

Operating instructions | EN

AA3100

Electric cylinders for compact drive technology

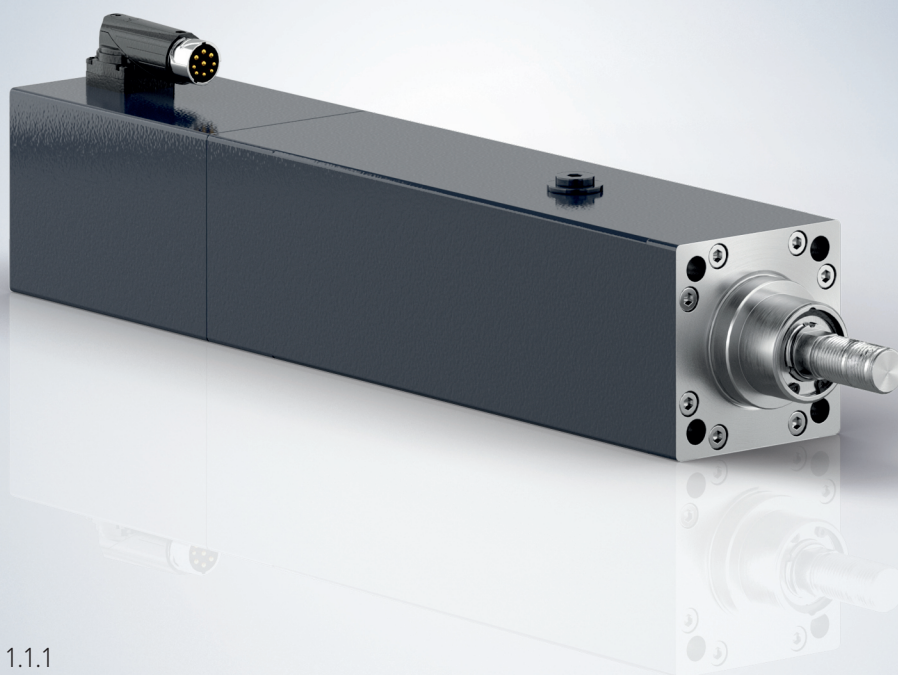


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1 Documentation notes

1.1 Disclaimer

Beckhoff products are subject to continuous further development. We reserve the right to revise the operating instructions at any time and without prior announcement. 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 these operating instructions.

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 of other brand names or designations by third parties may lead to an infringement of the rights of the owners of the corresponding designations.

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 in this product as described in the operating instructions are delivered in a specific configuration of hardware and software, depending on the application regulations. 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 observe these operating instructions
- 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, you can obtain a list of revision levels for changes in the operating instructions.

- Send your request to motion-documentation@beckhoff.com.

Origin of the document

These operating instructions were originally written in German. All other languages are derived from the German original.

Product features

Only the product properties specified in the current operating instructions are valid. Further information given on the product pages of the Beckhoff homepage, in emails or in other publications is not authoritative.

1.3 Staff qualification

These operating instructions are intended for trained control and automation specialists with 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 operating instructions published at the respective time of each installation and commissioning is to be used. 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 are related to the activities you will perform with the product. Always read the chapter "For your safety", [Page 15] in the operating instructions. Observe the warnings in the chapters so that you can handle and work with the product as intended and safely.

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 comply will result in serious or fatal injuries.

WARNING

Failure to comply may result in serious or fatal injuries.

CAUTION

Failure to comply 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:

- product malfunctions
- damage to the product
- damage to the environment



Information

This symbol indicates information, tips, and notes for handling the product or the software.



Examples

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

**Required tool**

This symbol indicates a tool that is required for the following steps.

**Required accessories [+]**

This symbol shows the accessories required for the following steps. The accessories are not included in the scope of delivery and can be ordered from Beckhoff.

**Assembly material required**

This symbol shows the assembly material required for the following steps. The assembly material is not included in the scope of delivery and must be purchased separately.

**QR codes**

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


1.6 Beckhoff Services

Beckhoff and its international partner companies offer comprehensive support and service.

 www.beckhoff.com/en-en/support/global-availability/

1.6.1 Support services

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

 +49 5246 963-157

 support@beckhoff.com

 www.beckhoff.com/en-en/support/our-support-services/

1.6.2 Training offerings

Training in Germany takes place at the Beckhoff branches or, after consultation, at the customer's premises. Beckhoff offers both face-to-face and online training courses.

 +49 5246 963-5000

 training@beckhoff.com

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1.6.3 Service offerings

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

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1.6.4 Headquarters Germany

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🌐 www.beckhoff.com/en-en/

A detailed overview of the Beckhoff locations worldwide can be found at:

🌐 www.beckhoff.com/en-en/company/global-presence/

1.6.5 Downloadfinder

In the Download finder you will find configuration files, technical documentation and application reports to download.

🌐 www.beckhoff.com/documentations

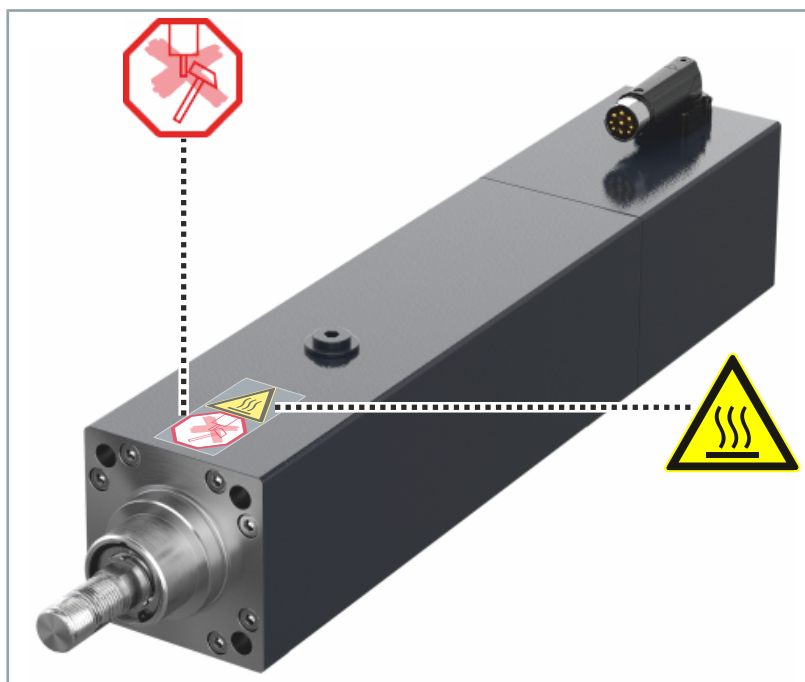
2 For your safety

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 of hot surface

During and after operation, there is a risk of burns on the housing of the electric cylinder due to hot surfaces above 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 47] and "Mechanical installation", [Page 44].

