

Technical Documentation



Product manual

Portal axes with spindle

PAS4xS

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Important information

The drive systems described here are products for general use that conform to the state of the art in technology and are designed to prevent any dangers. However, drives and drive controllers that are not specifically designed for safety functions are not approved for applications where the functioning of the drive could endanger persons. The possibility of unexpected or unbraked movements can never be totally excluded without additional safety equipment. For this reason personnel must never be in the danger zone of the drives unless additional suitable safety equipment prevents any personal danger. This applies to operation of the machine during production and also to all service and maintenance work on drives and the machine. The machine design must ensure personal safety. Suitable measures for prevention of property damage are also required.

See safety section for additional critical instructions.

Not all product variants are available in all countries.

Please consult the current catalogue for information on the availability of product variants.

We reserve the right to make changes during the course of technical developments.

All details provided are technical data and not promised characteristics.

In general, product names must be considered to be trademarks of the respective owners, even if not specifically identified as such.

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Writing conventions and symbols

Work steps If work steps must be carried out in sequence, they are shown as follows:

- Special prerequisites for the following work steps
- ▶ Step 1
- ◁ Important response to this work step
- ▶ Step 2

If a response to a work step is specified, this will inform you that the step has been carried out correctly.

Unless otherwise stated, the individual instruction steps must be carried in the given sequence.

Lists Lists can be sorted alphanumerically or by priority. Lists are structured as follows:

- Point 1
- Point 2
 - Subpoint to 2
 - Subpoint to 2
- Point 3

Making work easier Information on making work easier can be found at this symbol:



*This offers supplementary information on making work easier.
See the chapter on safety for an explanation of the safety instructions.*

1 Introduction

1.1 Overview of product properties

Berger Lahr has extended the portal axis range with the new spindle axes.

The spindle axes are based on specially developed and particularly distortion-resistant aluminium sections. A special feature is their ability to position heavy loads and oscillating torques with a ball screw drive and recirculating ball bearing guides accurately and repeatedly with high feed force.

Special features and options

- High positioning speed even at extended spindle length with one or more moving spindle supports
- User-friendly structure
 - Easy system integration with section technology (ITEM-compatible T-section slots)
 - Carriage with threaded holes and locating dowels for reproducible support of the load
 - External lubrication
 - Heavy loads can be distributed over up to three carriages
 - Metal strip cover optional
 - Motor attachment by coupling system
 - Stroke length available to millimetre accuracy
 - Sensors can be moved anywhere in T-section slots
- Belt drive gear optional (1:1)
- Linear encoder measuring system optional

1.2 Scope of supply

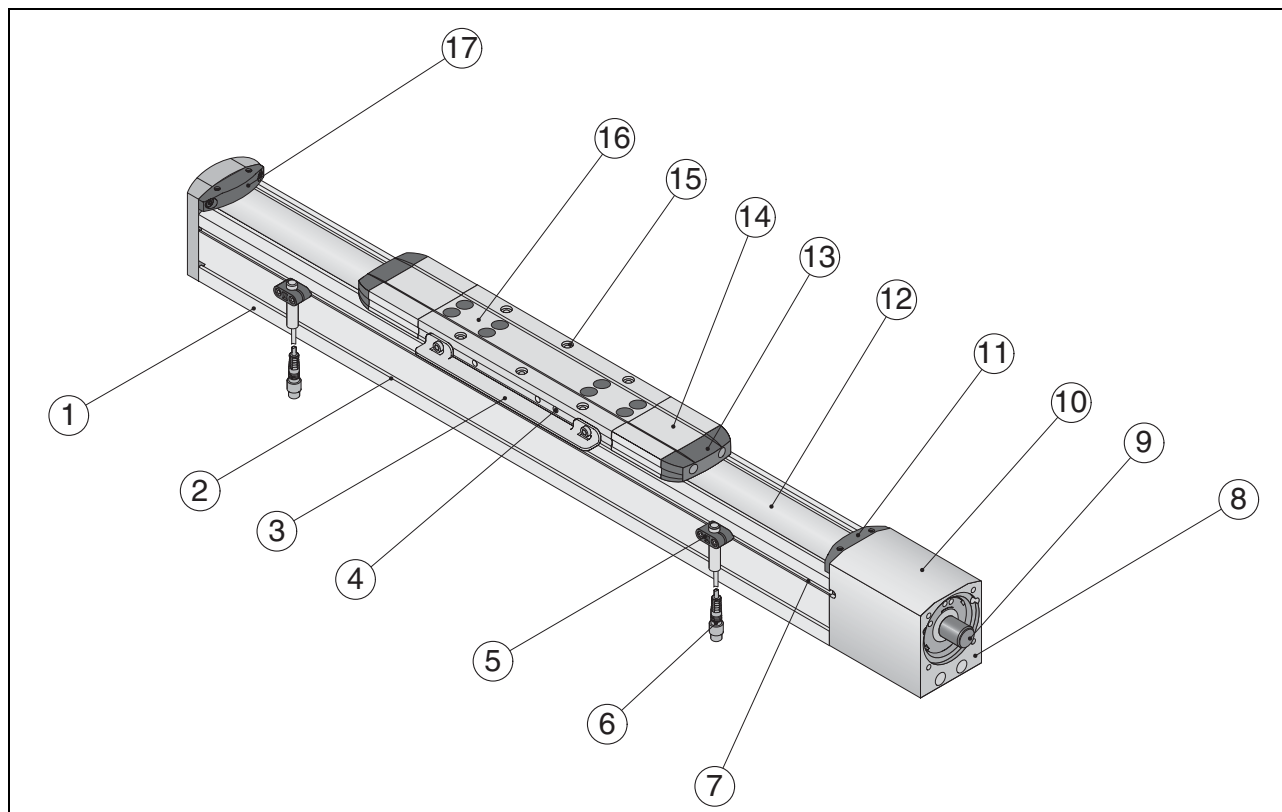


Figure 1.1 Components of a spindle axis

- (1) Axial section
- (2) T-slot fastening
- (3) Sensor contact plate
- (4) Lubrication nipple
- (5) Sensor retainer
- (6) Sensor with connector cable
- (7) T-slot for fastening the sensor retainer
- (8) Flange for drive attachment
- (9) Drive shaft
- (10) Drive block
- (11) Metal cover strip fastening
- (12) Metal cover strip
- (13) Buffer
- (14) Metal cover strip deflector
- (15) Threaded holes for mounting the load
- (16) Carriage
- (17) End plate with spindle bearing

1.3 Type code

Spindle axes	PAS	4	2	S	B	D	1200	C	1	N	B	xxx	S	N	/	I6
Product PAS = portal axis	PAS	4	2	S	B	D	1200	C	1	N	B	xxx	S	N	/	I6
product family 4 = basic line	PAS	4	2	S	B	D	1200	C	1	N	B	xxx	S	N	/	I6
Size (profile cross section) 2 = 60; (60 x 60 mm) 3 = 80; (80 x 80 mm) 4 = 110; (110 x 110 mm)	PAS	4	2	S	B	D	1200	C	1	N	B	xxx	S	N	/	I6
Carriage drive S = spindle A = support axis (without drive, guides only)	PAS	4	2	S	B	D	1200	C	1	N	B	xxx	S	N	/	I6
Guide type B = recirculating ball bearing guide	PAS	4	2	S	B	D	1200	C	1	N	B	xxx	S	N	/	I6
Feed per revolution B = 5 mm (with PAS42, PAS43, PAS44) D = 10 mm (with PAS42, PAS43, PAS44) F = 16 mm (with PAS42) G = 20 mm (with PAS43) H = 25 mm (with PAS44) N = support axis	PAS	4	2	S	B	D	1200	C	1	N	B	xxx	S	N	/	I6
Stroke length XXXX = in mm	PAS	4	2	S	B	D	1200	C	1	N	B	xxx	S	N	/	I6
Limit switch ¹⁾ A = 2 x PNP, normally closed contact, not wired B = 2 x PNP, normally closed contact, connected to IclA C = 2 x PNP, normally open contact, not wired D = 2 x PNP, normally open contact, connected to IclA E = 2 x NPN, normally closed contact, not wired F = 2 x NPN, normally closed contact, connected to IclA G = 2 x NPN, normally open contact, not wired H = 2 x NPN, normally open contact, connected to IclA N = without sensors	PAS	4	2	S	B	D	1200	C	1	N	B	xxx	S	N	/	I6
Carriage 1 = type 1 4 = type 4	PAS	4	2	S	B	D	1200	C	1	N	B	xxx	S	N	/	I6
Options B = with cover strap N = without cover strap	PAS	4	2	S	B	D	1200	C	1	N	B	xxx	S	N	/	I6
Number of carriages A = one B = two C = three	PAS	4	2	S	B	D	1200	C	1	N	B	xxx	S	N	/	I6
Distance between carriages 1..999 = distance in mm xxx = with only one carriage	PAS	4	2	S	B	D	1200	C	1	N	B	xxx	S	N	/	I6
Axis drive interface S = with motor D = with shaft	PAS	4	2	S	B	D	1200	C	1	N	B	xxx	S	N	/	I6
Toothed-belt drive gear N = without toothed-belt drive gear	PAS	4	2	S	B	D	1200	C	1	N	B	xxx	S	N	/	I6

Spindle axes	PAS	4	2	S	B	D	1200	C	1	N	B	xxx	S	N	/	I6
Motor/gearing interface	PAS	4	2	S	B	D	1200	C	1	N	B	xxx	S	N	/	I6
V6 - stepper motors VRDM364 / VRDM366																
V8 - stepper motors VRDM368																
V9 - stepper motors VRDM397 / VRDM3910																
V0 - stepper motors VRDM3913																
V1 - stepper motors VRDM311•																
I6 - IclA I•S61 / I•S62 with stepper motor																
I7 - IclA I•S63 with stepper motor																
I9 - IclA I•S91 / I•S92 with stepper motor																
I8 - IclA I•S93 with stepper motor																
S6 - servomotors SER36•																
S9 - servomotors SER39•																
S1 - servomotors SER311•																
A6 - IclA IFA6• with servomotor																
G9 - servomotors RIG39•																
G1 - servomotors RIG311•																
H5 - servomotors BSH055•																
H7 - servomotors BSH0701 / BSH0702																
H8 - servomotors BSH0703																
H1 - servomotors BSH1001 / BSH1002 / BSH1003																
H4 - servomotors BSH1004																
XX - third-party motor / third-party gearing without attachment																
XY - third-party motor / third-party gearing with attachment																

1) With 100 mm cable with connector wired at one end, other types as accessories

1.4 Documentation and literature references

The following User's manuals are supplied with this drive system:

- **Product manual**, describes the technical data, installation, commissioning and all operating modes and operating functions.
- **Motor manual**, describes the technical properties of the motors, including correct installation and commissioning.


The user's manuals can also be found in the Internet at

<http://www.schneider-motion.com/doku>.

1.5 Directives and standards

<i>CE mark</i>	With the declaration of conformity and the CE mark on the product the manufacturer certifies that the product complies with the requirements of all relevant EC directives.
<i>EC Machine Directive</i>	<p>The drive systems described here are not machines as defined by the EC Machine Directive (98/37/EEC) but components for installation in machines. They do not have moving parts designed for specific purposes. However, they can be components of a machine or system.</p> <p>The manufacturer must certify that the complete system conforms to the machine directive with the CE mark.</p>
<i>EC EMC Directive</i>	<p>The EC Electromagnetic Compatibility Directives (89/336/EEC) applies to products that cause electromagnetic interference or whose operation may be adversely affected by electromagnetic interference.</p> <p>Conformity with the EMC Directive can only be expected of drive systems after correct installation in the machine. The information on ensuring electromagnetic compatibility given in the chapter on "Installation" must be followed to ensure that the drive system in the machine or system is EMC-compatible and that the product can legally be operated.</p>
<i>EC Low-Voltage Directive</i>	<p>The EC Low-Voltage Directive (73/23/EEC) lays down safety requirements for 'electrical apparatus' as protection against the risks that can originate in such devices and can be created in response to external influences.</p> <p>The drive systems described here comply with the EN 50178 Standard as per the Low-Voltage Directive.</p>
<i>Declaration of conformity</i>	The declaration of conformity certifies that the drive system complies with the specific EC directive.
<i>Standards for safe operation</i>	<p>EN ISO 12100-1: Safety of machinery - Basic concepts, general principles for design - Part 1: Basic terminology, methodology</p> <p>EN ISO 12100-2: Safety of machinery - Basic concepts, general principles for design - Part 2: Technical principles</p> <p>EN 60204-1: Electrical equipment of machines, General requirements</p> <p>EN 60529: IP degrees of protection</p>
<i>Standards for compliance with EMC limit values</i>	EN 61800-3: Variable-speed electrical drives

1.6 Manufacturer's Declaration

<u>MANUFACTURER'S DECLARATION</u>		BERGER LAHR BERGER LAHR GmbH & Co. KG Breslauer Str. 7 D-77933 Lahr
according to EC Directive on Machinery 98/37/EG		
We hereby declare that the following product:		
Designation:	Portal axis with toothed belt	
Type:	PAS41x / PAS42x / PAS43x / PAS44x	
Product number:	73xx xxxx xxx	
in the version delivered is intended for installation in a machine. Commissioning is prohibited unless the machine meets the regulations according to the EC directives. Please observe the safety instructions in our technical documentation.		
Applied harmonized standards, especially	EN ISO 12100-1: 2003-11 Safety of machinery basic concepts, principles for design Part 1: Basic terminology, methodology EN ISO 12100-2: 2003-11 Safety of machinery basic concepts, principles for design Part 2: Technical principles and specifications	
Applied national standards and technical specifications, especially		
Company stamp:	Berger Lahr GmbH & Co. KG Postfach 11 80 · D-77901 Lahr Breslauer Str. 7 · D-77933 Lahr	
Date/ Signature:	03.07.2006	
Name/ Department:	Dr. Björn Hagemann / VP-Technology	

2 Safety

2.1 Qualification of personnel

Only technicians who are familiar with and understand the contents of this manual and the other relevant manuals are authorised to work on and with this drive system. The technicians must be able to detect potential dangers that may be caused by setting parameters, changing parameter values and generally by the mechanical, electrical and electronic equipment.

