rexroth
A Bosch Company

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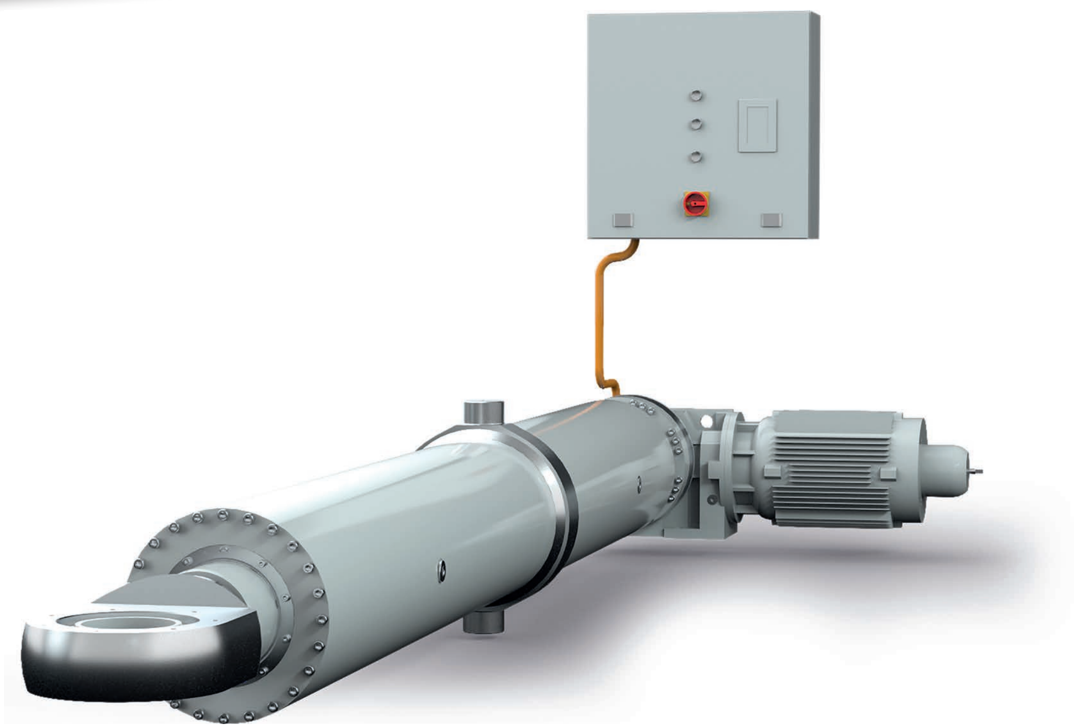
Electro Mechanical Actuator – EMA

Technical Information



KEY FEATURES

- For outdoor use in harsh environments
- Safety functions up to SIL 3 and PL e
- Plug & run with optional Control cabinet
- Portfolio according construction kit principle:
  - Forces up to 1030 kN *[231553 lbf]*
  - Stroke lengths up to 6590 mm *[259 in]*
  - Linear velocities up 833 mm/s *[33 in/s]*
- On request, larger forces, longer strokes or faster linear velocities may be realized outside the portfolio of pre-engineered solution

CONTENT

SYSTEM CODE

01		02		03	04		05	06	07	08		09	10	11	12		13	14	15	16		17	18	19	20	
EMA	-		-			/					/					/					/					

01	Electro Mechanical Actuator	**EMA**

Size

02	Size 190	**190**
	Size 210	**210**
	Size 270	**270**
	Size 325	**325**

Screw assembly

03	Planetary roller screw	**P**
	Ball screw	**B**
	Trapezoid screw	**T**

Stroke

04	Stroke length in mm, e.g. 3000	**3000**

Shell mounting

05	Round mid flange at shell	**ME4**
	Round flange at head	**ME7**
	Trunnion	**MT4**
	Other	**MXX**

Rod mounting

06	Threaded rod end	**G**
	Clevis with spherical bearing	**L**
	Clevis with spherical bearing and protection flanges	**P**
	Female clevis	**R**
	Other	**X**

Rod coating

07	Hard chromium plated stainless steel rod	**C**
	Enduroq 2000	**Q**
	Enduroq 2200	**R**
	Enduroq 3	**D**
	No rod coating, Duplex rod	**W**
	Other	**X**

Shock absorber

08	Without Shock absorber	**W**
	Shock absorber, specify load	**S**

Motor type

09	Synchronous servo motor	**S**
	Asynchronous servo motor	**A**
	Three phase motor	**P**
	Other	**X**

Motor configuration

10	Low linear velocity	**L**
	Medium linear velocity	**M**
	High linear velocity	**H**
	Other	**X**

01		02		03	04		05	06	07	08		09	10	11	12		13	14	15	16		17	18	19	20	
EMA	-		-			/					/					/					/					

Brake

11	Holding brake	**B**
	Without brake	**W**
	Other	**X**

Manual operation

12	Without Hand wheel	**W**
	Hand wheel	**M**
	Other	**X**

Motor encoder

13	Without encoder	**W**
	Standard encoder	**B**
	Advanced encoder C (SIL 2 / PL d)	**C**
	Advanced encoder H (SIL 3 / PL e)	**H**
	Other	**X**

Position switches

14	Without Position switches	**W**
	Position switches (digital)	**D**
	Position switches (mechanical)	**M**
	Other	**X**

Load sensing

15	Without load sensing	**W**
	Indirect load sensing / limiting	**I**
	Direct load sensing / limiting	**L**
	Other	**X**

Additional options

16	Without	**W**
	With	**Z**

17	Preservation 3 layer epoxy RAL5010	**W**
	Preservation 3 layer epoxy, specify RAL	**R**

18	No piston rod extension	**W**
	Piston rod extension, speciy LY	**Y**

19	Without lifting lugs	**W**
	With lifting lugs	**L**

20	Standard lubricatoin	**W**
	Biodegradable lubrication	**B**
	Other, specify type	**X**

PRODUCT DESCRIPTION

The Electro Mechanical Actuator (EMA) is a heavy duty plug & run mechanical actuator especially developed for an outside harsh (salty) environment with high humidity and a wide temperature range. It is suitable for markets such as Civil, Marine, Offshore and Heavy Industry. The EMA focusses on high forces in combination with large strokes. It provides users with a standard, configurable electromechanical linear actuator optionally including a control cabinet with an IndraDrive system. A smart, freely programmable drive system allows the realization of complex travel profiles. Parameters for force, position and travel linear velocity can be set as required over the complete working travel range.

Structural design
The mechanical system in the EMA is based on proven screw assemblies in a wide range of type, diameter and lead combinations. The screw assembly converts torque into linear motion with a high mechanical efficiency. During this process, the piston rod fastened to the screw drive nut is extended and retracted. Both the screw drive nut and the piston rod are guided in the housing and are locked against rotation. The screw assembly in an EMA is driven by an electric motor. All flanged connections are sealed including the rod to head interface which has a wiper to prevent dirt ingress. Thanks to grease lubrication, the EMA requires only minimal maintenance at long intervals.

Electrical design
The electrical system in the EMA consist of an electric motor and optionally several sensors and switches. The EMA can be controlled with a control cabinet of Rexroth. The EMA control cabinet comprises of a controller (frequency converter or drive) with technology functions like position-force control (PFC).

EMA combined with a Bosch Rexroth drive controller and sensors makes it possible to integrate further safety functions like Safe Direction (SDI), Safe Stop (SS1), or Safe Torque Off (STO). These safety functions are provided by the safe drive technology in the frequency converter. The EMA communicates with the overall control system over a fieldbus system.

