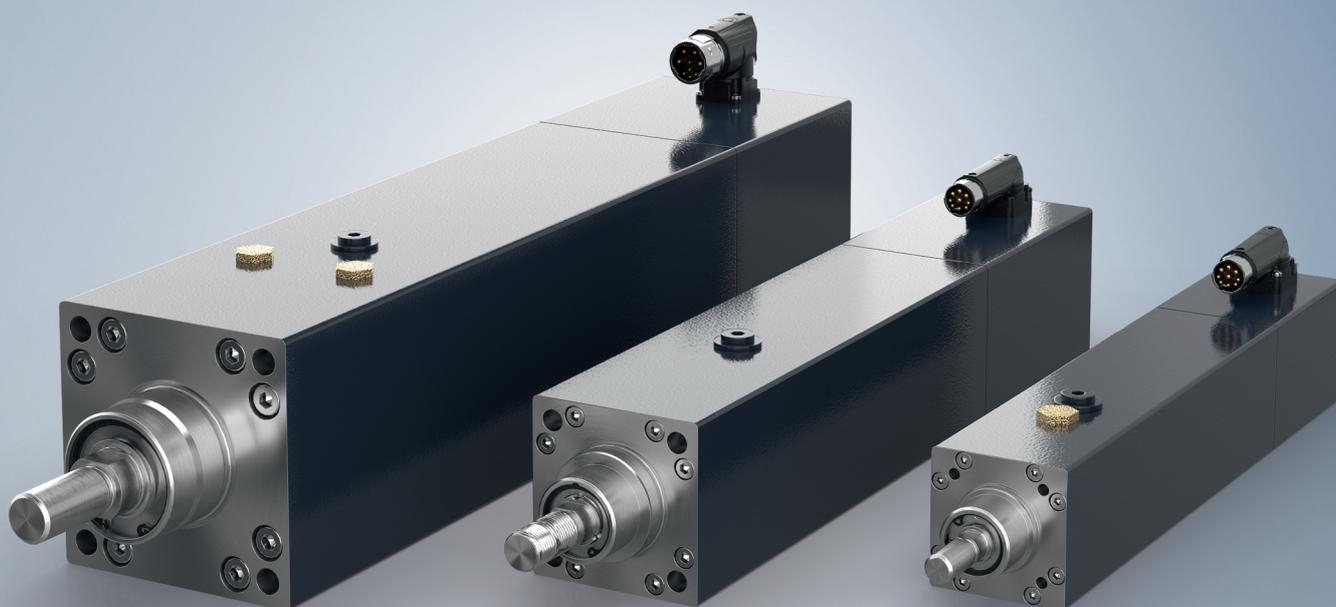


**BECKHOFF** New Automation Technology

Operating instructions | EN

AA3000

Electric cylinders





# Table of contents

<b>1 Documentation notes</b>	6
1.1 Disclaimer	6
1.1.1 Trademarks	6
1.1.2 Patents	6
1.1.3 Limitation of liability	7
1.1.4 Copyright	7
1.2 Version numbers	8
1.3 Staff qualification	9
1.4 Safety and instruction	11
1.5 Explanation of symbols	11
1.6 Beckhoff Services	13
1.6.1 Support services	13
1.6.2 Training offerings	13
1.6.3 Service offerings	13
1.6.4 Headquarters Germany	14
1.6.5 Downloadfinder	14
<b>2 For your safety</b>	15
2.1 Safety pictograms	15
2.2 General safety instructions	16
2.2.1 Before operation	16
2.2.2 During operation	17
2.2.3 After operation	17
<b>3 Product overview</b>	18
3.1 Name plate	19
3.2 Type key	20
3.3 Product characteristics	21
3.4 Ordering options	22
3.4.1 Integrated anti-twist protection [+]	22
3.4.2 Holding brake [+]	23
3.5 Intended use	24
3.6 Improper use	24
<b>4 Technical data</b>	25
4.1 Definitions and technical terms	25
4.2 Data for operation and environment	26
4.2.1 General housing properties	27
4.2.2 Environmental conditions	27
4.2.3 Specifications for intended use	27
4.2.4 Switching thresholds for temperature shutdown	27
4.2.5 Power derating	28
4.3 Size AA3023	29
4.3.1 Service life AA3023	30
4.3.2 Dimensional drawing AA3023	31
4.4 Size AA3033	32
4.4.1 Service life AA3033	33

4.4.2	Dimensional drawing AA3033 .....	34
4.5	Size AA3053 .....	35
4.5.1	Service life AA3053 .....	36
4.5.2	Dimensional drawing AA3053 .....	37
<b>5</b>	<b>Scope of supply</b> .....	<b>38</b>
5.1	Packaging .....	38
<b>6</b>	<b>Transport and storage</b> .....	<b>39</b>
6.1	Conditions .....	39
6.2	Transport .....	40
6.2.1	Transport AA3023 and AA3033 .....	41
6.2.2	Transport AA3053 .....	41
6.3	Long-term storage .....	42
<b>7</b>	<b>Technical description</b> .....	<b>43</b>
7.1	Installation position .....	43
7.2	Temperature sensor LPTC-600 .....	45
7.3	Spindle end .....	46
<b>8</b>	<b>Mechanical installation</b> .....	<b>47</b>
8.1	Flange mounting .....	47
8.2	Fastening the end of the spindle .....	48
<b>9</b>	<b>Electrical installation</b> .....	<b>50</b>
9.1	Power box .....	50
9.1.1	Pin assignment itec® (OCT) .....	51
9.1.2	Pin assignment M23-speedtec® (OCT) .....	51
9.2	Connect the motor cable .....	52
9.2.1	Establish the itec® plug connection .....	53
9.2.2	Establish the M23-speedtec® connector .....	54
9.3	Select motor cables .....	55
9.4	Select extension cable .....	56
<b>10</b>	<b>Commissioning</b> .....	<b>57</b>
10.1	Before commissioning .....	57
10.1.1	System requirements .....	58
10.1.2	Mechanical and electrical requirements .....	59
10.1.3	Testing the holding brake [+] .....	59
10.2	During commissioning .....	60
10.2.1	Electric cylinder with integrated anti-twist protection [+] .....	60
10.2.2	Electric cylinder without integrated anti-twist protection [+] .....	61
10.3	During operation .....	62
10.4	After operation .....	63
<b>11</b>	<b>Maintenance and cleaning</b> .....	<b>64</b>
11.1	Maintenance .....	64
11.2	Maintenance intervals .....	65
11.3	Lubrication of the spindle drive .....	66
11.4	Cleaning .....	68
<b>12</b>	<b>Accessories</b> .....	<b>70</b>

12.1 Mechanical accessories .....	70
<b>13 Fault correction .....</b>	<b>71</b>
<b>14 Decommissioning .....</b>	<b>75</b>
14.1 Disassembly .....	75
14.2 Disposal .....	76
14.2.1 Returning to the vendor .....	76
<b>15 Guidelines and Standards .....</b>	<b>77</b>
15.1 Standards .....	77
15.2 Guidelines .....	77
15.3 Test centers .....	77
15.4 EU conformity .....	78
15.5 CCC conformity .....	78
<b>Index .....</b>	<b>79</b>

## 1 Documentation notes

### 1.1 Disclaimer

Beckhoff products are subject to continuous further development. We reserve the right to revise the documentation at any time and without notice. No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams, and descriptions in this documentation.

#### 1.1.1 Trademarks

Beckhoff®, TwinCAT®, TwinCAT/BSD®, TC/BSD®, EtherCAT®, EtherCAT G®, EtherCAT G10®, EtherCAT P®, Safety over EtherCAT®, TwinSAFE®, XFC®, XTS® and XPlanar® are registered and licensed trademarks of Beckhoff Automation GmbH.

The use by third parties of other brand names or trademarks contained in this documentation may lead to an infringement of the rights of the respective trademark owner.

#### 1.1.2 Patents

The EtherCAT technology is protected by patent rights through the following registrations and patents with corresponding applications and registrations in various other countries:

- EP1590927
- EP1789857
- EP1456722
- EP2137893
- DE102015105702



EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH.

### 1.1.3 Limitation of liability

All components of this product described in the original operating instructions are delivered in a hardware and software configuration, depending on the application requirements. Modifications and changes to the hardware or software configuration that go beyond the documented options are prohibited and nullify the liability of Beckhoff Automation GmbH & Co. KG.

**The following is excluded from the liability:**

- Failure to comply with this documentation
- Improper use
- Use of untrained personnel
- Use of unauthorized spare parts

### 1.1.4 Copyright

© Beckhoff Automation GmbH & Co. KG, Germany

The copying, distribution and utilization of this document as well as the communication of its contents to others without express authorization is prohibited. Offenders will be held liable for the payment of damages.

We reserve all rights in the event of registration of patents, utility models and designs.

## 1.2 Version numbers



### **Provision of revision levels**

On request we can send you a list of revision levels for changes to the documentation.

- Send your request to: [motion-documentation@beckhoff.de](mailto:motion-documentation@beckhoff.de)

### **Origin of the document**

This documentation was originally written in German. All other languages are derived from the German original.

### **Product features**

The valid product features are always those specified in the current documentation. Further information given on the product pages of the Beckhoff homepage, in emails or in other publications is not authoritative.

## 1.3 Staff qualification

This documentation is aimed at trained specialists working in control technology and automation who have knowledge of the applicable and required standards and directives.

Specialists must have knowledge of drive technology and electrical equipment as well as knowledge of safe working on electrical systems and machines. This includes knowledge of proper setup and preparation of the workplace as well as securing the working environment for other persons.

The documentation published at the time must be used for each installation and commissioning. The products must be used in compliance with all safety requirements, including all applicable laws, regulations, provisions and standards.

### **Instructed person**

Instructed persons have a clearly defined task area and have been informed about the work to be carried out. Instructed persons are familiar with:

- the necessary protective measures and protective devices
- the intended use and risks that can arise from use other than for the intended purpose

### **Trained person**

Trained persons meet the requirements for instructed persons. Trained persons have additionally received training from the machine builder or vendor:

- machine-specific or
- plant-specific

### **Trained specialists**

Trained specialists have received specific technical training and have specific technical knowledge and experience. Trained specialists can:

- apply relevant standards and directives
- assess tasks that they have been assigned
- recognize possible hazards
- prepare and set up workplaces

## **Qualified electricians**

Qualified electricians have comprehensive technical knowledge gained from a course of study, an apprenticeship or technical training. They have an understanding of control technology and automation. They are familiar with relevant standards and directives. Qualified electricians can:

- independently recognize, avoid and eliminate sources of danger
- implement specifications from the accident prevention regulations
- assess the work environment
- independently optimize and carry out their work

## 1.4 Safety and instruction

Read the contents that refer to the activities you have to perform with the product. Always read the chapter "For your safety", [Page 15] in the documentation. Observe the warning notes in the chapters so that you can handle and work properly and safely with the product.

## 1.5 Explanation of symbols

Various symbols are used for a clear arrangement:

- ▶ The triangle indicates instructions that you should execute.
- The bullet point indicates an enumeration.
- [...] The square brackets indicate cross-references to other text passages in the document.
- [1] The number in the square brackets refers to the position in the adjacent figure.
- [+] The plus sign in square brackets indicates ordering options and accessories.

In order to make it easier for you to find text passages, pictograms and signal words are used in warning notices:

### **DANGER**

Failure to observe will result in serious or fatal injuries.

### **WARNING**

Failure to observe may result in serious or fatal injuries.

### **CAUTION**

Failure to observe may result in minor or moderate injuries.

## NOTICE

Notes are used for important information on the product. The possible consequences of failure to observe these include:

- Malfunctions of the product
- Damage to the product
- Damage to the environment



### Information

This sign indicates information, tips and notes for dealing with the product or the software.



### Examples

This symbol shows examples of how to use the product or software.



### QR-Codes

This symbol shows a QR code, via which you can watch videos or animations. Internet access is required in order to use it.

You can read the QR code, for example, with the camera of your smartphone or tablet. If your camera doesn't support this function you can download a free QR code reader app for your smartphone. Use the Appstore for Apple operating systems or the Google Play Store for Android operating systems.

*If you cannot read the QR code on paper, make sure that the lighting is adequate and reduce the distance between the reading device and the paper. In the case of documentation on a monitor screen, use the zoom function to enlarge the QR code and reduce the distance.*

## 1.6 Beckhoff Services

Beckhoff and its international partner companies offer comprehensive support and service. A detailed overview of our international technical support can be found online at global availability.

 [www.beckhoff.com/en-en/support/global-availability/](http://www.beckhoff.com/en-en/support/global-availability/)

### 1.6.1 Support services

Beckhoff Support offers technical advice on the use of individual Beckhoff products and system planning. Our support engineers offer you competent assistance, for comprehension questions as well as for commissioning.

 +49 5246 963-157

 [support@beckhoff.com](mailto:support@beckhoff.com)

 [www.beckhoff.com/en-en/support/our-support-services/](http://www.beckhoff.com/en-en/support/our-support-services/)

### 1.6.2 Training offerings

We offer worldwide training courses for our products and technologies, always concentrating on direct local contact with our customers. Please note that we offer both classroom and online training courses.

 +49 5246 963-5000

 [training@beckhoff.com](mailto:training@beckhoff.com)

 [www.beckhoff.com/en-en/support/training-offerings/](http://www.beckhoff.com/en-en/support/training-offerings/)

### 1.6.3 Service offerings

Our service experts support you worldwide in all areas of after-sales service.

 +49 5246 963-157

 [service@beckhoff.com](mailto:service@beckhoff.com)

 [www.beckhoff.com/en-en/support/our-service-offerings/](http://www.beckhoff.com/en-en/support/our-service-offerings/)

## 1.6.4 Headquarters Germany

Beckhoff Automation GmbH & Co. KG  
Hülshorstweg 20  
33415 Verl, Germany

 +49 5246 963-0

 [info@beckhoff.com](mailto:info@beckhoff.com)

 [www.beckhoff.com/en-en/](http://www.beckhoff.com/en-en/)

A detailed overview of our worldwide locations can be found online at Global presence.

 [www.beckhoff.com/en-en/company/global-presence/](http://www.beckhoff.com/en-en/company/global-presence/)

## 1.6.5 Downloadfinder

Our download finder contains all the files we offer for download: from our application reports to our technical documentation and configuration files.

 [www.beckhoff.com/documentations](http://www.beckhoff.com/documentations)

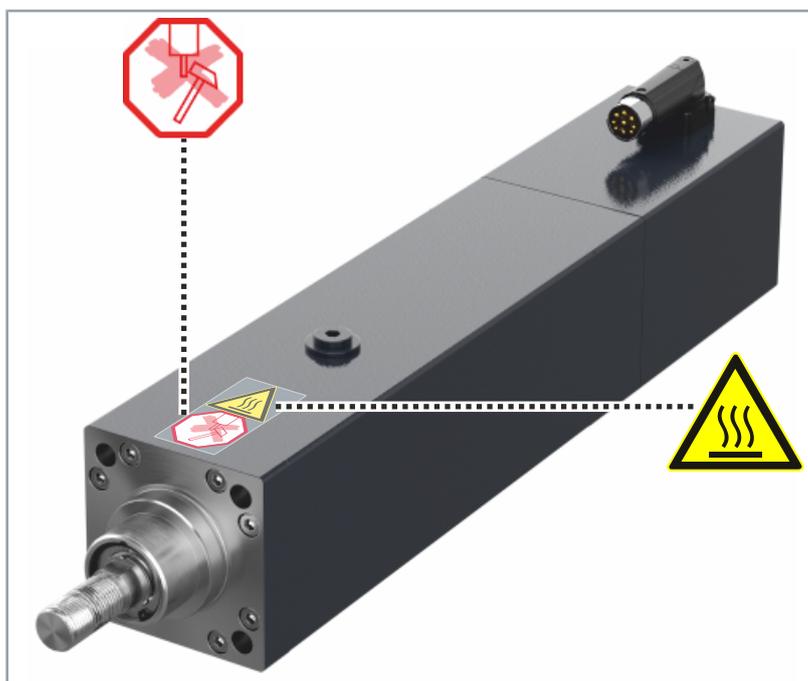
## 2 For your safety

Read this chapter containing general safety information. Furthermore, the chapters in this documentation contain warning notices. Always observe the safety instructions for your own safety, the safety of other persons and the safety of the product.