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 any electric cylinders while they are live. Ensure that the protective conductor is properly connected. Never loosen electrical connections when live. Only work on electric cylinders when the device is switched off. Disconnect all components from the mains and protect them against unintentional 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 61]

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 59].

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 shutdown", [Page 28]. 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

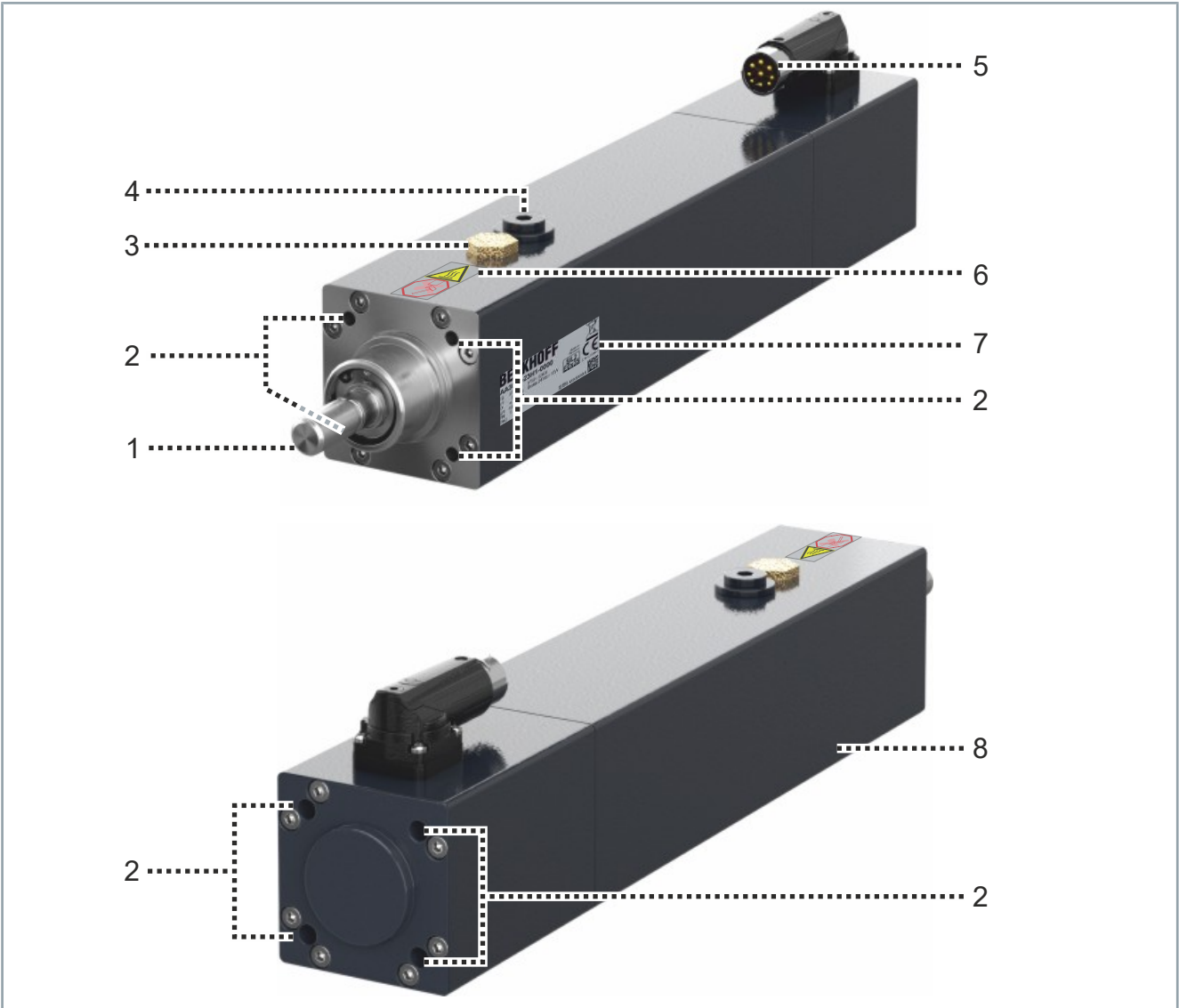
De-energize and switch off components before working on them

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 68].

No direct skin contact with solvents or lubricants

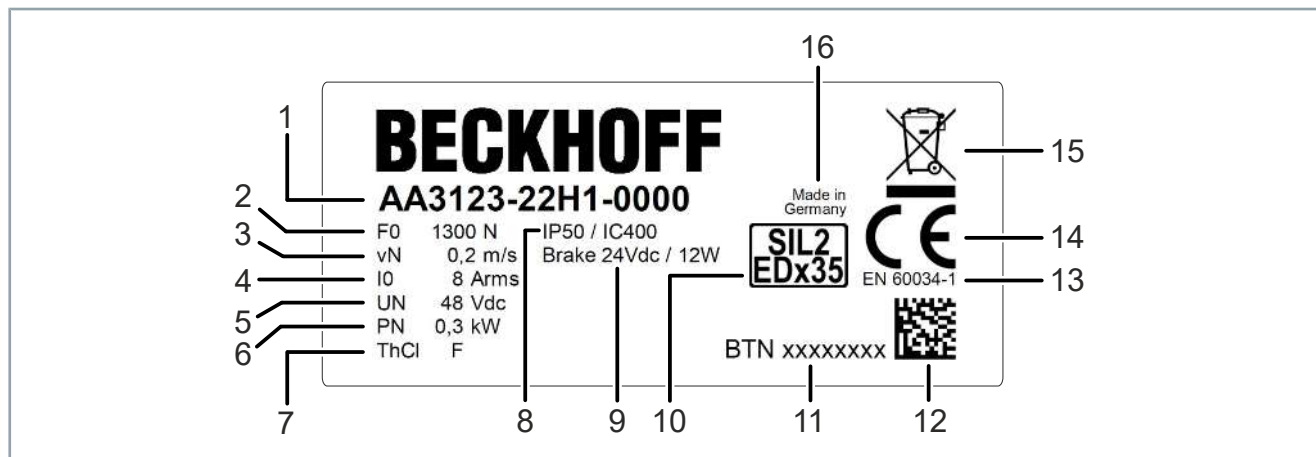
In case of improper use, the solvents or lubricants used can lead to skin irritations. Avoid direct skin contact.