Advantages
- Ready to install solution – pre-assembled, with only a few defined interfaces
- Sustainable, clean solution
- Easy startup – Plug & run
- Little maintenance expenditure
- Energy efficient operation – power on demand
- Cost saving trough open standards in the control concept
- “Safety on board” – functional safety possible
- Remote access / I4.0 capabilities

TECHNICAL SUMMARY

The EMA can be ordered as a single actuator or optional including control cabinet providing users with a complete package which is optimized and tested from the network connection to the piston rod. This includes pre-configured drive control parameters, software, firmware and technology functions. Drive amplifier control cabinets complete the overall system.
The portfolio according to the pre-engineered solutions offers:
- Forces up to 1030 kN *[231553 lbf]*
- Stroke lengths up to 6590 mm *[295 in]*
- Actuator linear velocities up to 833 mm/s *[33 in/s]*

> ☞ On request, larger forces, longer strokes or higher actuator linear velocities may be realized outside the portfolio of pre-engineered solutions, see page 35.

Available technologies
In the area of mechanical drive technology, Bosch Rexroth offers a wide range of capabilities. From sole screw assemblies, converting rotary motions into linear motions or vice versa, to complete motion system, next to the EMA:
- Contact our Motion Simulation Technology department for an experienced drive and control partner, with extensive and in-depth motion platform technology know-how.
- Contact our Electromechanical Cylinder (EMC) department, a high-performance alternative to pneumatic and hydraulic cylinders for harsh industrial conditions. The EMC is available with stroke lengths up to 1500 mm *[59 in]* and forces up to 56 kN *[12589 lbf]*

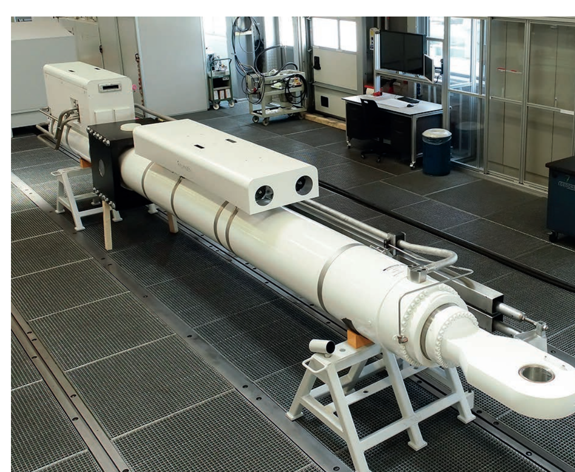
Motion Simulation Technology

www.boschrexroth.com/motion

Electromechanical Cylinder

www.boschrexroth.com/emc

Electro Hydraulic Actuator

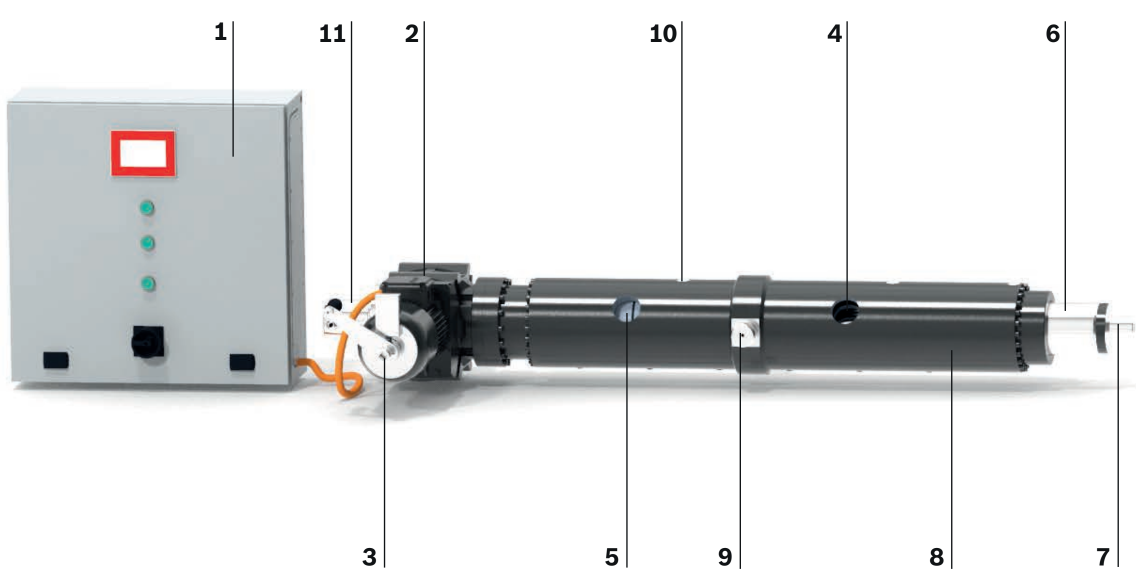


The Electro Hydraulic Actuator (EHA) is a heavy duty plug & run hydraulic actuator especially developed for outside harsh (salty) environment with high humidity and a wide temperature range. The EHA combines the power density of hydraulics and flexible capabilities of a mechanical actuator, and has the benefits of an hydraulic operating principle (e.g. the capability to absorb high external shock loads).
The portfolio according to the pre-engineered solutions offers:
- Forces up to 10000 kN *[2248089 lbf]*
- Stroke lengths up to 27 m *[1063 in]*

For more information on Electro Hydraulic Actuators, see RE 08142.
www.boschrexroth.com/electric-actuators

PRODUCT OVERVIEW

1. The **Control cabinet** is the brain of the actuator. This component controls the actuator. The cabinet, which is optional, contains a converter to control the motor. This converter is intelligent and optionally executed with PFC (Position Force Control) and a PLC program. It has all Inputs and Outputs to control a single actuator.
2. The **Motor and Gearbox** are the heart of the actuator. The motor gets power and control signals from the control cabinet and converts electrical power to mechanical power.
3. **Manual operation** is optional. In case of a power failure a hand wheel or external motor can be connected.
4. The **Screw** converts the rotational movement of the electric motor to linear movement of the nut. This nut is mechanically connected to the actuator rod. The load capacity depends on the type, diameter and pitch of the screw.
5. A **Shock absorber** is an optional mechanical spring configuration, allowing a limited travel when the actuator is e.g. overloaded in its application.
6. The **Rod** transmits the force converted by the screw. This component has a tubular form and is produced from carbon steel, stainless steel or duplex. The rod slides thru the head, guided by bearings. To minimize the wear and scratch introduction to the rod, the surface is coated by a hard, smooth, thin layer which is lubricated.
   Bosch Rexroth has developed an array of rod coatings called Endurqo, see page 16.
7. Several standard **Rod mounting** interfaces are available, even custom rod interfaces. Standard, the rod end has an external thread.
8. The actuator **Shell** is a robust, steel component to protect the inner components from the environment. When a trunnion or mid flange is welded on it is also a force transmitting component.
9. Several standard **Shell mounting** interfaces are possible, including custom shell interfaces. This interface transmits the force exerted by the actuator to the connected construction.
10. To maintain the actuator screw several **Lubrication points** are included. Proper lubrication of the screw, the piston rod and the anti-rotation guide is important.
11. The sense of the actuator is the optional **Absolute rotary encoder**. This rotary encoder measures the angular rotation of the screw and is converted to linear displacement of the rod. Thanks to this component it is possible to control the position of the rod.

