Safe Brake System
Synchronous Servomotors

Edition 07/2013
1 General Information ........................................................................................................... 5
  1.1 Use of this documentation ......................................................................................... 5
  1.2 Structure of the safety notes ...................................................................................... 5
  1.3 Rights to claim under warranty .............................................................................. 6
  1.4 Content of the documentation ................................................................................. 6
  1.5 Exclusion of liability ................................................................................................. 6
  1.6 Other applicable documentation .............................................................................. 6
  1.7 Product names and trademarks .............................................................................. 6
  1.8 Copyright .................................................................................................................. 6

2 Safety Notes ..................................................................................................................... 7
  2.1 General information ................................................................................................. 7
  2.2 Target group ............................................................................................................. 7
  2.3 Designated use ......................................................................................................... 8
  2.4 Transport / storage ................................................................................................. 8
  2.5 Setup ........................................................................................................................ 9
  2.6 Electrical connection ............................................................................................... 9
  2.7 Startup / operation ................................................................................................... 10

3 System Description ......................................................................................................... 11
  3.1 System overview ..................................................................................................... 12

4 Functional Safety .......................................................................................................... 13
  4.1 Safety functions ....................................................................................................... 13
  4.2 Performance levels that can be achieved ............................................................... 15
  4.3 Differences between BY and BY(FS) brakes ......................................................... 21

5 Components ..................................................................................................................... 22
  5.1 Motor ....................................................................................................................... 22
  5.2 Gear units ............................................................................................................... 22
  5.3 Brake ...................................................................................................................... 23
  5.4 Safety-rated encoders ............................................................................................ 25
  5.5 Safety-rated brake control ..................................................................................... 26
  5.6 Frequency inverters ............................................................................................... 29
  5.7 SEW controller ....................................................................................................... 30
  5.8 MOVISAFE® UCS..B safety module ...................................................................... 31
  5.9 Prefabricated cables .............................................................................................. 32
  5.10 Additional documentation .................................................................................... 33

6 Project Planning ................................................................................................................. 34
  6.1 Project planning procedure for BY..(FS) brakes .................................................... 34
  6.2 Brake BY..(FS) ....................................................................................................... 39

7 Technical Data .................................................................................................................. 46
  7.1 Technical data of BY brakes ................................................................................. 46
  7.2 Safety characteristics .............................................................................................. 51
8 Appendix............................................................................................................ 52
8.1 Mounting positions of CMP servomotors .................................................. 52
Index................................................................................................................... 53
1 General Information

1.1 Use of this documentation

The documentation is an integral part of the product and contains important information on operation and service. The document is for all persons who plan, configure, and start up safety-rated brakes and safety-rated braking systems.

The documentation must be accessible and legible. Make sure that persons responsible for the system and its operation, as well as persons who work independently on the unit, have read through the documentation carefully and understood it. If you are unclear about any of the information in this documentation, or if you require further information, contact SEW-EURODRIVE.

1.2 Structure of the safety notes

1.2.1 Meaning of signal words

The following table shows the graduation and meaning of the signal words for safety notes, warnings regarding potential risks of damage to property, and other notes.

<table>
<thead>
<tr>
<th>Signal word</th>
<th>Meaning</th>
<th>Consequences if disregarded</th>
</tr>
</thead>
<tbody>
<tr>
<td>▲ DANGER!</td>
<td>Imminent hazard</td>
<td>Severe or fatal injuries</td>
</tr>
<tr>
<td>▲ WARNING!</td>
<td>Possible dangerous situation</td>
<td>Severe or fatal injuries</td>
</tr>
<tr>
<td>▲ CAUTION!</td>
<td>Possible dangerous situation</td>
<td>Minor injuries</td>
</tr>
<tr>
<td>NOTICE</td>
<td>Possible damage to property</td>
<td>Damage to the drive system or its environment</td>
</tr>
<tr>
<td>INFORMATION</td>
<td>Useful information or tip: Simplifies handling of the drive system.</td>
<td></td>
</tr>
</tbody>
</table>

1.2.2 Design of the section-related safety notes

Section-related safety notes do not apply to a specific action, but to several actions pertaining to one subject. The symbols used either indicate a general hazard or a specific hazard.

This is the formal structure of a safety note for a specific section:

⚠️ SIGNAL WORD!

Type and source of danger.

Possible consequence(s) if disregarded.
  - Measure(s) to prevent the danger.

1.2.3 Design of the embedded safety notes

Embedded safety notes are directly integrated into the instructions just before the description of the dangerous action.

This is the formal structure of an embedded safety note:

- ▲ SIGNAL WORD! Type and source of hazard.
  - Possible consequence(s) if disregarded.
    - Measure(s) to prevent the hazard.
1.3 **Rights to claim under warranty**

A requirement of fault-free operation and fulfillment of any rights to claim under limited warranty is that you adhere to the information in the documentation. Therefore read the documentation before you start working with the unit.

1.4 **Content of the documentation**

This document contains additional safety-related information and conditions for operation in safety-related applications.

1.5 **Exclusion of liability**

You must comply with the information contained in this documentation to ensure safe operation and to achieve the specified product characteristics and performance features. SEW-EURODRIVE assumes no liability for injury to persons or damage to equipment or property resulting from non-observance of these operating instructions. In such cases, any liability for defects is excluded.

1.6 **Other applicable documentation**

This document supplements the operating instructions and limits the application notes according to the following information. Use this document only together with the operating instructions.

1.7 **Product names and trademarks**

All product names in this documentation are trademarks or registered trademarks of their respective titleholders.

1.8 **Copyright**

© 2013 SEW-EURODRIVE. All rights reserved.

Unauthorized duplication, modification, distribution or any other use of the whole or any part of this documentation is strictly prohibited.
2 Safety Notes

2.1 General information

The following basic safety notes must be read carefully to prevent injury to persons and damage to property. The operator must ensure that the basic safety notes are read and adhered to.

Ensure that persons responsible for the machinery and its operation as well as persons who work independently have read through the documentation carefully and understood it. If you are unclear about any of the information in this documentation, or if you require further information, please contact SEW-EURODRIVE.

Also adhere to the supplementary safety notes in this document and in the documentation of the connected components from SEW-EURODRIVE.

This document does not replace the detailed documentation of the connected components.

This document assumes that the user has access to and is familiar with the documentation for all connected components from SEW-EURODRIVE.

Never install damaged products. Never take damaged products into operation. Submit a complaint to the shipping company immediately in the event of damage.

Removing covers without authorization, improper use or incorrect installation and operation may result in severe injuries to persons or damage to machinery. Consult the documentation for additional information.

2.2 Target group

The document is for all persons who plan, configure, and start up safety-rated brakes and safety-rated braking systems.

Any work with software may only be performed by adequately qualified personnel. Qualified personnel in this context are persons who have the following qualifications:

• Appropriate instruction.
• Knowledge of this documentation and other applicable documentation.
• SEW-EURODRIVE recommends additional product training for products that are operated using the respective software.

Any mechanical work on the components may only be performed by adequately qualified personnel. Qualified personnel in the context of this documentation are persons familiar with the design, mechanical installation, troubleshooting and servicing of the product who possess the following qualifications:

• Training in mechanical engineering, e.g. as a mechanic or mechatronics technician (final examinations must have been passed).
• Knowledge of this documentation and other applicable documentation.

Any electrical work on connected units may only be performed by adequately qualified electricians. Qualified electricians in the context of this documentation are persons familiar with electrical installation, startup, troubleshooting and servicing of the product who possess the following qualifications:

• Training in electrical engineering, e.g. as an electrician or mechatronics technician (final examinations must have been passed).
Safety Notes

Designated use

- Knowledge of this documentation and other applicable documentation.
- Knowledge of the relevant safety regulations and laws.
- Knowledge of the other standards, guidelines, and laws mentioned in this documentation.

The above mentioned persons must have the authorization expressly issued by the company to install, operate, program, configure, label and ground units, systems and circuits in accordance with the standards of safety technology.

All work in further areas of transportation, storage, operation and waste disposal must only be carried out by persons who are trained appropriately.

2.3 Designated use

Safety-rated brakes are electromechanical brakes from SEW-EURODRIVE that are intended for use in functional safety applications.

A safety-rated braking system is a combination of various drive components, e.g. frequency inverter, motor, and brake that in its entirety is designed to fulfill safety functions.

A safety-rated brake or a safety-rated braking system is used to implement safety functions that ensure machine and operator safety.

INFORMATION

Ensure compliance with nationally applicable laws and directives before you start designated operation.

2.4 Transport / storage

Observe the notes on transportation, storage and proper handling.

Observe the climatic conditions for the each component.
2.5 Setup

The components must be installed and cooled according to the regulations and specifications in the corresponding documentation.

Protect the components from excessive strain. Ensure that elements are not deformed and/or insulation spaces are maintained, particularly during transportation. Avoid contact with electronic elements and contacts.

System components can contain elements that can be damaged by electrostatic energy and could be destroyed in case of improper handling. Prevent mechanical damage or destruction of electric components (may pose health risk).