The technicians must have sufficient technical training, knowledge and experience to recognise and avoid dangers.

The technicians must be familiar with the relevant standards, regulations and safety regulations that must be observed when working on the drive system.

2.2 Intended use

The drive systems described here are products for general use that conform to the state of the art in technology and are designed to prevent any dangers. However, drives and drive controllers that are not specifically designed for safety functions are not approved for applications where the functioning of the drive could endanger persons. The possibility of unexpected or unbraked movements can never be totally excluded without additional safety equipment. For this reason personnel must never be in the danger zone of the drives unless additional suitable safety equipment prevents any personal danger. This applies to operation of the machine during production and also to all service and maintenance work on drives and the machine. The machine design must ensure personal safety. Suitable measures for prevention of property damage are also required.

In the system configuration described the drive systems must be used in industrial applications only and must have a fixed connection only.

In all cases the applicable safety regulations and the specified operating conditions, such as environmental conditions and specified technical data, must be observed.

The drive system must not be commissioned and operated until completion of installation in accordance with the EMC regulations and the specifications in this manual.

To prevent personal injury and damage to property damaged drive systems must not be installed or operated.

Changes and modifications of the drive systems are not permitted and if made all no warranty and liability will be accepted.

The drive system must be operated only with the specified wiring and approved accessories. In general, use only original accessories and spare parts.

The drive systems must not be operated in an environment subject to explosion hazard (ex area).

2.3 General safety instructions

DANGER

Electric shock

High voltages at the motor connection may occur unexpectedly.

- Make sure that the drive (including DC bus) is disconnected from power before working on the drive system
- AC voltages may jump over unused wires in the motor cable. Isolate unused wires at both ends of the motor cable.
- The motor generates voltage when the shaft is rotated. Lock the motor shaft to prevent rotation before starting work on the drive system.

Failure to follow these instructions will result in death or serious injury.

WARNING

Risk of injury by heavy weight, falling parts or crushing!

- Take the weight of the axis into account during mounting. It may be necessary to use a crane.
- Install the threaded fasteners (torque, screw locking) to ensure that axis and attachments do not come apart even under strong accelerations or continuous vibration.
- Note that axes subject to external forces (vertical axes) may drop unexpectedly.

Failure to follow these instructions can result in death, serious injury or equipment damage.

WARNING

Danger of injury by loss of control!

- Observe the accident prevention regulations. (For USA see also NEMA ICS1.1 and NEMA ICS7.1)
- The system manufacturer must take the potential error possibilities of the signals and the critical functions into account to ensure a safe state during and after errors. Some examples are: emergency stop, final position limitation, power failure and restart.
- The assessment of error possibilities must also include unexpected delays and the failure of signals or functions.
- Suitable redundant control paths must be in place for dangerous functions.
- Check that measures taken are effective.

Failure to follow these instructions can result in death or serious injury.

▲ CAUTION

Hot surfaces can cause burns and damage to system components!

The drive temperature can exceed 100°C (212°F) in some conditions.

- Avoid contact with the hot drive.
- Do not place combustible or heat-sensitive components in immediate vicinity.
- Follow the actions described for heat dissipation.
- Check the temperature of the drive during the test run.

Failure to follow these instructions can result in injury or equipment damage.

3 Technical Data

For definitions and explanations of terms see chapter 10 "Glossary".

3.1 Environmental conditions

When considering the ambient temperature a distinction is made between the permissible temperatures during operation and the permissible storage and transport temperature.

Ambient operating temperature

Temperature	[°C]	0 - +50
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Ambient climate for transport and storage

The environment during transport and storage must be dry and dust-free. The maximum oscillation and shock stress must be within the specified limits. The bearing and transport temperature must remain within the specified range.

Temperature	[°C]	-25 ... +70
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Relative humidity

The relative humidity is allowed as follows:

rel. air humidity	corresponding to IEC60721-3-3, Class 3K3, non-condensing
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Installation height

Installation height above mean sea level for 100% power	[m]	< 1500
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3.2 Mechanical data

Service life

Use the information in the catalogue to calculate the service life.

Repeat accuracy

The repeat accuracy is ± 0.02 mm. This value is influenced by temperature change, speed and load changes.

Stroke reserve

Size	Stroke reserve	
PAS42	[mm]	10
PAS43	[mm]	15
PAS44	[mm]	20

Positioning accuracy

The positioning accuracy with spindle axes depends primarily on the accuracy class of the threaded spindle.

Thread length of spindle [mm]	To	315	400	500	630	800	1000	1250	1600	2000	2500	3150
Tolerances [$\pm \mu\text{m}$]	P7	52	57	63	70	80	90	105	125	150	175	210

* As per DIN 69051 (Part 3) Standard

3.2.1 PAS42x

Characteristic values		PAS42SB		
Spindle pitch	[mm]	5	10	16
Guide type		Recirculating ball bearing guide		
Max. payload	[kg]	24		
Max. stroke length	[mm]	1500		
Min. stroke length	[mm]	9		
Max. speed	[m/s]	0.25	0.50	0.80
Max. acceleration	[m/s ²]	10		
Max. drive force $F_{x_{dynmax}}$	[N]	1035	680	785
Max. force $F_{y_{dynmax}}$	[N]	3535		
Max. force $F_{z_{dynmax}}$	[N]	3535		
Max. torque $M_{x_{dynmax}}$	[Nm]	24		
Max. initialising driving torque M_{max}	[Nm]	0.9	1.2	2.2
Load ratings drive system C_0/C_{dyn}	[N]	24200 / 14200		
Repeat accuracy	[mm]	±0.02		
No-load torque 0-stroke axis (without carriage)	[Nm]	0.40		
Moment of inertia 0-stroke axis (without carriage)	[kgcm ²]	1.05		
Moment of inertia per m stroke	[kgcm ² /m]	0.35	0.45	0.45
Moment of inertia per kg payload	[kgcm ² /kg]	0.006	0.025	0.065
Moment of inertia of coupling assembly (without motor)	[kgcm ²]	0.3		
Mass 0-stroke axis (without motor, without carriage)	[kg]	1.80		
Mass of stroke per m stroke (incl. spindle and profile)	[kg/m]	6.9		
Mass of motor attachment (without motor)	[kg]	0.55		
Internal diameter of clutch for motor attachment	[mm]	6 ... 14		
Drive shaft diameter	[mm]	16 g6		
Profile cross section (W x H)	[mm]	60 x 60		
Axial planar moment of inertia I_x/I_y	[mm ⁴]	461963 / 598338		
Elasticity module (aluminium)	[N/mm ²]	0.72 x 10 ⁵		
Spindle				
Spindle diameter	[mm]	16		
Spindle accuracy		P7 in accordance with DIN 69051 Part 3		
Max. spindle speed	[1/min]	3000		
Spindle axial play	[mm]	0.04		

Carriage		Type 1			Type 4		
		5	10	16	5	10	16
Spindle pitch	[mm]	5	10	16	5	10	16
Max. torque of carriage $M_{y_{dynmax}}$	[Nm]	265			585		
Max. torque of carriage $M_{z_{dynmax}}$	[Nm]	265			585		
Max. stroke length with/without cover strap	[mm]	1785 / 1880			1605 / 1700		
No-load torque of carriage	[Nm]	0.01	0.02	0.04	0.01	0.02	0.04
Moment of inertia of carriage with/without strap redirection (incl. spindle component)	[kgcm ²]	0.20 / 0.10	0.20 / 0.15	0.25 / 0.20	0.30 / 0.25	0.30 / 0.25	0.35 / 0.30
Mass of carriage with/without strap redirection (incl. spindle and profile component)	[kg]	3.6 / 2.8			5.25 / 4.45		

Note: the data apply to a spindle axis without drive. The listed torques and forces are based on an operational performance of 15000 km.

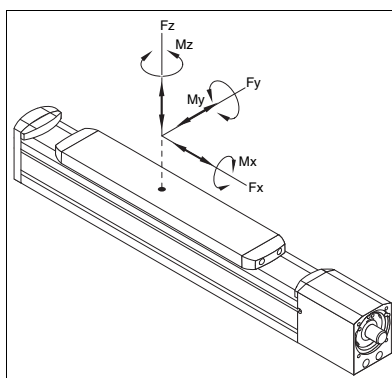
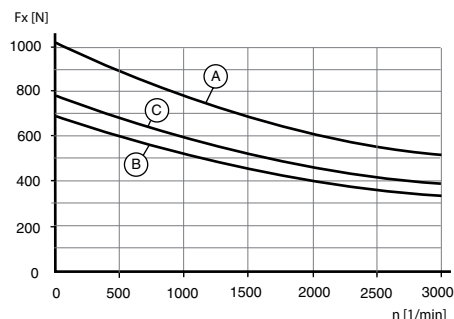


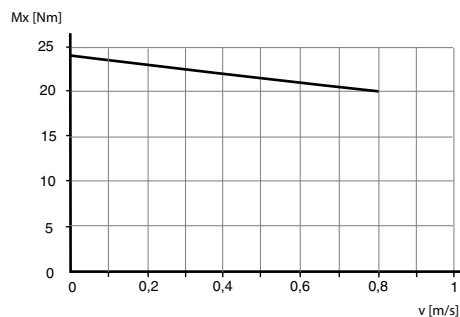
Figure 3.1 Forces and torques

PAS42SB characteristic curves

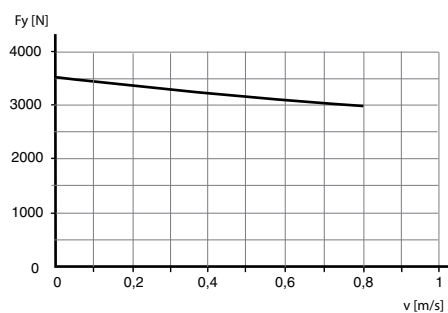
Max. feed force F_{x_dynmax}



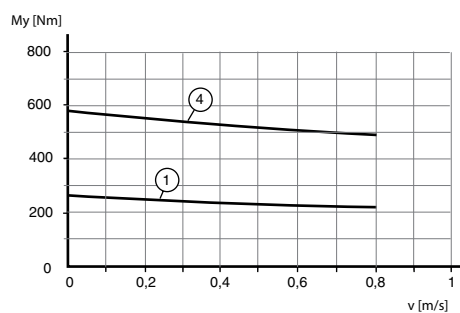
Max. torque M_{x_dynmax}



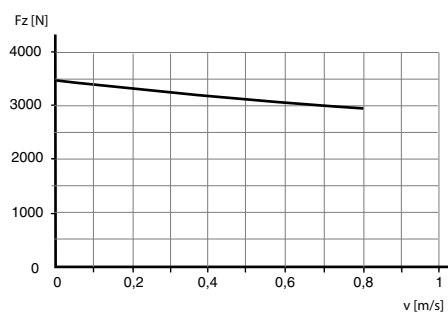
Max. force F_{y_dynmax}



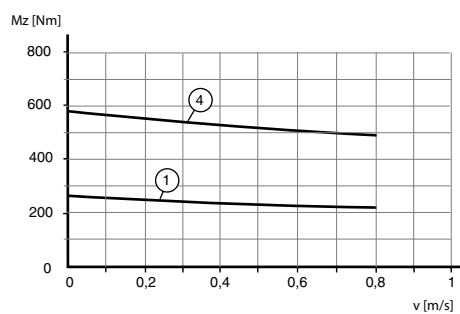
Max. torque of carriage M_{y_dynmax}



Max. force F_{z_dynmax}

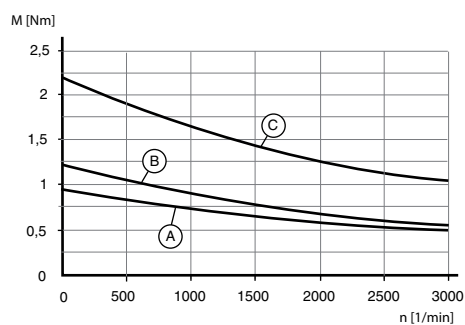


Max. torque of carriage M_{z_dynmax}



- (1) Carriage type 1
- (4) Carriage type 4
- (A) Spindle pitch 5 mm
- (B) Spindle pitch 10 mm
- (C) Spindle pitch 16 mm