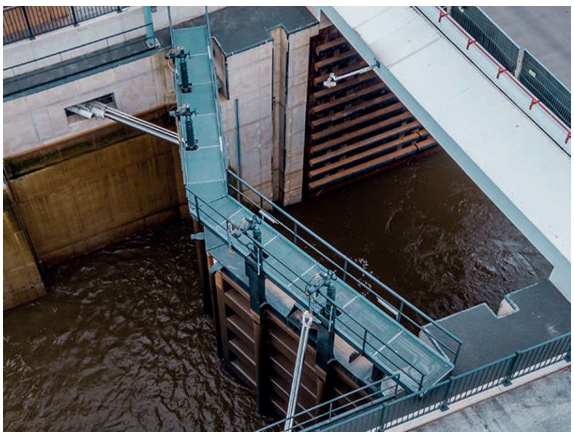


APPLICATION AREAS

The EMA fits in many application areas. Due to their characteristics, they offer advantages in terms of controllability, sustainability and efficiency, and can therefore increase flexibility and quality in any application. Their compact design makes them ideal for use in tightly confined spaces.

Possible application areas are:

Civil engineering, ports and waterways



- Miter, Radial & sliding gates for locks & dams
- Culvert gates for water regulation
- Moving architecture
- Weir control

- Moveable bridges
- Storm surge barriers
- Turbine regulation
- Ferry ramps

Others

- Materials handling
- Renewable energy
- Testing technology
- Transport technology

Offshore, marine & dredging

- Crane systems
- Latches and door control
- Lifting and sliding equipment
- Hatch cover systems

SELECTION CRITERIA

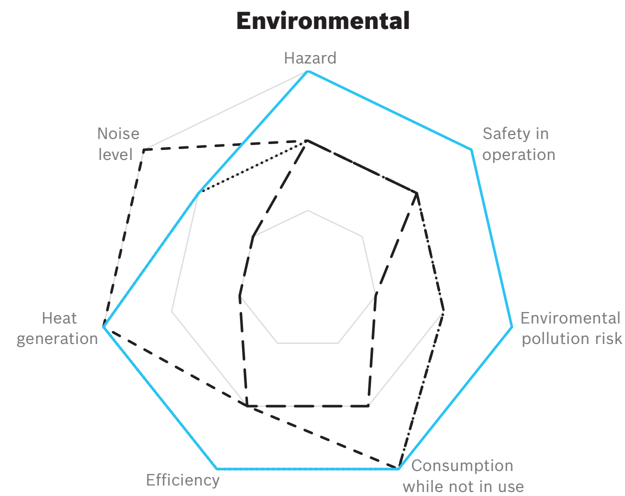
Selecting the optimal drive technology for your application can be difficult. Therefor selection criteria are of importance. Selection criteria can be binary via yes or no. For example, if the drive can't meet the required force, then it is ruled out. Other criteria can be rated and weighed such as the required maintenance can be less important than the investment costs. The following graphs show several selection criteria clustered in three categories.

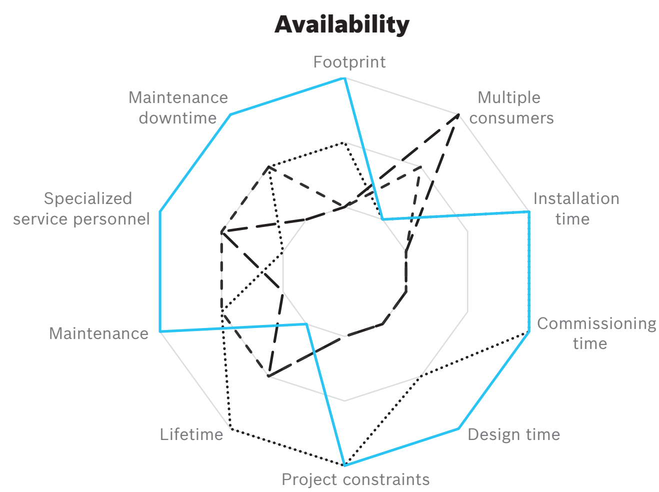
Environmental aspects are criteria which interact with the environment. An organization must assess these aspects and their impact.

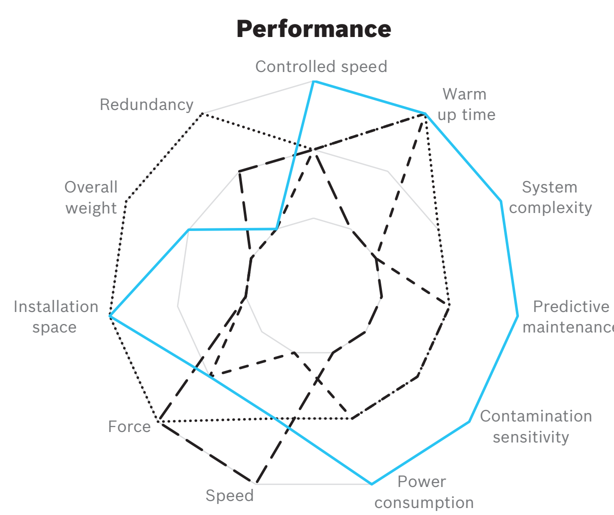
Availability focuses on the degree to which the system, when required in its applicable field, is available. Often described as a mission capable rate.

Performance criteria of the system are characteristics that are required for satisfactory performance of the system in its application.

In the shown graphs systems are weighed against actuators on a very general level. Note once more that it is of importance that you weigh the criteria against the application, no one solution fits all!







Hydraulic system
Mechanical system
Hydraulic actuator
Mechanical actuator

SELECTION GUIDE

1. Load cycle

Load

To select the right EMA size, the load cycle is key. It is important to differentiate static and dynamic forces. Dynamic forces occur when the actuator is moving (e.g. extending or retracting). Static forces may occur when the actuator is not moving. These forces are externally introduced. The dynamic force is divided in a maximum and mean square force [F_m]. The mean square force over the load cycle serves as the input for calculating the theoretical lifetime of the screw.