3 Product overview



Item number	Explanation
1	Spindle end
2	Threaded holes for mounting
3	Pressure equalization element
4	Screw plug for lubrication
5	Power/feedback connection
6	Safety pictograms
7	Name 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

AA31uv-wxyz-0000	Explanation
AA31	Product area Electric cylinders for compact drive technology
u	Flange size 2 = 58 mm 3 = 75 mm
v	Overall length 3 = standard
w	Lead and integrated anti-twist protection 1 = pitch 5 mm without integrated anti-twist protection 2 = pitch 5 mm with integrated anti-twist protection 3 = pitch 10 mm without integrated anti-twist protection 4 = pitch 10 mm with integrated anti-twist protection
x	Hub 2 = 150 mm 3 = 200 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 AA3100 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:

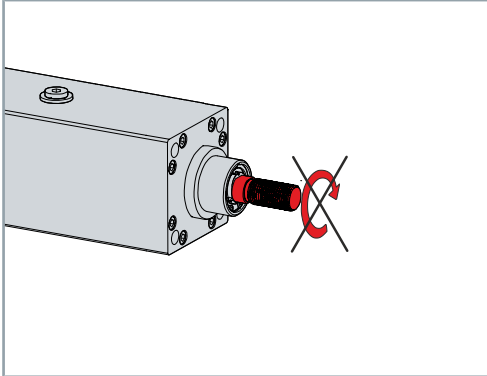
- Additional redundant brake units
- Mechanical safeguards or interlocks
- Attachment of a weight counterbalance

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 ensures the translatable 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.



No translatable spindle movement due to lack of anti-twist protection

Anti-twist protection is always mandatory to ensure translatable 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

Defect due to 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 a homing and use the NC end positions to prevent possible damage to the spindle drive.
- Read the chapter "Commissioning", [Page 54] before executing homing.

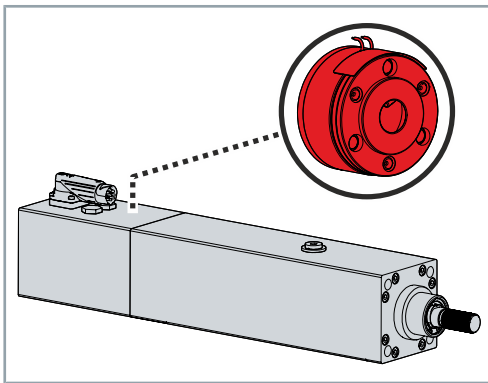
NOTICE

Defect due to unsecured 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 the homing.
- Read the chapter "Commissioning", [Page 54] 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 51].

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
- 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 AA3100 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 $\pm 10\%$.

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_{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_{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_{RMS}]

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

Voltage constant k_E [mV_{RMS}/min⁻¹]	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 [kgcm²]	Total moment of inertia of the moving masses of an electric cylinder. Significantly influences the dynamics and running behavior
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 η [%]	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_{dyn} [kN]	The axial force that a ball screw can theoretically support with a nominal service life of 10 ⁶ 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
Color	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 AA3123", [Page 32]
- "Dimensional drawing AA3133", [Page 35]

4.2.2 Environmental conditions

Environmental requirements	
Climate category – operation	2K3 according to EN 60721
Ambient temperature during operation	+5 °C ... +40 °C, extended temperature range
Ambient temperature during transport	-25 °C ... +70 °C, maximum fluctuation 20 K/hour
Ambient temperature during storage	-25 °C ... +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 [%] 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 70].

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.

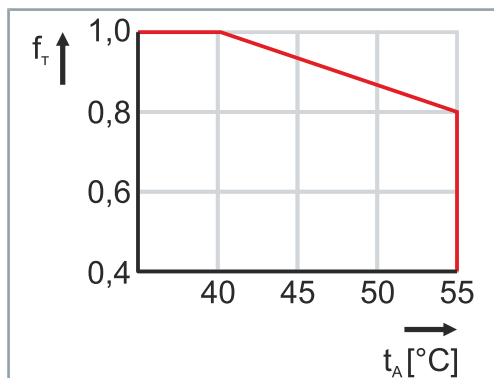


Illustration: Power data when exceeding the specified temperature limit

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:

$$F_{CA_red} = F_C \times f_T$$

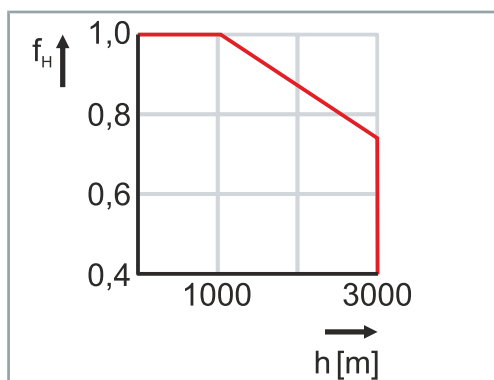


Illustration: Power data when exceeding the specified installation altitude

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 AA3123

Electrical data

AA3123	-12yz	-22yz	-32yz	-42yz
Maximum nominal supply voltage U_n [V DC]	48	48	48	48
Peak current I_{max} [A]	32	32	32	32
Continuous current I_0 [A]	8.1	8.1	8.1	8.1
Nominal output P_n [kW]	0.3	0.3	0.3	0.3
Force constant K_f [N/A]	160	160	80	80
Voltage constant ph-ph (20 °C) k_E [V_{rms}/k_{min}^{-1}]	10.1	10.1	10.1	10.1
Winding resistance [Ω] ph-ph R_{20}	0.67	0.67	0.67	0.67
Winding inductance L [mH] (ph-ph), at 1 kHz	1.57	1.57	1.57	1.57

Mechanical data

AA3123	-12yz	-22yz	-32yz	-42yz
Peak force F_{max} [N]	5300	5300	2650	2650
Continuous force F_0 [N]	1300	1300	650	650
Maximum acceleration a_{max} [m/s^2]	10	10	20	20
Maximum velocity v_{max} [m/s]	0.28	0.28	0.56	0.56
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]	± 0.015	± 0.015	± 0.015	± 0.015
Positioning with backlash [mm]	–	± 0.020	–	± 0.030
Moment of inertia J [$kgcm^2$]	1.5	1.5	1.5	1.5
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