The following applications are prohibited unless explicitly permitted:

- Use in areas that are possibly contaminated with explosive gas or explosive dust.
- Use in areas exposed to harmful oils, acids, gases, vapors, dust, radiation, etc.
- Use in non-stationary applications which are subject to mechanical vibration and impact loads in excess of the requirements in EN 61800-5-1.

2.6 Electrical connection

Observe the applicable national accident prevention guidelines when working on live components.

Electrical installation must be carried out in compliance with pertinent regulations (e.g. cable cross sections, fusing, protective conductor connection). For any additional information, refer to the applicable documentation.

You find notes on EMC-compliant installation, such as shielding, grounding, arrangement of filters and routing of lines, in the documentation of the respective component. Always observe these notes even with inverters bearing the CE marking. The manufacturer of the system or machine is responsible for maintaining the limits established by EMC legislation.

Protective measures and protection devices must comply with the regulations in force (e.g. EN 60204 or EN 61800-5-1).
2.7 **Startup / operation**

Systems into which a safety-rated brake or a safety-rated braking system is installed must be equipped with additional monitoring and protection devices, if necessary, according to the applicable safety regulations; e.g. the law governing technical equipment, accident prevention regulations, etc.

Do not touch live parts or power connections immediately after disconnecting the components from the supply voltage because there may still be some charged capacitors. Observe the notes about the individual components.

Keep all covers and doors closed during operation.

The fact that the status LED and other display elements (such as the display LED) are no longer illuminated does not indicate that the unit has been disconnected from the power supply and no longer carries any voltage.

Check that there is no voltage present before touching power connections even if the LED display indicates that there is no voltage.

Mechanical blockage or internal safety functions of the unit can cause a motor standstill. Eliminating the cause of the problem or performing a reset may result in the drive restarting automatically. If, for safety reasons, this is not permitted for the driven machine, disconnect the unit from the supply system before correcting the error.
3 System Description

The system description offers information about using components, especially brakes, in a system. The system description shows different possibilities for integrating electromagnetic brakes into a safe brake system. The differences between systems with and without safety-rated components are also depicted.

The following chapters describe the individual components that are required for a system with a safe brake system.

The following main chapter describes project planning and lists important points that must be taken into consideration when configuring the individual components.

The last chapter contains an overview of the necessary technical data.
3.1 **System overview**

Only the electromechanical brake is not able to meet higher safety requirements, for example PL d. When electromechanical brakes are used, additional components are required such as for brake control or brake diagnostics. The electromechanical brake unit is only considered a brake system when it is paired with additional components. This system can achieve various safety levels, depending on the design, all the way to PL e.

A safe brake system in a plant generally contains the following components:

- CMPZ. synchronous servomotor with brake
- Encoder on the CMPZ. synchronous servomotor, for example AK1H
- Brake control, for example BST, BMK, BMV
- MOVIDRIVE® or MOVIAXIS® frequency inverters
- Higher-level SEW controller
- Safety controller, for example MOVISAFE® UCS..B

The system being described consists of the following components:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gear units R..7, F..7, K..7, S..7, SPIROPLAN® W.., BS.F, PS.F, PS.C</td>
</tr>
<tr>
<td>2+3</td>
<td>CMPZ. synchronous servomotor with brake</td>
</tr>
<tr>
<td>4</td>
<td>Encoder on the CMPZ. synchronous servomotor, for example AK1H</td>
</tr>
<tr>
<td>5</td>
<td>Brake control, for example BST, BMK, BMV</td>
</tr>
<tr>
<td>6</td>
<td>MOVIDRIVE® or MOVIAXIS® frequency inverters</td>
</tr>
<tr>
<td>7</td>
<td>Higher-level SEW controller</td>
</tr>
<tr>
<td>8</td>
<td>Safety controller, for example MOVISAFE® UCS..B</td>
</tr>
</tbody>
</table>

**NOTE**

There is an optional extension of the safe brake system available for the gear unit [1] to make it a drive system. The user is responsible for evaluating the use of the gearmotor in the functional safety and this evaluation is not part of the documentation.
4 Functional Safety

4.1 Safety functions

By expanding the safety-rated brake into a brake system, the following safety functions can be implemented.

- SBA (safe brake actuation)
- SBH (safe brake hold)

INFORMATION

- SBA and SBH additionally require the safety function SBC for safety-related shutdown of the power supply of the brake, see section “Brake control”.
- A drive can, depending on the configuration and use in the application, generate more torque than the brake is able to stop. When activating the Safety Function SBA / SBH, the drive with the Safety Function STO - Safe Torque Off must also be switched off.
- SBA and SBH are defined by SEW-EURODRIVE in accordance with the standard DIN EN 61800-5-2.

4.1.1 SBC – Safe Brake Control

The SBC function provides a safe output signal for controlling an external brake. This means no power is supplied to release the brake electrically.

\[ V \]

\[ t \]

\[ t_1 \] = Point of time when the drive is stopped
\[ t_2 \] = Point of time when SBC is triggered
\[ \Delta t \] = Safety-relevant period of time
4.1.2 SBA (safe brake actuation)

When activated, the SBA function brakes uses the electromechanical brake in order to stop the motor shaft safely. This braking operation is considered an emergency stop braking.

4.1.3 SBH – Safe Brake Hold

Once activated, the SBH function uses the electromechanical brake to hold the current of the motor shaft safely. The motor shaft is already stopped when the function is activated.
4.2 Performance levels that can be achieved

Brakes are a component of a safe brake system. The performance level of the safe brake system that can be achieved is influenced by the following factors:

- The safety architecture, category (cat.) selected in accordance with EN ISO 13849
- How often the system is used in the application (B10d, MTTFd)
- An available brake diagnosis (DC)
- The application in which the system is used (horizontal or vertical application)

The performance level that is actually achieved with the selected system must be calculated by the user as proof.

Typical architectures for safe brake systems are described below. These are merely examples and can vary from case to case depending on the requirements of the system.

- The safety control (e.g. UCS..B, F-PLC) as well as the encoder system (standard or FS encoder, motor or distance encoder) can vary and depends on the requirements of the application, additional axes or safety functions.
- The safe brake control (SBC) can be implemented using a contactor or BST, depending on the brake voltage and braking power required.
- The brake diagnostics can be performed with controllers for MOVIDRIVE®, FCB21 for MOVIAxis® or user-specific solutions.
- When using 2 brakes, you can combine different brakes (standard or FS brakes, motor brakes or external brakes), and combine with customer-specific solutions (clasp brakes, locking, mechanical bolts). At SEW-EURODRIVE, redundancy is usually implemented using 2 brakemotors in a group drive or synchronous operation on one axis.

If the technology and application allow it, we recommend using FS brakes. These are intended for use as safety-rated brakes in functional safety applications. SEW-EURODRIVE certifies to users that the FS brake is a safety-rated component. A certificate from the German Technical Control Board (TÜV) is available for download at www.sew-eurodrive.com. Integrating the FS brake into the brake system helps users to evaluate the overall system and increases system safety.

The differences between the examples are listed in the table below:

<table>
<thead>
<tr>
<th></th>
<th>Horizontal applications</th>
<th>Vertical applications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PL c</td>
<td>PL d</td>
</tr>
<tr>
<td>SBA</td>
<td>Example 2</td>
<td>Example 2</td>
</tr>
<tr>
<td>SBH</td>
<td>Example 1</td>
<td>Example 3</td>
</tr>
</tbody>
</table>
### Functional Safety

Performance levels that can be achieved

---

#### Key:

<table>
<thead>
<tr>
<th>Illustration</th>
<th>Meaning</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Energy supply</td>
<td>Supplies the components with power, e.g. motors and brakes</td>
</tr>
<tr>
<td></td>
<td>Brake control</td>
<td>Serves to control an electromechanical brake. The brake is controlled by a standard control system. Brake rectifiers are not included in the concept drawings. They might be required in addition.</td>
</tr>
<tr>
<td></td>
<td>Contact monitoring</td>
<td>Feedback of the contact monitoring of a contactor.</td>
</tr>
<tr>
<td></td>
<td>Disconnection channel</td>
<td>Shows the signal path of the safe disconnection.</td>
</tr>
<tr>
<td></td>
<td>Binary control of the PLC brake diagnostics</td>
<td>Symbolizes the binary connection for controlling the brake diagnostics.</td>
</tr>
<tr>
<td></td>
<td>Encoder signal line</td>
<td>Path of the encoder signals. Additional adapter or split cables are indicated in the encoder signal line.</td>
</tr>
<tr>
<td></td>
<td>Adapter cable</td>
<td>The adapter cable (DAE..B) is necessary if the encoder is directly connected to the safety module or encoder simulation, respectively.</td>
</tr>
<tr>
<td></td>
<td>Encoder split cable</td>
<td>The symbol shows the splitting of encoder signals between frequency inverter and safety module.</td>
</tr>
</tbody>
</table>
Example 1

System design:
- Cat. 1: single-channel architecture without brake diagnostics
- Use of a safety-rated brake

Performance level that can be achieved:
Max. PL c according to DIN EN 13849-1.
Example 2

With MOVIAXIS®

System design:
- Cat. 3: 2-channel architecture with brake diagnostics (channel 1: frequency inverter, channel 2: safety-rated brake)
- Use of a safety-rated brake

Description:
SBA: The inverter shuts down the drive (safety function SS1). The SS1 function is monitored via the safety monitor and the FS encoder. If the safety monitor detects a fault, the inverter activates STO and the brake is applied. The brake shuts down the drive.