Stroke

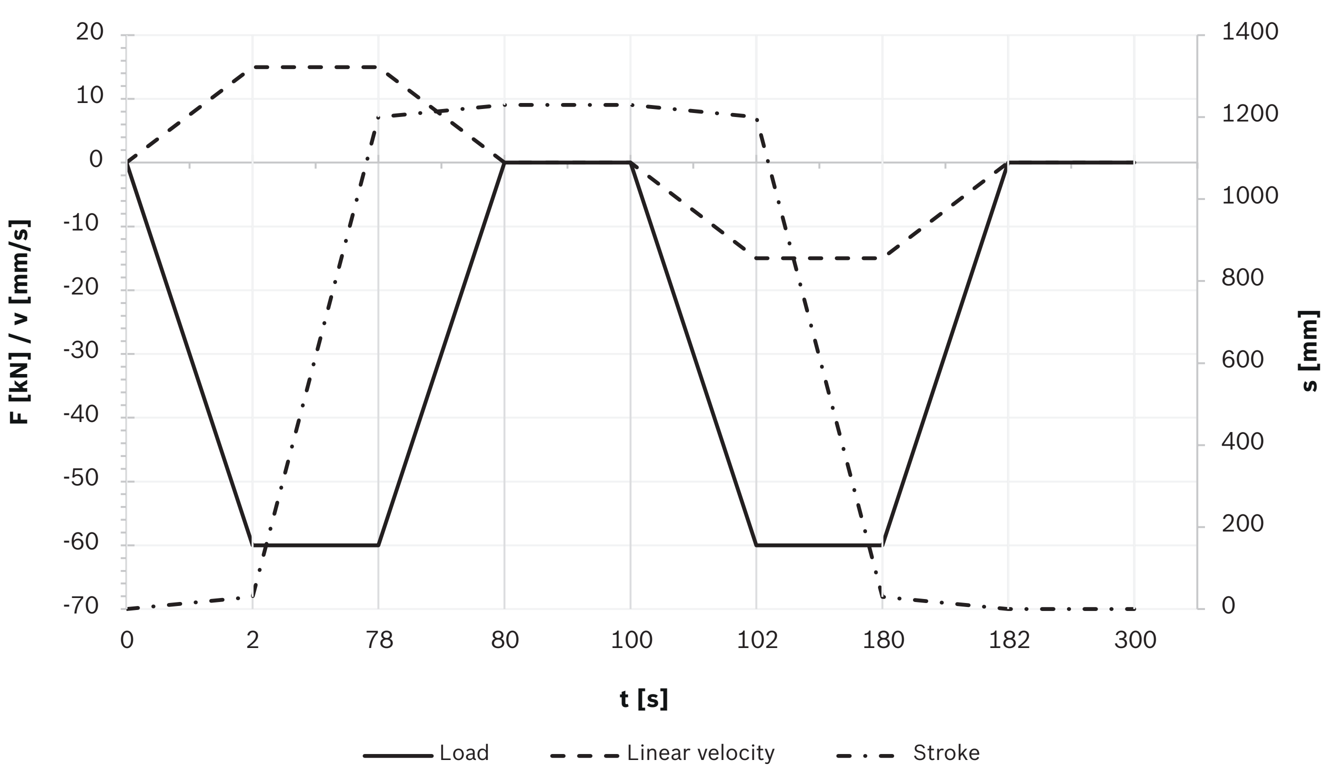
The stroke determines the length of the actuator and the screw. The maximum possible length of the screw limits the stroke. The stroke can limit the maximum compressive force of the actuator due to buckling. Besides buckling, the stroke can also limit the maximum linear velocity of the actuator because of centrifugal forces on the screw.

Linear velocity

The linear velocity of the actuator together with the force determines the required installed power, thus the electric motor type and size. The linear velocity is limited by the maximum allowed linear velocity of the nut or is limited due to the stroke.

2. Required lifetime

The theoretical lifetime is determined by the average load and the dynamic load capacity of the screw. The larger the difference, the longer the theoretical lifetime. Requirements for the lifetime expectancy could result in a larger screw size selection.



SELECTION EXAMPLE

1. Load cycle
For this selection example the cycle as shown on the previous page is used.

2. Required lifetime
The actuator performance criteria is 24 cycles per day, 225 days per year. The desired lifetime is 20 years, which is 266 km.

3. Screw selection on load
For the load carrying capacity of the screw, it is important to determine if the actuator is pulling, pushing or multidirectional. In this example, only pushing loads are specified. The section ‘Static load’ on page 13 shows the load capacity of the screws.

☞ Bosch Rexroth performs all screw calculations according DIN ISO 3408-5

In this example case, according the screw calculations, the maximum force-stroke ratio is at 1230 mm were the maximum force is 60 kN. The EMA-190 with a PLSA 48x10 fulfils this requirement.

4. Screw selection on lifetime
For the example case, the PLSA 48x10 does not fulfill the desired lifetime requirement as shown in the section ‘Dynamic load & Lifetime’ on page 15.

The PLSA 60x20 fulfills both the lifetime and force requirements, however the selection could be interpreted as over dimensioned for the lifetime. However, when the desired lifetime would be reduced to 252 km (lifetime of 19 years) an EMA-190 would fulfill. The result remains a theoretical calculated lifetime, when the screw is lubricated and maintained in compliance as prescribed.

5. Screw selection on linear velocity
The maximum linear velocity of the screw is verified over the complete stroke length. The linear velocity of the example cycle is check using the section 'Linear velocity' on page 15. In this case, all screws fulfill over the complete stroke length.

6. Selection
Next select your motor configuration based on the linear velocity requirements and the additional options required, see page 16.

☞ For detailed calculations methods on force and lifetime, and more information on Rexroth Screw Assemblies, see “Screw Assemblies, R999001185”

TECHNICAL DATA

(For applications outside these parameters, please consult us!)

General				
Weight	kg	See page 31		
Ambient operational temperature range	°C	-10 ... +40[1]		
Ambient non-operational temperature range	°C	-15 ... +60[1]		
Ingress Protection class acc. EN 60034-5	IP	65	67	68[2]

[1] For higher or lower temperatures, please consult us.

[2] Ingress Protection class 68 depends on the depth (m), duration (h) and performance. Please consult us.

Mechanical					
Installation position	Any				
Mounting options shell	Mid flange (ME4)	Front flange (ME7)	Trunnion (MT4)	Other[3] (MXX)	
Mounting options rod	Threaded (G)	Clevis with spherical bearing (L)	Clevis with spherical bearing and protection flanges (P)	Female clevis (R)	Other[3] (MXX)

The actuator is preserved with three layers of epoxy. Standard, the mean layer thickness is 280 microns. Optionally a custom preservation system is applied

[3] For custom shell or rod mounting options please consult us.

Standards	
DIN19704-1/2/3:2014	NEN6786-1:2017
RTD1018:2014	SB270:2016, Chapter 41 version 3
DIN EN ISO 12100	Directive 2001/95/EC
Directive 2006/42/EC	Directive 1999/34/EC

Each actuator is tested according to Bosch Rexroth standard, in line with ISO 10100: 2001. See page 34 for other tests.

Boundaries on application conditions

- The correct mechanical alignment of the movement axis and the mounting points of the EMA and rod must be ensured. Ensure correct mechanical alignment during installation at both the retracted and extended position. The actuator must be free of stresses. Lateral forces on the guides of the rod and screw nut must be avoided.
- The maximum loads must be considered to not damage the screw or cause buckling of the actuator, see page 13.
- The maximum admissible velocities when moving into the end positions, also considering external loads, must be observed, see page 15.
- Number of load cycles: When expecting shock loads or high cyclic dynamic loads consult us for suitability.

Safety instructions

For more information about Intended use and safety, see “Safety for Linear Motion Systems R320103152”. Service and repair work has to be performed by Bosch Rexroth BV or by personnel especially trained for this purpose. No warranty is accepted for damage as a consequence of assembly, maintenance or repair work not performed by Bosch Rexroth BV.

Check lists for electromechanical actuators

When the application parameters of the actuator deviate from the values specified in the data sheet, the actuators can only be offered as a special version upon request. For offers, the characteristics and application parameters must be described in the check lists, see page 35.

EMA CHARACTERISTICS

The main component of an EMA is the screw. Screw Assemblies convert rotary motion combined with torque into linear motion and axial force. During this process, the piston rod fastened to the screw nut is extended or retracted. Both the screw nut and the piston rod are guided in the housing by an anti-rotating device.

Each Screw Assembly has its own characteristic such as mechanical efficiency. Depending on screw type a self-locking effect is in place. The PLSA and BASA from Rexroth are not self-locking due to the low level of friction between the screw and the nut. An EMA can optionally be equipped with a self-locking mechanism, see page 18.