Max. driving torque M_{max}



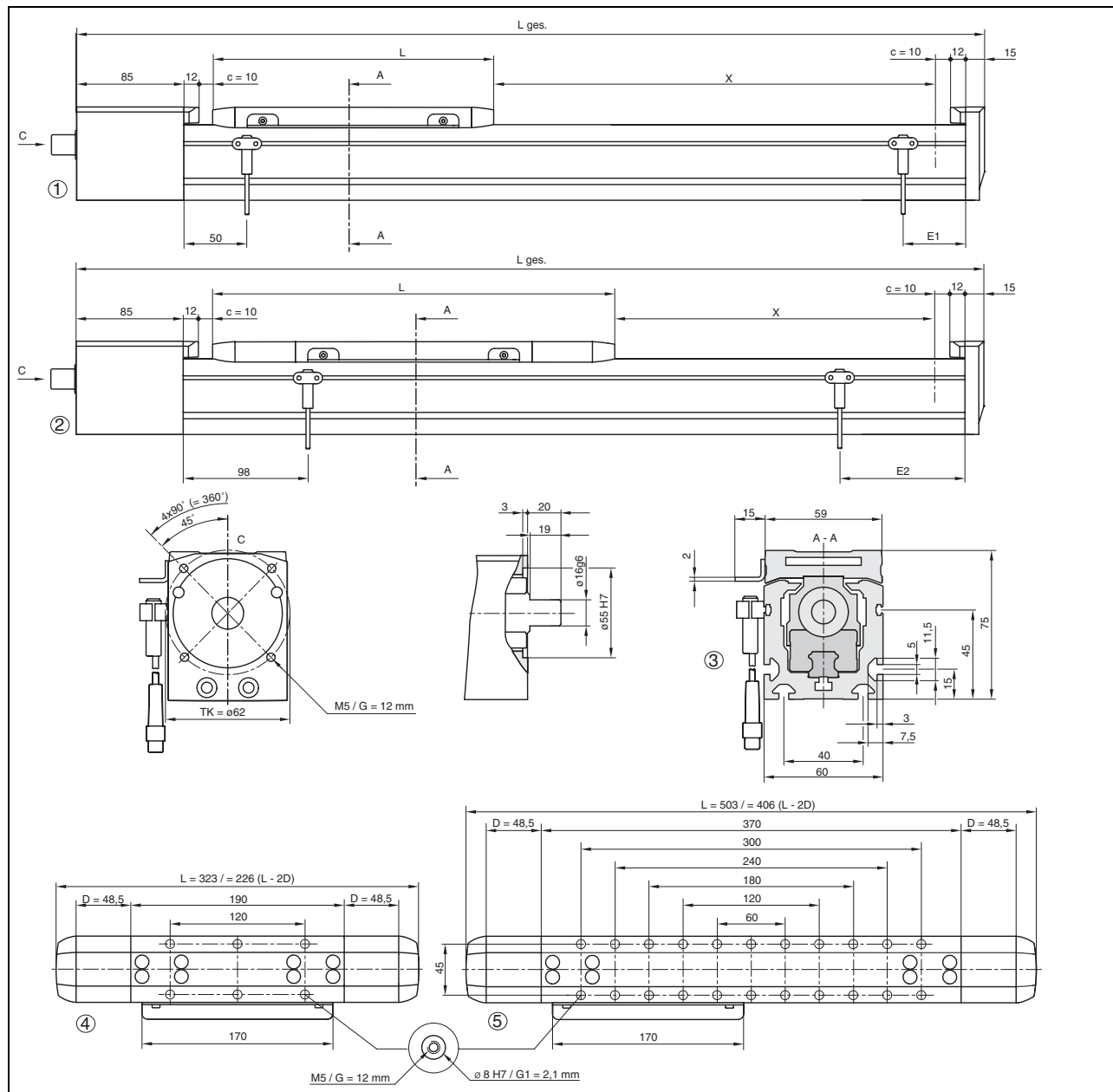


Figure 3.2 Dimensional drawing PAS42S

(1) = axis without cover strap	$L_{\text{total without cover strap}} = 144 + L + X$ (per additional carriage: $+ L + m$)
(2) = axis with cover strap	$L_{\text{total with cover strap}} = 144 + L + X$ (per additional carriage: $+ L + m$)
(3) = cross section with recirculating ball bearing guide	$L = \text{carriage length with cover strap (without cover strap: } L - 2D)$
(4) = carriage type 1	$x = \text{working stroke}$
(5) = carriage type 4	$m = \text{minimum distance between 2 carriages}$ with cover strap 90 mm, without cover strap 35 mm
	$c = \text{limit switch safety distances to the mechanical stop}$
	$D = \text{cover strap turning block}$
$G = \text{thread depth}$	$E1 = \text{carriage type 1: with cover strap 98 mm, without cover strap 50 mm}$
$G1 = \text{insertion depth}$	$E2 = \text{carriage type 4: with cover strap 248 mm, without cover strap 230 mm}$

3.2.2 PAS43x

Characteristic values		PAS43SB		
Spindle pitch	[mm]	5	10	20
Guide type		Recirculating ball bearing guide		
Max. payload	[kg]	60		
Max. stroke length	[mm]	3000		
Min. stroke length	[mm]	11		
Max. speed	[m/s]	0.25	0.5	1.00
Max. acceleration	[m/s ²]	10		
Max. drive force $F_{x_{dynmax}}$	[N]	1180	1140	950
Max. force $F_{y_{dynmax}}$	[N]	5550		
Max. force $F_{z_{dynmax}}$	[N]	5550		
Max. torque $M_{x_{dynmax}}$	[Nm]	52		
Max. initialising driving torque M_{max}	[Nm]	1	2	3.3
Load ratings drive system C_0/C_{dyn}	[N]	38400 / 22300		
Repeat accuracy	[mm]	±0.02		
No-load torque 0-stroke axis (without carriage)	[Nm]	0.60		
Moment of inertia 0-stroke axis (without carriage)	[kgcm ²]	2.30		
Moment of inertia per m stroke	[kgcm ² /m]	0.95	1.10	1.15
Moment of inertia per kg payload	[kgcm ² /kg]	0.006	0.025	0.101
Moment of inertia of coupling assembly (without motor)	[kgcm ²]	1.15		
Mass 0-stroke axis (without motor, without carriage)	[kg]	3.35		
Mass of stroke per m stroke (incl. spindle and profile)	[kg/m]	11.7		
Mass of motor attachment (without motor)	[kg]	1.1		
Internal diameter of clutch for motor attachment	[mm]	9 ... 20		
Drive shaft diameter	[mm]	20 g6		
Profile cross section (W x H)	[mm]	80 x 80		
Axial planar moment of inertia I_x/I_y	[mm ⁴]	1480068 / 1851166		
Elasticity module (aluminium)	[N/mm ²]	0.72 x 10 ⁵		

Spindle

Spindle diameter	[mm]	20
Spindle accuracy		P7 in accordance with DIN 69051 Part 3
Max. spindle speed	[1/min]	3000
Spindle axial play	[mm]	0.04

Carriage		Type 1			Type 4		
		5	10	20	5	10	20
Spindle pitch	[mm]						
Max. torque of carriage $M_{y_{dynmax}}$	[Nm]	485			1070		
Max. torque of carriage $M_{z_{dynmax}}$	[Nm]	485			1070		
Max. stroke length with/without cover strap	[mm]	3070 / 3190			2860 / 2980		
No-load torque of carriage	[Nm]	0.02	0.04	0.09	0.02	0.04	0.09
Moment of inertia of carriage with/without strap redirection (incl. spindle component)	[kgcm ²]	0.50 / 0.35	0.55 / 0.40	0.75 / 0.55	0.80 / 0.60	0.85 / 0.70	1.10 / 0.90
Mass of carriage with/without strap redirection (incl. spindle and profile component)	[kg]	7.45 / 5.75			10.75 / 9.05		

Note: the data apply to a spindle axis without drive. The listed torques and forces are based on an operational performance of 15000 km.

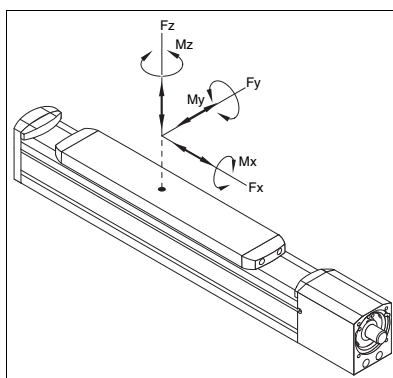
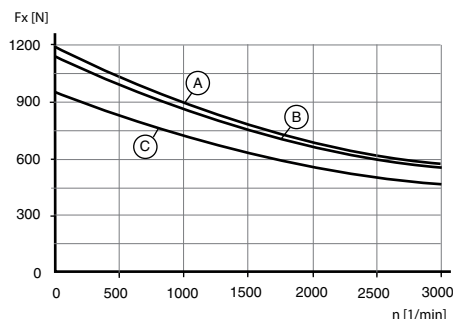


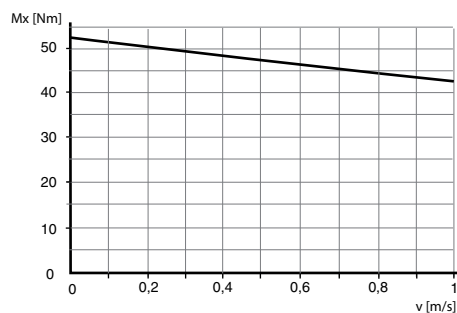
Figure 3.3 Forces and torques

PAS43SB characteristic curves

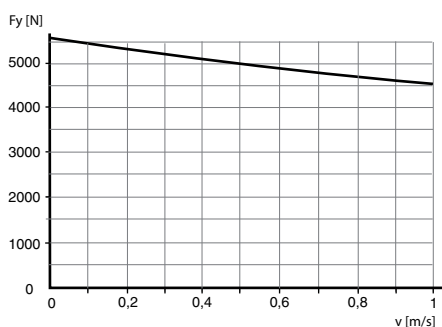
Max. feed force $F_{x_{dynmax}}$



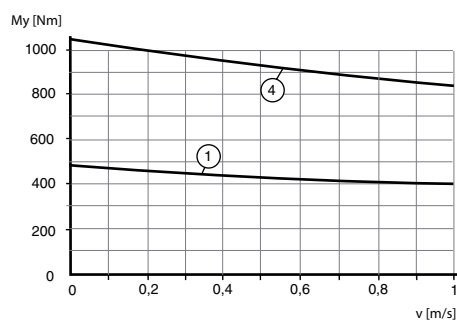
Max. torque $M_{x_{dynmax}}$



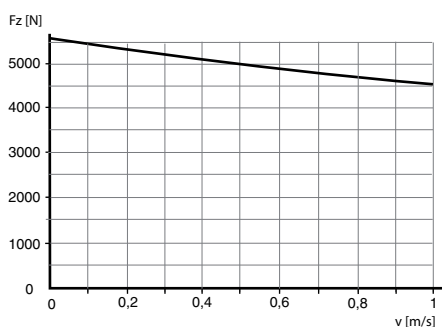
Max. force $F_{y_{dynmax}}$



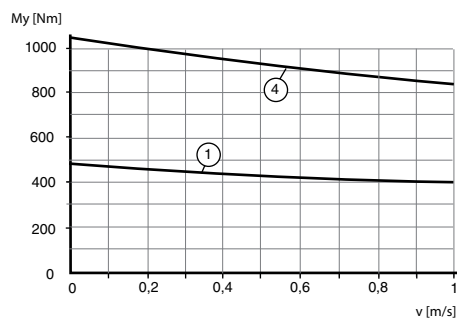
Max. torque of carriage $M_{y_{dynmax}}$



Max. force $F_{z_{dynmax}}$

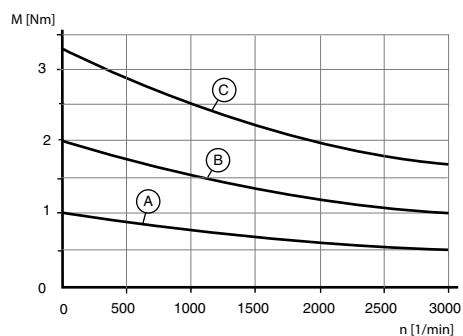


Max. torque of carriage $M_{z_{dynmax}}$



- (1) Carriage type 1
- (4) Carriage type 4
- (A) Spindle pitch 5 mm
- (B) Spindle pitch 10 mm
- (C) Spindle pitch 20 mm