Performance level that can be achieved:
Max. PL d according to DIN EN 13849-1 (observe the restricted area of application).
Example 3

System design:
- Cat. 3: 2-channel architecture with brake diagnostics (channel 1: brake 1, channel 2: brake 2)
- Use of two brakes (redundancy)

Description:
SBA: The inverter shuts down the drive (safety function SS1). The SS1 function is monitored via the safety monitor and the FS encoder. If the safety monitor detects a fault, the inverter activates STO and the brakes are applied. The two brakes shut down the drive.

SBH: The inverter stops the drive (safety function SOS). The SOS function is monitored via the safety monitor and the FS encoder. If the safety monitor detects a fault, the inverter activates STO and the drive is stopped by the two brakes.

Performance level that can be achieved:
Max. PL d according to DIN EN 13849-1 (observe the restricted area of application).
Example 4

System design:
- Cat. 3: 2-channel architecture with brake diagnostics (channel 1: brake 1, channel 2: brake 2)
- Use of two brakes (redundancy)

Description:
SBA: The inverter shuts down the drive (safety function SS1). The SS1 function is monitored via the safety monitor and the FS encoder. If the safety monitor detects a fault, the inverter activates STO and the brakes are applied. The two brakes shut down the drive.

SBH: The inverter stops the drive (safety function SOS). The SOS function is monitored via the safety monitor and the FS encoder. If the safety monitor detects a fault, the inverter activates STO and the drive is stopped by the two brakes.

The difference between this and example 3 is the adjustment of the encoder system and the disconnection of the energy supply to the motor (STO). This must correspond to the required PL e.

Performance level that can be achieved:
Max. PL e according to DIN EN 13849-1 (observe the restricted area of application).
4.3 Differences between BY and BY(FS) brakes

The most important differences between the technical properties of the standard BY.. brake and the safety-rated BY..(FS) brake are listed below.

<table>
<thead>
<tr>
<th></th>
<th>BY.. standard brake</th>
<th>BY..(FS) FS brake</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brake type</td>
<td>All</td>
<td>All</td>
</tr>
<tr>
<td>Field of application</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Holding brake</td>
<td>Yes</td>
<td>Yes (with emergency switching off properties)</td>
</tr>
<tr>
<td>Working brake</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-20 °C – +40 °C</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Other ambient temperatures</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Braking torques</td>
<td>All</td>
<td>Restrictions depending on the mounting position</td>
</tr>
<tr>
<td>Brake options</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manual brake release</td>
<td>All</td>
<td>HF not permitted</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HR cannot be retrofitted</td>
</tr>
<tr>
<td>Maintenance of the drive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customer</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>SEW-EURODRIVE</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Motor type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CMP. motors</td>
<td>All CMPZ motors</td>
<td>Approved are CMPZ71, CMPZ80, CMPZ100</td>
</tr>
<tr>
<td>Motor options</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KY</td>
<td>Yes</td>
<td>Must be used</td>
</tr>
<tr>
<td>TF</td>
<td>Yes (special design)</td>
<td>No</td>
</tr>
<tr>
<td>Z</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Speed class</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6000 rpm</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Encoder</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>Approved are</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• RH1M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• EK1H</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• AK1H</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• AK1H(FS)</td>
</tr>
<tr>
<td>Gear unit combination with</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pinion bore/pinion shaft end</td>
<td>All</td>
<td>Restriction of the permitted braking torques</td>
</tr>
<tr>
<td>Gear units</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RM.., R.07, R.17</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>WT.., W..10, W..20, W..30</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>PS.C</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Hollow shaft with shrink disk</td>
<td>Yes</td>
<td>Restriction of the permitted braking torques</td>
</tr>
<tr>
<td>TorqLOC®</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Gear unit adapter</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Special designs</td>
<td>Yes</td>
<td>No (upon request to SEW-EURODRIVE)</td>
</tr>
<tr>
<td>Mounting position</td>
<td>All</td>
<td>Restriction of the permitted braking torques</td>
</tr>
<tr>
<td>SEW measures</td>
<td>Standard</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Additional assembly steps</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Additional documentation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Traceability up to batch monitoring</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Manipulation protection at critical points</td>
</tr>
<tr>
<td>Category</td>
<td>B</td>
<td>1</td>
</tr>
<tr>
<td>$B_{10d}$ value</td>
<td>Standard</td>
<td>Higher values than the standard</td>
</tr>
<tr>
<td></td>
<td>Specification per size</td>
<td>Specification per size</td>
</tr>
</tbody>
</table>

All the other components such as the gear unit type, suitable ratio $i$, service factor $f_B$, load change, output shaft, etc. must be selected and evaluated by the customer.
5 Components

5.1 Motor

In systems with safety-rated components, CMPZ motors can be used in sizes 71 – 100 and speed classes 2000, 3000 and 4500.

5.2 Gear units

The versatile R..7, F..7, K..7, S..7, BSF, PSF and SPIROPLAN® W37/W47 series standard gear units can be used.

When mounting these gear units to a CMP motor with a safety-rated brake, note that certain types might be excluded from use.

The following gear units may not be used on CMPZ motors with safety-rated brakes:

- RM.., R07, R17
- W..10, W..20, W..30
- PS.C
- Variable-speed gear unit
- Gear unit with TorqLOC®
- /AL, /AM, /AQ., /EHW adapters

Limitations apply when using gear units with shrink disk on the output shaft with safety-rated brakes as this is a frictional connection. If you still want to use these gear units, consult SEW-EURODRIVE in advance.
5.3 Brake

5.3.1 Principles of the SEW brake

Basic design

The SEW brake is an electromagnetic disk brake with a DC coil that releases electrically and brakes using spring force. The system meets all fundamental safety requirements: The brake is applied automatically if the power fails.

The principal parts of the brake system are the brake coil itself [8] (BS accelerator coil + TS coil section = holding coil), comprising the magnet [9] with an encapsulated winding and a tap, the moving pressure plate [6], the brake springs [7], the brake disk [1] and the brake endshield [2].

Basic functions

The pressure plate is forced against the brake disk by the brake springs when the electromagnet is deenergized. The brake is applied to the motor. The number and type of brake springs determine the braking torque. When the brake coil is connected to the corresponding DC voltage, the force of the brake springs [4] is overcome by magnetic force [11], thereby bringing the pressure plate into contact with the magnet. The brake disk moves clear and the rotor can turn.

![Diagram of SEW brake components]

- [1] Brake disk
- [2] Brake endshield
- [3] Driver
- [4] Spring force
- [6] Pressure plate
- [7] Brake spring
- [8] Brake coil
- [9] Magnet
- [10] Motor shaft
5.3.2 Special features of FS brakes

There are a few differences between safety-rated brakes and non-safety-rated brakes. You can find these differences in a table in the “Differences between BY.. and BY..(FS)” (page 21) section.

**Manual brake release**

In brakemotors with the HR option “Manual brake release with automatic reengaging function,” you can release the brake manually using the provided lever. The following table specifies the actuation force required at maximum braking torque to release the brake by hand. The values are based on the assumption that you operate the lever at the upper end.

<table>
<thead>
<tr>
<th>Brake type</th>
<th>Motor size</th>
<th>Actuation force $	ext{F}_H$ in N</th>
</tr>
</thead>
<tbody>
<tr>
<td>BY2</td>
<td>CMPZ71</td>
<td>50</td>
</tr>
<tr>
<td>BY4</td>
<td>CMPZ80</td>
<td>70</td>
</tr>
<tr>
<td>BY8</td>
<td>CMPZ100</td>
<td>90</td>
</tr>
</tbody>
</table>

---

*Figure showing a lever with force $F_H$.*
5.4 Safety-rated encoders

NOTE

Under certain conditions, non-safety-rated encoders can also be used in safe brake systems.

Contact SEW-EURODRIVE for more information.

5.4.1 Absolute and speed encoders

You can use the following encoders in a safety-rated system:

• AK1H

Description

The AK1H is a high-resolution multi-turn encoder from the Hiperface® product range. It has a resolution of 1024 sine/cos periods per revolution and is connected to the motor shaft using a cone.
5.5 Safety-rated brake control

If the BY..(FS) brake is used in safety-related applications, then brake control must be taken into consideration in the safety evaluation.

Various brake controllers are available for controlling disk brakes with a DC coil, depending on the requirements and the operating conditions. All brake control systems are fitted as standard with varistors to protect against overvoltage.

NOTE
Under certain conditions, non-safety-rated brake controls can also be used in safe brake systems.
Contact SEW-EURODRIVE for more information.

5.5.1 Safety-related BST brake module

The safety-related BST brake module safely disconnects the energy supply to the brake.