When working with control and automation products, many dangers can result from careless or incorrect use. Work particularly thoroughly, not under time pressure and responsibly towards other people.

### 2.1 Safety pictograms

You will find safety symbols on Beckhoff products and packaging. The symbols may be glued, printed, or lasered on and may vary depending on the product. They serve to protect people and to prevent damage to the products. Safety symbols may not be removed and must be legible for the user.



#### **Warning: hot surface**

During and after operation there is a risk of burns from the housing of the electric cylinder due to hot surfaces over 60°C. Allow the housing of the electric cylinder to cool down for at least 15 minutes.



#### **Avoid impacts on the spindle end**

Impacts on the spindle end can exceed the permissible forces in axial and radial direction. Internal components such as the integrated anti-twist protection [+], the ball screw, or the encoder system can be damaged or destroyed as a result.

## 2.2 General safety instructions

This chapter provides you with instructions on safety when handling the product. This product is not capable of stand-alone operation and is therefore categorized as an incomplete machine. The product must be installed in a machine or plant by the machine manufacturer. Read the documentation prepared by the machine manufacturer.

### 2.2.1 Before operation

#### **Protective equipment**

Do not remove or bypass any protective devices. Check all protective devices before operation. Make sure that all emergency switches are present at all times and can be reached by you and other people. People could be seriously or fatally injured by unprotected machine parts.

#### **Shut down and secure the machine or plant**

Shut down the machine or plant. Secure the machine or plant against being inadvertently started up.

#### **Correctly ground electrical components or modules**

Avoid electric shocks due to improper grounding of electrical components or modules. Ground all conductive components as specified in the chapters: "Electrical installation", [Page 50] and "Mechanical installation", [Page 47].

#### **Keep the immediate environment clean**

Keep your workplace and the surrounding area clean. Ensure safe working.

#### **Do not use defective or damaged electric cylinders**

Adhere to the specifications from the technical data for storage, transport, and operation. Check electric cylinder for damage. Do not use damaged electric cylinders.

#### **Check safety pictograms**

Check whether the designated pictograms are on the product. Replace missing or illegible stickers.

#### **Observe tightening torques**

Mount and repeatedly check connections and components, complying with the prescribed tightening torques.

#### **Use the original packaging only**

When shipping, transporting, storing and packing, use the original packaging or non-conductive materials.

## 2.2.2 During operation

### **Do not work on live electrical parts**

Do not open the electric cylinder while it is live. Ensure that the protective conductor is properly connected. Never disconnect electrical connections while they are live. Only work on the electric cylinder when the voltage has dropped to < 50 V. Disconnect all components from the mains and secure against reconnection.

### **Check for grease leakage at the spindle drive**

Check the spindle drive for leaking grease and remove the grease from the spindle environment. Please also refer to chapter "Cleaning", [Page 68]

Avoid excessive greasing of the spindle and contamination of the environment with the escaping grease. Ensure that you read the chapter "Lubrication of the spindle drive", [Page 66].

### **Avoid temperatures above 200°C near the spindle**

Avoid surface temperatures of over 200°C in the immediate vicinity of the spindle drive. Escaping grease could liquefy completely at high temperatures.

Adequately shield hot surfaces to protect them from accidental contact and possible grease leakage.

### **Do not touch hot surfaces**

Check the cooling of the surfaces with a thermometer. Do not touch the components during and immediately after operation. Allow the components to cool sufficiently after switching off.

### **Avoid overheating**

Operate the electric cylinder within the technical specifications. Please refer to chapter "Switching thresholds for temperature shut-down", [Page 27]. Activate and monitor the temperature sensor of the electric cylinder. Provide for sufficient cooling. Switch off the electric cylinder immediately if the temperature is too high.

### **Do not touch any moving or rotating components**

Do not touch any moving or rotating components. Fasten all parts or components on the machine or plant.

### **Keep travel path clear and do not enter area**

Keep the travel path of the spindle drive clear when operating the electric cylinder. Maintain a safety distance of at least 25 cm from all moving parts in the travel range.

## 2.2.3 After operation

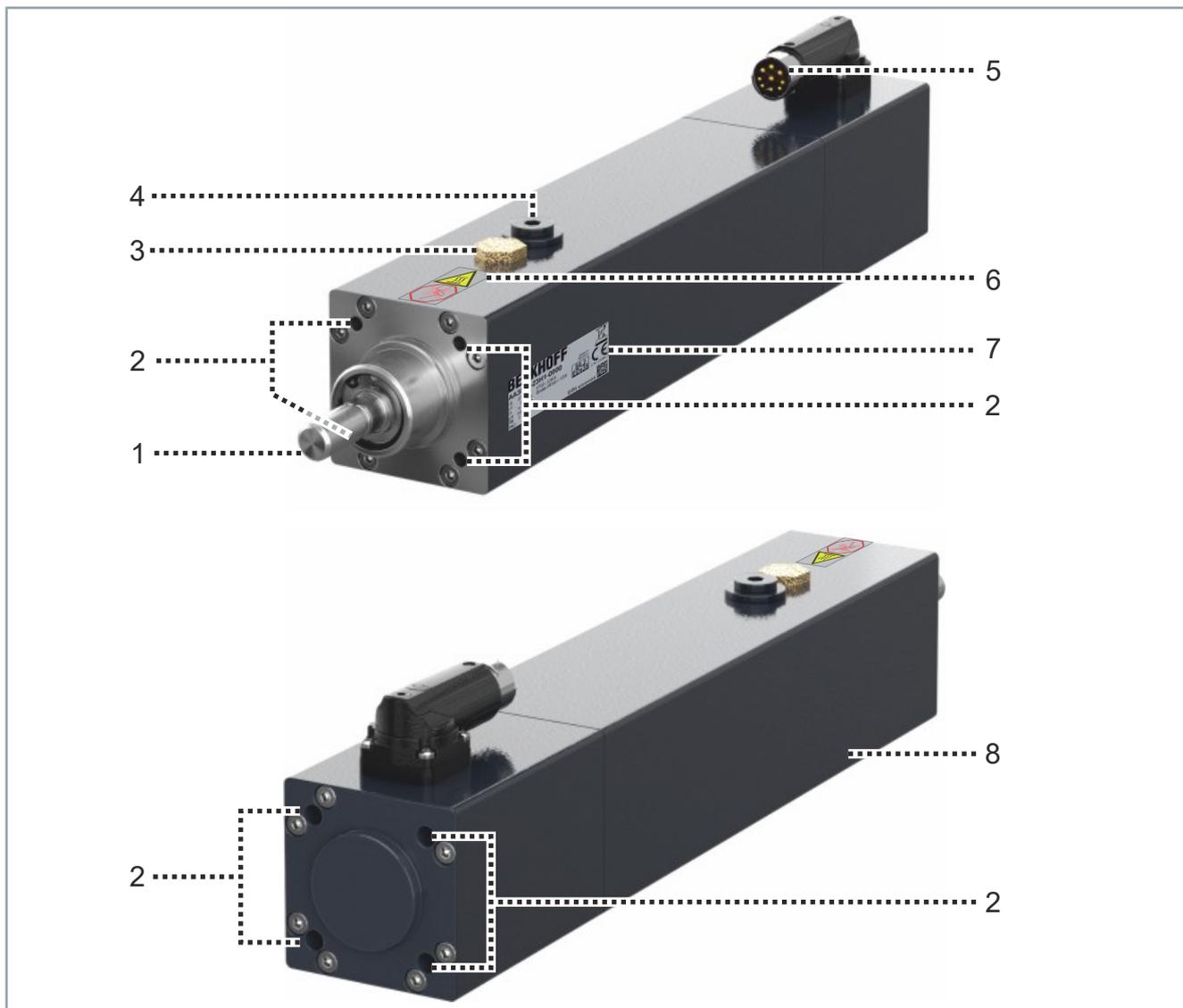
### **De-energize and switch off components before working on them**

Check the functionality of all safety-relevant devices. Secure the working environment. Secure the machine or plant against being inadvertently started up. Observe the chapter "Decommissioning", [Page 75].

### **No direct skin contact with solvents or lubricants**

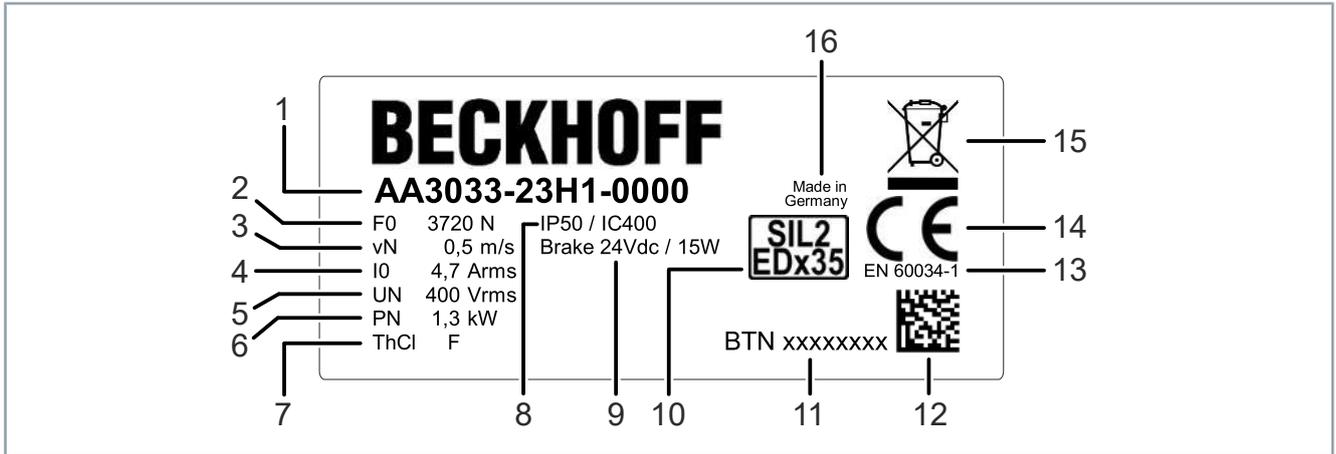
In case of improper use, the solvents or lubricants used can lead to skin irritations. Avoid direct skin contact.

### 3 Product overview



Item number	Explanation
1	Spindle end
2	Threaded holes for mounting
3	Bleeding
4	Screw plug lubrication
5	Power box
6	Safety pictograms
7	Identification plate
8	Housing

### 3.1 Name plate



Item number	Explanation
1	Product number
2	Continuous force
3	Nominal velocity
4	Standstill current
5	Nominal voltage
6	Nominal output
7	Insulation class
8	Protection class
9	Brake type
10	Safety Integrity Level
11	Beckhoff Traceability Number (BTN)
12	DataMatrix code
13	Additional information standard
14	CE conformity
15	WEEE compliance
16	Country of manufacture

## 3.2 Type key

AA3tuv-wxyz-0000	Explanation
AA3	Product area • Electric cylinder
t	Series electric cylinders • 0 = standard
u	Flange size • 2 = 58 mm • 3 = 75 mm • 5 = 110 mm
v	Overall length • 3 = standard
w	Lead and integrated anti-twist protection • 1 = lead 5 mm without integrated anti-twist protection • 2 = lead 5 mm with integrated anti-twist protection • 3 = lead 10 mm without integrated anti-twist protection • 4 = lead 10 mm with integrated anti-twist protection • 5 = lead 20 mm without integrated anti-twist protection • 6 = lead 20 mm with integrated anti-twist protection
x	Hub • 2 = 150 mm • 3 = 200 mm • 4 = 250 mm
y	Feedback system • H = OCT, 24 bit, SIL 2 capable, multi-turn absolute encoder
z	Holding brake • 0 = without holding brake • 1 = 24 V DC holding brake
0000	Versions • 0000 = standard • 1xxx = special version

### 3.3 Product characteristics

Ball screw	The installed ball screw is designed for high axial forces, precise positioning and long service life. The direct-drive ball screw nut is bolted to the rotor of the motor and, in interaction with the threaded spindle, translates the rotation of the motor into a linear motion.
Integrated anti-twist protection [+]	The optional, integrated anti-twist protection supports the rotational torque acting on the threaded spindle and thus ensures that the rotational movement of the rotor is converted into a linear movement of the threaded spindle.
Neodymium permanent magnets	The magnets installed in the motor are permanent magnets. Neodymium is a hard magnetic material that enables the precise and highly dynamic positioning of the motors.
Three-phase stator winding	The three-phase winding in the stator reduces the amount of material required while maintaining the same electrical output. All phase angles are 120°.
Temperature monitoring	A temperature sensor LPTC-600 is installed to monitor and measure the winding temperature and to protect the electric cylinder against overheating. This can be read out by the user.
OCT	OCT (One Cable Technology) saves the encoder cable by transmitting the encoder signals digitally to the servo drive via the existing motor cable.
Electronic identification plate	The electronic identification plate contains all specific data of the drive and can be read directly from the Beckhoff drive system for automatic parameterization.
ISO 15552 compatible	The dimensions and mounting points of the AA3000 electric cylinder are designed to be compatible with the standard ISO 15552 cylinders for pneumatic cylinders. This design makes it particularly easy to retrofit an existing application.
Holding brake [+]	The optional permanent magnet holding brake operates according to the quiescent current principle and opens at a voltage of 24 V DC +6/-10% with > 10,000,000 switching cycles. It is not suitable for service braking, as there is no monitoring for wear and functionality by the servo drive and the configuration. This applies in particular to vertical axes.

#### NOTICE

##### **Safety measures for vertical axes must be applied**

When operating vertical axes, appropriate additional measures must be taken; for example, including but not limited to:

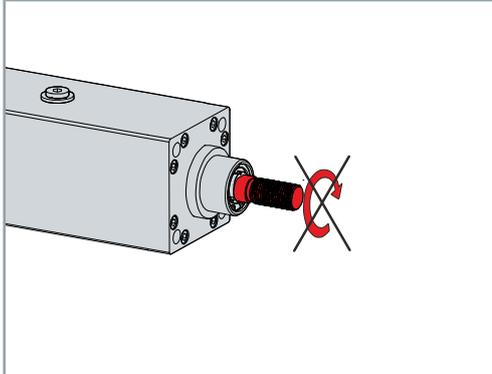
- Additional redundant brake units
- Mechanical safeguards or interlocks
- Attachment of a weight counterbalance

Permanent magnet holding brakes alone are not approved for the protection of persons. In line with ISO 13849-1 and ISO 13849-2, additional precautions must be taken for personal protection.

## 3.4 Ordering options

Ordering options are defined via the type key and must be ordered separately. It is not possible to fit one at a later date.

### 3.4.1 Integrated anti-twist protection [+]



The integrated anti-twist protection assures the translatory movement of the spindle. It facilitates assembly and enables the use of compensating elements, as no external anti-twist protection is required via the application.

The integrated anti-twist protection ensures that torques are not transmitted to the application. The load on the guide systems is lower.

#### NOTICE

##### Provide anti-twist protection

Anti-twist protection is always mandatory to assure the translatory movement of the spindle.

- Electric cylinders without an integrated anti-twist protection must always be supplemented by an external anti-twist protection.
- Implement the external anti-twist protection constructively in the application.

#### NOTICE

##### Unsecured end positions

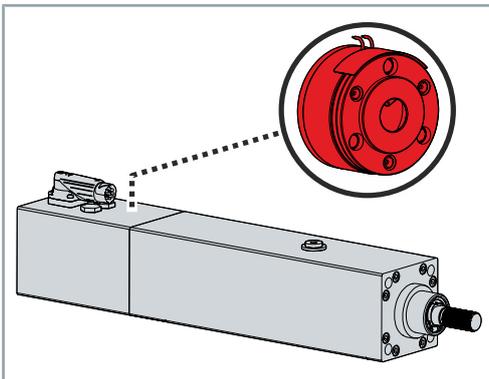
Moving the electric cylinder without secured end positions leads to a defect in the product if the end positions of the spindle are exceeded. Electric cylinders without integrated anti-twist protection [+] do not have a factory-set end position safety device.