Max. driving torque M_{max}



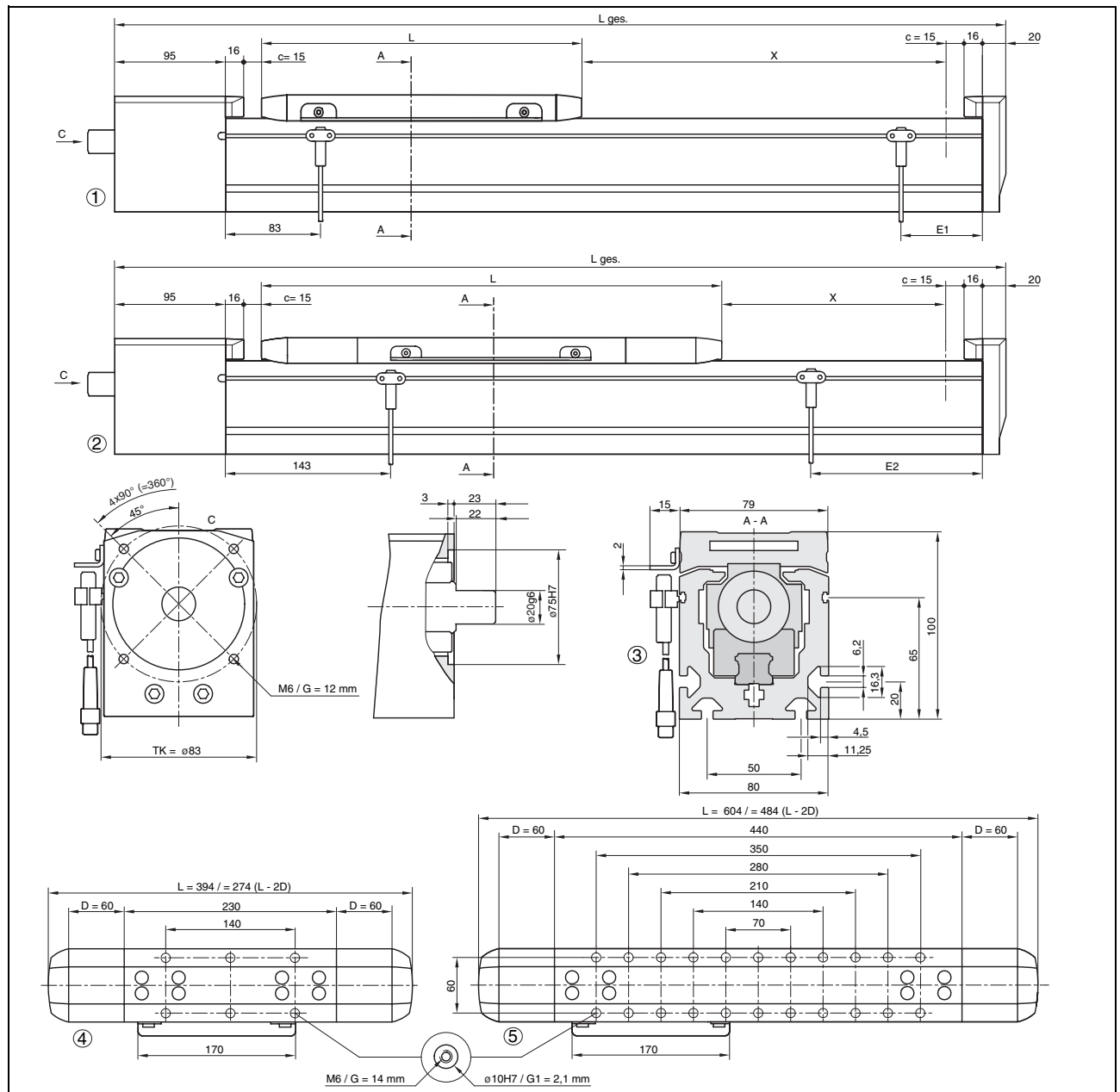


Figure 3.4 Dimensional drawing PAS43S

(1) = axis without cover strap	$L \text{ total without cover strap} = 177 + L + X$ (per additional carriage: $+ L + m$)
(2) = axis with cover strap	$L \text{ total with cover strap} = 177 + L + X$ (per additional carriage: $+ L + m$)
(3) = cross section with recirculating ball bearing guide	$L = \text{carriage length with cover strap}$ (without cover strap: $L - 2D$)
(4) = carriage type 1	$x = \text{working stroke}$
(5) = carriage type 4	$m = \text{minimum distance between 2 carriages}$ with cover strap 90 mm, without cover strap 40 mm
	$c = \text{limit switch safety distances to the mechanical stop}$
	$D = \text{cover strap turning block}$
$G = \text{thread depth}$	$E1 = \text{carriage type 1: with cover strap 143 mm, without cover strap 83 mm}$
$G1 = \text{insertion depth}$	$E2 = \text{carriage type 4: with cover strap 353 mm, without cover strap 293 mm}$

3.2.3 PAS44x

Characteristic values		PAS44SB		
Spindle pitch	[mm]	5	10	25
Guide type		Recirculating ball bearing guide		
Max. payload	[kg]	100		
Max. stroke length	[mm]	3000		
Min. stroke length	[mm]	13		
Max. speed	[m/s]	0.25	0.50	1.25
Max. acceleration	[m/s ²]	10		
Max. drive force Fx _{dynmax}	[N]	1285	1975	1780
Max. force Fy _{dynmax}	[N]	7890		
Max. force Fz _{dynmax}	[N]	7890		
Max. torque Mx _{dynmax}	[Nm]	85		
Max. initialising driving torque M _{max}	[Nm]	1.1	3.5	8
Load ratings drive system C ₀ /C _{dyn}	[N]	52400 / 31700		
Repeat accuracy	[mm]	±0.02		
No-load torque 0-stroke axis (without carriage)	[Nm]	0.80		
Moment of inertia 0-stroke axis (without carriage)	[kgcm ²]	5.65		
Moment of inertia per m stroke	[kgcm ² /m]	2.00	2.30	2.40
Moment of inertia per kg payload	[kgcm ² /kg]	0.006	0.025	0.158
Moment of inertia of coupling assembly (without motor)	[kgcm ²]	2.44		
Mass 0-stroke axis (without motor, without carriage)	[kg]	7.40		
Mass of stroke per m stroke (incl. spindle and profile)	[kg/m]	19		
Mass of motor attachment (without motor)	[kg]	2.5		
Internal diameter of clutch for motor attachment	[mm]	12 ... 24		
Drive shaft diameter	[mm]	25 g6		
Profile cross section (W x H)	[mm]	110 x 110		
Axial planar moment of inertia Ix/Iy	[mm ⁴]	5024548 / 6354771		
Elasticity module (aluminium)	[N/mm ²]	0.72 x 10 ⁵		
Spindle				
Spindle diameter	[mm]	24		
Spindle accuracy		P7 in accordance with DIN 69051 Part 3		
Max. spindle speed	[1/min]	3000		
Spindle axial play	[mm]	0.04		

Carriage		Type 1			Type 4		
		5	10	25	5	10	25
Spindle pitch	[mm]	5	10	25	5	10	25
Max. torque of carriage $M_{y_{dynmax}}$	[Nm]	820			1885		
Max. torque of carriage $M_{z_{dynmax}}$	[Nm]	820			1885		
Max. stroke length with/without cover strap	[mm]	2950 / 3110			2680 / 2840		
No-load torque of carriage	[Nm]	0.03	0.06	0.14	0.03	0.06	0.14
Moment of inertia of carriage with/without strap redirection (incl. spindle component)	[kgcm ²]	1.50 / 1.00	1.60 / 1.10	2.25 / 1.70	2.35 / 1.85	2.50 / 2.00	3.40 / 2.80
Mass of carriage with/without strap redirection (incl. spindle and profile component)	[kg]	15.20 / 11.45			22.45 / 18.70		

Note: the data apply to a spindle axis without drive. The listed torques and forces are based on an operational performance of 15000 km.

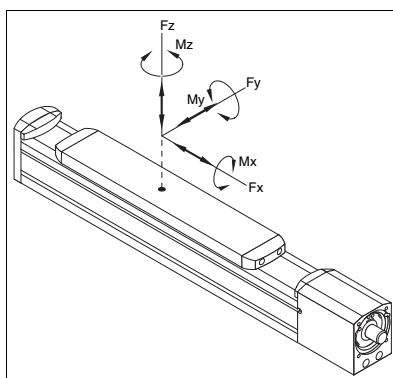
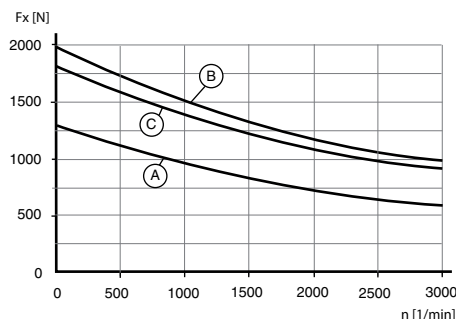


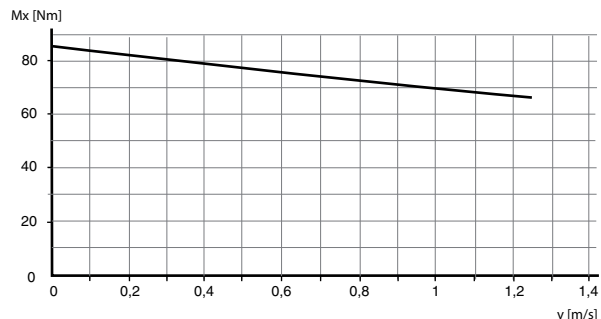
Figure 3.5 Forces and torques

PAS44SB characteristic curves

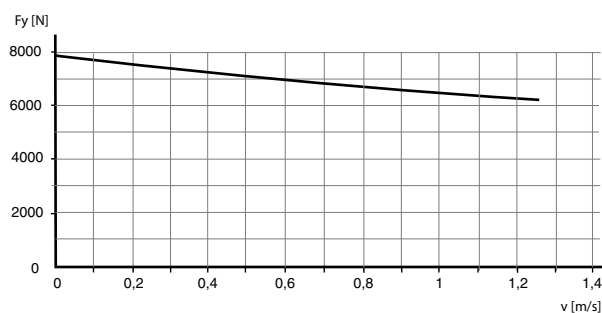
Max. feed force F_{x_dynmax}



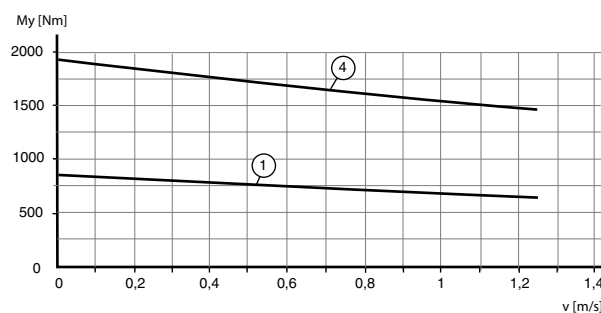
Max. torque M_{x_dynmax}



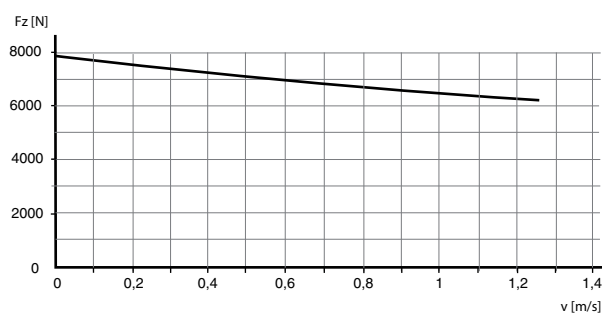
Max. force F_{y_dynmax}



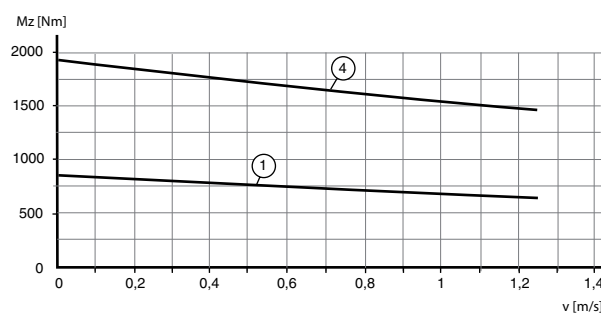
Max. torque of carriage M_{y_dynmax}



Max. force F_{z_dynmax}

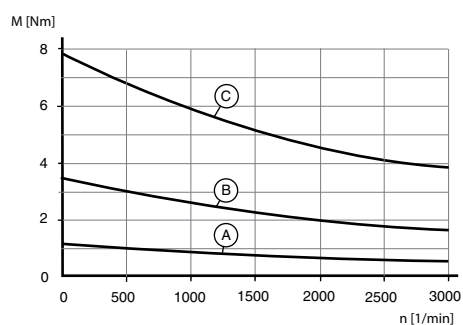


Max. torque of carriage M_{z_dynmax}



- (1) Carriage type 1
- (4) Carriage type 4
- (A) Spindle pitch 5 mm
- (B) Spindle pitch 10 mm
- (C) Spindle pitch 25 mm