The BST brake module offers the following safety function:
- SBC (safe brake control), up to PL d according to EN ISO 13849

The BST brake module offers many advantages compared to conventional technology:
- Less space required in the control cabinet (no contactor and no motor protection switch)
- Improved energy balance (energy efficient as the regenerative energy from the DC link can be used)
- Reduced wiring work
- Easy installation
- Easy safety assessment
- No wear

Integrated Safety Technology

The safety technology of the safety-related BST brake module described in this document has been developed and tested in accordance with the following safety requirements:
- Category 3 according to EN 954-1
- Performance level d according to EN ISO 13849-1

This was certified by TÜV Nord. A copy of the TÜV certificate can be obtained from SEW-EURODRIVE.

Safe condition

Safety-relevant use of the BST brake module means the de-energized condition of the connected brake is defined as safe condition. This is the basis of the safety concept.
Safety concept

- The safety-related BST brake module enables the connection of an external fail-safe safety switching device/safety controller. The safety switching device disconnects the safe control voltage $V_{24 \, \text{v}_{ \text{safe}}}$ when a connected control device (e.g. emergency stop device) is activated.

- Disconnecting the safe control voltage $V_{24 \, \text{v}_{ \text{safe}}}$ means the connected brake is disconnected from the power supply. The power supply required for releasing the connected brake is interrupted safely.

- Instead of separating the brake control galvanically from the power supply using contactors or switches, the disconnection procedure described here prevents the power semiconductors in the safety-related BST brake module from being activated, in this way ensuring safe disconnection. This means that all connected brakes are de-energized although the supply voltage is still present at the safety-related BST brake module.

Safety function

The following drive-related safety function can be used:

- **SBC** (Safe Brake Control according to IEC 61800-5-2)

  The SBC function safely de-energizes the connected brake by disconnecting the safety-related control voltage $V_{24 \, \text{v}_{ \text{safe}}}$, The safety-related control voltage must be disconnected using a suitable external safety switching device/safety controller.

INFORMATION

Safety-related brake control must be carried out using the safety-related control voltage $V_{24 \, \text{v}_{ \text{safe}}}$ (terminal 5/6) only.
The following BST unit types are permitted for safety-related applications:

<table>
<thead>
<tr>
<th>Type designation</th>
<th>Part number</th>
<th>Approved SEW disk brakes</th>
</tr>
</thead>
<tbody>
<tr>
<td>BST 0.6S-460V-00</td>
<td>0 829 971 4</td>
<td>All brake coils with a coil voltage of AC 460 V and a coil power ≤ 120 W. Several brake coils can be connected for redundant systems. In this case, the total power must not exceed 120 W.</td>
</tr>
<tr>
<td>BST 0.7S-400V-00</td>
<td>1 300 077 2</td>
<td>All brake coils with a coil voltage of AC 400 V and a coil power ≤ 120 W. Several brake coils can be connected for redundant systems. In this case, the total power must not exceed 120 W.</td>
</tr>
<tr>
<td>BST 1.2S-230V-00</td>
<td>1 300 133 7</td>
<td>All brake coils with a coil voltage of AC 230 V and a coil power ≤ 120 W. Several brake coils can be connected for redundant systems. In this case, the total power must not exceed 120 W.</td>
</tr>
</tbody>
</table>

The BST units are connected directly to the frequency inverters' DC link.

- MOVIDRIVE® B: Can be connected directly to the terminals of the DC link.
- MOVIAXIS®: The BST can be connected to the DC link using the BST connection set (in preparation). See the addendum to the operating instructions for more information.

The following table shows the technical data for safety-related control voltage $V_{24\text{ V safe}}$ at terminals 5/6:

<table>
<thead>
<tr>
<th>Safety-related control voltage $V_{24\text{ V safe}}$</th>
<th>Min.</th>
<th>Typical</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input voltage range according to DIN EN 61131-2 DC 24 V</td>
<td>DC 20.4 V</td>
<td>DC 24 V</td>
<td>DC 28.8 V</td>
</tr>
<tr>
<td>Input current</td>
<td></td>
<td>50 mA</td>
<td></td>
</tr>
<tr>
<td>Input capacitance</td>
<td></td>
<td>4.7 μF</td>
<td>6 μF</td>
</tr>
<tr>
<td>Switch-on/switch-off threshold</td>
<td></td>
<td>DC 10 V</td>
<td></td>
</tr>
<tr>
<td>Input voltage for OFF state (brake de-energized)</td>
<td></td>
<td>DC 6 V</td>
<td></td>
</tr>
<tr>
<td>Duration from switching off the safety-related control voltage at BST until switching off the brake voltage $V_B$ plus the brake application time of the connected brake.</td>
<td></td>
<td>6 ms</td>
<td></td>
</tr>
</tbody>
</table>

Safety-related control cable

- Cable length | 100 m (328 ft)
- Cable cross section | 0.5 mm² (AWG 20) | 1.5 mm² (AWG 16)

1) The brake application time for cut-off in the AC circuit must be used.
5.6 **Frequency inverters**

An extensive product range of SEW-EURODRIVE frequency inverters is available for electronically controlled drives. SEW-EURODRIVE recommends the following inverter series for safety-related drive systems:

- **MOVIDRIVE® B**: High-performance drive inverter for dynamic drives in the power range 0.55 – 250 kW. Great diversity of applications due to extensive expansion options with technology and communication options. Three-phase supply system connection for AC 230 V and AC 400 – 500 V.

- **MOVIAXIS®**: High-performance, versatile multi-axis servo inverter with axis module nominal currents from 2 – 133 A. Wide variety of applications due to extensive expansion options with technology and communication options, as well as optional sinusoidal regenerative power supply. Three-phase line connection for AC 380 – 500 V.
5.7 **SEW controller**

5.7.1 **MOVI-PLC®**

The MOVI-PLC® controller runs on the universally parameterizable MultiMotion software platform from SEW-EURODRIVE. The platform provides comprehensive motion control functions, in particular for technology functions, such as:

- Positioning
- Electronic gear unit / synchronous operation
- Cams
- Interpolation
- Touch probe function
- Cam controller

The MOVI-PLC® control software is programmed using the PLC Editor.

5.7.2 **CCU (Configurable Control Unit)**

Control technology from SEW-EURODRIVE includes the configurable control unit (CCU) for easily configurable applications with standardized and immediately executable application modules, which merely have to be parameterized. The functions match the specific application and can be configured easily and quickly without any programming knowledge. An integrated diagnostic function helps to speed up and facilitate startup.

The platform provides comprehensive motion control functions, in particular for technology functions, such as:

- Positioning
- Synchronous operation
- Touch probe function
- Winding
- Robot kinematics
- Flying saw, rotating knife
- Energy efficient storage/retrieval system
5.8 **MOVISAFE® UCS..B safety module**

The MOVISAFE® UCS..B product series comprises modular, programmable safety controllers for implementing safe disconnection and drive monitoring functions (velocity and position monitoring). The safety controllers are designed for installation in the control cabinet.

The modular design of the UCS..B safety controllers makes it possible to adjust the safety-relevant functionality to the specific application. Two module series are available:

- Safety controllers UCS..B Compact for separate monitoring of up to 2 axes, consisting of
  - Basic module with integrated logic, inputs and outputs as well as up to 2 encoder interfaces
  - Optional function expansion with PROFIsafe interface/PS for connection to a higher-level safety controller
  - Optional expansion module with additional inputs and outputs
  - Optional expansion module with PROFIBUS or PROFINET interface for connection to a higher-level controller.

- Safety controllers UCS..B Multi-axis for monitoring up to 12 axes, consisting of
  - Basic module with integrated logic as well as inputs and outputs (optionally available with integrated PROFIBUS, PROFINET interface for connection to a higher-level controller)
  - Optional axis expansion module with 1 or 2 encoder interfaces
  - Optional expansion module with additional inputs and outputs
5.9 Prefabricated cables

SEW-EURODRIVE offers prefabricated cables with plugs for straightforward and reliable motor connection.

Cable and contact are connected using the crimp technique. Cables are available by the meter.

Prefabricated cables are divided into:
- Power cables (motor cable, brakemotor cable, extension cable)
- Feedback cables (encoder cable, extension cable).

5.9.1 Preselection of cables

Prefabricated cables were preselected by SEW-EURODRIVE according to the standard EN 60204. The routing types “fixed installation” and “cable carrier installation” were considered.

Using other standards for the machine construction can result in diverging cross sections.
## 5.10 Additional documentation

The following table provides an overview of additional documentation for the individual components.

You can order these publications from SEW-EURODRIVE.