AA3123	-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

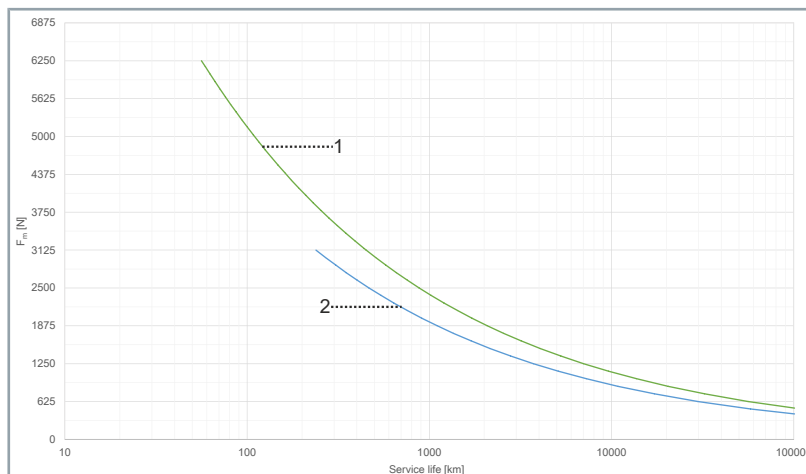
Holding brake performance data [+]

AA3123	-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

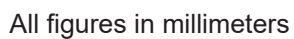
4.3.1 Service life AA3123

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 58] and "Spindle end", [Page 43].



Curve	Electric cylinder	Lead p [mm]
1	AA3123-w2Hz-0000	5
2	AA3123-w2Hz-0000	10



Technical drawing of a hydraulic cylinder assembly. The drawing shows a side view of the cylinder with various dimensions and labels.

Dimensions (mm):

- Overall length: 310
- Stroke length: 76-89
- Distance from front flange to stroke start: 56
- Front flange diameter: $\varnothing 35$ f8
- Front flange thread: M12x1,25
- Front flange thickness: 4
- Distance from front flange to rear flange: 22
- Distance from front flange to rear flange (including stroke): 30
- Rear flange diameter: $\varnothing 35$ f8
- Rear flange thickness: 4

Labels:

- pressure compensation element
- Relubrication

Technical drawings of the M6x12 and M6x22 models. Drawing A shows the M6x12 model with dimensions: 25 (height of the top section), 58 (height of the main body), and 38 (width). Drawing B shows the M6x22 model with dimensions: 38 (width). Both drawings show a square base with four mounting holes and a central circular feature.

4.4 Size AA3133

Electrical data

AA3133	-13yz	-23yz	-33yz	-43yz
Maximum nominal supply voltage U_n [V DC]	48	48	48	48
Peak current I_{\max} [A]	32	32	32	32
Continuous current I_0 [A]	8	8	8	8
Nominal output P_n [kW]	0.3	0.3	0.25	0.25
Force constant K_f [N/A]	352	352	176	176
Voltage constant k_E [$V_{\text{rms}}/k_{\text{min}}^{-1}$] Ph-Ph (20 °C)	23.5	23.5	23.5	23.5
Winding resistance R_{20} [Ω] Ph-Ph	0.63	0.63	0.63	0.63
Winding inductance L [mH] Ph-Ph, at 1 kHz	2.35	2.35	2.35	2.35

Mechanical data

AA3133	-13yz	-23yz	-33yz	-43yz
Peak force F_{\max} [N]	11950	11950	5950	5950
Continuous force F_0 [N]	2800	2800	1400	1400
Maximum acceleration a_{\max} [m/s^2]	10	10	20	20
Maximum velocity v_{\max} [m/s]	0.12	0.12	0.24	0.24
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]	± 0.015	± 0.015	± 0.015	± 0.015
Positioning with backlash [mm]	–	± 0.020	–	± 0.030
Moment of inertia J [kgcm^2]	4.6	4.6	4.6	4.6
Moment of inertia with holding brake J_{br} [kgcm^2]	5.2	5.2	5.2	5.2
Weight m [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

AA3133	-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

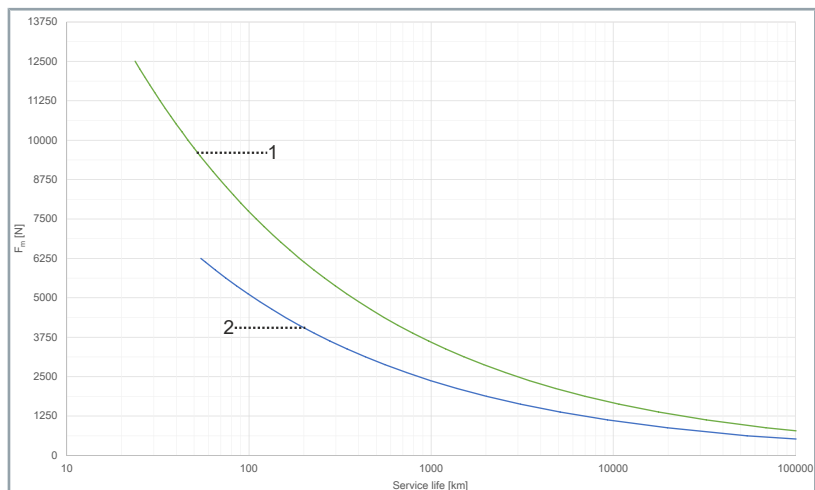
Holding brake performance data [+]

AA3133	-13yz	-23yz	-33yz	-43yz
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_{bri} [ms]	30	30	30	30

4.4.1 Service life AA3133

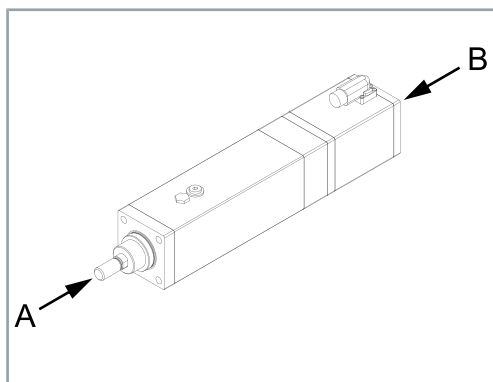
The following diagram shows the expected service life of the ball screw and ball bearings in relation to the equivalent dynamic load.

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 58] and "Spindle end", [Page 43].