Max. driving torque M_{max}



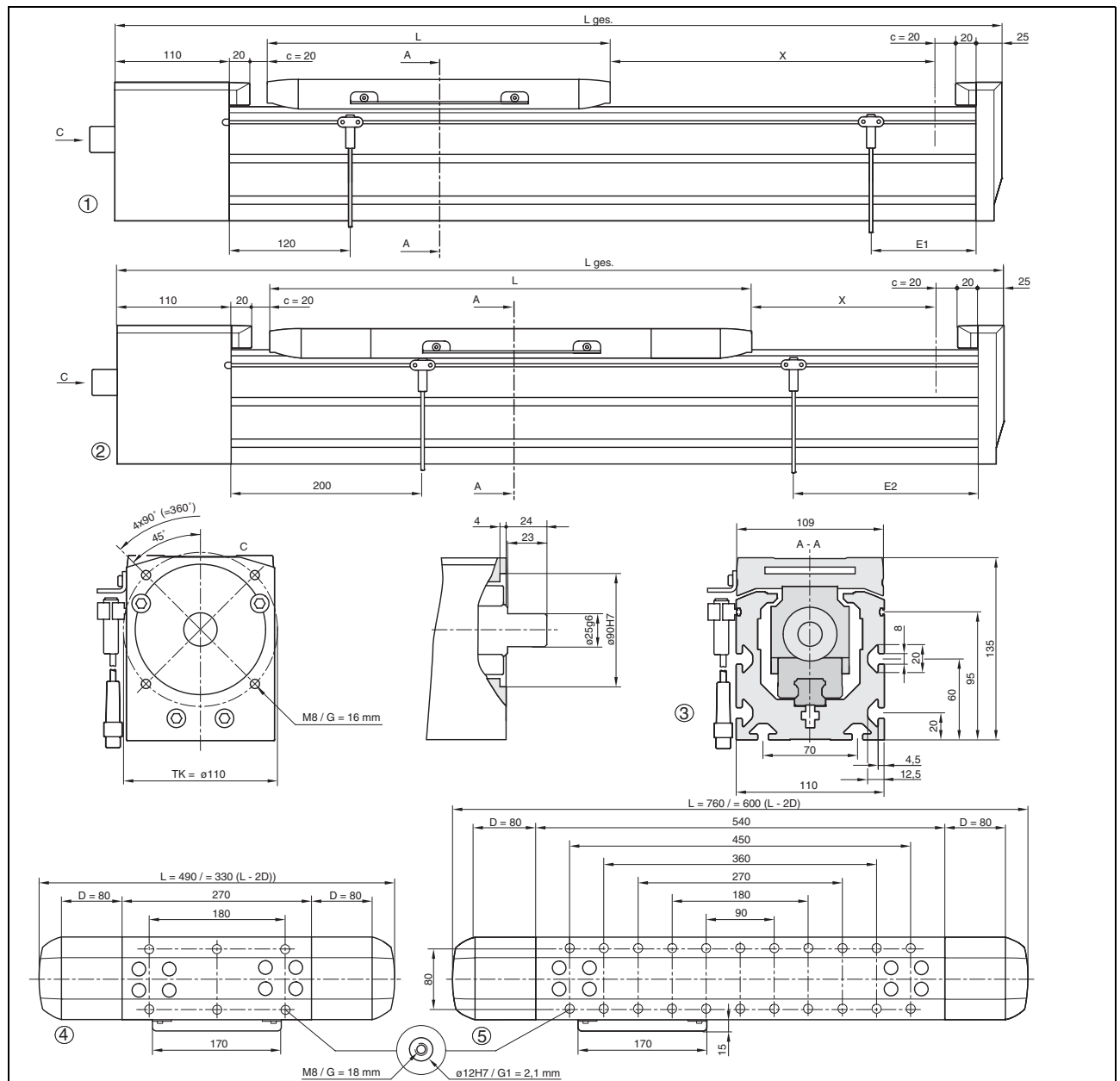


Figure 3.6 Dimensional drawing PAS44S

(1) = axis without cover strap	$L \text{ total without cover strap} = 215 + L + X$ (per additional carriage: $+ L + m$)
(2) = axis with cover strap	$L \text{ total with cover strap} = 215 + L + X$ (per additional carriage: $+ L + m$)
(3) = cross section with recirculating ball bearing guide	$L = \text{carriage length with cover strap}$ (without cover strap: $L - 2D$)
(4) = carriage type 1	$x = \text{working stroke}$
(5) = carriage type 4	$m = \text{minimum distance between 2 carriages}$ with cover strap 90 mm, without cover strap 40 mm
	$c = \text{limit switch safety distances to the mechanical stop}$
	$D = \text{cover strap turning block}$
$G = \text{thread depth}$	$E1 = \text{carriage type 1: with cover strap 200 mm, without cover strap 120 mm}$
$G1 = \text{insertion depth}$	$E2 = \text{carriage type 4: with cover strap 470 mm, without cover strap 390 mm}$

3.2.4 Standard tightening torques

Special tightening torques are applicable for mounting sensors, expanding hub, clamping hub, shaft journal etc. They are listed in the specified chapters.

The generally applicable internal hex tightening torques for Allen screws are applicable for mounting motor, gearing, contact plate, T-slot nuts, clamping claws, threaded holes in the carriage, strap turning block etc.

Thread	Wrench size [mm]	M _{Amax.} [Nm]
M3	2.5	1.1
M4	3	2.5
M5	4	5
M6	5	8.5
M8	6	21
M10	8	42
M12	10	70

Table 3.1 Maximum tightening torques for screws, ISO 4762 - 8.8

3.2.5 T-slot nuts

All specified T-slot nuts are made of galvanised steel.

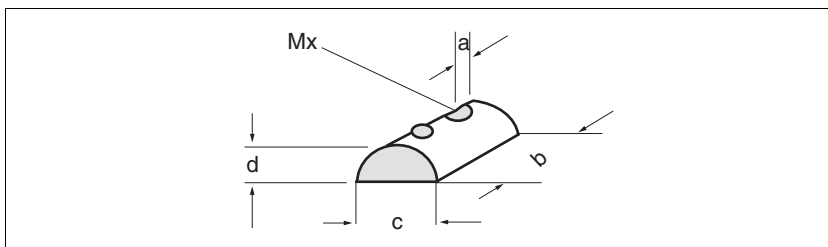


Figure 3.7 Outline drawing of T-slot nuts

Designation		5 x M5	6 x M6	8 x M6	8 x M8
Series (slot width)		5	6	8	8
Thread		M5	M6	M6	M8
Weight m	[g]	2	4	10	10
a	[mm]	4	5.5	6.5	7.5
b	[mm]	11.5	17	23	23
c	[mm]	8	10.6	13.8	13.8
D	[mm]	4	6.4	7.3	7.3

Table 3.2 T-slot nuts, characteristics and dimensions

3.2.6 Coupling assembly

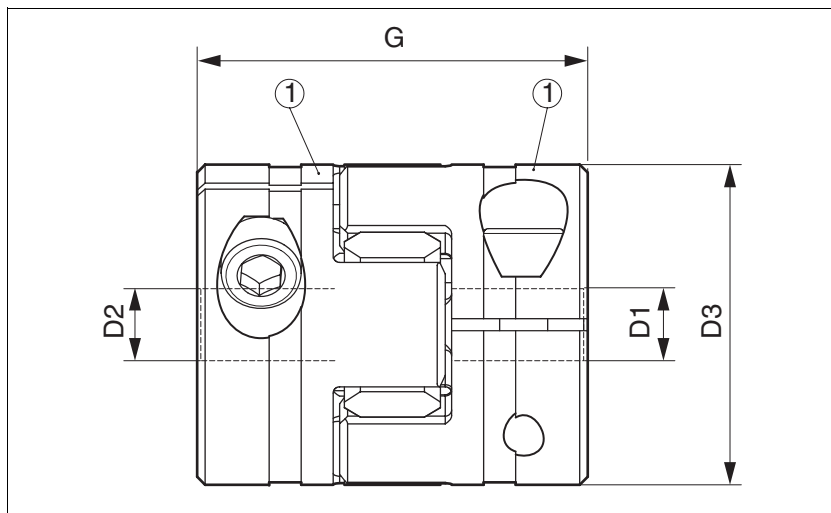


Figure 3.8 Outline drawing of clamping hub (1)

			Clamping hub PAS42	Clamping hub PAS43	Clamping hub PAS44
Moment of inertia (smallest hole diameter)	$J_{rot.}$	[kgcm ²]	0.15	0.55	1.22
Fastening screw ISO 4762			M5	M6	M8
Wrench size		[mm]	4	5	6
Tightening torque		[Nm]	14	14	35
Diameter	D3	[mm]	40	55	65
Block size	G	[mm]	50	58	62

3.3 Electrical Data

3.3.1 Motor

For more information please see the motor manual.

3.3.2 Sensors

Four types of sensors (limit switches and reference switches) with the following outputs are available:

- PNP/NC (Normally Closed) - normally closed contact
- NPN/NC (Normally Closed) - normally closed contact
- PNP/NO (Normally Open) - normally open contact
- NPN/NO (Normally Open) - normally open contact

Technical data for all types

Model		Cylindrical thread M8 x 1
Approvals		CE
Electrical connection (PUR cable with M8 connector)	[m]	0.10
Nominal switching distance S_n (with steel)	[mm]	1.5
Assured switching distance (with steel)	[mm]	0 ... 1.2
Hysteresis		1 to 15% of the actual switching distance
Degree of protection as per IEC 60529		IP67
Temperature (storage)	[°C]	-40 ... +85
Temperature (operation)	[°C]	-25 ... +70
Material of housing		Nickel-plated brass
Material of cable		PUR, 3 x 0.12 mm ² , length 10 cm
Oscillation stress as per IEC 60068-2-6		25gn, amplitude ± 2 mm ($f = 10 \dots 50$ Hz)
Shock stress as per IEC 60068-2-27		50gn, duration 11 ms
Output function display		Yellow LED
Operating voltage function display		No
Supply voltage (PELV)	[V _{DC}]	12 ... 24 with reverse polarity protection
Operating voltage (incl. residual ripple)	[V _{DC}]	10 ... 36
Switching current (overload and short-circuit protection)	[mA]	< 200
Voltage drop, output force-tripped	[V]	< 2
No-load current	[mA]	< 10
Maximum switching frequency	[Hz]	5000
Time delay before availability	[ms]	< 10
Make time	[ms]	< 0.1
Break time	[ms]	< 0.1

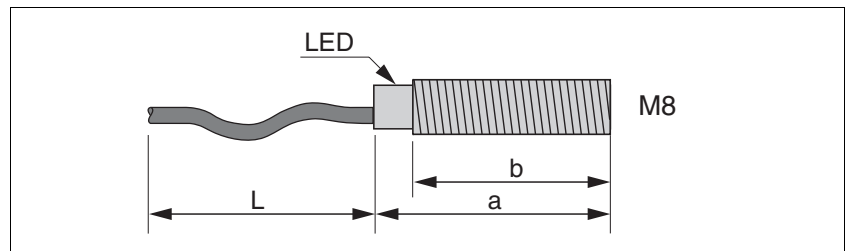


Figure 3.9 Outline drawing of sensor

a	[mm]	33
b	[mm]	25
L	[mm]	100

For information on the terminal assignment see chapter 5.3.1 "Connection of sensors".

4 Engineering

This chapter contains basic information on options for use of the product, which are essential for the engineering.

The specified technical parameters and the maintenance intervals must be observed to ensure safe and reliable continuous operation. See chapter 9.2 "Maintenance".

- The maintenance intervals must be included in the system maintenance schedule.

The linear axis is designed for use in continuous operation. The service life must be calculated case by case based on the application.

4.1 Spindle pitch

The pitch of the recirculating ball spindle is based on the travel of the carriage during one revolution of the recirculating ball spindle. The greater the pitch the higher the maximum speed.

The pitch of the threaded spindle means:

- large pitch requires high driving torque
- large pitch means high speed
- large pitch means high imprecision
- large pitch means low self-locking

4.2 Cantilever principle

The linear axis can also be used as a cantilever axis (carriage fixed, axial section moves).

Note that the moving mass is increased because the axial section, motor and power supply must also be moved with the axis.

4.3 Toothed-belt drive gear

The drive can be attached with backlash-free belt drive gear to save space. The drive gear can be oriented horizontally, left and right and also vertically upwards and downwards.

4.4 Support axis

A support axis carries loads that are applied asymmetrically to the carriage and improves the stability and service life of the system. The support axis does not have its own drive elements.

4.5 Sensors

Position of limit switches The travel between limit switches and the end block must be sufficient for the braking distance.

Limit switch type Your controller interfaces must be suitable for the limit switches and reference switches.

WARNING

Loss of control over controller

If unsuitable limit switches are installed, earth faults or line break will be detected as On status and will cause failure of the protection function.

- For protection against line break and earth fault use only sensors of the "normally closed contact" and "PNP" (sink) types as limit switches.

Failure to follow these instructions can result in death, serious injury or equipment damage.

5 Installation



The chapter on engineering contains basic information that you should know before starting the installation.

⚠ WARNING

Risk of injury by heavy weight, falling parts or crushing!

- Take the weight of the axis into account during mounting. It may be necessary to use a crane.
- Install the threaded fasteners (torque, screw locking) to ensure that axis and attachments do not come apart even under strong accelerations or continuous vibration.
- Note that axes subject to external forces (vertical axes) may drop unexpectedly.

Failure to follow these instructions can result in death, serious injury or equipment damage.

⚠ WARNING

Danger of injury and damage to system components by unbraked motor!

Loss of power or faults that result in switching off the power amplifier mean that the motor is no longer actively braked and may run against a mechanical stop at high speed.

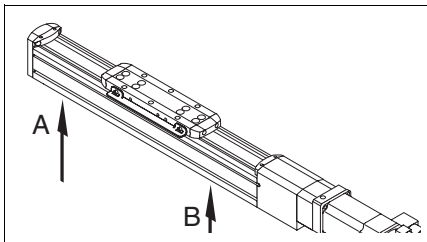
- Check the mechanical conditions.
- If necessary, use an absorbent mechanical stop or a suitable brake.

Neglect can result in an accident or damage to the system

5.1 Preparation of installation

Linear axes are precision products and must be handled carefully. Shocks and impacts on the carriages or the threaded spindle may damage the guideways and the ball screw drive. This may cause inaccuracies in the guideway travel and even premature failure.

Transport the linear axis in its packaging as close as possible to the installation site. Do not remove the packaging until the axis is at the installation site.



The linear axis must only be lifted in the specified range A and B (see figure). The distance from the end blocks should be approx. $\frac{1}{4}$ of the total length of the linear axis.

In the case of a linear axis with motor it must not be used as a load-holding point. However, the motor may be held to steady the load.

5.2 Mechanical installation

Accessibility for service

When mounting the linear axis, motor and sensors make sure that they are accessible for service.