<table>
<thead>
<tr>
<th>Components</th>
<th>Operating instructions</th>
<th>Catalog</th>
<th>Gear units</th>
<th>Operating instructions</th>
<th>Catalog</th>
<th>Brake</th>
<th>Drive Engineering - Practical Implementation</th>
<th>Addendum to the operating instructions</th>
<th>Data sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEW Controller</td>
<td>MultiMotion for MOVI-PLC®</td>
<td></td>
<td></td>
<td>“Configuration Software – Application Configurator for CCU”</td>
<td></td>
<td></td>
<td>“MOVIDRIVE® MDX60B/61B”</td>
<td>“MOVIDRIVE® MDX60B/61B”</td>
<td>“MOVIDRIVE® MDX60B/61B”</td>
</tr>
<tr>
<td>MOVISAFE® UCS.B safety module</td>
<td>“MOVISAFE® UCS.B Safety Modules”</td>
<td></td>
<td>MOVISAFE® MDX60B/61B</td>
<td>“MOVIDRIVE® MDX60B/61B”</td>
<td>“MOVIDRIVE® MDX60B/61B”</td>
<td></td>
<td>“MOVIDRIVE® MDX60B/61B”</td>
<td>“MOVIDRIVE® MDX60B/61B”</td>
<td>“MOVIDRIVE® MDX60B/61B”</td>
</tr>
</tbody>
</table>
6 Project Planning

6.1 Project planning procedure for BY..(FS) brakes

NOTE

Gearmotor project planning is a prerequisite for safety-rated brake project planning.

If you have questions about gearmotor project planning, you can find more information in the catalog “Synchronous Servo Gearmotors”.

The standard configuration is performed according to the catalog and is the basis for a configuration of the safety-rated brake on a (gear-) motor. This is expanded to include additional safety measures during configuration. The gear unit utilization is additionally taken into consideration by the braking torque.

The following project planning notes are examples. They already include these additional checks. It might be necessary to adapt the following project planning notes to the specific application.

The project planning notes do not guarantee a safe drive or drive system. The safety-rated BY..(FS) brake is intended for use in functional safety applications. As a component, it is part of the drive system. The user must conclusively evaluate whether the drive system is suitable for functional safety.

Furthermore, there are limits in terms of the available combinations in connection with a BY..(FS) brake (e.g. no TorqLOC®). The limits are listed in an overview table in section “Differences between BY brakes and BY(FS) brakes” (page 21).

Key to the project planning procedure illustrations:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>JX</td>
<td>Reduced mass moment of inertia of the system on the motor shaft kgm²</td>
</tr>
<tr>
<td>JM</td>
<td>Internal mass moment of inertia (motor and gear unit) kgm²</td>
</tr>
<tr>
<td>J2</td>
<td>Mass moment of inertia of the additional flywheel mass (flywheel fan) kgm²</td>
</tr>
<tr>
<td>ηOverall</td>
<td>Overall efficiency (system and gear unit) -</td>
</tr>
<tr>
<td>ηGear unit</td>
<td>Retrodriving efficiency of the gear unit -</td>
</tr>
<tr>
<td>WBmax</td>
<td>Max. occurring braking work J</td>
</tr>
<tr>
<td>Wmax_perm</td>
<td>Maximum permitted braking work per switching operation J</td>
</tr>
<tr>
<td>WInsp</td>
<td>Maximum braking work until inspection J</td>
</tr>
<tr>
<td>NB</td>
<td>Number of permitted emergency stop braking operations until brake maintenance -</td>
</tr>
<tr>
<td>Mbrake,output</td>
<td>Braking torque on the output side Nm</td>
</tr>
<tr>
<td>Mamax</td>
<td>Maximum permitted gear unit torque for continuous duty Nm</td>
</tr>
<tr>
<td>ML</td>
<td>Static torque of the load (without η), related to the motor shaft Nm</td>
</tr>
<tr>
<td>MB</td>
<td>Braking torque Nm</td>
</tr>
<tr>
<td>FR,brake</td>
<td>Overhung of the gear unit during braking N</td>
</tr>
<tr>
<td>d0</td>
<td>Mean diameter of the installed transmission element in mm mm</td>
</tr>
<tr>
<td>fZ</td>
<td>Transmission element factor -</td>
</tr>
<tr>
<td>FR,system</td>
<td>Additional overhung load, such as overhung load caused by belt tension N</td>
</tr>
<tr>
<td>FR,total</td>
<td>The overhung load on the gear unit N</td>
</tr>
<tr>
<td>FR,permitted</td>
<td>Maximum permitted overhung load N</td>
</tr>
<tr>
<td>ηM</td>
<td>Motor speed rpm</td>
</tr>
</tbody>
</table>
6.1.1 Project planning procedure for the brake on a trolley

Project planning procedure trolley

1) Calculations of maximum energy braking work

\[
W_{B,\text{max}} = \frac{M_B}{M_B + M_L} \times \left( J_M + J_Z + J_X \times \eta_{\text{total}} \right) \times \eta_M^2
\]

Drive change

\[ W_{B,\text{max}} \leq W_{\text{max,perm}} \]

Calculation of the number of permitted emergency braking stops until brake maintenance:

\[ NB = \frac{W_{\text{insp}}}{W_{B,\text{max}}} \]

Required value reached?

Note:
For values for \( W_{\text{max,perm}} \), see chapter "Maximum permitted braking work for emergency switching off with BY..(FS) brakes".
For values for \( W_{\text{insp}} \), see chapter "Characteristic data of BY.. / BY..(FS) brakes".

\[ M_\text{L} \text{ and } \eta \text{ are application data and must be specified by the user} \]
2) \( M_L \) and \( J_L \) are application data and must be specified by the user. \( \eta'_{\text{gear}} \) is the efficiency of the gear unit for retrodriving torques. Information about determining these values can be found in the catalog “Synchronous Servo Gearmotors”.

3) Application torques may have to be taken into consideration.
6.1.2 Project planning procedure for the brake on a hoist

Project planning procedure hoist

Calculation of maximum occurring braking work\(^1\)

\[ W_{B_{\text{max}}} = \frac{M_B}{M_B + \frac{L}{\eta_{\text{total}}}} \times \left( J_M + J_Z + J_X \times \eta_{\text{total}} \right) \times \eta_M^2 \]

Calculation of maximum occurring braking work\(^1\)

\[ W_{B_{\text{max}}} = \frac{M_B}{M_B - M_L \times \eta_{\text{total}}} \times \left( J_M + J_Z + J_X \times \eta_{\text{total}} \right) \times \eta_M^2 \]

\[ W_{B_{\text{max}}} \leq W_{\text{max}_{\text{perm}}} \]

Yes

Calculation of the number of permitted emergency braking stops until brake maintenance:

\[ N_B = \frac{W_{\text{insp}}}{W_{B_{\text{max}}}} \]

Required value reached?

No

Yes

\(^1\) \( M_L \) and \( \eta \) are application data and must be specified by the user

\(^2\) The greater of the two values for upward and downward travel has to be checked.

Note:

For values for \( W_{\text{max}_{\text{perm}}} \), see chapter "Maximum permitted braking work for emergency switching off with BY..(FS) brakes"

For values for \( W_{\text{insp}} \), see chapter "Characteristic data of BY.. / BY..(FS) brakes"
3) M_L and J_x are application data and must be specified by the user. n_gear is the efficiency of the gear unit for retrodriving torques. Information about determining these values can be found in the catalog “Synchronous Servo Gearmotors”.

4) Application torques may have to be taken into consideration.
6.2 Brake BY...(FS)

6.2.1 General information

The BY...(FS) working brake can only be mounted on CMPZ71 – CMPZ100 motors (motor design with additional flywheel mass).

The size of the brakemotor and its electrical connection must be selected carefully to ensure the longest possible service life.

The following aspects described in detail must be taken into account:
1. Selecting the braking torque in accordance with the project planning data.
2. Dimensioning and routing of the cable.
3. Selecting the brake contactor, if applicable.
4. Important design information.

6.2.2 Selecting the brake in accordance with the project planning data

The mechanical components, brake type and braking torque, are determined when the drive motor is selected. The drive type or application areas and the standards that have to be taken into account are used for the brake selection.

Selection criteria:
• Servomotor motor size.
• Number of emergency-off braking operations.
• Level of braking torque (“soft braking”/“hard braking”).
• Hoist application
• Minimum/maximum deceleration
• Encoder system used

Values determined / calculated during brake selection:

<table>
<thead>
<tr>
<th>Basic specification</th>
<th>Link/addition/comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor type</td>
<td>Brake type, brake control system</td>
</tr>
<tr>
<td>Braking torque</td>
<td>Brake springs</td>
</tr>
<tr>
<td>Brake application time</td>
<td>Connection type of the brake control (important for the electrical design for wiring diagrams)</td>
</tr>
<tr>
<td>Braking time</td>
<td></td>
</tr>
<tr>
<td>Braking distance</td>
<td>The required data can only be observed if the aforementioned parameters meet the requirements</td>
</tr>
<tr>
<td>Deceleration</td>
<td></td>
</tr>
<tr>
<td>Braking accuracy</td>
<td></td>
</tr>
</tbody>
</table>

1) The braking torque is determined from the requirements of the application with regards to the maximum deceleration and the maximum permitted distance or time.

For detailed information on selecting the size of the brakemotor and calculating the braking data, refer to the documentation "Drive Engineering - Practical Implementation – Project Planning for Drives".
Selecting the brake

The brake suitable for the relevant application is selected by means of the following main criteria:

- Required braking torque
- Required working capacity

Braking torque

The braking torque is usually selected according to the required deceleration.