Curve	Electric cylinder	Lead p [mm]
1	AA3133-w3Hz-0000	5
2	AA3133-w3Hz-0000	10

4.4.2 Dimensional drawing AA3133



All figures in millimeters

Illustration: Perspective view

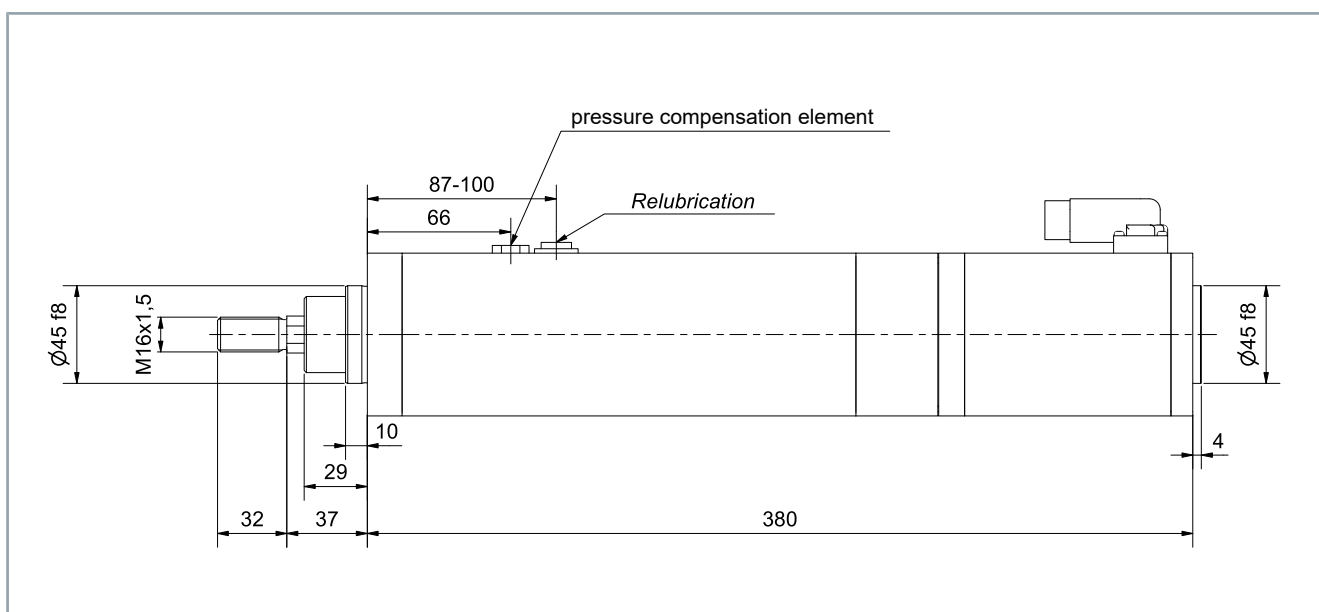


Illustration: Front view

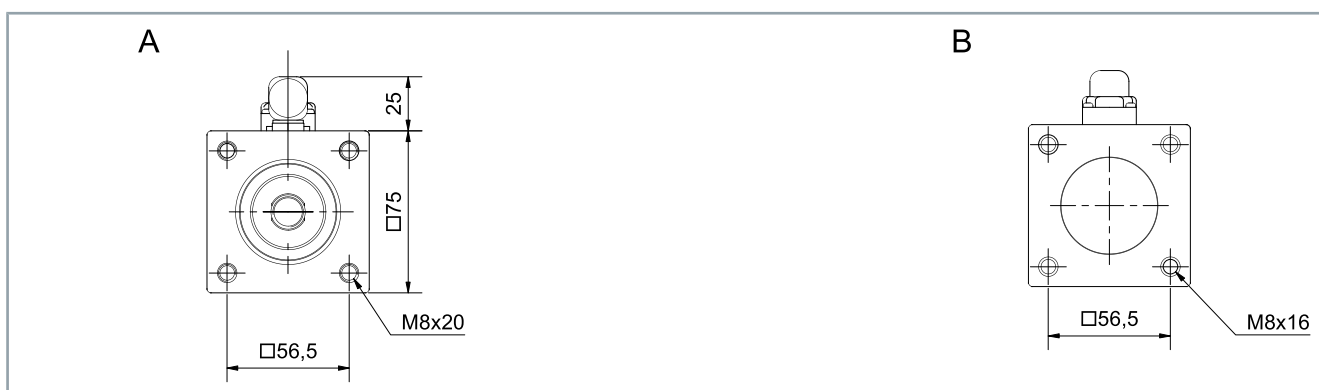


Illustration: Side view A and B to show flange dimensions

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 AA3100 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 27].

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]
AA3123	2
AA3133	2

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 due to mechanical loads

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

Malfunctions and damage to the electric cylinder due to improper lifting of 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 electric cylinder against falling down

⚠ WARNING

Possible injuries and damage to the product due to improper alignment

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

- Transport electric cylinder in horizontal position

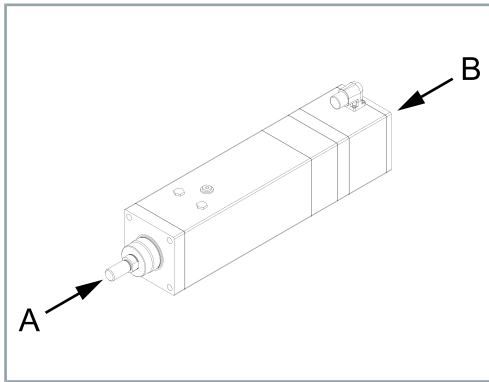


Legal regulations for the lifting of loads

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

Operating equipment for flange fastening

Size	AA3123	AA3133
Hexagon socket head cap screw DIN EN ISO 4762–8.8	M6	M8
A-flange screw depth [mm]	10	30
B-flange screw depth [mm]	20	25
Tightening torque [Nm]	10	24



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

6.2.1 Transport AA3123 and AA3133

The AA3123 and AA3133 series can be transported without auxiliary means.

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 37].

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.

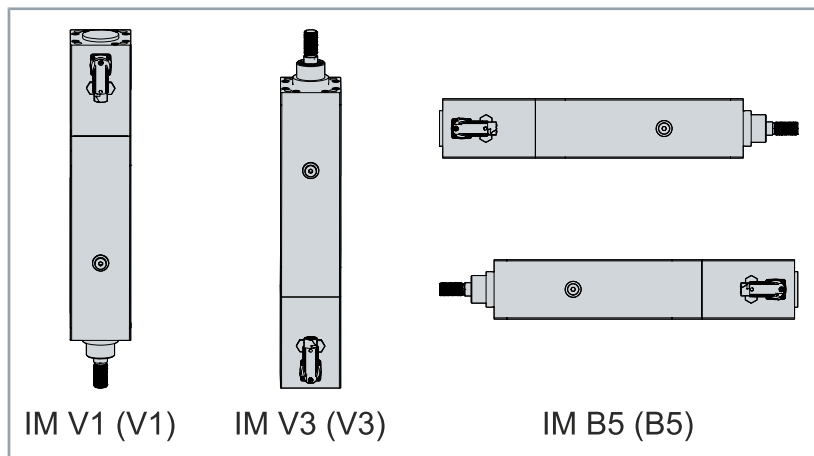
NOTICE

Contamination 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 59].
- 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.