- Provide for external end positions or stay within the stroke of the spindle.
- Perform homing and use the NC end positions to prevent possible damage to the spindle drive.
- Read the chapter "Commissioning", [Page 61] before executing homing.

**NOTICE****Save end positions during homing**

Moving the electric cylinder without secured end positions leads to a defect in the product if the end positions of the spindle are exceeded.

- Make sure that the electric cylinder does not exceed the end positions during homing.
- Read the chapter "Commissioning", [Page 61] before executing homing.

**3.4.2 Holding brake [+]**

A holding brake blocks the rotor and the spindle nut in the de-energized state. If the integrated anti-twist protection [+] option has been ordered or an external anti-twist device is available, the entire spindle drive is blocked. The holding brake increases the motor moment of inertia.

If no anti-twist protection is installed – either as an option or as an external attachment – the spindle can be extended or retracted by manual rotation if the holding brake blocks the rotor. This means that the encoder cannot detect the current spindle position and homing must be performed before restarting.

Further information can be found in chapter "Commissioning", [Page 57].

## 3.5 Intended use

The electric cylinder may only be operated for the purposes as defined in this documentation and under the specified ambient conditions.

The components are installed in electrical plants or machines. Stand-alone operation of the components is not permitted.

The operating temperature of the electric cylinder must be monitored by regular evaluation of the built-in temperature sensor.



### **Read the entire drive system documentation:**

- This translation of the original instructions
- When using AX5000:  
Translation of the original instructions of AX5000 servo drive
- When using AX8000:  
Translation of the original instructions of the AX8000 multi-axis servo system
- Machine manufacturer's complete documentation for the machine

## 3.6 Improper use

Any type of use that exceeds the permissible values from the technical data is regarded as inappropriate and is thus prohibited.



### **Non-approved areas of application**

The electric cylinders from the AA3000 series are not suitable for use in the following areas:

- Hazardous areas
- Areas with aggressive environments, for example aggressive gases or chemicals
- Areas with ionizing radiation and nuclear plants
- Aerospace industry
- Operation directly in the supply network without servo drive

## 4 Technical data



### Characteristic torque and speed curves

Detailed information on characteristic curves can be found under:  
[TE5910 | TwinCAT 3 Motion Designer](#)

### 4.1 Definitions and technical terms

This chapter provides information on various technical terms and their meaning.



#### Consider validity framework

All data, with the exception of the voltage constant, are based on 40°C ambient temperature and 100 K overtemperature of the winding. The data can have a tolerance of ±10%.

Stroke [mm]

Maximum possible travel of the spindle.

Peak force  $F_{\max}$  [N]

Maximum force delivered by the electric cylinder when operated with peak current.

### NOTICE

#### Thermal overload due to peak current

It is imperative that you adhere to the specified peak force, as it may be mechanically determined. Avoid thermal overload by

- periodically read the winding temperature.
- if necessary, allow for breaks to cool down.

Peak current  $I_{\max}$  [ $A_{\text{RMS}}$ ]

Sinusoidal peak current RMS value. The configured peak current of the servo drive used must be less or equal.

Continuous force  $F_0$  [N]

Force that the electric cylinder can apply at standstill. It can be maintained indefinitely at a velocity  $v < 0.05$  m/s and nominal environmental conditions.

Continuous current  $I_0$  [ $A_{\text{RMS}}$ ]

Sinusoidal current RMS value. This is taken up at a velocity of  $v < 0.05$  m/s in order to deliver the continuous force.

Peak velocity  $v_{\max}$  [m/s]

Maximum velocity that the electric cylinder can deliver. The value may be mechanically caused and must therefore be adhered to.

Nominal force  $F_n$  [N]

Force delivered by the electric cylinder when operated at nominal velocity and nominal current. Can be delivered indefinitely in continuous operation S1 and depends on the external load applied.

Force constant  $k_F$  [ $N/A_{\text{RMS}}$ ]

Indication of how much force the motor generates per ampere with the standstill current. The following applies:  $F_0 = I_0 \times k_F$ .

# Technical data

---

Voltage constant $k_E$ [mV <sub>RMS</sub> /min <sup>-1</sup> ]	Indication of the induced motor EMF at 20°C, based on 1000 rpm. This is specified as the sine RMS value between two terminals.
Moment of inertia J [kgcm <sup>2</sup> ]	Measure of the acceleration capacity of the electric cylinder.
Release delay time of brake $t_{brh}$ [ms]	Specification of the response time of the holding brake [+] when operated with the nominal voltage.
Winding inductance L [mH]	Indication of the motor inductance. It is the mean value for one motor revolution, with two energized phases, at 1 kHz. Saturation of the electric cylinder must be taken into account.
Lead p [mm]	Lead of the spindle used. One revolution corresponds to a linear movement that amounts to the length of the lead.
Mechanical efficiency $\eta$ [%]	Summary of all mechanical losses in the electric cylinder. This can be higher under certain circumstances and is variable to a small extent over the useful life.
Dynamic load rating $C_{dvn}$ [kN]	The axial force that a ball screw can theoretically support with a nominal service life of 10 <sup>6</sup> revolutions.
Heat input Q [W]	Proportion of the maximum power loss that is dissipated via the connection surface.
Temperature flange surface u [°C]	Maximum temperature of the flange surface when heat input Q is applied.
Warning temperature $t_w$ [°C]	Maximum permissible temperature of the stator winding [Motor warning temperature]. When this threshold is exceeded, the software issues a temperature warning.
Switch-off temperature $t_s$ [°C]	Critical threshold of stator winding temperature [Motor shut down temperature]. When this threshold is exceeded, the software switches off the electric cylinder.

## 4.2 Data for operation and environment

Beckhoff products are designed for operation under certain environmental conditions, which vary according to the product. The following specifications must be observed for operation and environment in order to achieve the optimum service life of the products.



### **Operate the electric cylinders only under the specified environmental conditions**

Operate the electric cylinders only in accordance with the specifications for operation and the environment listed in this chapter. This ensures a long service life and proper operation.

*Temperatures above 40°C, encapsulated installation, wood dust or abrasive components in solutions can shorten the service life of the electric cylinder.*

## 4.2.1 General housing properties

Property	
Surface coating	acrylic powder-coated
Hue	Anthracite gray; RAL7016
Protection rating in standard version	IP50 excluding the spindle drive
Protection rating in version with pneumatic fitting and vent hose	IP54 excluding the spindle drive

Further information can be found in the

- "Dimensional drawing AA3023", [Page 31]
- "Dimensional drawing AA3033", [Page 34]
- "Dimensional drawing AA3053", [Page 37].

## 4.2.2 Environmental conditions

Environmental requirements	
Climate category – operation	2K3 according to EN 60721
Ambient temperature during operation	+5°C to +40°C, extended temperature range
Ambient temperature during transport	-25°C to +70°C, maximum fluctuation 20 K/hour
Ambient temperature during storage	-25°C to +55°C, maximum fluctuation 20 K/hour
Power derating	No power derating for installation altitudes of 1000 m above sea level with temperature reduction of 10 K/1000 m.
Permissible humidity in operation	95% relative humidity, no condensation
Permissible humidity during transport and storage	5% to 95% relative humidity, no condensation
“Derating” power reduction [%] at installation altitudes above 1000 m and 40°C	
2000 m above sea level	6
3000 m above sea level	17
4000 m above sea level	30
5000 m above sea level	55

## 4.2.3 Specifications for intended use

Specifications for intended use	
Cooling	Convection
Insulation material class	F according to IEC 60085, UL1446 class F
Feedback system	Multi-turn absolute encoder OCT
Approvals	CE*

\*Further information can be found in chapter "Guidelines and Standards", [Page 77].

## 4.2.4 Switching thresholds for temperature shutdown

Winding temperature in intended use	
Warning temperature	120°C
Switch-off temperature	140°C

The temperature evaluation is executed via the encoder by converting the resistance value into a temperature and making it available to the downstream electronics. This temperature is referenced for the switching thresholds.

## 4.2.5 Power derating

Power derating may be necessary at high ambient temperature or when operating at a great height above sea level. Continuous forces are affected by the reduction.

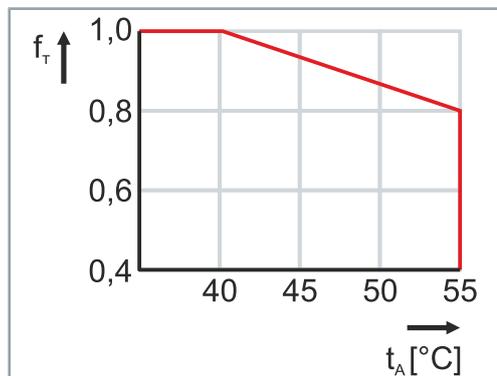


Illustration: Power data when exceeding the specified temperature limit

### Ambient temperature

$f_T$  = Temperature utilization factor

$t_A$  = Ambient temperature in °C

Calculation of the power data when exceeding the specified temperature limit > 40°C:

$$F_{CA\_red} = F_C \times f_T$$

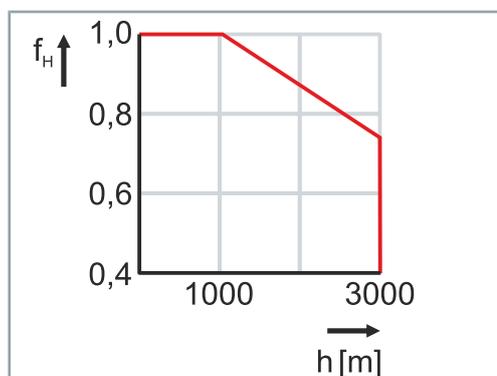


Illustration: Power data when exceeding the specified installation altitude

### Installation altitude

$f_H$  = Altitude utilization factor

$h$  = Altitude in meters

Calculation of the performance data if the specified installation altitude is exceeded > 1000 m above sea level:

$$F_{CA\_red} = F_C \times f_H$$

Calculation of the power reduction

### Ambient temperature and installation altitude

Calculation of the power data when exceeding the specified limits:

Ambient temperature > 40°C and installation altitude > 1000 m above sea level:

$$F_{CA\_red} = F_C \times f_T \times f_H$$

## 4.3 Size AA3023

## Electrical data

AA3023	-12yz	-22yz	-32yz	-42yz
Maximum nominal supply voltage $U_n$ [V AC]	480	480	480	480
Peak current $I_{max}$ [A]	8.8	8.8	8.8	8.8
Continuous current $I_0$ [A]	2.0	2.0	2.0	2.0
Nominal output $P_n$ [kW]	0.6	0.6	0.6	0.6
Force constant $K_f$ [N/A]	710	710	355	355
Voltage constant $kE$ [ $V_{rms}/k_{min}^{-1}$ ] ph-ph (20°C)	55	55	55	55
Winding resistance $R_{20}$ [ $\Omega$ ] ph-ph	14.5	14.5	14.5	14.5
Winding inductance $L$ [mH], ph-ph at 1 kHz	34.6	34.6	34.6	34.6

## Mechanical data

AA3023	-12yz	-22yz	-32yz	-42yz
Peak force $F_{max}$ [N]	6250	6250	3125	3125
Continuous force $F_0$ [N]	1407	1407	704	704
Maximum acceleration $a_{max}$ [ $m/s^2$ ]	10	10	20	20
Maximum velocity $v_{max}$ [m/s]	0.5	0.5	1	1
Overall length [mm]	310	310	310	310
Maximum travel, stroke [mm]	150	150	150	150
Dynamic load rating $C_{dyn}$ [kN]	14	14	9	9
Static load rating $C$ [kN]	31	31	19	19
Lead $p$ [mm]	5	5	10	10
integrated anti-twist protection	–	yes	–	yes
Spindle diameter [mm]	15	15	15	15
Positioning clearance [mm]	$\pm 0.015$	$\pm 0.015$	$\pm 0.015$	$\pm 0.015$
Positioning with backlash [mm]	–	$\pm 0.020$	–	$\pm 0.030$
Rotor moment of inertia $J$ [ $kgcm^2$ ]	1.5	1.5	1.5	1.5
Rotor moment of inertia with holding brake [+] $J_{br}$ [ $kgcm^2$ ]	1.7	1.7	1.7	1.7
Weight $m$ [kg]	3.8	3.8	3.8	3.8
Weight with holding brake [+] $m_{br}$ [kg]	4.0	4.0	4.0	4.0

## Compatibility with ISO 15552 for pneumatic cylinders

AA3023	-12yz	-22yz	-32yz	-42yz
corresponds to pneumatic cylinder size with piston diameter [mm]	$\varnothing 40$	$\varnothing 40$	$\varnothing 40$	$\varnothing 40$
Dimensions flange [mm]	58 x 58	58 x 58	58 x 58	58 x 58
Drilling pattern threaded holes for mounting [mm]	38 x 38	38 x 38	38 x 38	38 x 38
Thread dimension spindle end	M12 x 1.25	M12 x 1.25	M12 x 1.25	M12 x 1.25

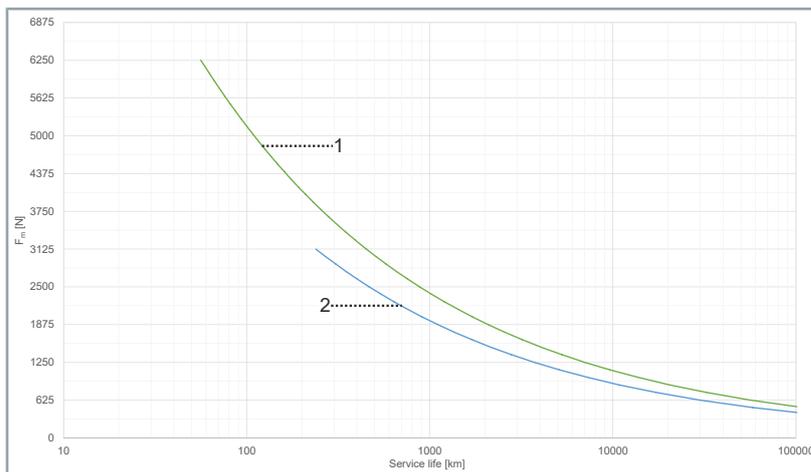
## Holding brake performance data [+]

AA3023	-12yz	-22yz	-32yz	-42yz
Holding force at 120°C $F_{br120}$ [N]	1508	1508	754	754
Supply voltage $U_{br}$ [V DC]	24	24	24	24
Electrical power $P_{br}$ [W]	12	12	12	12
Current at 20°C $I_{on}$ [A]	0.5	0.5	0.5	0.5
Current at 120°C $I_{on}$ [A]	0.36	0.36	0.36	0.36
Release delay time $t_{brh}$ [ms]	50	50	50	50
Application delay time $t_{brl}$ [ms]	20	20	20	20

### 4.3.1 Service life AA3023

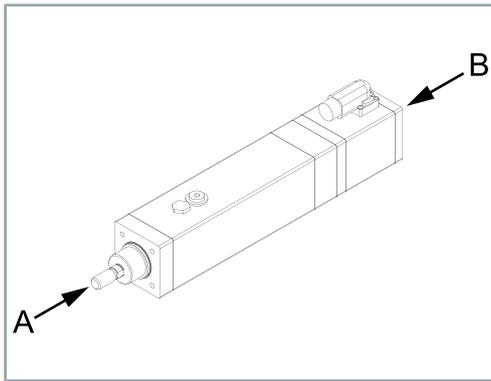
The following diagram shows the expected service life of the ball screw and ball bearings in relation to the equivalent dynamic load.

The values apply in compliance with the permissible maintenance intervals, the ideal conditions and the permitted radial forces at the spindle end. For more information, see the chapters "Maintenance intervals", [Page 65] and "Spindle end", [Page 46].