EMA	PLSA d_0xP [mm]	BASA d_0xP [mm]	TRSA d_0xP [mm]	$F_{max\ stat}$ [kN]	$F_{max\ dyn}$ [kN]	s_{max} [mm]	s_{max}[1)] [mm]	v_{max} [mm/s]
190	48x10	UC	UC	158	116	4930	4760	520
210	60x20	UC	UC	262	205	4800	4620	833
270	75x20	UC	UC	499	316	4670	4480	667
325	99x20	UC	UC	1030	656	6590	6540	539

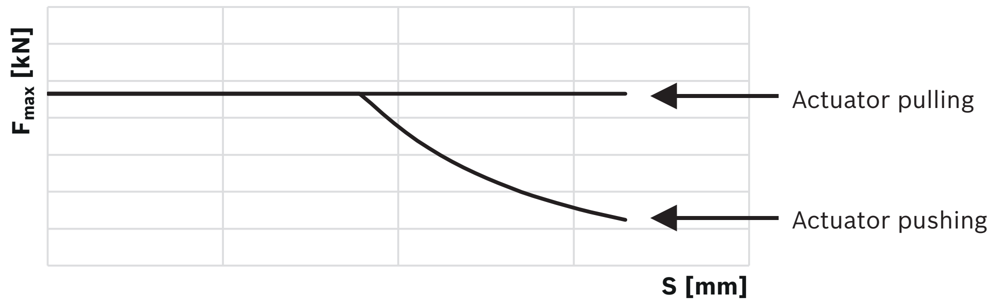
PLSA = Planetary Screw Assembly
BASA = Ball Screw Assembly
TRSA = Trapezoid Screw Assembly
d_0 = Diameter of screw drive
P = Screw drive lead
UC = Under construction, please consult us.
$F_{max\ stat}$ = Maximum permissible static force allowed, buckling not taken into account, see page 13.
$F_{max\ dyn}$ = Maximum permissible dynamic force which the actuator can drive, see page 14.
S_{max} = Maximum reachable stroke length, buckling not taken into account, see page 13 and page 14.
v_{max} = Maximum permissible linear velocity, stroke length not taken into account, see page 15.

[1)] Maximum stroke including optional Shock absorber.

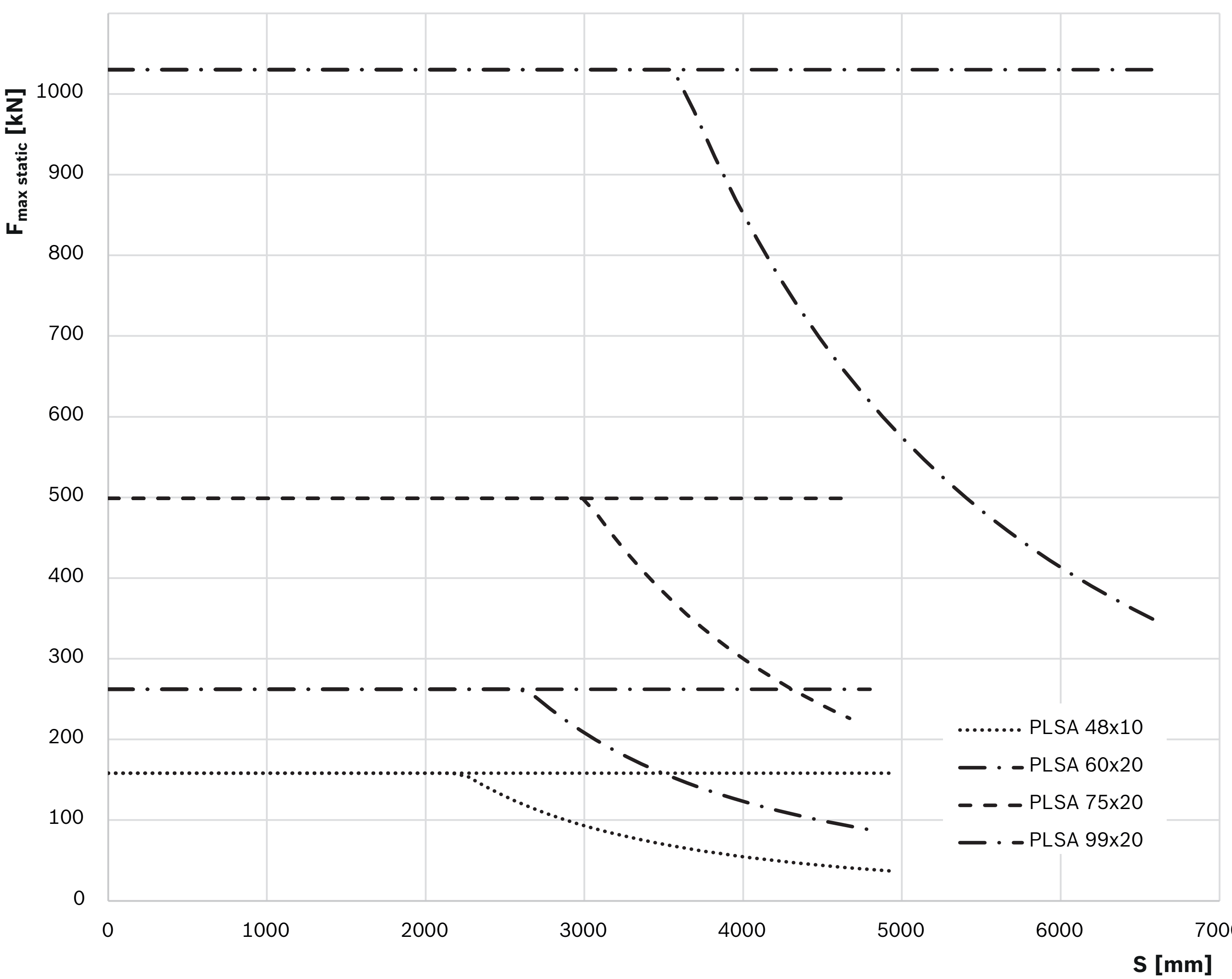
☞ For more information on Rexroth Screw Assemblies, see "Screw Assemblies, R999001185"

STATIC LOAD

The static load graph shows two lines per screw. The horizontal line is the maximum static load of the screw when the actuator is pulling. The second line, which decreases over a certain stroke, shows the maximum static load of the screw when the actuator is pushing. The load limitation is due to buckling.