⚠ WARNING

Risk of injury due to unsecured axes

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

- Read the chapter "Ordering options", [Page 23].
- Observe the note on the optional holding brake [+] in chapter "Product characteristics", [Page 22].

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 only:

- 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 consideration of 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 AA3100 series.

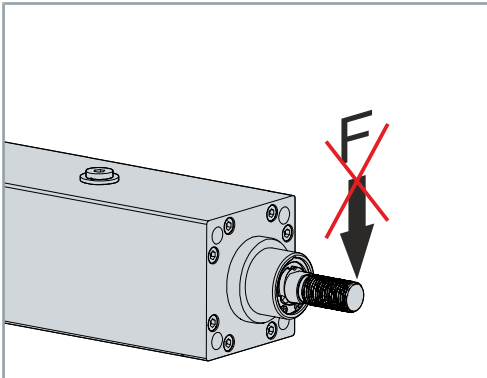
The LPTC-600 is integrated in the monitoring system of the servo drive when using the pre-assembled power cable. Configure the servo drive according to the motor temperature warning at 120 °C and the switch-off temperature at 140 °C.

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.



NOTICE

Reduced lifetime due to high radial forces

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

- 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

Commercially available connecting elements or coupling elements from pneumatics avoid 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.

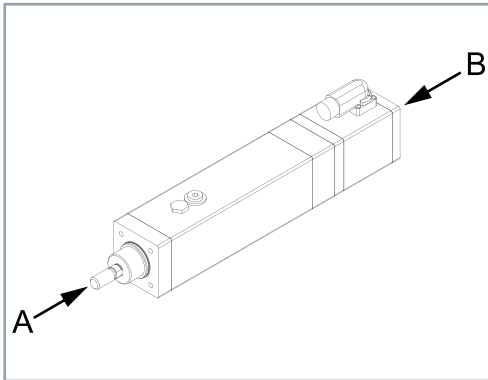
NOTICE

Damage due to inadmissible loads

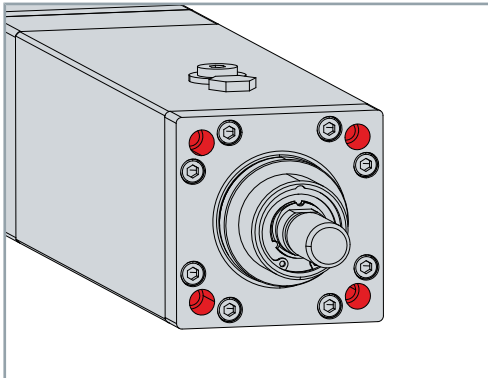
Shocks, impacts, torques or radial forces acting on the spindle can directly damage the spindle drive or reduce the lifetime of the electric cylinder.

- Do not bend any components during transport or handling
- Furthermore, note vibration qualities and vibration resistance
- Provide additional support for the electric cylinder if required

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, the corresponding screw depths and the tightening torques.

Size	AA3123	AA3133
Hexagon socket head cap screw DIN EN ISO 4762–8.8	M6	M8
A-flange screw depth [mm]	10	30
B-flange screw depth [mm]	20	25
Tightening torque [Nm]	10	24

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

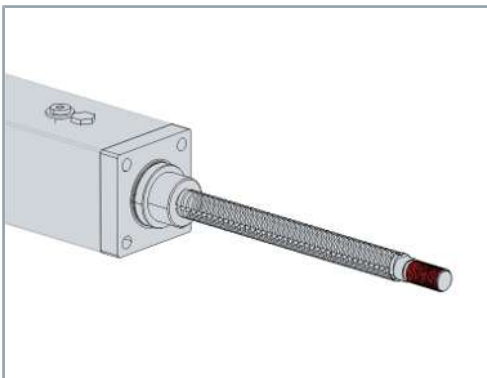
8.2 Fastening the end of the spindle

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.

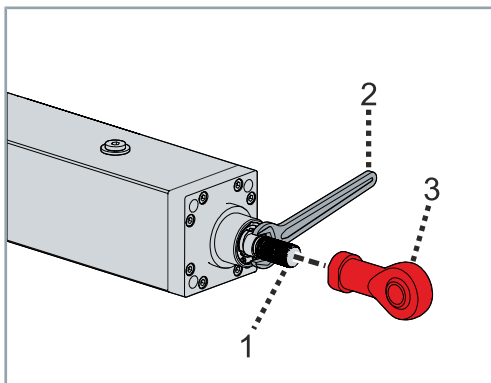
Size	AA3123	AA3133
External thread at spindle end	M12 x 1.25	M16 x 1.5
available thread length [mm]	24	32
Width across flats	13	17

Assembly of fasteners

The external thread of the spindle end is adapted to the common sizes of the pneumatic standard ISO 15552. 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.

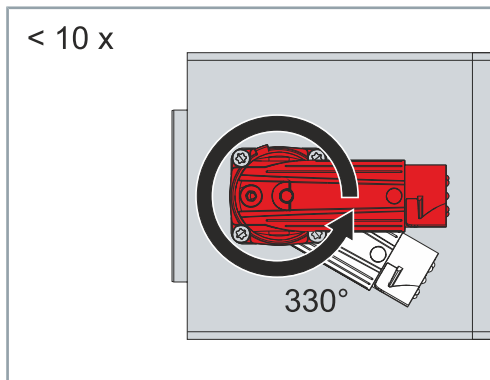
9.1 Power / feedback connection

NOTICE

Wear and limited data transmission due to high mechanical stress

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° to bring it into a safe indexing position.
- Only adjust the angle box with the 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
AA3123	rotatable angle box itec®
AA3133	rotatable angle box itec®

9.1.1 Pin assignment itec® (OCT)



Illustration: rotatable angle box itec® (OCT)

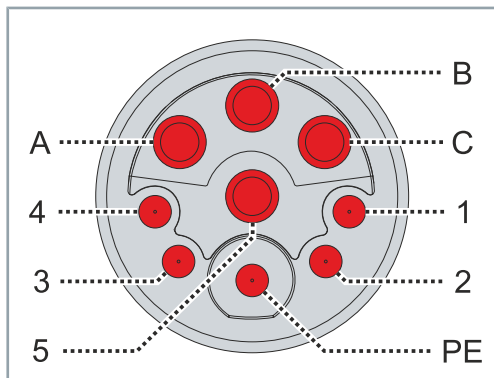


Illustration: Mating face power box itec® (OCT)

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

9.2 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.