Mounting position

The linear axis can be installed in any position.

If a linear axis with attached motor is mounted in a vertical position, the motor should be at the top.

The threaded spindle is under tension and there is no buckling load.

If the axis is used as a cantilever axis (carriage fixed, axial section moves), the motor should be at the bottom because of the above reason.

5.2.1 Attachment of the linear axis

To attach the linear axis the specified T-slots on the axial section only must be used. Use the applicable T-slot nuts (bottom or on the side) of clamping claws (side), as specified in chapter 8 "Accessories and spare parts".

Note the following in particular:

- When using motors with a larger cross section than the axial section the axis must be supported or the clamping surface must be cut out as required.
- The end blocks are larger than the axial section. This must be taken into account on the clamping surface.
- If the side slots are used for fastening, in some circumstances the sensor cable cannot be completely installed in the slots.

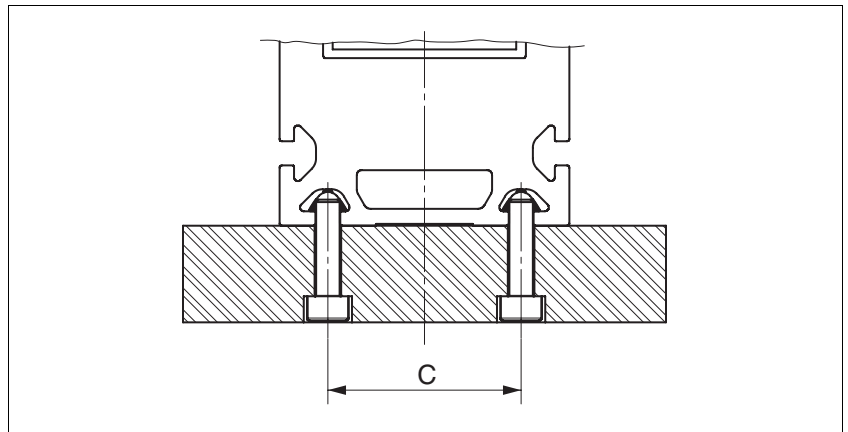


Figure 5.1 Fastening with T-slot nuts

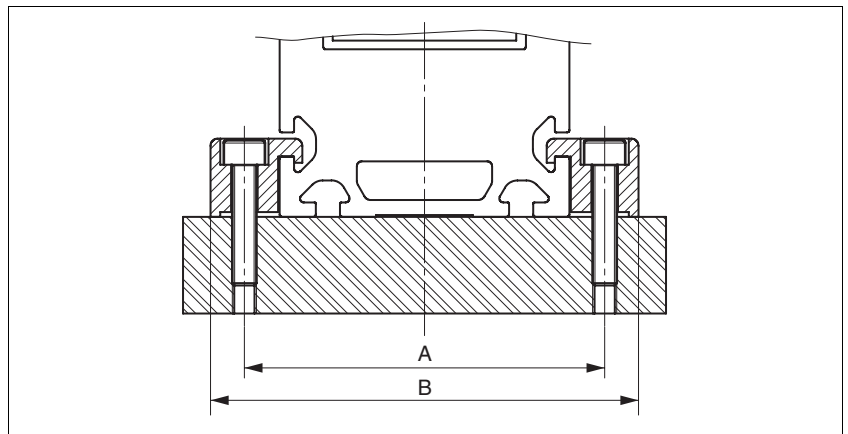


Figure 5.2 Fastening with clamping claws

Hole distance		PAS42	PAS43	PAS44
A	[mm]	74	96	130
B	[mm]	88	112	150
C	[mm]	40	50	70



The greater the load or the demands on the sequence accuracy the shorter the distance between the T-slot nuts or the clamping claws must be.

Orientation with reference to sequence accuracy

Because of the manufacturing process of the extruded profiles linear axes tend to have variations in straightness and twist. The permissible variations are generally well within the specifications of EN 12020-2 with PAS linear axes.

The guideway has a precision of ± 0.02 mm in relationship to the outside of the axial section. The outside is marked by a groove in the side slot. Use this side for orientation of the axis.

The linear axis can be aligned as follows with reference to the side sequence accuracy. The clamping surface must be machined smooth and flat.

- ▶ Fasten the fastening screws of the T-slot nuts or the clamping claws lightly.
- ▶ Measure the variations over the complete stroke with a measuring probe while traversing the carriage manually.
- ▶ Tighten the fastening screws one by one to correct the variations and align the linear axis.

5.2.2 Mounting contact plate and sensor with alignment

Inductive sensors are used as limit switches and reference switches. Check the sensor type.

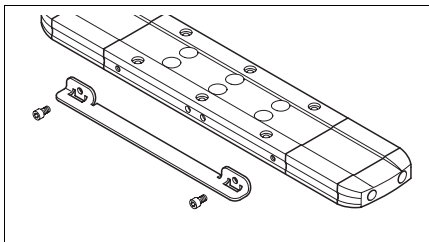
- You need a set of Allen keys, a feeler gauge, the sensor retainer and the sensor.

A sensor is fastened to the axial section with a retainer. There is a T-slot in the axial section with a milled slot in the end block for insertion of the fastening screws to hold the retainer.

Mounting contact plate

The contact plate for the inductive sensors must be mounted on the carriage. There are threaded holes for fastening on both sides of the carriage.

- ▶ For mounting select the side of the carriage that will be easily accessible for service.
- ▶ Screw the contact plate to the carriage with M4 screws (see figure).

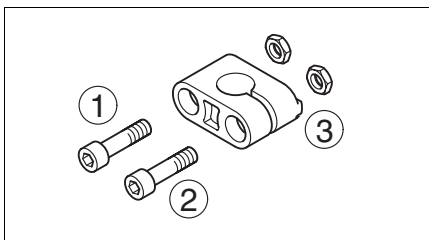


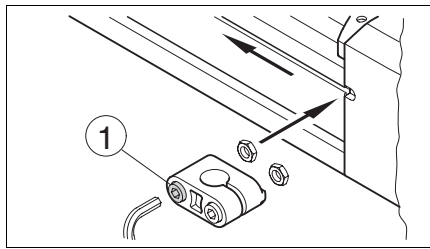
Mounting retainer

There are two M3 Allen screws with Allen nuts on the retainer.

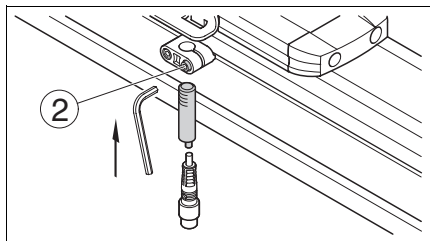
- Fasten the retainer in the slot with the screw (1).
- The sensor is fastened to the retainer with the screw (2).

There is also a cam (3) on both sides of the retainer to prevent the retainer from rotating in the T-slot.





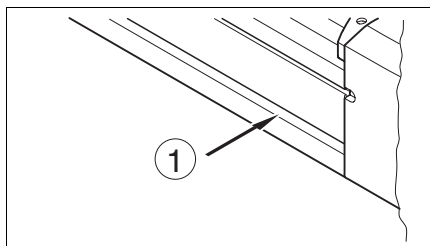
- ▶ Slide the nuts singly to the milled section in the T-slot.
- ▶ Position the retainer with the two screws. Leave the two screws loose at first.
- ▶ Slide the retainer to the desired position and tighten the screw (1) to a torque of 0.3 Nm.



Alignment of sensor

Because the sensors are inductive, a distance from the contact plate is required when mounting the sensor. This "switching distance" for PAS linear axes is 0.5 ± 0.1 mm.

- ▶ Traverse the carriage until the contact plate is under the sensor retainer.
- ▶ Slide the sensor through the retainer opening until the switching distance of sensor and contact plate has been reached. Check the distance with a feeler gauge.
- ▶ Tighten the screw (2).
- ▶ Finally check the "switching distance" with the feeler gauge again.



Layout of sensor cables

The slot (1) can hold up to 3 sensor cables. Suitable slot covers are available on request.

5.2.3 Mounting motor or gearing

Unless otherwise specified in the text, the standard tightening torques listed on page 3-14 are applicable.

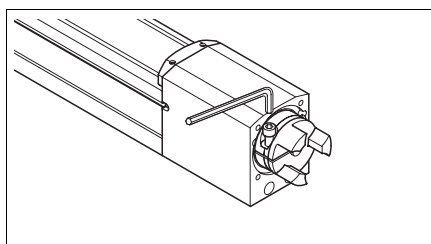
Clamping hub		PAS42	PAS43	PAS44
Fastening screw ISO 4762		M5	M6	M8
Wrench size	[mm]	4	5	6
Tightening torque	[Nm]	14	14	35

Table 5.1 Tightening torques for clamping hubs

The motor is mounted on a backlash-free coupling.

Unless included in the scope of supply, appropriate couplings and motor adapter plates (also for gearing) can be found in chapter 8 "Accessories and spare parts".

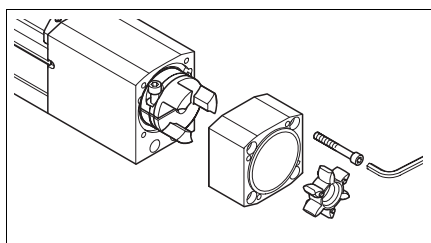
- ▶ Clean all parts before assembly. Check all parts for damage and discard damaged parts.
- ▶ The coupling has two clamping hubs with different holes. Slide the matching clamping hub on to the drive shaft of the linear axis to the stop.
- ▶ Tighten the clamping screw (tightening torque see Table 5.1).



- ▶ Position the ring gear.

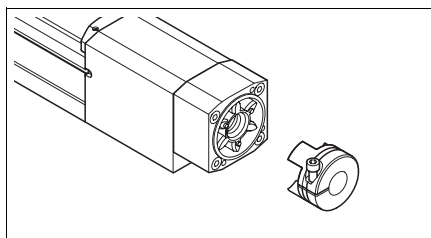
The ring gear can move axially to compensate for axial displacement of the shafts.

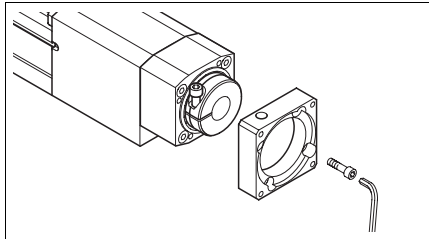
- ▶ Mount the coupling housing with the four screws. Make sure that it is positioned flat.



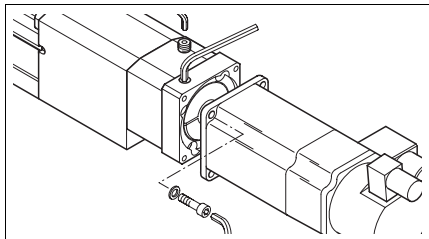
- ▶ Position the clamping hub (not too far). Note the size of the block on page 3-15.

Check the orientation of the clamping screw (preferably upwards). The clamping screw is tightened later through the hole in the motor adapter plate.

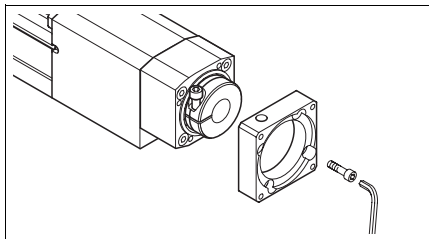


Installation of motor only

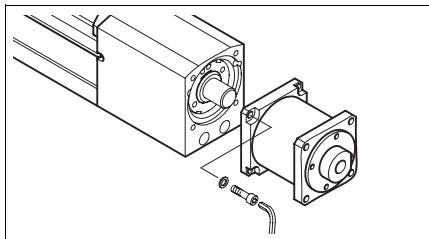
- ▶ Position the motor adapter plate flat. Check the position of the side hole through which you can tighten the clamping hub screw.
- ▶ Tighten the four screws.



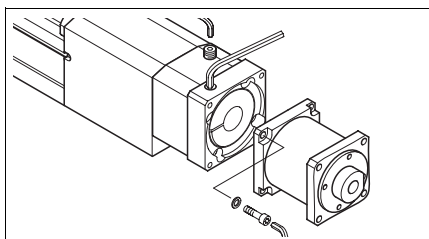
- ▶ Position the motor flat. Secure the motor to prevent its falling.
- ▶ Fasten the motor to the motor adapter plate with four screws and washers.
- ▶ Remove the screw plug in the side hole of the motor adapter plate.
- ▶ Tighten the fastening screw of the clamping hub through the hole (tightening torque see Table 5.1).
- ▶ Close the hole with the screw plug.

Installation of gearing only

- ▶ Position the motor adapter plate flat. Check the position of the side hole through which you can tighten the clamping hub screw.
- ▶ Tighten the four screws.



- ▶ A flange plate is required for gearing without an installed flange. Mount the flange plate to the gearing with the four screws. Make sure that the flange is positioned flat.

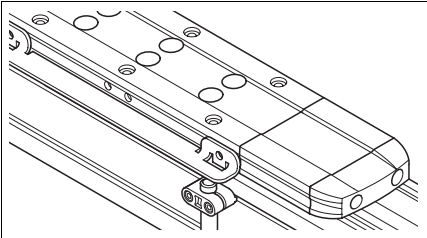


- ▶ Mount the gearing flange (or the flange plate) to the motor adapter plate with the four screws. Make sure that the flange is positioned flat.
- ▶ Remove the screw plug in the side hole of the motor adapter plate.
- ▶ Tighten the clamping screw of the clamping hub through the hole (tightening torque see Table 5.1).
- ▶ Close the hole with the screw plug.