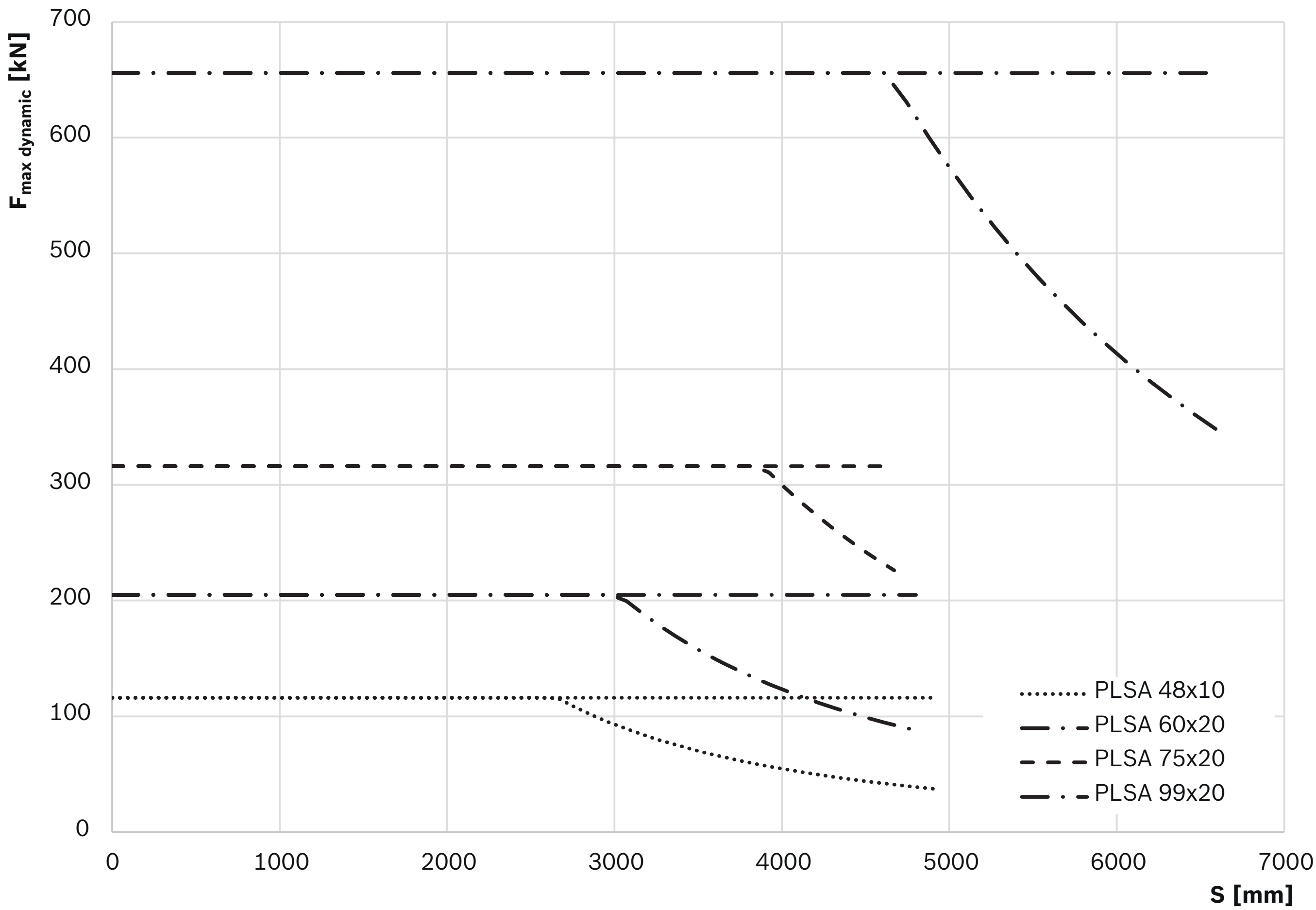
The next graph shows the maximum static load characteristics of several screw sizes. In tension the full load capacity of the screw is utilized. When relative long stroke lengths are combined with pushing loads, buckling will limit the allowable load on the actuator.



DYNAMIC LOAD

The next graph shows the maximum dynamic load for different screw sizes. Dynamic load is the load which is actively driven by torque of the electric motor. Similar to static load, the maximum pushing load is limited at relative long stroke lengths due to buckling.

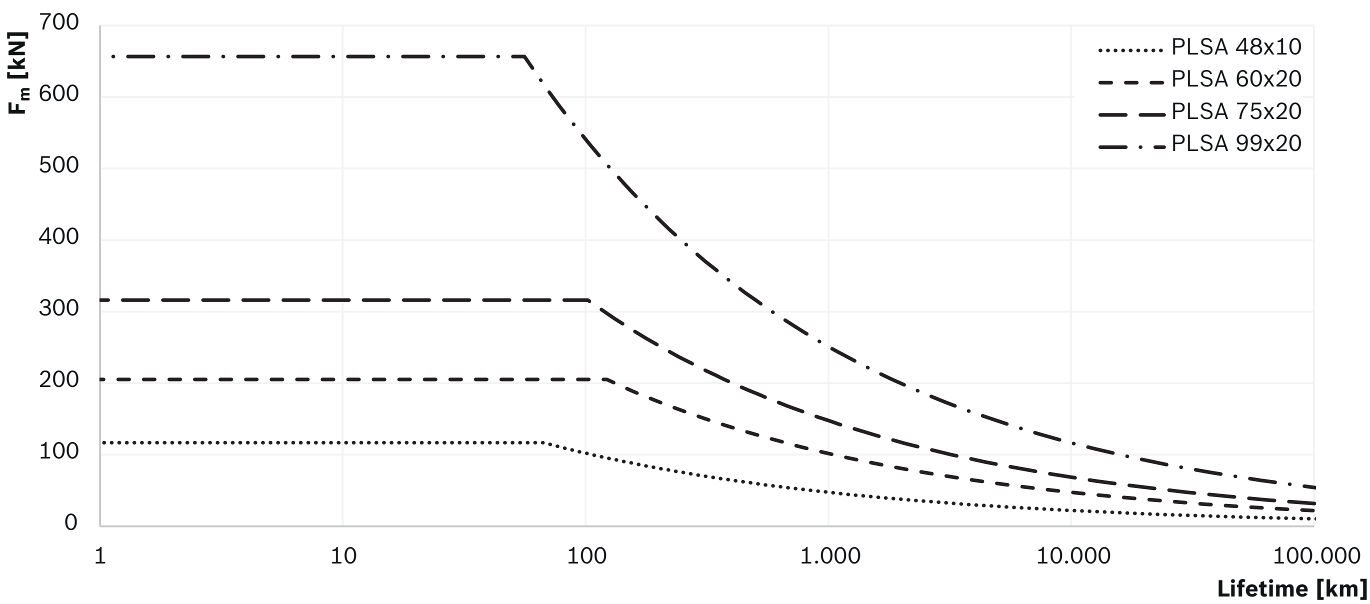
Note the that the horizontal line indicates the maximum load in a pulling situation. The second line, which decreases over a certain stroke, shows the maximum dynamic load of the screw when the actuator is pushing.



LIFETIME

The next graph shows the nominal, calculated theoretical lifetime in kilometers corresponding with the mean square force [F_m] of several screw sizes. To calculate the mean square force, see page 8.

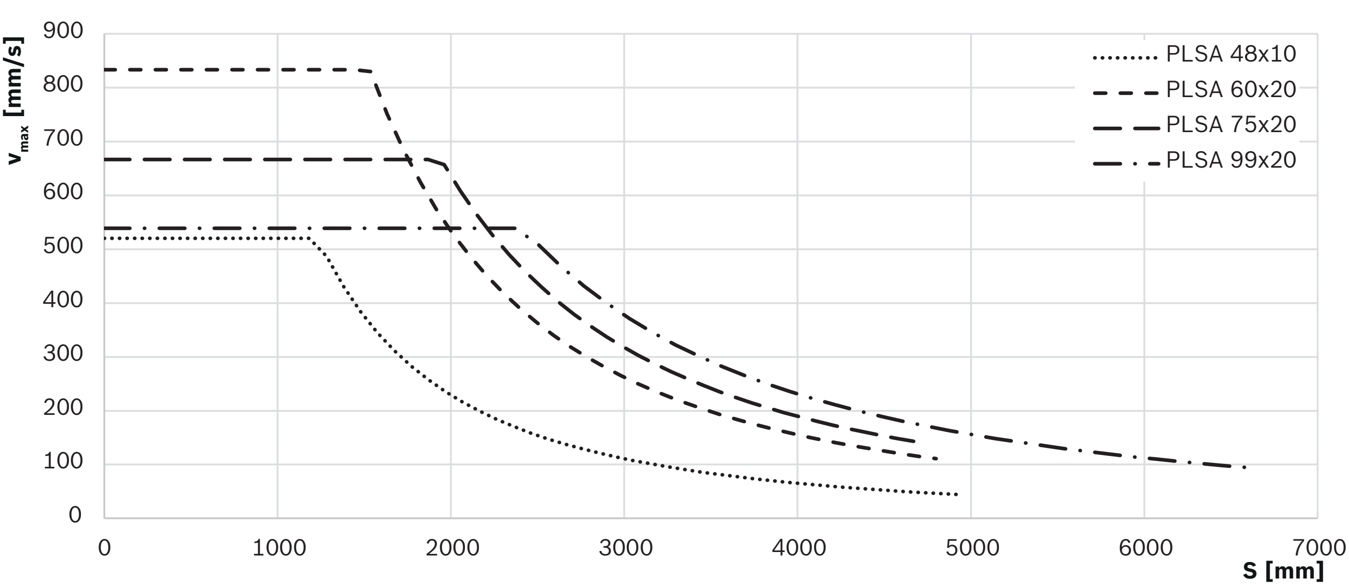
☞ Indicated values in the graphs below apply on compliance with the specified lubrication intervals, see page 32, and for normal operation.