Curve	Electric cylinder	Lead p [mm]
1	AA3023-w2Hz-0000	5
2	AA3023-w2Hz-0000	10

### 4.3.2 Dimensional drawing AA3023



All figures in millimeters

Illustration: Perspective view

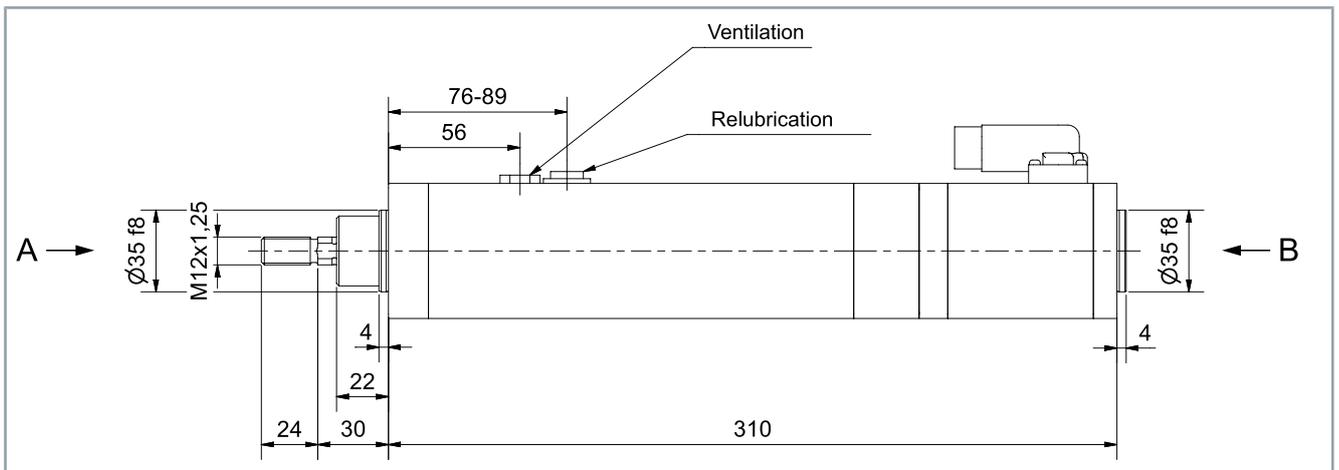


Illustration: Front view

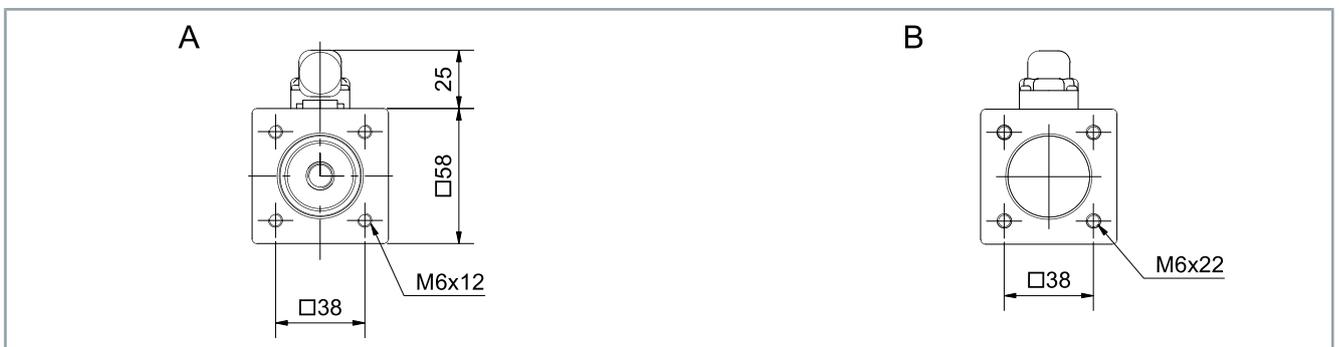


Illustration: Side view A and B to show flange dimensions

## 4.4 Size AA3033

### Electrical data

AA3033	-13yz	-23yz	-33yz	-43yz
Maximum nominal supply voltage $U_n$ [V AC]	480	480	480	480
Peak current $I_{max}$ [A]	15.0	15.0	15.0	15.0
Continuous current $I_0$ [A]	4.7	4.7	4.7	4.7
Nominal output $P_n$ [kW]	1.3	1.3	1.3	1.3
Force constant $K_f$ [N/A]	789	789	395	395
Voltage constant $kE$ [ $V_{rms}/k_{min}^{-1}$ ] ph-ph (20°C)	57	57	57	57
Winding resistance $R_{20}$ [ $\Omega$ ] ph-ph	3.9	3.9	3.9	3.9
Winding inductance $L$ [mH] ph-ph, at 1 kHz	14.0	14.0	14.0	14.0

### Mechanical data

AA3033	-13yz	-23yz	-33yz	-43yz
Peak force $F_{max}$ [N]	12500	12500	6250	6250
Continuous force $F_0$ [N]	3720	3720	1860	1860
Maximum acceleration $a_{max}$ [ $m/s^2$ ]	10	10	20	20
Maximum velocity $v_{max}$ [m/s]	0.5	0.5	1.0	1.0
Overall length [mm]	380	380	380	380
Maximum travel, stroke [mm]	200	200	200	200
Dynamic load rating $C_{dyn}$ [kN]	21	21	11	11
Static load rating $C$ [kN]	54	54	26	26
Lead $p$ [mm]	5	5	10	10
integrated anti-twist protection	–	yes	–	yes
Spindle diameter [mm]	20	20	20	20
Positioning clearance [mm]	$\pm 0.015$	$\pm 0.015$	$\pm 0.015$	$\pm 0.015$
Positioning with backlash [mm]	–	$\pm 0.020$	–	$\pm 0.030$
Rotor moment of inertia $J$ [ $kgcm^2$ ]	4.6	4.6	4.6	4.6
Rotor moment of inertia with holding brake [+] $J_{br}$ [ $kgcm^2$ ]	5.2	5.2	5.2	5.2
Weight [kg]	7.2	7.2	7.2	7.2
Weight with holding brake [+] $m_{br}$ [kg]	7.5	7.5	7.5	7.5

### Compatibility with ISO 15552 for pneumatic cylinders

AA3033	-13yz	-23yz	-33yz	-43yz
corresponds to pneumatic cylinder size with piston diameter [mm]	$\varnothing 63$	$\varnothing 63$	$\varnothing 63$	$\varnothing 63$
Dimensions flange [mm]	75 x 75	75 x 75	75 x 75	75 x 75
Drilling pattern threaded holes for mounting [mm]	56.5 x 56.5	56.5 x 56.5	56.5 x 56.5	56.5 x 56.5
Thread dimension spindle end	M16 x 1.5	M16 x 1.5	M16 x 1.5	M16 x 1.5

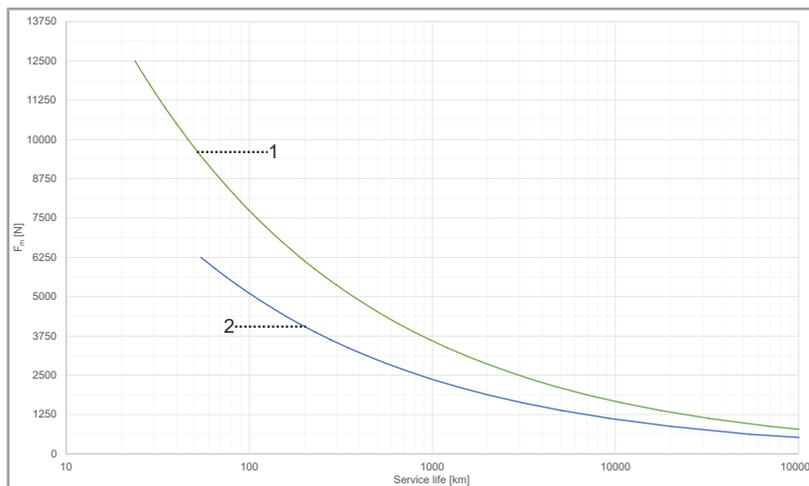
**Holding brake performance data [+]**

<b>AA3033</b>	<b>-13yz</b>	<b>-23yz</b>	<b>-33yz</b>	<b>-43yz</b>
Holding force at 120°C $F_{br120}$ [N]	4046	4046	2023	2023
Supply voltage $U_{br}$ [V DC]	24	24	24	24
Electrical power $P_{br}$ [W]	15	15	15	15
Current at 20°C $I_{on}$ [A]	0.63	0.63	0.63	0.63
Current at 120°C $I_{on}$ [A]	0.45	0.45	0.45	0.45
Release delay time $t_{brh}$ [ms]	70	70	70	70
Application delay time $t_{brl}$ [ms]	30	30	30	30

**4.4.1 Service life AA3033**

The following diagram shows the expected service life of the ball screw and ball bearings in relation to the equivalent dynamic load.

The values apply in compliance with the permissible maintenance intervals, the ideal conditions and the permitted radial forces at the spindle end. For more information, see the chapters "Maintenance intervals", [Page 65] and "Spindle end", [Page 46].



<b>Curve</b>	<b>Electric cylinder</b>	<b>Lead p [mm]</b>
1	AA3033-w3Hz-0000	5
2	AA3033-w3Hz-0000	10



## 4.5 Size AA3053

## Electrical data

AA3053	-14yz	-34yz	-44yz	-54yz	-64yz
Maximum nominal supply voltage $U_n$ [V AC]	480	480	480	480	480
Peak current $I_{max}$ [A]	18.4	36.8	36.8	36.8	36.8
Continuous current $I_0$ [A]	7.4	7.4	7.4	7.4	7.4
Nominal output $P_n$ [kW]	2.6	2.6	2.6	2.6	2.6
Force constant $K_f$ [N/A]	1689	844	844	422	422
Voltage constant $kE$ [ $V_{rms}/k_{min}^{-1}$ ] ph-ph (20°C)	115	115	115	115	115
Winding resistance $R_{20}$ [ $\Omega$ ] ph-ph	2.45	2.45	2.45	2.45	2.45
Winding inductance $L$ [mH] ph-ph, at 1 kHz	11.1	11.1	11.1	11.1	11.1

## Mechanical data

AA3053	-14yz	-34yz	-44yz	-54yz	-64yz
Peak force $F_{max}$ [N]	25000	25000	25000	12500	12500
Continuous force $F_0$ [N]	12466	6233	6233	3166	3166
Maximum acceleration $a_{max}$ [ $m/s^2$ ]	10	20	20	40	40
Maximum velocity $v_{max}$ [m/s]	0.25	0.5	0.5	1.0	1.0
Overall length [mm]	475	475	475	475	475
Maximum travel, stroke [mm]	250	250	250	250	250
Dynamic load rating $C_{dyn}$ [kN]	33	55	55	23	23
Static load rating $C$ [kN]	120	141	141	52	52
Lead $p$ [mm]	5	10	10	20	20
integrated anti-twist protection	–	–	yes	–	yes
Spindle diameter [mm]	32	32	32	32	32
Positioning clearance [mm]	$\pm 0.020$	$\pm 0.015$	$\pm 0.015$	$\pm 0.015$	$\pm 0.015$
Positioning with backlash [mm]	–	–	$\pm 0.025$	–	$\pm 0.035$
Rotor moment of inertia $J$ [ $kgcm^2$ ]	26.4	26.4	26.4	26.4	26.4
Rotor moment of inertia with holding brake [+] $J_{br}$ [ $kgcm^2$ ]	29.7	29.7	29.7	29.7	29.7
Weight [kg]	20.0	20.0	20.0	20.0	20.0
Weight with holding brake [+] $m_{br}$ [kg]	21.0	21.0	21.0	21.0	21.0

## Compatibility with ISO 15552 for pneumatic cylinders

AA3053	-14yz	-34yz	-44yz	-54yz	-64yz
corresponds to pneumatic cylinder size with piston diameter [mm]	$\varnothing 100$				
Dimensions flange [mm]	110 x 110				
Drilling pattern threaded holes for mounting [mm]	89 x 89				
Thread dimension spindle end	M20 x 1.5				

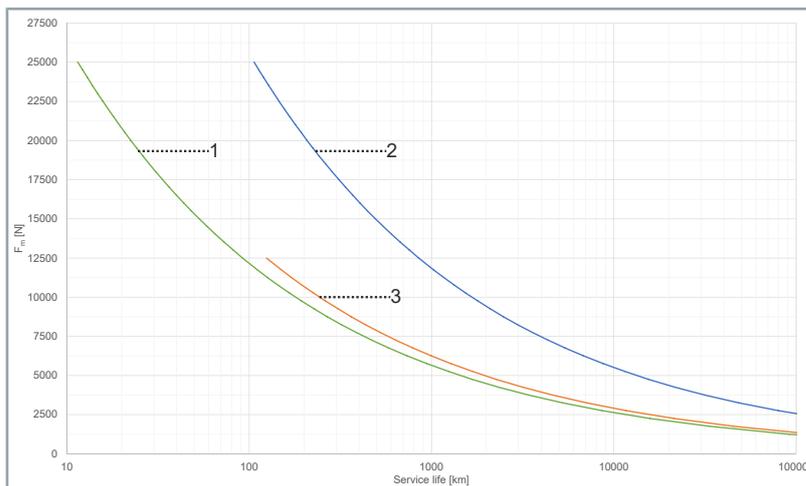
## Holding brake performance data [+]

AA3053	-14yz	-34yz	-44yz	-54yz	-64yz
Holding force at 120°C $F_{br120}$ [N]	16336	8168	8168	4084	4084
Supply voltage $U_{br}$ [V DC]	24	24	24	24	24
Electrical power $P_{br}$ [W]	24	24	24	24	24
Current at 20°C $I_{on}$ [A]	1.0	1.0	1.0	1.0	1.0
Current at 120°C $I_{on}$ [A]	0.71	0.71	0.71	0.71	0.71
Release delay time $t_{brh}$ [ms]	90	90	90	90	90
Application delay time $t_{brl}$ [ms]	30	30	30	30	30

### 4.5.1 Service life AA3053

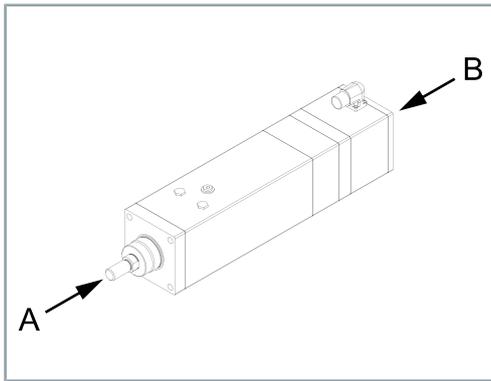
The following diagram shows the expected service life of the ball screw and ball bearings in relation to the equivalent dynamic load.

The values apply in compliance with the permissible maintenance intervals, the ideal conditions and the permitted radial forces at the spindle end. For more information, see the chapters "Maintenance intervals", [Page 65] and "Spindle end", [Page 46].