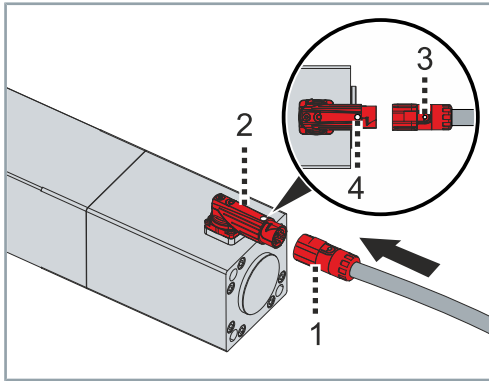
- Keep the pins and the inside of the component free of dirt.
- Carefully connect the plug
- Check connector for damage and replace if necessary



Trouble-free application and assembly

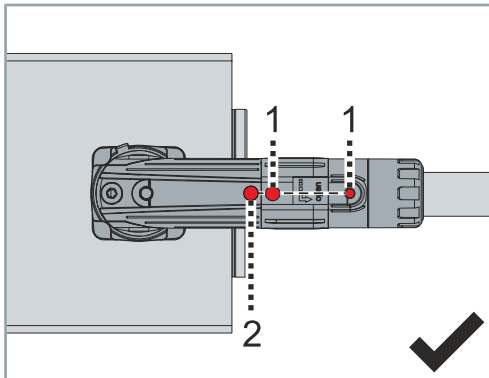
- Wire in accordance with the applicable regulations and standards.
- Use pre-assembled and shielded cables according to the servo drive used.

9.2.1 Establish the itec® plug connection



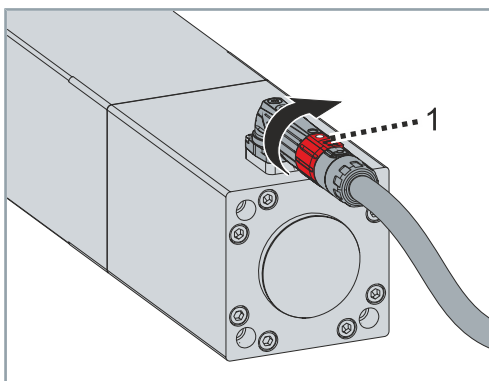
- Push the itec® connector [1] of the motor cable straight onto the power box [2] of the electric cylinder.
- Make sure that the marking point of the motor cable [3] and the marking point of the power box [4] are opposite each other.

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.

9.3 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. The use of other cables can cause unexpected faults and result in exclusion of warranty.

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.

AA3123, AA3133

Motor cables for ELM72xx Servomotor EtherCAT Terminals

Servo drive	Ordering information	Laying method
ELM7211 to ELM7231	ZK4704-0401-2xxx	Fixed installation
	ZK4704-0421-2xxx	Highly dynamic
	ZK4704-0461-2xxx	Torsion-capable



The maximum cable length for the ELM72xx is limited to a maximum of 20 m OCT cable including extension.

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:

ELM72xx servo drive

Motor cable	Ordering information of the extension cable	Laying method
ZK4704-0401-2xxx	ZK4701-0401-2xxx	Fixed installation
ZK4704-0421-2xxx	ZK4701-0421-2xxx	Highly dynamic
ZK4704-0461-2xxx	ZK4701-0461-2xxx	Torsion-capable

Connect the extension cable as described in chapter "Connect the motor cable", [Page 48].

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
- TwinCAT NC PTP
- Servomotor EtherCAT Terminal ELM72xx
- Electric cylinder AA3100

10.1 Before commissioning

Pay attention to the following points before commissioning:

- ▶ Read the operating instructions for the Servomotor EtherCAT Terminal used
- ▶ ELM72xx Servomotor EtherCAT Terminal Read functional description
- ▶ ELM72xx Servomotor EtherCAT Terminal Read diagnosis messages
- ▶ ELM72xx Servomotor EtherCAT Terminal Read 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



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 1.1.45.0 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.



Check and update software version

The automatic protection of the end positions of the electric cylinder requires at least one installed version of TwinCAT NC PTP.

- Check the TwinCAT 3 software version to see if an NC PTP is available
- If necessary, install TwinCAT 3 NC PTP (TF5000 or higher)



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:

ELM72xx SW 2 Rev. 17 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 and the type code table to check whether the electric cylinder used is equipped with an integrated anti-twist protection [+] and/or a holding brake [+].



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 40]
- ▶ 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 64].
- ▶ 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 27].
- ▶ 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 nameplate. Thus, the output encoder position value corresponds to the absolute position of the spindle. A 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 due to incorrect end position

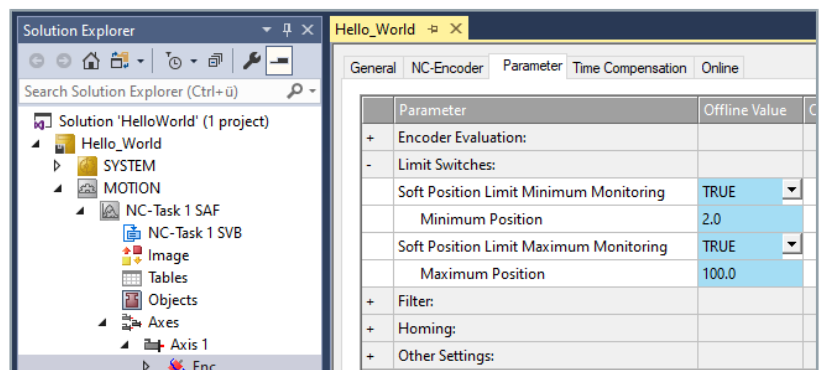
By manually changing the software end positions or the encoder offset in the configuration, the mechanical end positions can be exceeded and the electric cylinder can be damaged.

- 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
- ▶ Create DriveManager 2 project and scan drives
- ▶ 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 nameplate. The current encoder position is undefined and does not match the zero position of the spindle. Therefore, it is mandatory to perform a homing in order to determine the offset position of the encoder from this.

NOTICE

Damage to the electric cylinder due to incorrect end position

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

- Make manual changes to the software end positions with care

NOTICE

Damage to the electric cylinder due to missing homing

Commissioning without determining the encoder offset and the software end positions by means of a suitable 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 the homing

Mechanics

The end positions of the electric cylinder are no mechanical end stops and must not be used as such. During the homing, the end positions must be secured with external end stops.