Calculations performed according respective screw catalogs.

LINEAR VELOCITY

The next graph shows the maximum linear velocities for several screw sizes. The screw limits the linear velocity when at a relatively long stroke. The linear velocity decreases over the stroke due to centrifugal forces on the screw.



OPTIONS

PISTON ROD COATINGS

The coating of the piston rod is of eminent importance for the functioning of the actuator. Bosch Rexroth has developed an array of rod coatings, called **Enduroq**, for different environmental conditions. The ones most suitable for outside harsh (salty) environment with high humidity and a wide temperature range, are available for this actuator series.

The choice of the rod coating mainly depends on the chemical activity, i.e. corrosivity, of the environment, and the expected amount and type of abrasive particles in and around the application. At Bosch Rexroth we are always available for advice regarding the most suitable rod coating in your application, so please contact us!

The comparative table below shows the main differences between the rod coatings. Certain tests in this table are standardized, whenever no standardized tests were available applicable tests are developed by Bosch Rexroth.

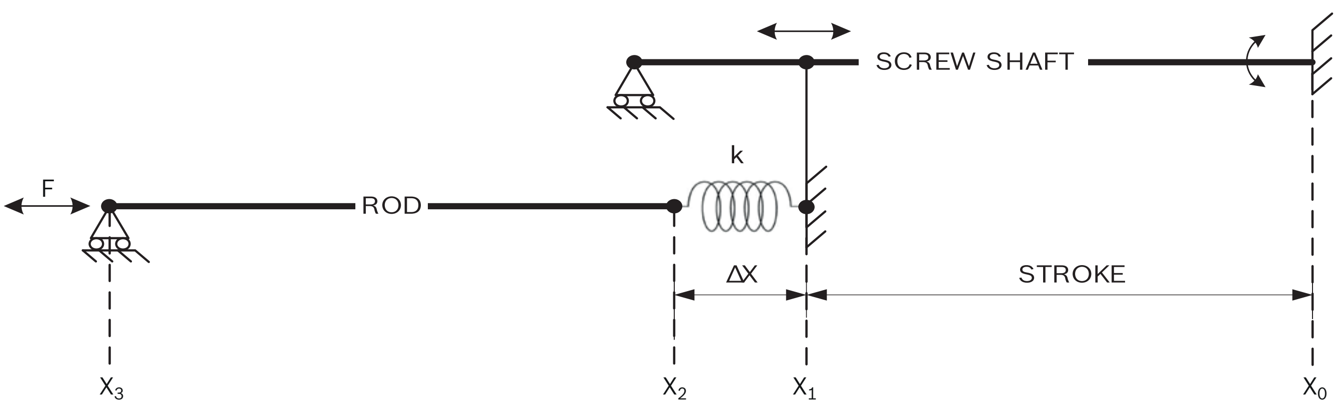
Coating	Hard chromium plated (C)	Enduroq 2000 (Q)	Enduroq 2200 (R)	Enduroq 3 (D)	Test Method
Material	Cr (50 μm) on Stainless steel rod	NiCr based	NiCr based	Co based	-
Application process	Galvanic	High Velocity Oxygen Fuel	High Velocity Oxygen Fuel	Laser Cladding	-
Wear resistance	2 of 7	7 of 7	7 of 7	5 of 7	Bosch Rexroth Scratch&Wear
Impact strength	12 J	10 J	8 J	>15 J	ASTM D2794-9
Corrosion resistance	~ 13,500 h	~ 15,000 h	~ 60,000 h	> 80,000 h	DNV-C1 (SDCT)
Corrosion resistance	n/a	No Pass	Pass	Pass	NBD10300

Environmental conditions
The environment in which an actuator is operated can have a significant effect on its service life. Both very high and very low temperatures can affect seals, lubrication and the performance of the motor. Abrasive dirt and chemicals can damage the seals and ultimately cause the screw drive to fail over the long term.

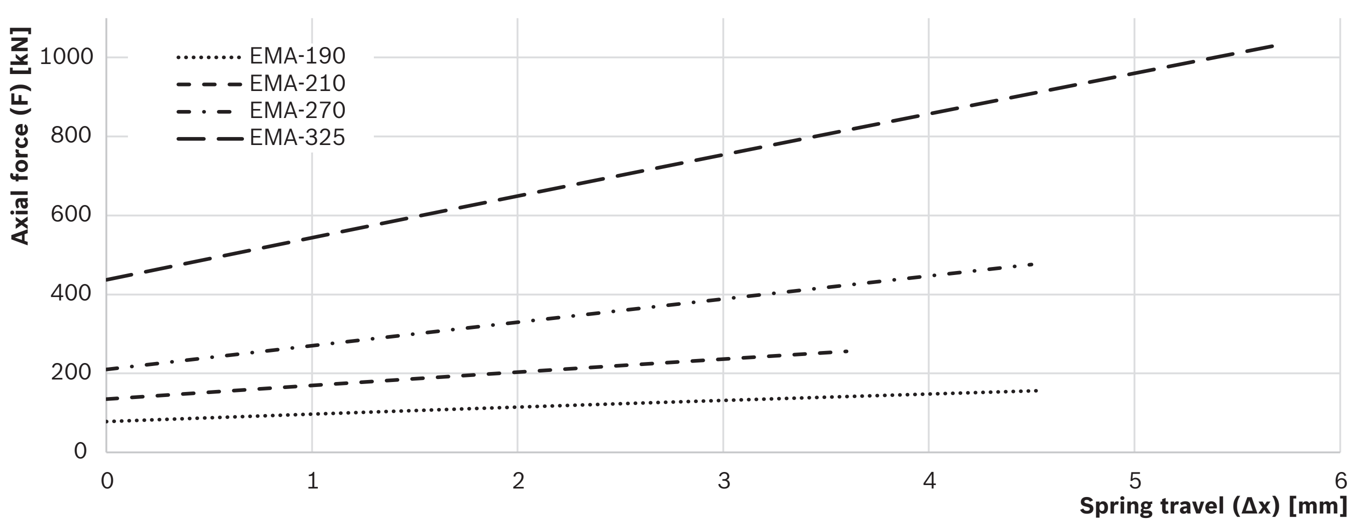
SHOCK ABSORBER

An EMA is a stiff construction element. Therefore, in some applications, the actuator can be equipped with a shock absorbing mechanism. E.g. in civil applications, it is required to apply an overload protection according to DIN19704-2:2014. If a shock absorber is not selected, while an application requires one, this could result in damage to the actuator or external structure due to overload. The function of the shock absorber can partly be compared to a pressure relief valve in a hydraulic system. In contrast to a hydraulic relief valve function, the “shock absorbing” stroke length is limited. Reasons to equip an EMA with a shock absorbing mechanism are:

- Temperature deviations in the external construction: because of temperature deviations, the construction where the actuator is attached to can change shape. This can cause high stresses in the actuator which are not allowable.
- Sudden stops with a high inertia: when the actuator is attached to an object with large mass inertia, a sudden power fail stops the screw. When the screw has stopped, the mass continues thanks to its inertia. This will cause a high load on the actuator rod. When a shock absorber is applied, the force on the screw is limited to protect against overload.