Possible braking torque gradation can be found in the section “Technical Data of the BY Brake” in the “Synchronous Servomotors” catalog.

Braking torque in hoist applications

NOTE

The selected braking torque must be greater than the maximum load torque by at least factor 2.

Working capacity

The working capacity of the brake is determined by the permitted braking work done \( W_1 \) per braking operation and the total permitted braking work \( W_{\text{insp}} \) until maintenance of the brake.

The overall permitted braking work \( W_{\text{insp}} \) can be found in the section “Technical Data of the BY Brake” in the “Synchronous Servomotors” catalog.

Permitted number of braking operations until maintenance of the brake:

\[
NB = \frac{W_{\text{insp}}}{W_1}
\]

Braking work per braking operation:

\[
W_1 = \frac{J_{\text{ges}} \times n^2 \times M_B}{182.4 \times (M_B + M_L)}
\]

- \( NB \) = Number of braking operations until service
- \( W_{\text{insp}} \) = Total braking work until service in J
- \( W_1 \) = Braking work per braking operation in J
- \( J_{\text{ges}} \) = Total mass moment of inertia (related to the motor shaft) in \( \text{kgm}^2 \)
- \( n \) = Motor speed rpm
- \( M_B \) = Braking torque in Nm
- \( M_L \) = Load torque in Nm (observe the +/- character)
  - +: for vertical upward and horizontal movement
  - -: for vertical downward movement
Emergency stop features

The limits of the permitted maximum braking work must not be exceeded, not even for emergency switch-off.

The emergency switch-off properties must therefore be based on the directions of movement.

1. Braking during vertical movement

In hoist applications, the limits of the permitted maximum braking work (including emergency stops) may not be exceeded.

Please consult SEW-EURODRIVE if you need values for increased emergency switch-off braking work in hoist applications.

2. Braking during horizontal movement

For horizontal motion like in travel drive applications, higher braking work might be permitted per cycle in emergency stop situation under the following conditions A - D.

A Selected braking torque

All braking torques are permitted. In contrast to BE brakes, with BY brakes, you don’t have to select a braking torque that is reduced by at least one stage in terms of the brake size when using them with DR motors.

B Brake wear

The specific wear of the brake lining increases significantly in case of an emergency stop. It can reach a factor of 100 under certain circumstances.

This additional wear must be taken into account when determining the maintenance cycle.

C Braking process

During the braking process, the effective dynamic braking torque can be reduced due to the heating of the brake lining during braking. In extreme cases, the effective braking torque can be reduced to 60% of the rated value. This must be noted when determining the braking distance.

Example: BY8 with $M_B = 80 \text{ Nm}$, minimal effective $M_B = 48 \text{ Nm}$

D Braking speed

A decisive factor for the permitted increased braking work is the speed at which the braking process is triggered. The lower the speed, the higher the permitted braking work.

Please consult SEW-EURODRIVE if you need values for increased emergency switch-off braking work in travel drive applications.

3. Braking during inclined upwards movement

Because inclined upward movement has a vertical and a horizontal component, the permitted emergency stop braking work is predominantly determined according to point 1.

Please contact SEW-EURODRIVE if you are unable to classify the direction of motion as solely vertical or solely horizontal.
6.2.3 No-load starting frequency

The following no-load starting frequency $Z_0$ must not be exceeded in order to prevent the BY brake from heating up.

<table>
<thead>
<tr>
<th>Brake</th>
<th>No-load starting frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>BY2</td>
<td>7200 1/h</td>
</tr>
<tr>
<td>BY4</td>
<td>7200 1/h</td>
</tr>
<tr>
<td>BY8</td>
<td>7200 1/h</td>
</tr>
</tbody>
</table>

6.2.4 Determining the brake voltage

The brake voltage should always be selected on the basis of the available AC supply voltage or motor operating voltage. This means the user is always guaranteed the most cost-effective installation for lower braking currents.

The standard brake voltages are listed in the following table:

<table>
<thead>
<tr>
<th>Brake</th>
<th>BY2, BY4, BY8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brake voltage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DC 24 V</td>
</tr>
<tr>
<td></td>
<td>AC 110 V</td>
</tr>
<tr>
<td></td>
<td>AC 230 V</td>
</tr>
<tr>
<td></td>
<td>AC 400 V</td>
</tr>
<tr>
<td></td>
<td>AC 460 V</td>
</tr>
</tbody>
</table>

1) The 24 V brake voltage requires a strong current and is only possible with limited cable length.

When releasing the brake, the holding current can increase by up to 7 times. The voltage at the brake coil may not drop below 90% of the rated voltage.

6.2.5 Selecting the brake control system

Only SEW brake control systems are used for controlling the brake. All brake control systems are fitted as standard with varistors to protect against overvoltage.

The brakes are available with DC and AC voltage connection.

- AC voltage connection:
  - BME, equipped with DIN rail profile
- DC voltage connection:
  - BSG.

Two types of electrical cut-off are available:

- Normal application times: cut-off in the AC circuit.
- Particularly short application times: cut-off in the AC and DC circuits.

The brake control systems are mounted in the control cabinet. Retaining screws are included in the scope of delivery.
The following options are available:

- AC supply, cut-off in the AC and DC circuits without additional switch contact, particularly short application times: BMP.
- AC supply, brake heating function when switched off: BMH.
- The BMK/BMKB/BMV control system energizes the brake coil if the supply system and a DC 24 V signal (e.g. from the PLC) are present simultaneously. The brake is applied if one condition is not being met. BMK/BMKB/BMV allow for shortest response and application times.
- Safe brake control up to PL d, supply via DC link: BST

**NOTE**

For emergency switch-off and emergency stop and for hoists in general, a disconnection of all poles is required (terminal 1 and 2 of the brake rectifier).

The following table lists SEW brake control systems for installation in the control cabinet. The different housings have different colors (= color code) to make them easier to distinguish.

<table>
<thead>
<tr>
<th>Brake control</th>
<th>Function</th>
<th>Voltage</th>
<th>Holding current $I_{H\text{max}}$ (A)</th>
<th>type</th>
<th>Part number</th>
<th>Color code</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME</td>
<td>One-way rectifier with electronic switching</td>
<td>AC 150 – 500 V</td>
<td>1.5</td>
<td>BME 1.5</td>
<td>825 722 1</td>
<td>Red</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AC 42 – 150 V</td>
<td>3.0</td>
<td>BME 3</td>
<td>825 723 X</td>
<td>Blue</td>
</tr>
<tr>
<td>BMH</td>
<td>One-way rectifier with electronic switching and heating function</td>
<td>AC 150 – 500 V</td>
<td>1.5</td>
<td>BMH 1.5</td>
<td>825 818 X</td>
<td>Green</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AC 42 – 150 V</td>
<td>3</td>
<td>BMH 3</td>
<td>825 819 8</td>
<td>Yellow</td>
</tr>
<tr>
<td>BMP</td>
<td>One-way rectifier with electronic switching, integrated voltage relay for cut-off in the DC circuit</td>
<td>AC 150 – 500 V</td>
<td>1.5</td>
<td>BMP 1.5</td>
<td>825 685 3</td>
<td>White</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AC 42 – 150 V</td>
<td>3.0</td>
<td>BMP 3</td>
<td>826 566 6</td>
<td>Light blue</td>
</tr>
<tr>
<td>BMK</td>
<td>One-way rectifier with electronic switching, DC 24 V control input and cut-off in the DC circuit</td>
<td>AC 150 – 500 V</td>
<td>1.5</td>
<td>BMK 1.5</td>
<td>826 463 5</td>
<td>Water blue</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AC 42 – 150 V</td>
<td>3.0</td>
<td>BMK 3</td>
<td>826 567 4</td>
<td>Bright red</td>
</tr>
<tr>
<td>BMKB</td>
<td>One-way rectifier with electronic switch mode, DC 24 V control input, cut-off in the DC circuit and a diode to signal the readiness for operation</td>
<td>AC 150 – 500 V</td>
<td>1.5</td>
<td>BMKB 1.5</td>
<td>828 160 2</td>
<td>Water blue</td>
</tr>
<tr>
<td>BSG</td>
<td>Control unit for DC 24 V connection with electronic switching</td>
<td>DC 24 V</td>
<td>5.0</td>
<td>BSG</td>
<td>825 459 1</td>
<td>White</td>
</tr>
<tr>
<td>BMV</td>
<td>Electric switching, DC 24 V control input and cut-off in the DC circuit</td>
<td>DC 24 V</td>
<td>5.0</td>
<td>BMV</td>
<td>1 300 006 3</td>
<td>White</td>
</tr>
</tbody>
</table>
Quick reaction times

A particular feature of the SEW brake is its patented two coil system. This system consists of accelerator coil and coil section. The special SEW brake control system ensures that the accelerator coil is switched on with a high current inrush when the brake is released, after which the coil section is switched on. The result is a particularly short response time when releasing the brake. The brake disk moves clear very swiftly and the motor starts up with hardly any brake friction.