Curve	Electric cylinder	Lead p [mm]
1	AA3053-w4Hz-0000	5
2	AA3053-w4Hz-0000	10
3	AA3053-w4Hz-0000	20

### 4.5.2 Dimensional drawing AA3053



All figures in millimeters

Illustration: Perspective view

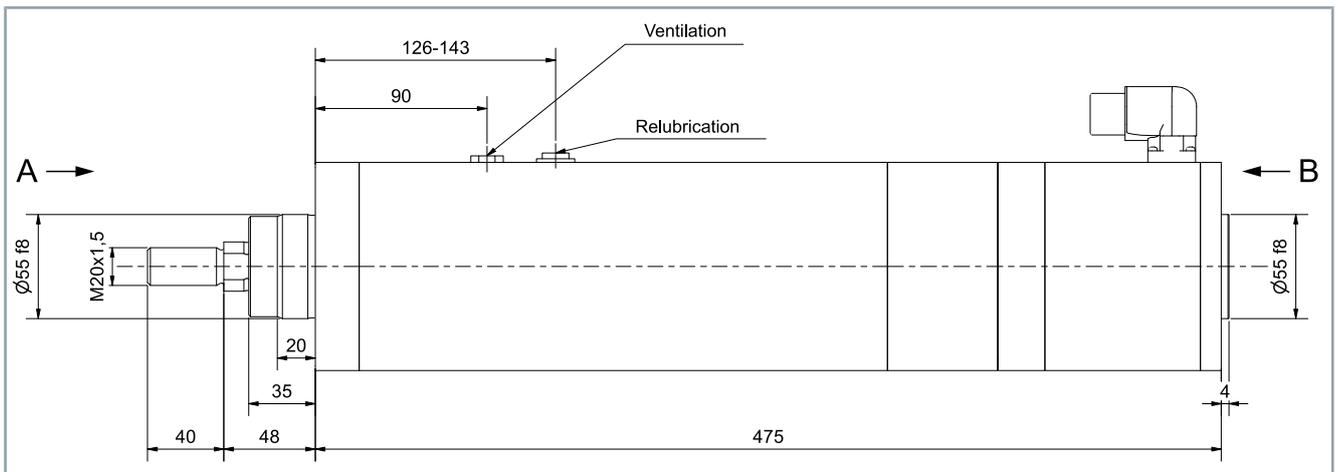


Illustration: Front view

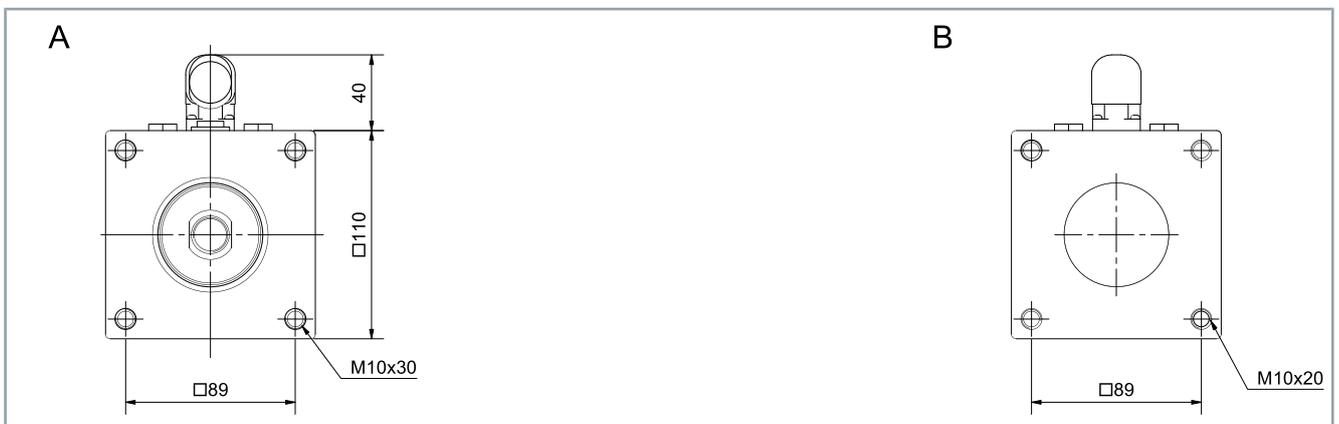


Illustration: Side view A and B to show flange dimensions

## 5 Scope of supply



### **Check the scope of supply for missing or damaged parts**

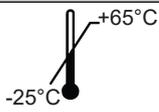
Check your delivery for completeness. If any parts are missing or became damaged during transport, contact the carrier, vendor or our service department immediately.

Check the shipment for the following contents:

- Electric cylinders from the AA3000 series
- Short information

### 5.1 Packaging

Instructions for handling are printed on the packaging:

Symbol	Explanation
	These are the permitted maximum and minimum temperatures at which the device may be stored and transported.
	This is the correct position for the packaging.
	Protect the packaging against wetness.
	The contents are fragile.

## 6 Transport and storage

### NOTICE

#### Damage to the electric cylinder and loss of warranty

Failure to observe the following sections on transport and storage may result in damage to the electric cylinder and invalidation of the warranty.

- Comply with the conditions for transport and storage.
- Note the sections below.

### 6.1 Conditions

During transport and storage, ensure that the electric cylinder and individual components are not damaged. Observe the following sections and comply with the specifications for operation and environment.

Further information can be found in chapter "Data for operation and environment", [Page 26].

#### Environmental conditions

	during transport	during storage
Climate category	2K3 according to EN 60721	
Ambient temperature	-25°C to +70°C, maximum fluctuation 20 K/hour	-25°C to +55°C, maximum fluctuation 20 K/hour
Air humidity	5% to 95% relative humidity, no condensation	

#### Transport conditions

- Use suitable means of transport.
- Transport and store only in horizontal position.
- Use the original manufacturer's packaging.
- Observe the maximum stacking height.

#### Maximum stacking height

The table shows the maximum stacking height at which you may store and transport the product in its original packaging on a pallet:

Size	Stacking height [pieces]
AA3023	2
AA3033	2
AA3053	1

## 6.2 Transport

### **⚠ WARNING**

#### **Serious to fatal accidents caused by suspended loads**

A falling electric cylinder can cause serious to fatal accidents.

- Use suitable means of transport
- Secure electric cylinder against falling down
- Do not move under suspended loads.

### **NOTICE**

#### **Damage to the electric cylinder**

Falling down and hard impacts will damage the electric cylinder.

- Avoid hard impacts on the electric cylinders.
- Use suitable means of transport
- Secure electric cylinder against falling down

### **NOTICE**

#### **Faults and damage to the electric cylinder**

If the electric cylinder is lifted on the shaft, this will cause faults and damage to the spindle drive.

- Use specified attachment points.
- Use suitable means of transport.
- Secure the electric cylinder against falling down.

### **NOTICE**

#### **Possible injuries and damage to the product**

Do not transport the electric cylinder with the spindle vertically downwards, as the spindle may come loose accidentally.

- Transport electric cylinder in horizontal position
- Transport electric cylinder size AA3053 with at least two eye-bolts.

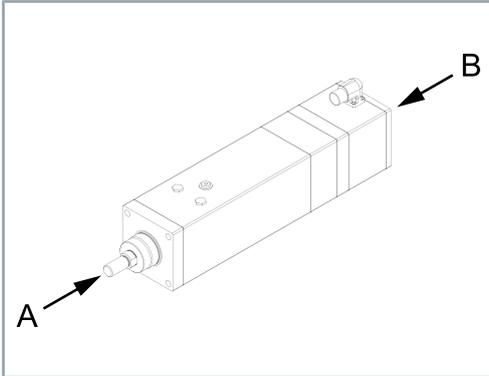


#### **Legal regulations for the lifting of loads**

When transporting electric cylinders, comply with the legal regulations on lifting loads for employees.

## Operating equipment for flange fastening

Size	AA3023	AA3033	AA3053
Hexagon socket head cap screw DIN EN ISO 4762–8.8	M6	M8	M10
A-flange screw depth [mm]	10	30	40
B-flange screw depth [mm]	20	25	25
Tightening torque [Nm]	10	24	50

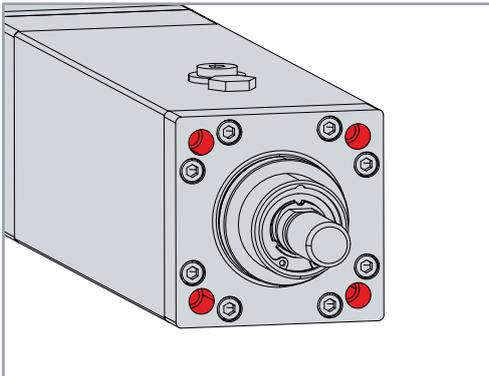


The mounting holes on the A-flange and B-flange are suitable for fastening eyebolts for transport.

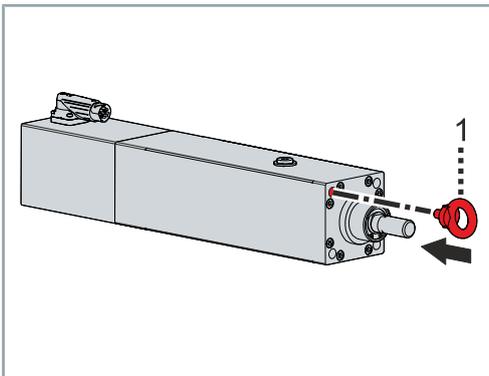
### 6.2.1 Transport AA3023 and AA3033

The AA3023 and AA3033 series can be transported without auxiliary means.

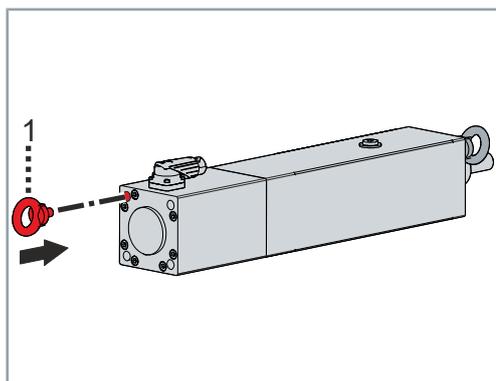
### 6.2.2 Transport AA3053



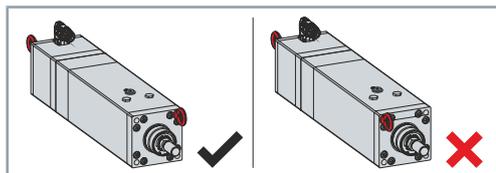
An AA3053 series electric cylinder can be transported with lifting equipment. The mounting holes on the flange side can be used as attachment points. Only use suitable and sufficiently dimensioned lifting equipment.



- Screw an eyebolt [1] into one of the four holes on the A-flange of the electric cylinder.



- ▶ Screw in an eyebolt [1] at an identical position in the drilling pattern of the B-flange.



The eyebolts are installed correctly.

- ▶ Attach suitable lifting equipment to eyebolts.
- ▶ Lift electric cylinder with suitable lifting gear.

### 6.3 Long-term storage

#### NOTICE

##### Damage to the product due to incorrect storage

Exceeding the specified maximum storage time can lead to changes in the properties of the lubricant used and damage the electric cylinder during subsequent operation. Damage to the electric cylinder or maintenance work not carried out will affect the service life of the installed components and parts. Condensation water can lead to damage during subsequent operation or to rust formation.

- Store product for a maximum of two years
- Check that the product is in proper working condition every 6 months
- Keep the ambient temperature constant
- Avoid solar radiation
- Avoid high air humidity

You have the option of storing the electric cylinder for a short or longer period of time. We recommend that the original packaging be used for storage. Comply with the conditions for transport and storage. For more information, see chapter "Transportation and storage", [Page 39].

In the original packaging, the electric cylinder is protected against chemical and aggressive substances within the scope of classes 1C2 (chemical substances) and 1B2 (biological conditions).

Ensure the storage space is vibration-free.

## 7 Technical description

### 7.1 Installation position

#### NOTICE

##### Damage to the electric cylinder due to ingress of liquids

In the vertical installation position IM V3, liquids or foreign bodies can enter the electric cylinder via the spindle drive.

- Keep the flange area of the electric cylinder free of liquids or foreign bodies
- Protect the spindle drive from contamination and liquid ingress by using additional attachments such as bellows or design measures.

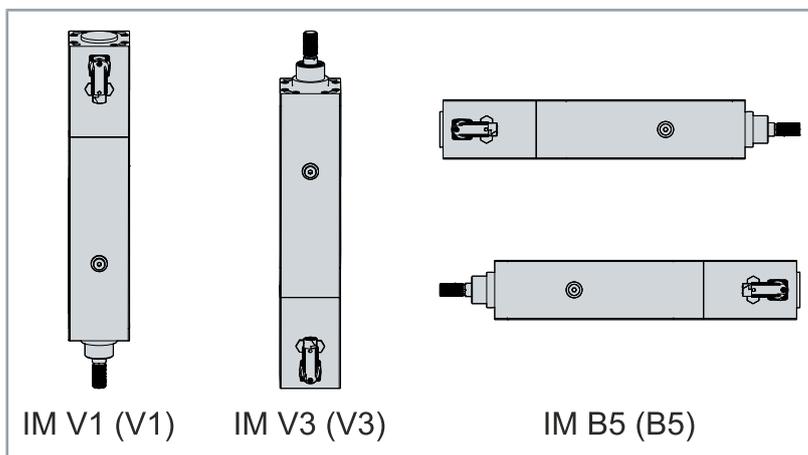
#### NOTICE

##### Damage to the electric cylinder due to leakage of liquids and lubricants

In the vertical installation position IM V1, liquids or lubricants can escape from the electric cylinder via the spindle drive.

- Lubricate electric cylinder according to maintenance intervals. Further information can be found in chapter "Lubrication of the spindle drive", [Page 66].
- Protect the application from contamination by means of additional attachments (e.g. bellows) or design measures.

The standard installation position of the electric cylinders is the design IM B5 and IM V1 according to DIN EN 60034-7.



## NOTICE

### **Secure vertical axes additionally**

The ball screw has no self-locking feature and can therefore extend or retract accidentally when de-energized. Vertical axes must always be additionally secured.

- Read the chapter "Ordering options", [Page 22].
- Observe the note on the optional holding brake [+] in chapter "Product characteristics", [Page 21].

The built-in holding brake [+] is not suitable for service braking, as there is no monitoring for wear and functionality by the servo drive and the configuration. This applies in particular to vertical axes.

## NOTICE

### **Safety measures for vertical axes must be applied**

When operating vertical axes, appropriate additional measures must be taken; for example, including but not limited to:

- Additional redundant brake units
- Mechanical safeguards or interlocks
- Attachment of a weight counterbalance

Permanent magnet holding brakes alone are not approved for the protection of persons. In line with ISO 13849-1 and ISO 13849-2, additional precautions must be taken for personal protection.

## 7.2 Temperature sensor LPTC-600

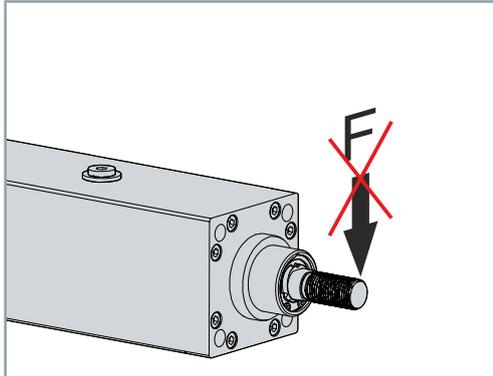
The temperature sensor LPTC-600 is installed in all electric cylinders of the AA3000 series.

The LPTC-600 is integrated in the monitoring system of the servo drive when using the pre-assembled power cable. Configure the servo drive according to the motor temperature warning at 120°C and the switch-off temperature at 140°C.

The following table shows the resistance values of the temperature sensor:

Temperature [°C]	T/°C [%/K]	LPTC-600 Resistance [Ω]			Temperature error [K]
		Minimum	Nominal value	Maximum	
-40	0.84	340	359	379	±6.48
-30	0.83	370	391	411	±6.36
-20	0.82	403	424	446	±6.26
-10	0.80	437	460	483	±6.16
0	0.79	474	498	522	±6.07
10	0.77	514	538	563	±5.98
20	0.75	555	581	607	±5.89
25	0.74	577	603	629	±5.84
30	0.73	599	626	652	±5.79
40	0.71	645	672	700	±5.69
50	0.70	694	722	750	±5.59
60	0.68	744	773	801	±5.47
70	0.66	797	826	855	±5.34
80	0.64	852	882	912	±5.21
90	0.63	910	940	970	±5.06
100	0.61	970	1000	1030	±4.90
110	0.60	1029	1062	1096	±5.31
120	0.58	1089	1127	1164	±5.73
130	0.57	1152	1194	1235	±6.17
140	0.55	1216	1262	1309	±6.63
150	0.54	1282	1334	1385	±7.10
160	0.53	1350	1407	1463	±7.59
170	0.52	1420	1482	1544	±8.10
180	0.51	1492	1560	1628	±8.62

## 7.3 Spindle end



The spindle end is used for force transmission via a backlash-free and frictional connection. This frictional connection is made via the external thread according to ISO 15552.