For the procedure for mounting a motor to the gearing see the corresponding gearing manual.

5.2.4 Mounting customer application on carriage



There are threaded holes for an application interface on the top of the carriage.

Every threaded hole has an indentation for inserting a locating dowel for centring. For appropriate locating dowels see chapter 8 "Accessories and spare parts".

Threaded hole		PAS42S	PAS43S	PAS44 S
Diameter	[mm]			
Depth	[mm]			

5.3 Electrical installation

5.3.1 Connection of sensors

The sensors are fitted with a M8 x 1 connector.

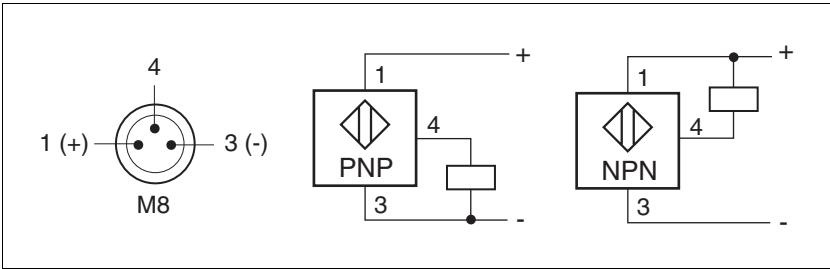


Figure 5.3 M8 pin assignment for sensors

Pin	Description	Colour
1	PELV supply voltage (+)	BN (brown)
3	PELV supply voltage (-)	BU (blue)
4	Output	BK (black)

The cable length is 100 mm. Extension cables with sockets are available in various lengths as accessories, see chapter 8 "Accessories and spare parts".

5.3.2 Motor connection

For more information please see the motor manual.

5.4 Checking installation

After completion of all steps we recommend checking the installation to prevent any errors before operation of the system.

- ▶ Make sure the drive system is correctly installed and wired up.
Check in particular basic connections such as mains supply and 24V power supply.
- ▶ Check in detail:
 - Are all protective conductors connected?
 - Are all fuses correct?
 - Are any live cable ends exposed?
 - Are all cables and connectors safely installed and connected?
 - Are the sensors correctly mounted?
 - Can the carriage with the sensor contact plate be traversed freely over the complete path?
 - Do the sensors function?

6 Commissioning

6.1 General safety instructions

⚠ WARNING

Unexpected movements may cause injury and damage to the system

When the axis is operated for the first time there is a high risk of unexpected movements because of possible wiring errors or unsuitable parameters.

- Check that the axis is securely fastened so it cannot break loose even under strong acceleration.
- Note that axes subject to external forces (vertical axes) may drop unexpectedly.
- Make sure that a functioning button for EMERGENCY STOP is within reach.
- Make sure that the system is free and ready for movement before switching it on.
- Conduct the initial test movements at a reduced speed.

Failure to follow these instructions can result in death, serious injury or equipment damage.

6.2 Commissioning procedure



The following commissioning steps are also required if you are using a configured unit under changed operating conditions.

- ▶ Check the function of the limit switch. The integrated LED must display the switching status correctly.
- ▶ Before operation make sure that the loads that are actually applied conform to the required and planned data.
- ▶ Conduct the initial test movements at a reduced speed. During testing check that the controller reacts correctly to the limit switches in both directions of travel.
- ▶ Check the distance of the limit switches to the mechanical stops. The movement must be stopped by the limit switches before the carriage reaches the mechanical stop.
- ▶ Make sure that the limit switches are positioned with reference to the position of the carriage so the movements are actually limited by a limit switch in both directions.
- ▶ Run a complete test under realistic conditions.

7 Diagnostics and troubleshooting

7.1 Troubleshooting

Malfunction	Cause	Correction
The carriage overruns the limit switch	Limit switch is faulty	Replace limit switch, page 9-4
	Error in controller	Correct error
Motor load increases, controller switches off because of overload.	Guideways and/or ball screw drive distorted or excessive friction caused by poor lubrication.	Contact service
Noise generation and vibrations during operation of the linear axis at high speeds.	Spindle speed too high	Reduce speed
	Poor lubrication (with noise generation)	Lubricate, page 9-2
	Concentricity error in threaded spindle caused by shock or impact.	Threaded spindle must be replaced. Contact service
Travel accuracy and noise generation on guideways.	Poor lubrication	Lubricate, page 9-2
	Damage to guideways, e.g. by shock or impact on the carriage.	Guideways must be replaced. Contact service
Carriage has play and positions inaccurately.	Play in ball screw drive or guideways after a crash or poor lubrication	Contact service

8 Accessories and spare parts



If you do have any order numbers and if you have any questions please contact your local dealer.

8.1 Clamping hub

for size	Description	Order number
PAS41	Clamping hub 6.35 x 5.5 / 25 x 12	MNA3MFCC06A06
	Clamping hub 8 x 5.5 / 25 x 12	MNA3MFCC08A06
	Clamping hub 9 x 5.5 / 25 x 12	MNA3MFCC09A06
	Clamping hub 10 x 5.5 / 25 x 12	MNA3MFCC10A06

for size	Description	Order number
PAS42	Clamping hub 6.35 x 7 / 40 x 27	MNA3MFCC06A07
	Clamping hub 8 x 7 / 40 x 27	MNA3MFCC08A07
	Clamping hub 9 x 7 / 40 x 27	MNA3MFCC09A07
	Clamping hub 10 x 7 / 40 x 27	MNA3MFCC10A07
	Clamping hub 11 x 7 / 40 x 27	MNA3MFCC11A07
	Clamping hub 12 x 7 / 40 x 27	MNA3MFCC12A07
	Clamping hub 14 x 7 / 40 x 27	MNA3MFCC14A07
	Clamping hub 16 x 7 / 40 x 27	MNA3MFCC16A07

for size	Description	Order number
PAS43	Clamping hub 9 x 7.5 / 55 x 32	MNA3MFCC09A08
	Clamping hub 11 x 7.5 / 55 x 32	MNA3MFCC11A08
	Clamping hub 12 x 7.5 / 55 x 32	MNA3MFCC12A08
	Clamping hub 14 x 7.5 / 55 x 32	MNA3MFCC14A08
	Clamping hub 19 x 7.5 / 55 x 32	MNA3MFCC19A08
	Clamping hub 20 x 7.5 / 55 x 32	MNA3MFCC20A08
	Clamping hub 22 x 7.5 / 55 x 32	MNA3MFCC22A08

for size	Description	Order number
PAS44	Clamping hub 12 x 9 / 65 x 37	MNA3MFCC12A09
	Clamping hub 14 x 9 / 65 x 37	MNA3MFCC14A09
	Clamping hub 19 x 9 / 65 x 37	MNA3MFCC19A09
	Clamping hub 20 x 9 / 65 x 37	MNA3MFCC20A09
	Clamping hub 22 x 9 / 65 x 37	MNA3MFCC22A09
	Clamping hub 23 x 9 / 65 x 37	MNA3MFCC23A09
	Clamping hub 24 x 9 / 65 x 37	MNA3MFCC24A09

8.2 Ring gear for coupling subassembly

for size	Description	Order number
PAS41	Ring gear 9 mm	MNA3MFR09A018
PAS42	Ring gear 14 mm	MNA3MFR14A034
PAS43	Ring gear 20 mm	MNA3MFR20A120
PAS44	Ring gear 25 mm	MNA3MFR25A320

8.3 Sensors

Sensors with signal display with 100 mm cable and 3-pin M8 circular plug-in connector.

The extension cables are suitable for trailing cables. They are fitted with M8 circular plug-in connector 3-pin female connectors at one end. The other end is open.

Designation	Description	Order number
Sensor	M8 PNP normally closed contact	XS508B1PBP01M8
Sensor	M8 NPN normally closed contact	XS508B1NBP01M8
Sensor	M8 PNP normally open contact	XS508B1PAP01M8
Sensor	M8 NPN normally open contact	XS508B1NAP01M8
Sensor retainer	Sensor retainer for M8 sensors, T-slot 3 mm, with screws and nuts, 10 units	MNA3MF010M8
Extension cable	length 5 m	MNA2SBCBGA050
Extension cable	length 10 m	MNA2SBCBGA100
Extension cable	length 20 m	MNA2SBCBGA200

8.4 T-slot covers

for size	Description	Order number
PAS42	2m long, slot size 5, 5 units	MNA3MC05A05
PAS43	2m long, slot size 6, 5 units	MNA3MC05A06
PAS44	2m long, slot size 8, 5 units	MNA3MC05A08

8.5 T-slot nuts

for size	Description	Order number
PAS42	Size 5 with M5 hole, 10 units	MNA3MF010T5N5
PAS43	Size 6 with M6 hole, 10 units	MNA3MF010T6N6
PAS44	Size 8 with M6 hole, 10 units	MNA3MF010T8N6
PAS44	Size 8 with M8 hole, 10 units	MNA3MF010T8N8

8.6 Clamping claws

for size	Description	Order number
PAS42	10 units clamping claws slot size NG 5 76 x 19 x 16.2	MNA3MF10/5/12
PAS43	10 units clamping claws slot size NG 6 76 x 24 x 21.5	MNA3MF10/6/13
PAS44	10 units clamping claws slot size NG 8 76 x 28 x 22	MNA3MF10/8/14

8.7 Locating dowels

for size	Description	Order number
PAS42	Locating dowel D08, 10 units	MNA3MF020LD01
PAS43	Locating dowel D10, 10 units	MNA3MF020LD02
PAS44	Locating dowel D12, 10 units	MNA3MF020LD03

8.8 Lubrication

The grease guns listed in the table below are supplied without a nozzle.
The nozzles must be ordered separately.

Designation	Description	Order number
Grease gun for lubrication of the recirculating ball bearing guide and spindle nut	Single-hand high-pressure grease gun 120 cm ³ capacity 120 cm ³ ; delivery 0.5 cm ³ / stroke operating pressure 400 bar;	MNA3MAP01
Nozzle D6 nipple D 20 degree	Nozzle Ø 6 mm curved model; length L = 200 mm; with M4 pointed tip for type D lubrication nipple; nozzle can be swivelled 360° around its own axis.	MNA3MAT02
Nozzle D6 nipple D 90 degree	Nozzle Ø 6 mm straight model; length L = 200 mm; with M4 pointed tip - 90° to side for type D lubrication nipple; nozzle can be swivelled 360° around its own axis.	MNA3MAT01

8.9 Product manual

Description	Order number
Product manual for PAS4xS spindle axes, DE	MNA1MLSMD00DE
Product manual for PAS4xS spindle axes, EN	MNA1MLSMD00EN
Product manual for PAS4xS spindle axes, IT	MNA1MLSMD00IT
Product manual for PAS4xS spindle axes, FR	MNA1MLSMD00FR
Product manual for PAS4xS spindle axes, ES	MNA1MLSMD00ES

9 Service, maintenance and disposal

DANGER

Electric shock

High voltages at the motor connection may occur unexpectedly.

- Make sure that the drive (including DC bus) is disconnected from power before working on the drive system
- AC voltages may jump over unused wires in the motor cable. Isolate unused wires at both ends of the motor cable.
- The motor generates voltage when the shaft is rotated. Lock the motor shaft to prevent rotation before starting work on the drive system.

Failure to follow these instructions will result in death or serious injury.

WARNING

Risk of injury by heavy weight, falling parts or crushing!

- Take the weight of the axis into account during mounting. It may be necessary to use a crane.
- Install the threaded fasteners (torque, screw locking) to ensure that axis and attachments do not come apart even under strong accelerations or continuous vibration.
- Note that axes subject to external forces (vertical axes) may drop unexpectedly.

Failure to follow these instructions can result in death, serious injury or equipment damage.

9.1 Service address

If you cannot resolve the fault yourself please contact your appointed sales partner. Have the following details available:

- Type, identification number and serial number of the product (type plate)
- Type of fault (possibly with fault number)
- Previous and concurrent conditions
- Your own ideas regarding the cause of the fault

Include this information if you return the product for inspection or repair.



*If you have any questions please contact your local dealer.
Your dealer will be happy to give you the name of a customer service outlet in your area.*

<http://www.berger-lahr.com>

9.2 Maintenance

9.2.1 Cleaning

Because of its design the linear axis resists penetration of dirt and foreign bodies. The guideway is internal and is covered.

The linear axis must be regularly inspected and, if necessary, cleaned to keep it functioning and to ensure its operating reliability over the long term.

- ▶ Do not use compressed air for cleaning.
- ▶ Clean large particles and pieces of dirt from the surface regularly.
- ▶ The anodised surface has only limited resistance to alkaline cleaning agents. Use only neutral cleaning agents for cleaning.
- ▶ Use only damp, soft and lint-free cleaning cloths to wipe the surface.

Cover strap

The cover strap must be cleaned regularly and coated with a thin film of lubricant to protect it against corrosion.

9.2.2 Lubrication

⚠ CAUTION

The product may be damaged by use of incorrect lubricants.

If the guide type of a toothed belt axis is not noted the incorrect lubricant may be used.

- Note the type code.

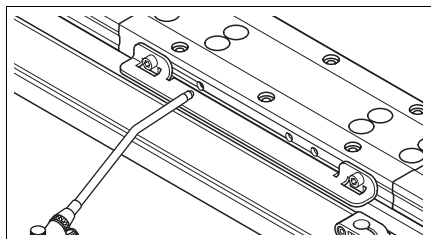
Failure to follow these instructions can result in equipment damage.