This principle of the two coil system also reduces self-induction so that the brake is applied more rapidly. The result is a reduced braking distance. The SEW brake can be cut off in the DC and AC circuits to achieve particularly short response times when applying the brake, for example for hoists.

6.2.6 Dimensioning and routing the cable for terminal boxes

a) Selecting the cable

Select the cross section of the brake cable according to the currents in your application. Observe the inrush current of the brake when selecting the cross section. When taking the voltage drop into account due to the inrush current, the value must not drop below 90 % of the rated voltage. The data sheets for the brakes provide information on the possible supply voltages and the resulting operating currents.

Information about the size of the cable cross-section and the cable lengths can be found in the “Cable Classifications” tables in the “Synchronous Servomotors” catalog.

Wire cross sections of max. 2.5 mm² can be connected to the terminals of the brake control systems. Intermediate terminals must be used if the cross sections are larger.

b) Routing information

Brake cables must always be routed separately from other power cables with phased currents unless they are shielded.

Ensure adequate equipotential bonding between the drive and the control cabinet (for an example, see the documentation Drive Engineering – Practical Implementation "EMC in Drive Engineering").

Power cables with phased currents are in particular

- Output cables from frequency inverters and servo inverters, soft start units and brake units
- Supply cables to braking resistors
6.2.7 Selection of the brake contactor

Due to the high current loading and the DC voltage to be switched at inductive load, contactors in utilization category AC 3 (EN 60947-4-1) must always be used for controlling the brake rectifiers.

For brake control via BSG and BMV, contactors in utilization category DC 3 must be used (EN 60947-4-1).

Standard variant

The CMPZ brakemotors with BME for are delivered without additional order information for AC connection.

Switching via contactor

<table>
<thead>
<tr>
<th>Brake size</th>
<th>AC connection</th>
<th>DC 24 V connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>BY2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BY4</td>
<td>BME</td>
<td>BSG</td>
</tr>
<tr>
<td>BY8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Control via inverter

<table>
<thead>
<tr>
<th>Brake size</th>
<th>AC connection</th>
<th>DC 24 V connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>BY2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BY4</td>
<td>BMK</td>
<td>BMV</td>
</tr>
<tr>
<td>BY8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.2.8 Important design information

a) EMC (electromagnetic compatibility)

The EMC instructions in the servo inverter documentation must also be taken into account for the operation of SEW servomotors with a brake.

The instructions on laying cables must always be adhered to.

b) Maintenance intervals

The time to maintenance is determined on the basis of the expected brake wear. This value is important for setting up the maintenance schedule for the machine to be used by the customer’s service personnel (machine documentation).
Technical Data

7 Technical Data

7.1 Technical data of BY brakes

The following tables list the technical data of the brakes. The type and number of brake springs determines the level of the braking torque. Unless specified otherwise in the order, maximum braking torque $M_{B\text{ max}}$ is installed as standard. Other brake spring combinations can produce the reduced braking torque values $M_{B\text{ red}}$.

<table>
<thead>
<tr>
<th>Brake type</th>
<th>$M_{B\text{ max}}$ Nm</th>
<th>$M_{B\text{ red}}$ Nm</th>
<th>$W_{\text{resp}}$ $10^3$ kJ</th>
<th>$P$ W</th>
<th>$t_1$ ms</th>
<th>$t_2$ ms</th>
<th>$t_3$ ms</th>
</tr>
</thead>
<tbody>
<tr>
<td>BY2</td>
<td>20</td>
<td>10</td>
<td>35</td>
<td>27</td>
<td>25</td>
<td>23</td>
<td>130</td>
</tr>
<tr>
<td>BY4</td>
<td>40</td>
<td>20</td>
<td>50</td>
<td>38</td>
<td>30</td>
<td>17</td>
<td>110</td>
</tr>
<tr>
<td>BY8</td>
<td>80</td>
<td>40</td>
<td>60</td>
<td>45</td>
<td>55</td>
<td>25</td>
<td>210</td>
</tr>
</tbody>
</table>

$M_{B\text{ max}}$ = Maximum braking torque

$M_{B\text{ red}}$ = Optional braking torque

$W_{\text{resp}}$ = Permitted total braking work (braking work until maintenance)

$P$ = Power consumption of the coil

$t_1$ = Response time

$t_2$ = AC/DC application time

$t_3$ = AC application time

NOTE

The response and application times are guide values that were determined at maximum braking torque.

Possible response times of switching elements or controllers were not taken into account.

7.1.1 Motor assignment

The BY brake can be used for the following rated speeds and braking torques depending on the motor size:

<table>
<thead>
<tr>
<th>Motor type</th>
<th>Brake type</th>
<th>$M_{B1}$ Nm</th>
<th>$M_{B2}$ Nm</th>
<th>Speed class</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMPZ71S</td>
<td>BY2</td>
<td>14</td>
<td>10</td>
<td>2000, 3000, 4500</td>
</tr>
<tr>
<td>CMPZ71M/L</td>
<td>BY2</td>
<td>20</td>
<td>14</td>
<td>2000, 3000, 4500</td>
</tr>
<tr>
<td>CMPZ80S</td>
<td>BY4</td>
<td>28</td>
<td>20</td>
<td>2000, 3000, 4500</td>
</tr>
<tr>
<td>CMPZ80M/L</td>
<td>BY4</td>
<td>40</td>
<td>28</td>
<td>2000, 3000, 4500</td>
</tr>
<tr>
<td>CMPZ100S</td>
<td>BY8</td>
<td>55</td>
<td>40</td>
<td>2000, 3000, 4500</td>
</tr>
<tr>
<td>CMPZ100M/L</td>
<td>BY8</td>
<td>80</td>
<td>55</td>
<td>2000, 3000, 4500</td>
</tr>
</tbody>
</table>

$M_{B1}$ = Preferred braking torque

$M_{B2}$ = Optional braking torque
### 7.1.2 Maximum permitted friction work

The following table lists the permitted friction work from which the braking procedure is triggered, depending on the start speed. The lower the speed, the higher the permitted braking work.

**NOTE**

If the motor is not stopped in a controlled manner with the inverter, but instead the brake is used for mechanical deceleration: Check that the brake can provide the required braking start speed in case of an emergency switching off situation.

<table>
<thead>
<tr>
<th>Start speed</th>
<th>Brake type</th>
<th>$M_{B_{\text{max}}}$ for all applications</th>
<th>$W_{1}$ Only trolley applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>rpm</td>
<td></td>
<td>Nm</td>
<td>kJ</td>
</tr>
<tr>
<td>2000</td>
<td>BY2</td>
<td>7</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>BY4</td>
<td>28</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td></td>
<td>28</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td></td>
<td>80</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>BY8</td>
<td>7</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20</td>
<td>11</td>
</tr>
<tr>
<td>3000</td>
<td>BY4</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>28</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>80</td>
<td>7</td>
</tr>
</tbody>
</table>
### 7.1.3 BY brake – operating currents

The following tables list the operating currents of the brakes at different voltages. The following values are specified:

- Inrush current ratio $I_B/I_H$; $I_B$ = accelerator current, $I_H$ = holding current
- Holding current $I_H$
- Rated voltage $V_N$

The acceleration current $I_B$ (= inrush current) only flows for a short time (ca. 120 ms) when the brake is released or during voltage dips below 70% of rated voltage.

The values for the holding currents $I_H$ are rms values (with DC 24 V arithmetic mean value). Use suitable measuring instruments for current measurements.

<table>
<thead>
<tr>
<th>Start speed</th>
<th>Brake type</th>
<th>$M_{B\text{ max}}$</th>
<th>$W_1$ for all applications</th>
<th>$W_1$ Only trolley applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>rpm</td>
<td></td>
<td>Nm</td>
<td>kJ</td>
<td>kJ</td>
</tr>
<tr>
<td>4500</td>
<td>BY2</td>
<td>7</td>
<td>16</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10</td>
<td>14</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>BY4</td>
<td>14</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20</td>
<td>9</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>28</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>BY8</td>
<td>28</td>
<td>22</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40</td>
<td>18</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>55</td>
<td>11</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>80</td>
<td>4</td>
<td>8</td>
</tr>
</tbody>
</table>

$M_{B\text{ max}}$ = Maximum braking torque

$W_1$ = Permitted braking work per cycle

### Technical Data of BY brakes

<table>
<thead>
<tr>
<th>Start speed</th>
<th>Brake type</th>
<th>$M_{B\text{ max}}$</th>
<th>$W_1$ for all applications</th>
<th>$W_1$ Only trolley applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>rpm</td>
<td></td>
<td>Nm</td>
<td>kJ</td>
<td>kJ</td>
</tr>
<tr>
<td>4500</td>
<td>BY2</td>
<td>7</td>
<td>16</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10</td>
<td>14</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>BY4</td>
<td>14</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20</td>
<td>9</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>28</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>BY8</td>
<td>28</td>
<td>22</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40</td>
<td>18</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>55</td>
<td>11</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>80</td>
<td>4</td>
<td>8</td>
</tr>
</tbody>
</table>