### Radial forces

Avoid radial forces on the spindle end. Make sure that the spindle drive is not strained in the application or subjected to high radial forces.

**NOTICE** High radial forces or tension in the application lead to asymmetrical loads in the spindle drive, which can greatly shorten the service life.

Commercially available connecting elements or coupling elements from pneumatics prevent the transmission of radial forces and can compensate for misalignments.

### Preferred backlash-free coupling elements

- Quick coupling with radial misalignment compensation
- Compensating coupling with five degrees of freedom, for transmission of axial forces

## 8 Mechanical installation

All work should be carried out with great care and without time pressure.

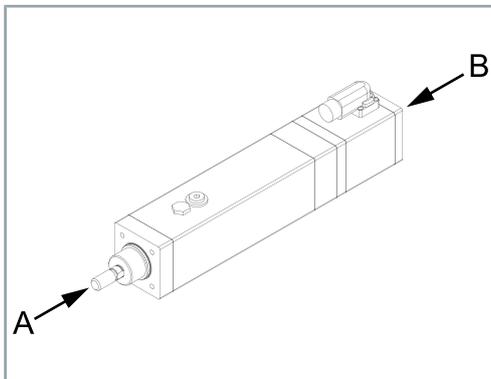
### NOTICE

#### Protect the electric cylinder from inadmissible load

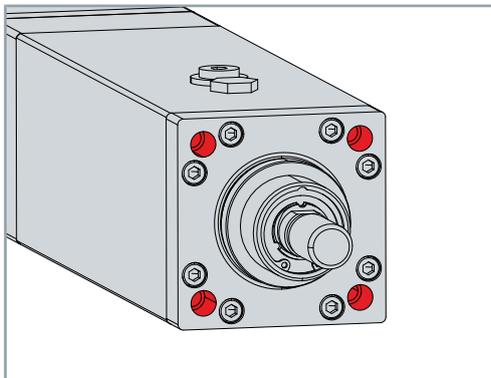
Do not bend any components during transport or handling. Furthermore, note vibration quality and vibration resistance. If necessary, provide additional support for the electric cylinder.

*Shocks, impacts, torques or radial forces acting on the spindle can directly damage the spindle drive or reduce the service life of the electric cylinder.*

### 8.1 Flange mounting



The electric cylinder can be mounted in the machine or system on the A-flange and/or on the B-flange.



For this purpose, the electric cylinder has four mounting holes per flange side to accommodate hexagon socket head cap screw. The dimensions of the screws to be used depends on the size.

The following table shows the screw size and the corresponding screw depths and tightening torques.

Size	AA3023	AA3033	AA3053
Hexagon socket head cap screw DIN EN ISO 4762–8.8	M6	M8	M10
A-flange screw depth [mm]	10	30	40
B-flange screw depth [mm]	20	25	25
Tightening torque [Nm]	10	24	50

## NOTICE

### Encoder signal fault

Insufficient or missing grounding of the electric cylinder can lead to interference of the encoder signals.

- ensure adequate grounding via the protective conductor
- ensure sufficient grounding via the mechanical connection of the electric cylinder to the application

## 8.2 Fastening the end of the spindle

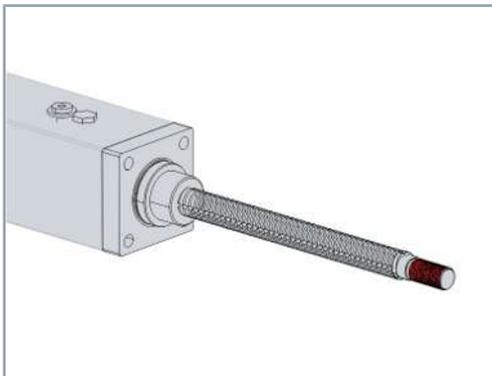
## NOTICE

### Damage to the mechanics of the electric cylinder

Transverse forces and torques can damage the ball screw and integrated anti-twist protection of the electric cylinder.

- Avoid transverse forces and torques during assembly
- In any case, use tools to hold the spindle in position, such as an open-end wrench.

Direct connection to the application



### Attachment of the application to the end of the spindle

The application can be connected to the electric cylinder via the external thread at the end of the spindle. The dimensions can be found in the table below.

The wrench flat is used exclusively for fixing the spindle to prevent unwanted torque being introduced into the spindle as a result of assembly.

Size	AA3023	AA3033	AA3053
External thread at spindle end	M12 x 1.25	M16 x 1.5	M20 x 1.5
available thread length [mm]	24	32	40
Width across flats	13	17	22

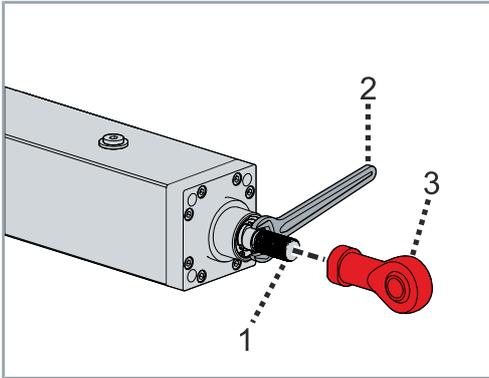
## Assembly of fasteners

The external thread of the spindle end is adapted to the common sizes of the pneumatic standard ISO15552. Commercially available accessories such as rod ends, compensating couplings or clevises can be mounted on the spindle end to connect the electric cylinder to the application.



### Mounting accessories on the spindle end

This example shows the mounting of a rod end on the spindle.



- Hold the spindle [1] with a suitable tool [2] at the wrench flat provided for this purpose while mounting the respective accessories [3].

## 9 Electrical installation

All work should be carried out with great care and without time pressure.

### 9.1 Power box

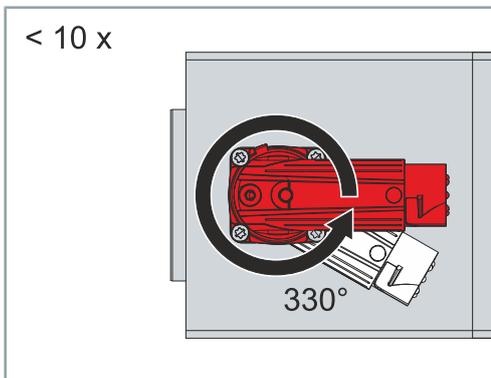
#### NOTICE

##### Wear and limited data transmission

The power box may be rotated up to ten times through 330° to bring it into a safe indexing position.

*If you turn the power box more than ten times, the cables inside and the latching mechanism of the power box may be damaged and the power box may no longer be moved to a safe indexing position.*

- The power box of the electric cylinder may be rotated a maximum of ten times through 330°.
- Only adjust the angle box with the plug connector plugged in.



The electric cylinder has OCT (One Cable Technology) and is connected to the power box with a motor cable. The power box combines the power supply and the feedback signals. It is designed as an angle box and can be rotated by 330°.

##### Design of the power box on the electric cylinder

The type of power box depends on the size or peak current of the electric cylinder.

Size	Power box
AA3023	rotatable angle box itec®
AA3033	rotatable angle box itec®
AA3053	rotatable angle box M23-speedtec®

### 9.1.1 Pin assignment itec® (OCT)

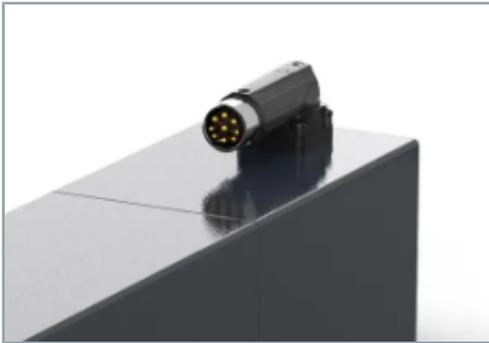


Illustration: rotatable angle box itec® (OCT)

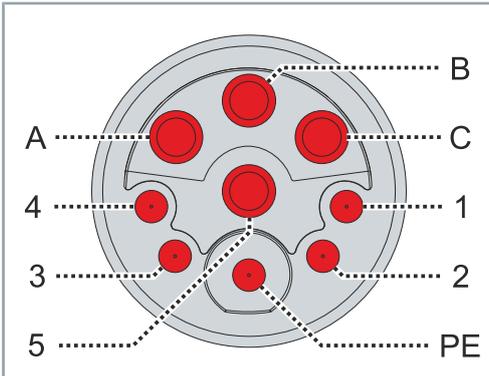


Illustration: Mating face power box itec® (OCT)

#### Pin assignment of the power box for itec® connector

Contact	Function	Core color/ Core identification
A	Motor phase U	black/1
B	Motor phase W	black/3
C	Motor phase V	black/2
1	Holding brake+	black/5
2	Holding brake-	black/6
3	Temperature+/OCT+	white
4	Temperature-/OCT-	blue
5	n.c.	n.c.
PE	PE	green-yellow

### 9.1.2 Pin assignment M23-speedtec® (OCT)



Illustration: rotatable angle box M23-speedtec® (OCT)

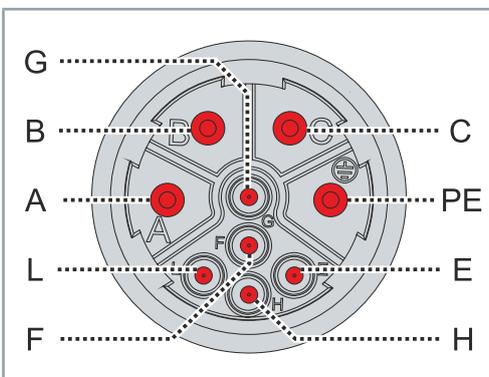


Illustration: Mating face power box M23-speedtec® (OCT)

#### Pin assignment of the power box for M23-speedtec® connector

Contact	Function	Core color/ Core identification
A	Motor phase U	black/1
B	Motor phase V	black/2
C	Motor phase W	black/3
D	PE	green-yellow
E	Temperature-/OCT-	blue
F	Shield	Shield
G	Brake+	black/5
H	Temperature+/OCT+	white
L	Brake-	black/6

## 9.2 Connect the motor cable

For simple and error-free installation of the electric cylinder, Beckhoff offers pre-assembled cables. These cables are tested with regard to the material used, shielding and connection type. Faultless function and compliance with technical standards are guaranteed. Using other cables can cause unexpected faults and render the warranty invalid.

### **NOTICE**

#### **Faulty contacting impairs function**

A faulty connection between the power box and connector can lead to a malfunction in the drive. The transmission of the encoder signals may be disturbed.

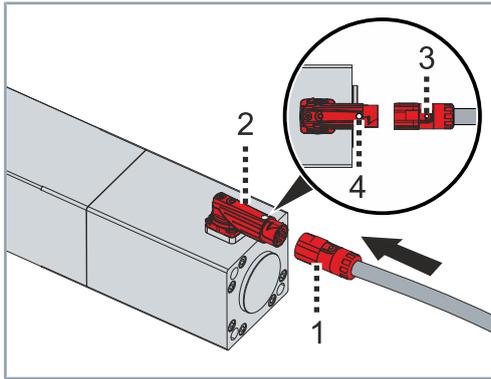
- Keep the pins and the inside of the component free of dirt.
- Carefully connect the plug
- Check connector for damage and replace if necessary



#### **Trouble-free application and assembly**

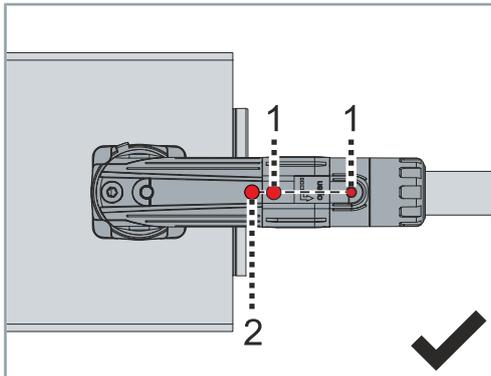
- Wire in accordance with the applicable regulations and standards.
- Use pre-assembled and shielded cables according to the servo drive used.

## 9.2.1 Establish the itec® plug connection



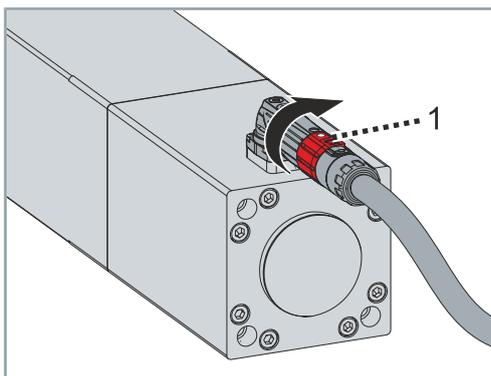
- ▶ Push the itec® connector [1] of the motor cable straight onto the power box [2] of the electric cylinder.
- ▶ Make sure that the marking point of the motor cable [3] and the marking point of the power box [4] are opposite each other.

The bayonet lock on the connector automatically twists when pushed onto the power box. When the end position is reached, the connector engages by the rotational movement and is locked.



- ▶ Check that the marking points on the motor cable connector [1] and the marking point on the power box [2] are opposite each other.

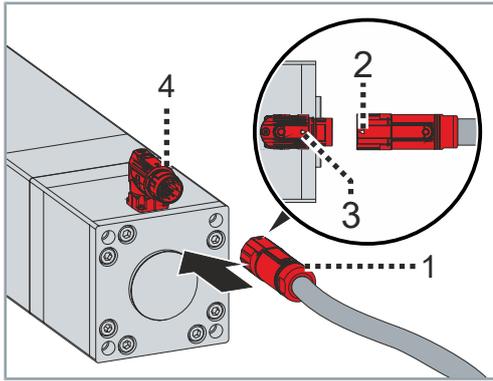
The plug connection between the motor cable and the power box has been made correctly.



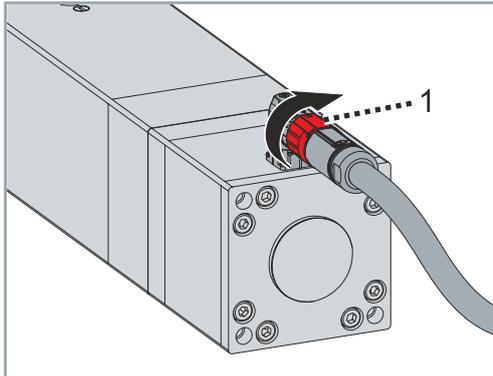
**If the itec® connector does not automatically lock into place on the power box during the rotational movement:**

- ▶ Turn the bayonet lock [1] of the itec® connector of the motor cable by hand to the correct position until the marking points are in line.

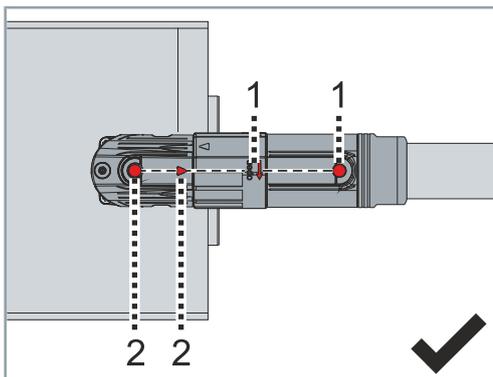
## 9.2.2 Establish the M23-speedtec® connector



- ▶ Align the cap nut of the M23-speedtec® connector [1] so that the marking arrow [2] of the connector and the marking arrow [3] of the power box [4] are opposite each other.
- ▶ Push the connector [1] of the motor cable straight onto the power box [4] of the electric cylinder.



- ▶ Turn the cap nut of the connector [1] to the right by hand.



- ▶ Make sure that the lettering "open" [1] and the marking point [1] on the connector [1] are in line with the marking elements [2] of the power box.

The M23-speedtec® connector is correctly connected.

## 9.3 Select motor cables

For faster and error-free installation of the electric cylinders, use the recommended pre-assembled motor cables according to the servo drive used. Using other cables can cause unexpected faults and render the warranty invalid.

