |
| FG424                                | 900          | 1100       | 1000 | 1200       | 900  | 1100       | 800  | 1000       | 900  | 1100       | 1100 | 1300       |
| FG453                                | 900          | 1100       | 1000 | 1200       | 900  | 1100       | 800  | 1000       | 900  | 1100       | 1100 | 1300       |
| FG424 / FG424<br>Primary gear stage  | 100          | 120        | 100  | 120        | 100  | 120        | 100  | 120        | 100  | 120        | 100  | 120        |
| FG952 / FG954                        | 1300         | 1500       | 2800 | 3200       | 1900 | 2200       | 1800 | 2100       | 1800 | 2100       | 3000 | 3500       |
| FG1353 / FG1354                      | 1300         | 1500       | 2800 | 3200       | 1900 | 2200       | 1800 | 2100       | 2200 | 2500       | 2500 | 2900       |
| FG954 / FG1354<br>Primary gear stage | 170          | 200        | 170  | 200        | 170  | 200        | 170  | 200        | 170  | 200        | 170  | 200        |

**Table 17 : Lubricant amounts for flat gears**

★ Preferred lubricant for FG 103: ISO VG 680 CLP

C2 Lubricants

| Gear oils                                                 |             |        |                                                                                     |                                                                                     |                                                                                      |                                                                                       |                                                                                       |                                                                                       |
|-----------------------------------------------------------|-------------|--------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Type                                                      | Temp.*      | ISO VG |    |    |    |    |    |    |
| CLP                                                       | 0...40°C    | 220    | Degol BG 220                                                                        | Energol GR-XP 220                                                                   | Alpha EP 220                                                                         | Renolin CLP 220                                                                       | Mobilgear 600 XP 220                                                                  | Omala S2 G 220                                                                        |
|                                                           | -10...25°C  | 100    | Degol BG 100                                                                        | Energol GR-XP 100                                                                   | Alpha EP 100                                                                         | Renolin CLP 100                                                                       | Mobilgear 600 XP 100                                                                  | Omala S2 G 100                                                                        |
|                                                           | 0 ... 40°C  | 680    | Degol BG 680                                                                        | Energol GR-XP 680                                                                   | Alpha EP 680                                                                         | Renolin SEW 680                                                                       | Mobilgear 600 XP 680                                                                  | Omala S2 G 680                                                                        |
| PG                                                        | -35...80°C  | 220    | Degol GS 220                                                                        | Energol SG-XP 220                                                                   | Alphasyn GS 220                                                                      | Renolin PG 220                                                                        | Glygoyle HE 220                                                                       | Tivela S 220                                                                          |
|                                                           | -30...80°C  | 460    | Degol GS 460                                                                        | Energol SG-XP 460                                                                   | Alphasyn GS 460                                                                      | Renolin PG 460                                                                        | Glygoyle HE 460                                                                       | Tivela S 460                                                                          |
| HC                                                        | -30...60°C  | 220    | Degol PAS 220                                                                       | -                                                                                   | Optigear Synthetic X220                                                              | Renolin Unisyn CLP 220                                                                | Mobil SHC 630                                                                         | Omala 220 HD                                                                          |
| Observe the instructions on the data sheet of your drive! |             |        |                                                                                     |                                                                                     |                                                                                      |                                                                                       |                                                                                       |                                                                                       |
| Getriebefette                                             |             |        |                                                                                     |                                                                                     |                                                                                      |                                                                                       |                                                                                       |                                                                                       |
| Type                                                      | Temp.*      | NLGI   |  |  |  |  |  |  |
| min.                                                      | -25...60°C  | 00     | FDP 00                                                                              | -                                                                                   | Olit CLS 00                                                                          | Renolit S2                                                                            | Mobiltemp SHC 32                                                                      | Aero Shell Grease 16                                                                  |
| PAO                                                       | -30...130°C | 00     | -                                                                                   | EP 00                                                                               | -                                                                                    | -                                                                                     | -                                                                                     | -                                                                                     |
| Observe the instructions on the data sheet of your drive! |             |        |                                                                                     |                                                                                     |                                                                                      |                                                                                       |                                                                                       |                                                                                       |

Table 18 : Lubricant table

\*Temp = recommended temperature range – can be surpassed or under passed depending on the application

- Notes:
- CLP : Mineral oil, lubricating oil
  - PG : Synthetic oil (polyglycol)
  - HC : Synthetic oil I (Lubricant on the basis of poly-alpha-olefin - PAO)

## D Screw tightening torques

| Thread | Strength class of screw connection |      |      | Terminal board / steel nuts | Terminal board / brass nuts |
|--------|------------------------------------|------|------|-----------------------------|-----------------------------|
|        | 8.8                                | 10.9 | 12.9 |                             |                             |
| M4     | 3.2                                | 5    | 6    | 1,5                         | 1,5                         |
| M5     | 6.4                                | 9    | 11   | 2,4                         | 3                           |
| M6     | 11                                 | 16   | 19   | 3,75                        | 5                           |
| M8     | 27                                 | 39   | 46   | 7,5                         | 10                          |
| M10    | 53                                 | 78   | 91   |                             |                             |
| M12    | 92                                 | 135  | 155  |                             |                             |
| M16    | 230                                | 335  | 390  |                             |                             |
| M20    | 460                                | 660  | 770  |                             |                             |
| M24    | 790                                | 1150 | 1300 |                             |                             |

Tolerance of all tightening torques =  $\pm 15\%$ 

Delivery status for terminal boards: upper nut tightened with reduced moment

**Table 19 : Screw tightening torques in Nm**

### Tightening torques for traction screws of motors

| Thread            | M4  | M5  | M6  | M8 | M10 |
|-------------------|-----|-----|-----|----|-----|
| Tightening torque | 1,8 | 3,8 | 6,5 | 16 | 32  |

Tolerance of all tightening torques =  $\pm 15\%$ 
**Table 20 : Tightening torques for traction screws of motors in Nm**

### Tightening torques for motors with frame size 160 and 180 (flange mounting)

| Motor frame size  | 160 | 180 |
|-------------------|-----|-----|
| Tightening torque | 25  | 35  |

These screws have to be additionally secured with Loctite 243

**Table 21 : Tightening torques for motors with frame size 160 and 180**

## E Safety parameters for rotary encoder

Definition of the safety parameter  $MTTF_d$ :

$MTTF_d$  (Mean Time To Dangerous Failure) is a statistical variable and is defined in the standard EN ISO 13849-1 as "Expected value of the mean time until the dangerous failure".

This emphasizes that it is a statistical variable, which is an empirically generated value. This value is not related to a "guaranteed service life" or a "failure-free time".

| Type                  | Company     | Designation       | $MTTF_d$ [hours] |
|-----------------------|-------------|-------------------|------------------|
| <b>Sensor bearing</b> | SKF         | BMB/BMO           | 166,000,000      |
| <b>Rotary encoder</b> | Baumer IVO  | GM400 / 401       | 722,126          |
|                       | Hengstler   | AC 58             | 1,400,000        |
|                       | Leine Linde | RSA 698           | 1,875,000        |
|                       | VS Sensorik | HMX 2             | 1,042,000        |
|                       | VS Sensorik | HDI 2 - NE - M142 | 1.226.400        |

**Table 22 : Safety parameters for rotary encoders**