- ▶ Please refer to chapter "Integrated anti-twist protection [+]", [Page 23].
- ▶ 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 the homing. The information on the position of the end positions can be found in the chapter Technical data.
- ▶ The dimensions for determining the zero position of the spindle can be found in dimensional drawing AA3123 and dimensional drawing AA3133.

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 name 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 position and lubrication stroke length.

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 40] .

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 As the volume increases: • Check electric cylinder for increased phase current and winding temperature 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 59].
Ball screw and ball bearing	10 million cycles	Check for running noises As the volume increases: • Check electric cylinder for increased phase current and winding temperature Do not continue to operate electric cylinder Contact Beckhoff Service
Cables	Regular intervals	Perform visual inspection and check for damage If required: • Replace cables
	5 million bending cycles	In case of drag chain suitable application: • Replace cables
Power box	500 mating cycles	In case of damage: • Contact Beckhoff Service
Connector	10 turning cycles	In case of damage: • Contact Beckhoff Service

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.



Local lack of lubrication

The 1,000,000 cycles only apply if the working stroke is greater than the lubrication stroke of the electric cylinder used. See "Chapter 10.3", [Page 55] for further information.

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 the use of the lubricant Klüberlub BE 71-501. For more information on the lubricant, please contact the manufacturer.

Lubrication position and lubrication stroke length

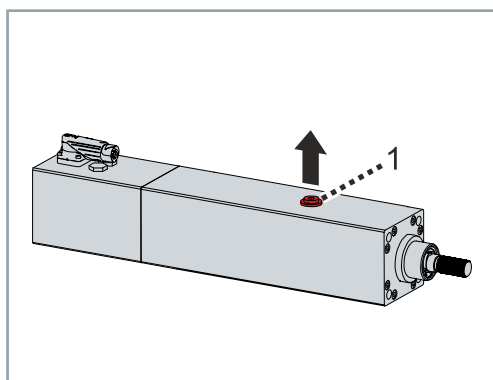
The approachable lubrication position is reached according to the distance in the following table. Select a lubrication position that you can approach without problems in your application in order to run the lubrication stroke in the corresponding length.

AA3123	-22yz	-42yz
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

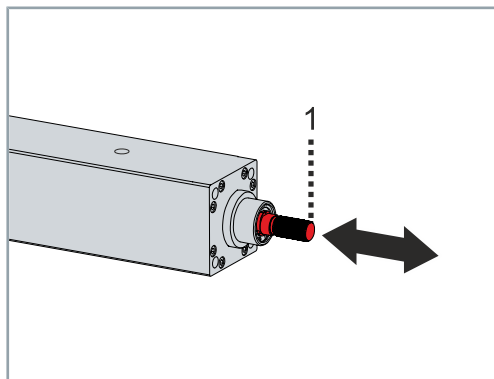
AA3133	-23yz	-43yz
Motor rotation angle [°]	120	120
Distance between lubrication positions [mm]	1.6	3.2
Grease quantity [g]	1.5	1.5
Lubrication stroke length [mm]	100 or ± 50	100 or ± 50

Carry out lubrication

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

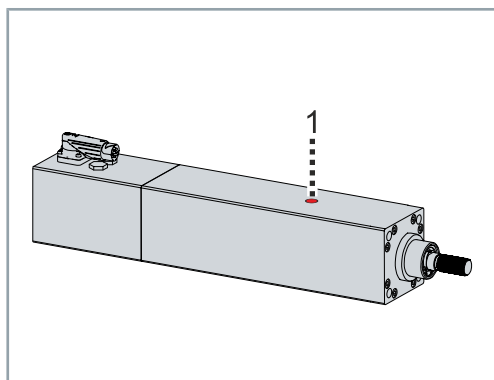


- Loosen screw with washer [1] and take out



- Move spindle [1] to next possible lubrication position

Further information can be found in chapter Lubrication position and lubrication stroke length.

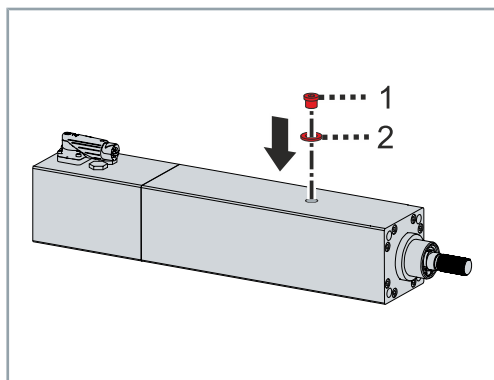


- Grease lubrication point [1] with grease gun
Lubrication point: DIN3405 D1 M6x1 funnel-type grease nipple

It is recommended to use a lubrication adapter:

Needle piece with 60 mm length

- 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 position and lubrication stroke length.

11.4 Cleaning

⚠ WARNING

Carrying 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 condition.
- 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 due to ingress of liquids

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

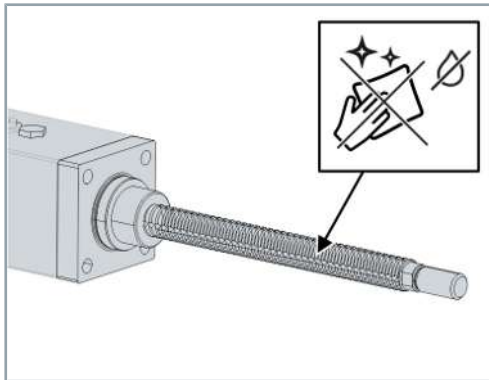
Housing

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	$\text{C}_6\text{H}_5\text{NH}_2\text{HCl}$
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	AA3123	AA3133
Pneumatic cylinder [mm]	Ø 40	Ø 63

To attach the accessories to the electric cylinder, follow the installation instructions in the chapter "Fastening the end of the spindle", [Page 45].

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																	
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												

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 nameplate 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 44]
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.

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 nameplate 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 nameplate 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.

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 69].

14.1 Disassembly

WARNING

Risk of injury due to unintentional machine movement

Unintentional machine movements can lead to serious or fatal injuries.

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



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 condition of the machine.
- ▶ Secure the machine against unintentional 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 61].
- ▶ 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 37].

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 EN 60034-8:2008

"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



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.

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.

Send your request to info@beckhoff.com.

15.5 CCC conformity



Export to Chinese Economic Area

Beckhoff electric cylinders of the AA3100 series are not subject to the **C**hina **C**ompulsory **C**ertificate; CCC. The products are exempt from this certification and can be exported to the Chinese economic area.

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