Further selection aids can be found in the line selection wizard of the TwinCAT 3 Motion Designer, on the [accessories overview](#) for drive components and on the product web pages of the electric cylinder.



### Selection of the motor cables

The cable selection wizard of the TwinCAT 3 Motion Designer for drive design displays the suitable cables corresponding to the set components of the axis. The integrated parts list generator also lists the necessary accessory components such as motor cables, chokes and mounting material.

TE5910 | TwinCAT 3 Motion Designer



### Define cable length via order specifications

The last four digits of the order code correspond to the cable length in decimeters: A ZK4xxx-xxxx-0020 cable is 2.00 m long.

AA3023, AA3033

#### Motor cables for AX5000 servo drives

Servo drive	Ordering information	Laying method
AX5101 to AX5106, AX5201 to AX5206	ZK4500-8002-xxxx	Fixed installation
	ZK4500-8022-xxxx	Highly dynamic
	ZK4500-8062-xxxx	Torsion-capable

#### Motor cables for AX8000 multi-axis servo system

Servo drive	Ordering information	Laying method
AX8108 and AX8206	ZK4800-8002-xxxx	Fixed installation
	ZK4800-8022-xxxx	Highly dynamic
	ZK4800-8062-xxxx	Torsion-capable

AA3053

#### Motor cables for AX5000 servo drives

Servo drive	Ordering information	Laying method
AX5101 to AX5112, AX5201 to AX5206	ZK4500-8003-xxxx	Fixed installation
	ZK4500-8023-xxxx	Highly dynamic
	ZK4500-8063-xxxx	Torsion-capable
AX5118 to AX5125	ZK4500-8004-xxxx	Fixed installation
	ZK4500-8024-xxxx	Highly dynamic
	ZK4500-8064-xxxx	Torsion-capable

#### Motor cables for AX8000 multi-axis servo system

Servo drive	Ordering information	Laying method
AX8108 and AX8206	ZK4800-8003-xxxx	Fixed installation
	ZK4800-8023-xxxx	Highly dynamic
	ZK4800-8063-xxxx	Torsion-capable
AX8118 and AX8525	ZK4800-8004-xxxx	Fixed installation
	ZK4800-8024-xxxx	Highly dynamic
	ZK4800-8064-xxxx	Torsion-capable

## 9.4 Select extension cable

### Ordering information of the motor extension cable

To extend the motor cable, use the following cables depending on the required installation type and the servo drive used:

Fixed installation

Motor cable AX5000	Motor cable AX8000	Ordering information of the extension cable
ZK4500-8002-xxxx	ZK4800-8002-xxxx	ZK4501-8002-xxxx
ZK4500-8003-xxxx	ZK4800-8003-xxxx	ZK4501-8003-xxxx
ZK4500-8004-xxxx	ZK4800-8004-xxxx	ZK4501-8004-xxxx

Highly dynamic installation

Motor cable AX5000	Motor cable AX8000	Ordering information of the extension cable
ZK4500-8022-xxxx	ZK4800-8022-xxxx	ZK4501-8022-xxxx
ZK4500-8023-xxxx	ZK4800-8023-xxxx	ZK4501-8023-xxxx
ZK4500-8024-xxxx	ZK4800-8024-xxxx	ZK4501-8024-xxxx

Torsion-capable installation

Motor cable AX5000	Motor cable AX8000	Ordering information of the extension cable
ZK4500-8062-xxxx	ZK4800-8062-xxxx	ZK4501-8062-xxxx
ZK4500-8063-xxxx	ZK4800-8063-xxxx	ZK4501-8063-xxxx
ZK4500-8064-xxxx	ZK4800-8064-xxxx	ZK4501-8064-xxxx

Connect the extension cable as described in chapter "Connect the motor cable", [Page 52].

## 10 Commissioning



### Example: Commissioning

The procedure for commissioning is described as an example. A different method may be appropriate or necessary, depending on the application of the components.

The commissioning described here includes the products

- TwinCAT 3 Drive Manager 2
- AX8000 multi-axis servo system
- AA3000 electric cylinder

### 10.1 Before commissioning

Pay attention to the following points before commissioning:

- ▶ Read the operating instructions of the servo drives used
- ▶ Read AX8000 multi-axis servo system functional description
- ▶ Read AX8xxx axis module diagnostic messages
- ▶ Read axis module AX8xxx object description
- ▶ In the case of multi-axis systems, commission each drive unit separately
- ▶ Please check the system requirements
- ▶ Check mechanical and electrical condition
- ▶ Only for electric cylinders with holding brake [+]: Check holding brake!

## 10.1.1 System requirements

### NOTICE

#### Check and update software version

The automatic securing of the end positions of the electric cylinder requires the following TwinCAT 3 Drive Manager 2 software version:

TE5950 | Version 1.1.44.0 or higher

*Product defect possible, as the end positions may not be secured.*

- Check the software status of TwinCAT 3 Drive Manager 2.
- Update to the required version.

### NOTICE

#### Check and update firmware version

The automatic securing of the end positions of the electric cylinder requires the following firmware version of the servo drive:

AX8000 | axis module FW 1.05 Build 8 or higher

AX5000 | servo drive FW 2.15 or higher

*Risk of defect. The end positions may not be secured.*

- Check the firmware version of the servo drive
- Update to the required version



#### TE5950 setup download

You can find the current setup file on the product website [TE5950 | TwinCAT 3 Drive Manager 2](#)

## 10.1.2 Mechanical and electrical requirements

- ▶ Use the "identification plate", [Page 19] and the "type code table", [Page 20] to check whether the electric cylinder used is equipped with an integrated anti-twist protection [+] and/or a holding brake [+].

**NOTICE** With integrated anti-twist protection [+], the end positions are provided by the electronic identification plate. Note the different start-up depending on the version of the anti-twist protection.

- ▶ Check travel path of the electric cylinder and remove blockages
- ▶ Check drive for damage
- ▶ Check mounting and alignment
- ▶ Tighten screw connections correctly
- ▶ Install mechanical, thermal and electrical protection devices, consider additional fuses according to "Installation position", [Page 43]
- ▶ Ensure wiring, connection and proper grounding for electric cylinder and servo drive

## 10.1.3 Testing the holding brake [+]

- ▶ Check the function of the holding brake [+] without load by applying 24 V DC to control the brake according to the pin assignment.
- ▶ If the holding brake releases, continue commissioning.
- ▶ If the holding brake does not release, the brake fault must be corrected before further commissioning. Further information can be found in chapter "Fault correction", [Page 71].
- ▶ Ensure holding torque of the brake

## 10.2 During commissioning

Pay attention to the following points during commissioning:

- ▶ Check function and adjustment of attachments
- ▶ Observe information for environment and operation. Further information can be found in chapter "Data for operation and environment", [Page 26].
- ▶ Check protective measures against moving and live parts

### 10.2.1 Electric cylinder with integrated anti-twist protection [+]

The mechanical end positions of the electric cylinder and the mechanical offset of the encoder position are stored in the electronic identification plate. Thus, the output encoder position value corresponds to the absolute position of the spindle. Homing to determine the position offset is therefore not necessary. The position values displayed in the software are valid.

#### NOTICE

##### Damage to the electric cylinder

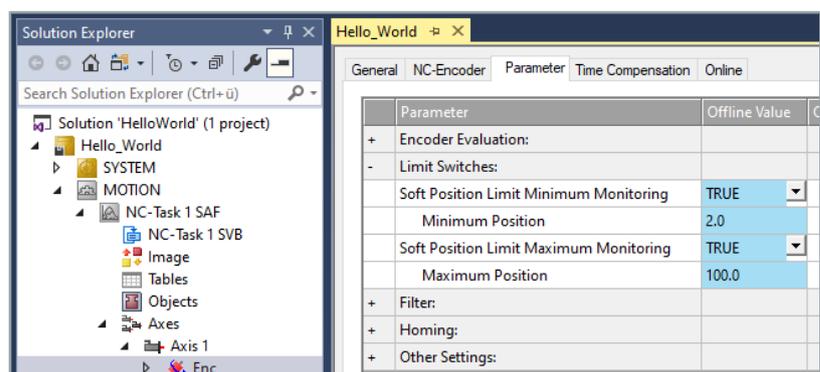
Manually changing the software end positions or the encoder offset in the configuration can result in the mechanical end positions being exceeded, and the electric cylinder can be damaged.

- Make manual changes to the software end positions with care.

#### Software

Carry out the instructions in the operating manual for servo drives:

- ▶ Build a new project and choose a target system
- ▶ Scan and take over devices
- ▶ Transfer parameters to the NC
- ▶ Check the use and value of the NC end positions. The screenshot shows an example of the parameter that contains the end position values transferred to the NC.



- ▶ Check the condition of the plant and activate the project

## 10.2.2 Electric cylinder without integrated anti-twist protection [+]

The end positions of an electric cylinder without integrated anti-twist protection [+] are unsecured ex works. No end positions are stored in the electronic identification plate. The current encoder position is undefined and does not match the zero position of the spindle. Therefore, it is mandatory to perform homing in order to determine the offset position of the encoder from this.

### NOTICE

#### Damage to the electric cylinder

Manually changing the software end positions or the encoder offset in the configuration can result in the mechanical end positions being exceeded, and the electric cylinder can be damaged.

- Make manual changes to the software end positions with care.

### NOTICE

#### Damage to the electric cylinder

Commissioning without determining the encoder offset and the software end positions by means of appropriate homing will result in damage to the product.

- Follow the instructions for commissioning an electric cylinder without integrated anti-twist protection [+]
- Provide suitable end stops for performing homing

## Mechanics

The end positions of the electric cylinder are not mechanical end stops and may not be used as such. During homing, the end positions must be secured with external end stops.

- ▶ Please refer to chapter "Integrated anti-twist protection [+]", [Page 22].
- ▶ Make sure that the external anti-twist protection is installed.
- ▶ Make sure that the electric cylinder does not exceed the external end stops and the end positions during homing. The information on the position of the end positions can be found in the chapter "Technical data", [Page 25].
- ▶ The dimensions for determining the zero position of the spindle can be found at "Dimensional drawing AA3023", [Page 31], "Dimensional drawing AA3033", [Page 34] and "for the AA3053", [Page 37].

## Software

Carry out the instructions in the operating manual for servo drives:

- ▶ Build a new project and choose a target system
- ▶ Scan and take over devices
- ▶ Transfer parameters to the NC
- ▶ Deactivate software end positions in preparation for homing
- ▶ Set limited force and limited speed for homing
- ▶ Perform homing at low speed and force limitation and determine offset of encoder
- ▶ Transfer encoder offset to the servo drive
- ▶ Change end positions manually: rear end position: 0 mm, front end position: stroke according to identification plate
- ▶ Activate software end positions and check NC parameters if necessary
- ▶ Check the condition of the plant and activate the project

## 10.3 During operation

**Please note the following:**

- ▶ Listen for atypical noises.
- ▶ Watch out for smoke development.
- ▶ Always check drive surfaces and cables for dirt, leaks, moisture or dust.
- ▶ Check temperature development.
- ▶ Check for lubricant leakage.
- ▶ Observe the maintenance intervals.
- ▶ Check function of safety devices.



### **Local lack of lubricating grease in the spindle drive**

If the working stroke is shorter than the specified lubrication stroke, there may be a local lack of grease in the spindle drive.

- Perform a complete lubrication stroke every 250,000 cycles.
- Shorten the maintenance interval if necessary.

Further information can be found in chapter "Lubrication of the spindle drive", [Page 66].

## 10.4 After operation

### **WARNING**

#### **Loosened holding brake [+] can lead to serious injuries**

When the holding brake [+] is released, the spindle moves without remanent torque.

- Make sure that the electric cylinder comes to a complete stop.
- Establish that the machine or equipment is in a safe state.
- Take into account the installation position of the electric cylinder. Further information can be found in chapter "Installation position", [Page 43] .

## 11 Maintenance and cleaning

### 11.1 Maintenance

To maintain the complete functionality of the drive system over its service life, the components must be inspected and serviced at regular intervals.

#### **⚠ WARNING**

##### **Maintenance work during operation can lead to serious or fatal injuries**

To carry out maintenance work, the machine must be brought into a safe state and secured against unauthorized restarting. The machine builder is responsible for ensuring that the connected motors and the machine are brought into a safe state in the event of a fault in the drive system.

- For maintenance work, bring the connected electric cylinders and the machine into a safe state.
- De-energize the connected electric cylinders and the machine.
- Secure the connected electric cylinders and the machine against unauthorized restarting.

## 11.2 Maintenance intervals

Under nominal conditions, the electric cylinder components have different operating hours. We have provided you with a list of maintenance work and intervals for the associated components below:

Component	Interval	Maintenance type
Ball screw	Monthly	Check for running noises <b>As the volume increases:</b> <ul style="list-style-type: none"> <li>• Check electric cylinder for increased phase current and winding temperature</li> </ul> Do not continue to operate electric cylinder Contact Beckhoff Service
Ball screw	1 million cycles	Lubricate the spindle drive. See chapter "Lubrication of the spindle drive", [Page 66].
Ball screw and ball bearing	10 million cycles	Check for running noises <b>As the volume increases:</b> <ul style="list-style-type: none"> <li>• Check electric cylinder for increased phase current and winding temperature</li> </ul> Do not continue to operate electric cylinder Contact Beckhoff Service
Cables	Regular intervals	Perform visual inspection and check for damage <b>If required:</b> <ul style="list-style-type: none"> <li>• Replace cables</li> </ul>
	5 million bending cycles	<b>In case of drag chain suitable application:</b> <ul style="list-style-type: none"> <li>• Replace cables</li> </ul>
Power box	500 mating cycles	<b>In case of damage:</b> <ul style="list-style-type: none"> <li>• Contact Beckhoff Service</li> </ul>
Connector	10 turning cycles	<b>In case of damage:</b> <ul style="list-style-type: none"> <li>• Contact Beckhoff Service</li> </ul>

## 11.3 Lubrication of the spindle drive

### Interval

In order to maintain the performance values of the electric cylinder during operation, the spindle drive must be lubricated at intervals of 1,000,000 cycles.

The spindle drives are supplied lubricated from the factory. The first interval can thus be performed directly without further lubrication. To carry out lubrication, the drive is moved to a lubrication position that is easily accessible in the application. The spindle is lubricated with the help of a grease gun and the lubrication stroke is run three times according to the size.

### Lubricant

Beckhoff recommends that Klüberlub BE 71-501 lubricant be used. For more information on the lubricant, please contact the manufacturer.

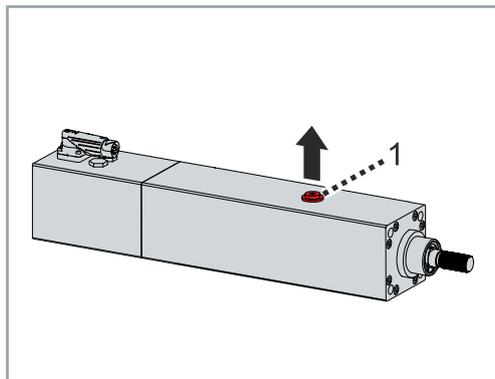
### Lubrication position and lubrication stroke length

The approachable lubrication position is reached according to the distance in the following table. Select a lubrication position that you can approach without problems in your application in order to run the lubrication stroke in the corresponding length.