Lubricant is used continuously during operation of the linear axis. Regular lubrication throughout the service life is essential for reliable operation.

Insufficient lubrication or the incorrect lubricant will increase wear and reduce the service life. The following factors influence the lubrication intervals:

- dust
- high operating temperatures
- heavy loads
- high oscillation load
- permanent small strokes
- high spindle speeds

9.2.3 Lubrication of recirculating ball bearing guides and spindle nuts



Recirculating ball bearing guide

The spindle axis is fitted with external lubrication for grease. It is filled at the factory. There are three flush-type lubrication nipples on each side of the carriage. The circulating balls on the guide rail are lubricated by the outer lubrication nipples. The spindle nut is lubricated by the centre lubrication nipples.

The lubrication interval depends on the load, speed, cycle time, environment etc. Under normal operating conditions the following recommended values can generally be used for lubrication intervals.

- 5000 km operational performance

Size	Lubricant	Lubricant quantity	Strokes
PAS42	Microlube GL 261	0.3 cm ³	1/4
PAS43	Microlube GL 261	0.6 cm ³	1 1/4
PAS44	Microlube GL 261	1.0 cm ³	2

Spindle nut

- 100 km operational performance at a pitch of 5 mm
- 200 km operational performance at a pitch of 10 mm
- 400 km operational performance at a pitch of 16 mm

Size	Lubricant	Lubricant quantity	Strokes
PAS42	Microlube GL 261	1.5 cm ³	3
PAS43	Microlube GL 261	3.5 cm ³	7
PAS44	Microlube GL 261	4.5 cm ³	9

When injecting lubricant a maximum flow must not be exceeded. Therefore, every stroke of the grease gun must not be less than 3 seconds. The linear axis carriage must be moved between strokes to allow the grease to distribute evenly in the lubricant reservoirs in the guide carriage and the ball drive nut.

For a suitable grease gun, nozzles and lubricants for normal operating conditions see chapter 8 "Accessories and spare parts".

Lubrication of recirculating ball bearing guides

- Inject the correct type and volume of grease into the two outer lubrication nipples on one side of the carriage.

Lubrication of spindle nuts

- Inject the correct type and volume of grease into the centre lubrication nipples on the carriage.

9.3 Replacement of parts

Replace only the parts described as required. All other parts can only be replaced by technicians trained by the manufacturer.

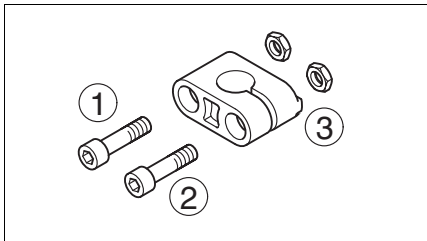
Align and check the axis after replacing parts as described in chapter 6 "Commissioning"

Carry out a complete installation after replacing the complete axis, see chapter 5 "Installation".

Unless otherwise specified in the text, the standard tightening torques listed in chapter 3.2.4 "Standard tightening torques" are applicable.

9.3.1 Replacement of sensor

The sensor can be replaced without changing the position of the retainer.



- You need a set of Allen keys, a feeler gauge and the replacement sensor.
- ▶ Unscrew the M3 screw (2) on the slotted side of the retainer until the sensor can be pulled out from below.
- ▶ Mount the new sensor as described in "Alignment" in chapter 5.2.2 "Mounting contact plate and sensor with alignment".

9.3.2 Replacement of motor, gearing or drive shaft

- ▶ To remove the motor or gearing proceed in reverse order of mounting. See chapter 5.2.3 "Mounting motor or gearing"

9.3.3 Replacement of cover strap (and turning blocks)

⚠ CAUTION

Risk of injury by sharp edges!

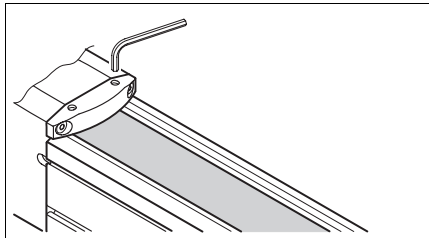
The cover strap has sharp edges. Dangerous sharp edges may be encountered, particularly when cutting.

- Wear safety gloves for replacement.

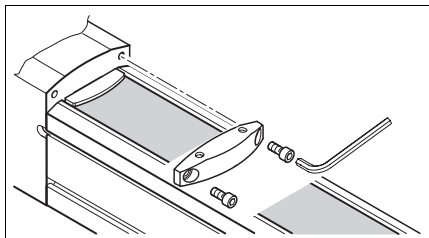
Failure to follow these instructions can result in death or serious injury.

When the cover strap is worn, it is recommended that the two turning blocks be replaced at the same time (plastic unit with wiper only).

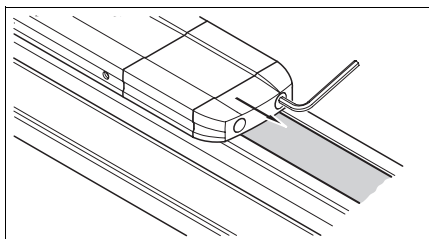
Carry all following steps on both sides of the carriage or axis.



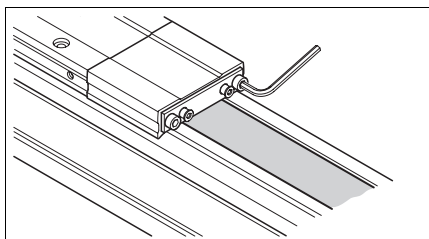
- You need a set of Allen keys, metal shears, a new cover strap and two new turning blocks.
- ▶ Loosen the two screws; they fasten the pressure plate and thus the cover strap.



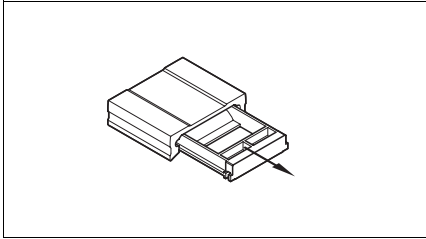
- ▶ Loosen the two screws and remove the strap clamp. Make sure that none of the screws or the pressure plate is dropped.



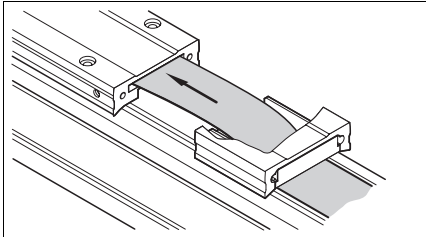
- ▶ Remove the buffer on the turning block. To do this loosen the two screws.



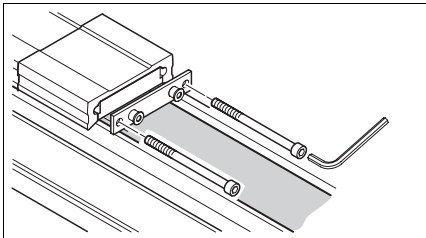
- ▶ Remove the turning block. To do this loosen the two screws. You can now remove the turning block.
- ▶ Pull the cover strap completely out.



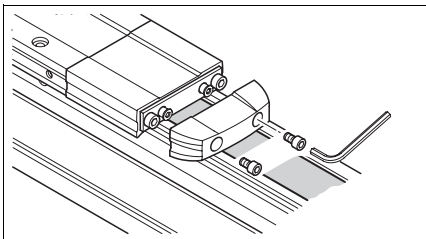
- ▶ Remove the old plastic unit from the retainer. Insert the new plastic unit.



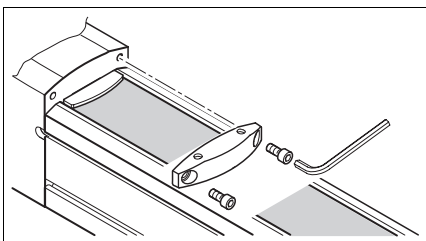
- ▶ Cut the new cover strap to the same length as the old cover strap with the shears. If the old cover strap is not available, the cutting is described below.
- ▶ Insert the new cover strap through the guide channel inside the carriage and through the turning blocks.



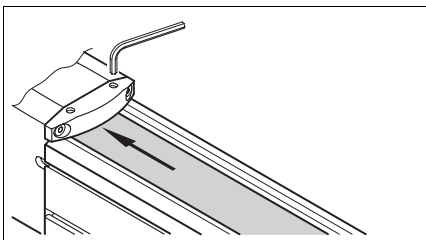
- ▶ Position the retainer plate for the plastic unit with the two press-in sockets for fastening the buffer on the carriage.
- ▶ Screw the turning block in place.



- ▶ Mount the buffer with the screws and washers.



- ▶ Position the cover strap along the axial section and align it symmetrically and evenly. Make sure that it is positioned flat in the magnetic strips.
- ▶ If it has not been cut as described above, cut the cover strap to the length that will allow it to be fixed at both ends with the pressure plates.
- ▶ Position the pressure plate.
- ▶ Screw the strap clamp in place.



- ▶ Tighten the threaded pins lightly to fasten the cover strap to the pressure plate.

9.4 Shipping, storage, disposal

Note the ambient conditions on page 3-1!

- | | |
|-----------------|--|
| <i>Shipping</i> | The product must be protected against shocks during transport. Use the original packaging for this purpose. |
| <i>Storage</i> | Store the product only under the specified, approved environmental conditions for room temperature and humidity.
Protect the product against dust and dirt. |
| <i>Disposal</i> | The product consists of various materials that can be recycled and must be disposed of separately. Dispose of the product in accordance with local regulations |

10 Glossary

10.1 Terms and Abbreviations

<i>Axial section</i>	The linear axis is based on a high-rigidity precision aluminium section.
<i>Ball screw drive</i>	The ball screw drive converts a rotary movement into a linear movement. It consists of the spindle, the nut system with circulating ball components and the balls as roller components. The ball screw drive has a very high efficiency. This enables it to execute precise and rigid advance movements and apply high feed forces with high positioning and repeat accuracy.
<i>Bending-critical spindle speed</i>	If the bending-critical spindle speed is exceeded, spindle deviations will occur with resulting oscillations. This will seriously affect the service life of the ball screw drive. Spindle supports are installed with longer spindle axes to increase the bending-critical spindle speed and the output.
<i>Breakaway torque</i>	The breakaway torque describes the driving torque required to overcome the static friction and that initiates the transition to sliding friction.
<i>Buckling load</i>	Buckling is the loss of stability of the spindles when the max. permissible feed forces whose line of application is along the spindle axis are exceeded. Exceeding the buckling load is expressed by a quickly increasing change in the shape of the spindle with a deviation to the side.
<i>Centring collar</i>	centric protrusion on the motor flange to ensure precise assembly.
<i>Drive constant</i>	The drive constant shows the path of the carriage that is covered by one revolution of the axis drive.
<i>ESD</i>	(E lectro S tatic D ischarge) is the electrostatic discharge and describes the processes and effects during compensation of electrical charges.
<i>Load torques</i>	The permissible load torques must be calculated corresponding to the service life. If the load torques exceed the specified values the service life of the axis will be reduced.
<i>Modulus of elasticity</i>	The modulus of elasticity is a material quantity that describes the connection between tension and extension during deformation. The higher the values the stiffer the material.
<i>Mounting position</i>	The linear axes can be installed in any desired position. However, note that all forces and torques must be below the maximum values of the axes.
<i>Path</i>	The path is the stroke between the switching points of the positive and negative limit switches. When specifying lengths a safety path between the limit switches and the mechanical stop must be provided.
<i>Positioning accuracy</i>	Positioning accuracy is the tolerance between a specified position and actual end position. The positioning accuracy is influenced by changes in temperature, load and speed and the accuracy of the switching point of the reference sensors.
<i>Recirculating ball bearing guide</i>	The axial section receives the forces and torques applied to the carriage via the recirculating ball bearing guide. High forces and torques can be received with recirculating ball bearing guides.
<i>Repeat accuracy</i>	The repeat accuracy is the capacity to reach a previously reached position again under the same conditions. The repeat accuracy is influenced

	by changes in temperature, load and speed and the accuracy of the switching point of the reference sensors.
<i>Self-locking</i>	The axes are not self-locking. This means that motors with a holding brake, a separate holding brake or suitable weight compensation for the linear axis is required, particularly when axes are vertically mounted.
<i>Sensors</i>	Inductive proximity switches are used as sensors for limit switches or reference switches. These switches are small safety limit switches as specified by EN60204-1.
<i>Sequence accuracy</i>	The aluminium sections are extruded sections that have deviations in straightness and torsion because of the manufacturing process. The tolerance of this variation is specified in EN 12020-2. The linear unit must be tensioned on an appropriately accurately machined base to achieve the desired guideway accuracy.
<i>Service life</i>	The service life is the path travelled by a linear axis before the first signs of material fatigue can be seen on the guideways, the drive components and the bearings. Service life specifications (kilometres covered) are based on the nominal values in the data sheet. If the nominal values are exceeded the service life will be correspondingly reduced.
<i>Stiffness</i>	The stiffness shows information on the capacity of part that is to be positioned to move and stop at the correct position, even under load variations.
<i>Stroke</i>	The stroke is the path covered by the carriage between the switching points of the limit switches.
<i>Stroke reserve</i>	The stroke reserve is the distance between the limit switches and the mechanical end stop.

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