$I_{H}$ Holding current, r.m.s. value in the incoming cable to the SEW brake rectifier

$I_{DC}$ Direct current with direct DC voltage supply

$V_N$ Nominal voltage (nominal voltage range)
7.1.4 Resistance values of BY brake coils

<table>
<thead>
<tr>
<th>Rated voltage $V_{N}$</th>
<th>$V_{AC}$</th>
<th>$V_{DC}$</th>
<th>$R_B \Omega$</th>
<th>$R_T \Omega$</th>
<th>$R_B \Omega$</th>
<th>$R_T \Omega$</th>
<th>$R_B \Omega$</th>
<th>$R_T \Omega$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24 (21.6 – 26.4)</td>
<td></td>
<td>5.2</td>
<td>20</td>
<td>4.3</td>
<td>13.3</td>
<td>3.8</td>
<td>11.2</td>
</tr>
<tr>
<td>BY2</td>
<td>110 (99 – 121)</td>
<td></td>
<td>16.3</td>
<td>64</td>
<td>13.7</td>
<td>42</td>
<td>12</td>
<td>35.5</td>
</tr>
<tr>
<td></td>
<td>230 (218 – 243)</td>
<td></td>
<td>82</td>
<td>320</td>
<td>69</td>
<td>210</td>
<td>60</td>
<td>177</td>
</tr>
<tr>
<td></td>
<td>400 (380 – 431)</td>
<td></td>
<td>260</td>
<td>1010</td>
<td>215</td>
<td>670</td>
<td>191</td>
<td>560</td>
</tr>
<tr>
<td></td>
<td>460 (432 – 484)</td>
<td></td>
<td>325</td>
<td>1270</td>
<td>275</td>
<td>840</td>
<td>240</td>
<td>700</td>
</tr>
</tbody>
</table>

- $R_B$ Accelerator coil resistance at 20 °C
- $R_T$ Coil section resistance at 20 °C
- $V_N$ Nominal voltage (nominal voltage range)

7.1.5 Braking work and braking torques

<table>
<thead>
<tr>
<th>Brake type</th>
<th>Braking work until maintenance $10^6$ J</th>
<th>Pressure plate order number</th>
<th>Braking torque</th>
<th>Braking torque settings</th>
<th>Purchase order number for brake springs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Nm Normal Red</td>
<td></td>
<td>Normal Red 0186 6621 0183 7427</td>
</tr>
<tr>
<td>BY2</td>
<td>35</td>
<td>1645 0450</td>
<td>20 6 -</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1645 0965</td>
<td>14 4 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10 3 -</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7 2 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BY4</td>
<td>50</td>
<td>1644 5856</td>
<td>40 6 -</td>
<td></td>
<td>0186 663X 0184 0037</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1644 7840</td>
<td>28 4 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>20 3 -</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>14 2 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BY8</td>
<td>60</td>
<td>1644 4876</td>
<td>80 6 -</td>
<td></td>
<td>1644 6011 1644 6038</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1644 7859</td>
<td>55 4 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>40 3 -</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>28 2 2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Depending on the mounting position V3 (brake on the bottom with manual brake release), the gray braking torques in the following table are not available:

<table>
<thead>
<tr>
<th>Brake Type</th>
<th>Braking work until maintenance $10^6$ J</th>
<th>Pressure plate order number</th>
<th>Braking torque settings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Braking work until maintenance $10^6$ J</td>
<td>Order number</td>
<td>Type and number of brake springs</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Normal</td>
</tr>
<tr>
<td>BY2</td>
<td>35</td>
<td>1645 0450</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1645 0965</td>
<td>14</td>
</tr>
<tr>
<td>BY4</td>
<td>50</td>
<td>1644 5856</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1644 7840</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>14</td>
</tr>
</tbody>
</table>
7.2 Safety characteristics

7.2.1 B₁₀d values for BY.. brake

Definition of the characteristic safety value B₁₀:

The value B₁₀ indicates the number of cycles until 10% of the components have failed.

<table>
<thead>
<tr>
<th>Size</th>
<th>BY</th>
<th>B₁₀d Switching cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>BY2</td>
<td></td>
<td>8,000,000</td>
</tr>
<tr>
<td>BY4</td>
<td></td>
<td>6,000,000</td>
</tr>
<tr>
<td>BY8</td>
<td></td>
<td>3,000,000</td>
</tr>
</tbody>
</table>

7.2.2 B₁₀d values for BY..(FS) brake

Definition of the characteristic safety value B₁₀d:

The value B₁₀d specifies the number of cycles at which 10% of components have failed dangerously (definition according to standard EN ISO 13849). Failed dangerously means in this context that the brake is not applied when required. This means the brake does not deliver the necessary braking torque.

<table>
<thead>
<tr>
<th>Size</th>
<th>BY..(FS)</th>
<th>B₁₀d Switching cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>BY2</td>
<td></td>
<td>15,000,000</td>
</tr>
<tr>
<td>BY4</td>
<td></td>
<td>12,000,000</td>
</tr>
<tr>
<td>BY8</td>
<td></td>
<td>9,000,000</td>
</tr>
</tbody>
</table>

7.2.3 MTTFd values for FS encoders

Definition of the characteristic safety value MTTFd:

The value MTTFd (Mean Time To Failure dangerous) specifies the mean time to dangerous failure / component fault.

<table>
<thead>
<tr>
<th>Motor size</th>
<th>Designation</th>
<th>MTTFd₁ [a]</th>
<th>Service life [a]</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMPZ71 – 100</td>
<td>AK1H</td>
<td>1073</td>
<td>20</td>
</tr>
</tbody>
</table>

1) Based on an ambient temperature of 40 °C
8 Appendix

8.1 Mounting positions of CMP servomotors

| Flange mounting on the input side of the flange | Flange mounting on the input side of the flange, input side bottom | Flange mounting on the input side of the flange, input side top |
| IM B5 | IM V1 | IM V3 |
## Index

### A
- Approved unit combinations ........................................... 28

### B
- BE brake
  - Basic structure ................................................... 23
  - Determining the brake voltage
    - Brake voltage of BY brakes 42
  - Function ............................................................. 23
- BE..(FS) brakes
  - Information about project planning for brakes ........... 39
- BY brake
  - Dimensioning and routing the cable ........................... 44
  - Important design information .................................... 45
  - Motor and brake assignment ...................................... 46
  - Operating currents of BY brakes ............................... 48
  - Resistance values of brake coils ............................... 49
  - Selecting the brake contactor .................................... 45
  - Selecting the brake control system ............................ 42
- BY brake emergency stop features ............................... 41
- BY brakes
  - Braking torque in hoist applications .......................... 40
  - Braking torques .................................................. 49
  - Braking work ..................................................... 49
  - General information ............................................... 39
  - Manual brake release ........................................... 24
  - Selecting the brake in accordance with project planning data ........................................... 39
  - Technical data .................................................... 46
  - Working capacity .................................................. 40
- B10d values ................................................................ 51

### C
- Copyright .................................................................... 6

### E
- Electrical connection .................................................... 9
- Embedded safety notes .................................................. 5
- Exclusion of liability .................................................... 6

### I
- Information on brake project planning .......................... 39
- Integrated safety technology ........................................ 26

### M
- Manual brake release BY brakes .................................. 24
- Mounting position ..................................................... 52
- MTTFd values ........................................................... 51

### N
- No-load frequency BY brake ........................................ 42
- Notes
  - Designation in the documentation ......................... 5

### P
- Prefabricated cables .................................................... 32
- Product description of encoders .................................. 25
- Description .............................................................. 25
- Type designation ...................................................... 25
- Product names .......................................................... 6

### R
- Rights to claim under warranty .................................... 6

### S
- Safe Brake Control (SBC) ............................................ 13
- Safe condition .......................................................... 26
- Safe Operating Stop (SOS) .......................................... 14
- Safe Stop 1 (SS1b) ...................................................... 14
- Safety concept .......................................................... 27
- Safety functions
  - Safe Brake Control (SBC) ........................................ 13
  - Safe Operating Stop (SOS) ........................................ 14
  - Safe Stop 1 (SS1b) ................................................... 14
- Safety notes ............................................................... 7
  - Design of section-related ......................................... 5
  - Design of the embedded ........................................... 5
  - Designation in the documentation ............................. 5
  - Electrical connection ............................................... 9
  - Setup ................................................................. 9
  - Transport ............................................................. 8
- Safety technology
  - Integrated ............................................................ 26
- SBC safety function (Safe Brake Control) according to IEC 61800-5-2 ........................................... 27
- SBC, safety function according to IEC 61800-5-2 ............. 27
- Section-related safety notes ........................................ 5
- Setup ................................................................. 9
- Signal words in the safety notes ................................... 5
Index

System
  Description .........................................................11
  Overview ............................................................12

T
  Technical data BY brake
    Resistance values of brake coils .........................49

Technical data BY brakes ..................................46
  Operating currents .............................................48
  Braking torques .................................................49
  Braking work ..................................................49
  Trademarks ....................................................6
  Transport ...........................................................8

U
  Unit combinations..............................................28
  Approved ........................................................28