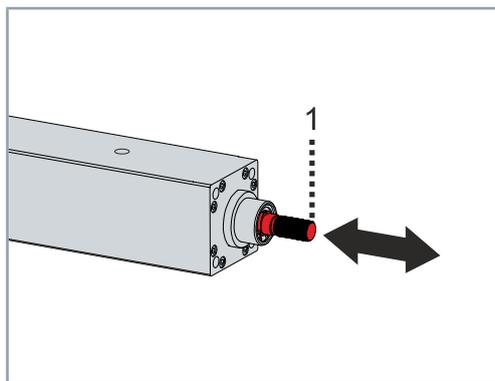
<b>AA3023</b>	<b>-22yz</b>	<b>-42yz</b>	
Motor rotation angle [°]	360	180	
Distance between lubrication positions [mm]	5	5	
Grease quantity [g]	1.5	1.5	
Lubrication stroke length [mm]	80 or ± 40	80 or ± 40	
<b>AA3033</b>	<b>-23yz</b>	<b>-43yz</b>	
Motor rotation angle [°]	120	120	
Distance between lubrication positions [mm]	1.6	3.2	
Grease quantity [g]	1.5	1.5	
Lubrication stroke length [mm]	100 or ± 50	100 or ± 50	
<b>AA3053</b>	<b>-14yz</b>	<b>-44yz</b>	<b>-64yz</b>
Motor rotation angle [°]	360	180	180
Distance between lubrication positions [mm]	5	5	10
Grease quantity [g]	2.0	2.0	2.0
Lubrication stroke length [mm]	150 or ± 75	150 or ± 75	150 or ± 75

## Carry out lubrication

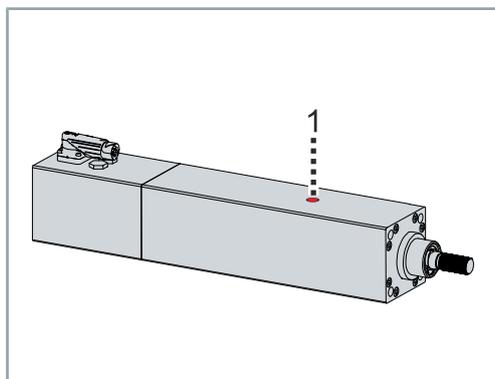
To perform lubrication, the spindle is moved to the lubrication position and lubricated with the help of a grease gun.



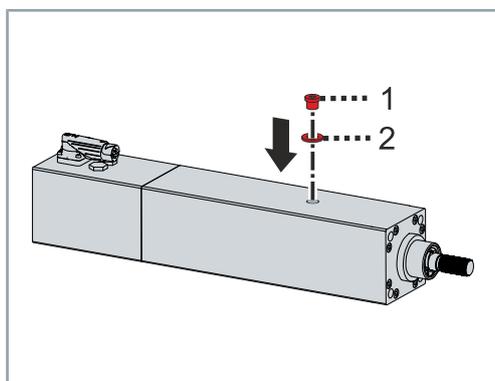
- ▶ Loosen screw with washer [1] and take out



- ▶ Move spindle [1] to next possible lubrication position
- Further information can be found in chapter "Lubrication of the spindle drive", [Page 66].



- ▶ Lubricate lubrication point [1] using a grease gun
- ▶ Wipe housing dry and remove excess grease



- ▶ Insert screw [1] with washer [2]
- ▶ Tighten screw [1]
- ▶ Observe the tightening torques:

Component	Specification	Tightening torque [Nm]
Screw [1]	DIN 908 M10x1	5.0

- ▶ Run lubrication stroke three times according to size
- Further information can be found in chapter "Lubrication of the spindle drive", [Page 66].

## 11.4 Cleaning

### ⚠ WARNING

#### Carrying out cleaning work during operation can lead to serious or fatal injuries

Basically, electronic devices are not fail-safe.

- For cleaning work, bring the connected electric cylinders and the machine into a safe state.
- De-energize the connected electric cylinders and the machine.

### NOTICE

#### Extreme soiling can lead to failure

Contamination, dust or chips can have a negative effect on the function of the components.

- Protect the components and especially the spindle from contamination.
- Clean the components regularly.

### NOTICE

#### Damage to the electric cylinder

Penetration of cleaning liquid into the electric cylinder by dipping or spraying can result in damage to the electric cylinder.

- Only wipe the electric cylinder with a cleaner and a cloth.
- Do not immerse the electric cylinder

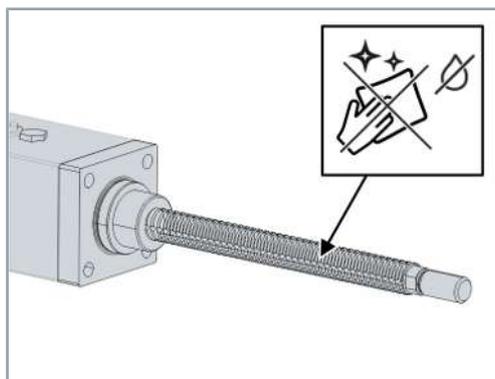
## Housing

Clean the housing components carefully with a damp cloth or a brush. Excess grease or soiling can be wiped off with a dry, lint-free cloth. Use grease-dissolving and non-aggressive cleaning agents for cleaning. Isopropanol cleaning agent can be used for cleaning.

#### Non-approved cleaning agents:

Non-approved cleaning agents	Chemical formula
Aniline hydrochloride	$C_6H_5NH_2HCl$
Bromine	$Br_2$
Sodium hypochlorite; bleaching solution	$NaClO$
Mercury (II) chloride	$HgCl_2$
Hydrochloric acid	$HCl$

## Output rod



The output rod must remain free of cleaning agents. If necessary, excess grease or oil can be wiped off with a lint-free cloth.

- Avoid contact with cleaning agents.
- Do not use any cleaning agents that may adhere to the spindle thread and enter the electric cylinder or the spindle nut during the working stroke.
- In the case of vertical installation, ensure that there is no cleaning agent on the cylinder opening.

## 12 Accessories

### 12.1 Mechanical accessories

The electric cylinders can be combined with common accessories for pneumatic cylinders. The different sizes correspond to the following standard cylinder sizes:

#### Accessories according to ISO 15552

Electric cylinder	AA3023	AA3033	AA3053
Pneumatic cylinder [mm]	Ø 40	Ø 63	Ø 100

To attach the accessories to the electric cylinder, follow the installation instructions in the chapter "Fastening the end of the spindle", [Page 48].

## 13 Fault correction

The following table describes a selection of faults. Depending on the application, other causes may be responsible for the fault. Conspicuous control behavior is the result of incorrect parameterization of the servo drive.

With multi-axis systems such as the AX8000, malfunctions may have different causes.

Error	Cause																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Motor standstill, no starting	1	2			5														
Electric cylinder runs sluggishly	1		3		5	6		8											
Start-up noises			3		5	6					11								19
Noises during operation	1		3		5	6		8			11								19
High temperature at idling speed				4			7		9										19
High temperature under load	1		3				7	8	9										
Untrue running behavior								8		10	11								19
Grinding noises								8				12							19
Brake fault													13	14					
Output stage fault					5										15	16			
Feedback error																	17	18	
Lack of braking effect					5	6													

## Fault correction

Number	Cause	Solution
1	Servo drive not enabled	Set ENABLE signal and enable servo drive
	Overload of the electric cylinder	Check the load and if necessary reduce it, then restart and enable the servo drive. Set ENABLE signal
	Mechanical blockage of the electric cylinder	Check mechanics and release blockage
	Holding brake [+] not released	Check the control configuration of the holding brakes [+] and reconfigure if necessary
2	Phase interruption in the power supply or reversed motor phases	Check servo drive and supply lines and replace any defective cables
3	Phase interruption after power supply	Check servo drive and supply lines and replace any defective cables
	Power cable or feedback line with defective shield	Check ground connection and shielding
4	Short-circuit in the voltage supply cable for the holding brake [+]	Replace defective cable, measure and check cable after replacement
	Output voltage of the servo drive too low	Check the settings in the configuration and read out the electronic identification plate of the electric cylinder again
	Defective holding brake [+]	Replace electric cylinder, then measure and check
5	Short circuit or earth leakage in the motor cable	Replace defective motor cable, then measure and check
6	Power connector not fitted correctly	Check the connectors on the power connector and on the electric cylinder
	Interruption in the feedback line or motor cable	Check cables for wire break or crushing. Replace defective cables, then measure and check.

Number	Cause	Solution
7	Required force too high.	Check design or configuration and adjust if necessary
	The spindle drive is clamped in the application.	Re-align electric cylinder or use compensating elements, see chapter "Mechanical installation", [Page 47]
8	Lubrication is not sufficient	Check spindle for contamination and clean if necessary
		Check maintenance interval and relubricate if necessary
		Check length of working stroke and insert lubrication stroke if necessary
9	Heat dissipation system of the electric cylinder not functioning	Clean the surface of the electric cylinder and the servo drive as well as the heat sinks and exhaust air slots
		Check the mounting depth of the servo drives and the electric cylinder.
10	Shield of feedback line or motor cable defective or inadequate	Check ground connection and shielding
11	Servo drive gain is set too high.	Reconfigure the parameters of the servo drive and adjust them if necessary
12	Contamination or foreign bodies inside the electric cylinder	Send in electric cylinder. The repair is carried out by the vendor.
	Rotating parts chafing on the housing or electric cylinder components	Inspect chafing parts and readjust if necessary
	Defective bearings; irreparable bearing damage	Send in electric cylinder. The repair is carried out by the vendor.

## Fault correction

Number	Cause	Solution
13	Short-circuit in the voltage supply cable for the holding brake [+]	Replace defective cable, then measure and check
14	Inadequate power supply of the holding brake [+]	Check the settings in the configuration and read out the electronic identification plate of the electric cylinder again
15	Short circuit or earth leakage in the electric cylinder	Replace defective electric cylinder, then measure and check
16	Insufficient power supply	Check the settings in the configuration and read out the electronic identification plate of the electric cylinder again
17	Interruption or crushing in the feedback line	Check cables for wire break or crushing. Replace defective cables, then measure and check.
18	Power connector of the electric cylinder incorrectly plugged in	Check correct seating of the connector for feedback signals and correct if necessary
	Loose fit of the feedback connector or no contact of the plug contacts with the power socket of the electric cylinder	Check the connector assembly. Contact Beckhoff Service if necessary
19	Check spindle surface for damage and contamination	Contact Beckhoff Service, avoid impacts on the spindle and sudden loads during operation and assembly

## 14 Decommissioning

Disassembly may only be carried out by qualified and trained personnel.

For more information, see chapter "Documentation notes", [Page 6].

When disposing of electronic equipment, ensure that you dispose of it in accordance with the applicable national regulations.

For more information, see the chapters "Disposal", [Page 76].

### 14.1 Disassembly

#### **⚠ WARNING**

##### **Risk of injury due to accidental machine movement**

For disassembly, make sure that the machine is de-energized and secured. Particularly in the case of vertical axes, machine parts can start moving accidentally after the electric cylinder has been released.

*Accidental machine movements can lead to serious or fatal injuries.*



##### **Do not remove components from the products**

Only

Beckhoff Automation GmbH & Co. KG is permitted to remove components.

Contact Beckhoff Service for further information.

##### **Removal of the electric cylinder from the machine**

- ▶ Allow the electric cylinder to cool down before removing it.
- ▶ Remove cables and electrical connections.
- ▶ Establish a safe state for the machine.
- ▶ Secure the machine against accidental movements by releasing the electric cylinder.
- ▶ If lubricants leak out, remove them and clean the working area of the spindle. Further information can be found in chapter "Cleaning", [Page 68].
- ▶ Loosen the connection of the spindle end with the application and remove all screwed-on connecting elements from the housing. Then remove the electric cylinder.
- ▶ Transport the electric cylinder to the workplace or storage place. Further information can be found in chapter "Transport and storage", [Page 39].

## 14.2 Disposal

Depending on your application and the products used, ensure the professional disposal of the respective components:

### **Cast iron and metal**

Dispose of cast and metal parts as scrap metal for recycling.

### **Cardboard, wood and foam polystyrene**

Dispose of packaging materials made of cardboard, wood or foam polystyrene in accordance with the regulations.

### **Plastics and hard plastics**

You can recycle parts made of plastic and hard plastic via the recycling depot or re-use them depending on the component designations and markings.

### **Oils and lubricants**

Dispose of oils and lubricants in separate containers. Hand over the containers at the used oil collection station.

### **Batteries and rechargeable batteries**

Batteries and rechargeable batteries may also be marked with the crossed-out trash can symbol. You must separate these components from the waste and are legally obliged to return used batteries and rechargeable batteries within the EU. Observe the relevant provisions outside the area of validity of the EU Directive 2006/66/EC.



### **Electronic components**

Products marked with a crossed-out waste bin must not be disposed of with general waste. Electronic components and device are considered as waste electrical and electronic equipment for disposal. Observe the national regulations for the disposal of old electrical and electronic equipment.

### 14.2.1 Returning to the vendor

In accordance with the WEEE-2012/19/EU directives, you can return used devices and accessories for professional disposal. The transport costs are borne by the sender.

Send the used devices with the note "For disposal" to:

Beckhoff Automation GmbH & Co. KG  
"Service" Building  
Stahlstrasse 31  
D-33415 Verl

In addition, you have the option to contact a local certified specialist company for the disposal of used electrical and electronic appliances. Dispose of the old components in accordance with the regulations applicable in your country.

## 15 Guidelines and Standards

### 15.1 Standards

**EN 60034-1:2010+Corr.:2010**

*"Rotating electrical machines – Rating and performance"*

**Generic standard EN 60034-5:2007**

*"Rotating electrical machines"*

Part 5: Degrees of protection provided by the integral design of rotating electrical machines

**Generic standard EN60034-8:2008**

*"Rotating electrical machines"*

Part 8: Terminal markings and direction of rotation

**RoHS: EN 50581:2012**

*"Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances"*

### 15.2 Guidelines

**2014/35/EU**

Low Voltage Directive

**2011/65/EU**

RoHS Directive

### 15.3 Test centers

	<p>The electric cylinders do not fall within the scope of the Machinery Directive. However, Beckhoff products are designed and evaluated in full compliance with all relevant regulations for personal safety and use in a machine or system.</p>
---	---

## 15.4 EU conformity



### **Provision**

Beckhoff Automation GmbH & Co KG will be pleased to provide you with EU declarations of conformity and manufacturer's declarations for all products on request.

Please send your request to: [info@beckhoff.com](mailto:info@beckhoff.com)

## 15.5 CCC conformity



### **Export to Chinese Economic Area**

Beckhoff electric cylinders of the AA3000 series are not subject to the **China Compulsory Certificate**; CCC. The products are exempt from this certification and can be exported to the Chinese economic area.

## Index

<b>A</b>		Holding brake [+]	23
Accessories		Integrated anti-twist protection [+]	22
	Pneumatic cylinder		70
<b>C</b>		<b>P</b>	
Cables		Pictograms	11
	Select	Power box	50
		Turning	50
Cleaning		Power derating	28
	Cleaning agents	Protection equipment	45
Connection		Temperature sensor	45
	Mechanics		47
<b>D</b>		<b>S</b>	
Disposal		Safety	15
		De-energized and voltage-free state	17
		Grounding	16
		Hot surfaces	17
		Intended use	24
		Keep the environment clean	16
		Keep travel path clear	17
		Moving or rotating components	17
		Overheating	17
		Protective equipment	16
		Safety pictograms	16
		Shut down and secure the machine or plant	16
		Solvents and lubricants	17
		Tightening torques	16
		Safety symbols	15
		Scope of supply	38
		Security	
		General safety instructions	16
		Shaft end A	46
		Signal words	11
		speedtec connector	
		Connection	54
		Storage	39
		Support	13
		Symbols	11
		<b>T</b>	
		Target group	9
		Technical data	26
		Tightening torques	
		Flange	41, 47
		Transport	39
<b>E</b>		<b>L</b>	
Electric cylinder		Label, see Safety symbols	
	Commissioning		15
	Disassembly	Lubricant	66
	Disposal	Lubrication	66
	Mechanical installation		47
	Storage		39
	Transport		39
Environmental conditions			26
<b>F</b>		<b>M</b>	
Faults		Maintenance	
			64
		Intervals	65
<b>G</b>		<b>O</b>	
General safety instructions		OCT	
			21
<b>H</b>		Operating Conditions	
Holding brake [+]			26
		Ordering options	
			22



More Information:  
**[www.beckhoff.com/aa3000](http://www.beckhoff.com/aa3000)**

Beckhoff Automation GmbH & Co. KG  
Hülshorstweg 20  
33415 Verl  
Germany  
Phone: +49 5246 9630  
[info@beckhoff.com](mailto:info@beckhoff.com)  
[www.beckhoff.com](http://www.beckhoff.com)