The Shock absorber is pre-tensioned to ensure that, during operating in normal conditions, the position of the rod will not deviate related to the screw shaft. The pre-tension depends on the required force to move. As a standard, the shock absorber is pre-tensioned at approximately 65% of the dynamic load capacity of the actuator. The pre-tension can be adjusted in production, for optimization to application requirements, please consult us.



☞ The characteristic stated above (pre-tensioning / configuration) is standard for this product. However, it can be adjusted to application parameters e.g. lower pre-tensioning which result in longer spring travel. Please consult us!

MOTOR TYPES

The electric motor of an EMA converts electrical energy into rotating movement driving the gearbox which is mechanically connected to the screw. As a result, electrical energy generates rotation of the screw in order to produce a linear movement.

As a standard, a three-phase asynchronous motor is applied which is suitable to drive with a variable speed. Each actuator size has three standard gearmotor combinations: low-, medium- and high linear velocity of the actuator.

When an application asks for a higher accuracy or dynamics, the EMA can be equipped with a MS2N Rexroth servo motor. This motor improves the dynamic behavior of the actuator and is more compact thanks to a relatively flat torque vs. speed curve. The MS2N motor is suitable to use in an industrial indoor environment.

Please consult us if your application involves special environmental conditions. The actuator can be adapted to the available installation space by mounting the motor as an extension to the axis (mount and coupling) or parallel to the axis. The type of motor attachment chosen also influences the technical performance data and the selectable mounting methods.

MOTOR CONFIGURATIONS

The motor types are chosen for intermittent operation duty (S3 – 40%). The motor rotational speed can be regulated using a frequency converter. All sizes are chosen to be regulated in a range from 20 to 100Hz were a maximum force can be driven within this range. When no frequency converter is connected, other transmission ratios are available to reach the desired linear velocity at mains frequency, please consult us.

EMA	Code	P_{motor} [kW]	F_{max} (S03-4%) [kN]	v_{min} (20Hz) [mm/s]	v_{nom} (50Hz) [mm/s]	v_{nom} (60Hz) [mm/s]	v_{max} (100Hz) [mm/s]
190	L	0.8	116	1.9	4.7	5.3	9.3
	M	2.2	116	5.3	13.3	16.0	26.7
	H	4.0	116	10.0	25.0	30.0	50.0
210	L	1.5	205	2.0	5.0	6.0	10.0
	M	4.0	201	5.6	14.0	16.8	28.0
	H	7.5	205	10.1	25.3	30.4	50.7
270	L	2.2	316	2.5	6.2	7.4	12.3
	M	5.5	316	5.7	14.2	17.0	28.3
	H	11.0	316	12.3	30.7	36.8	61.3
325	L	4.0	657	2.1	5.3	6.4	10.7
	M	11.0	657	5.6	14.0	16.8	28.0
	H	18.5	657	9.1	22.7	27.2	45.3

☞ Please consult us for other forces and duty cycles

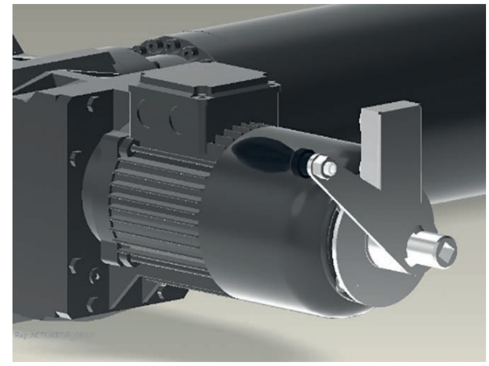
BRAKE

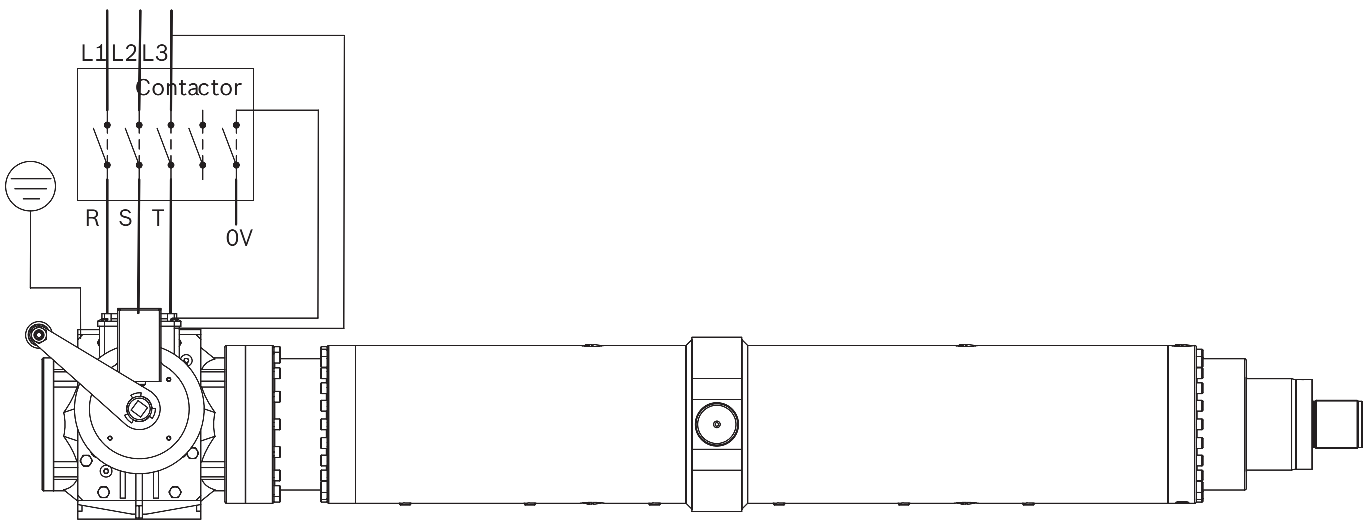
A standard EMA motor is equipped with a holding brake. The brake is a static brake and not intended as a dynamic brake. Rexroth screw assemblies have a high efficiency, thus are none self-locking. In most applications a holding brake is required for a safe operation when the screw is not self-self-lock. Optionally, an EMA can be configured without a brake. brake is power released. When power fails, the brake engages by a spring. The actuator decelerates motion and hold position. When the motor is energized the brake will disengage automatically. The brake can also be controlled via a separate control signal. Please consult us for the following options:

- Power applied brake, when power fails the brake releases.
- Double brake
- Brake sensor(s)

MANUAL OPERATION

An EMA has the option to apply manual operation. This allows movement of the actuator in case of power failure. The manual operation option is attached to the back of the electric motor. It consists of a crank with handle, mounting plate and switch. Normally, it is not connected to the motor shaft. When manual movement is desired, the crank can be unscrewed from the mounting plate and flipped over. When unscrewed, the switch will detect that the crank is not in a safe position. This signal has to be used to interrupt the power supply to the electric motor. The brake has to be released manually, before the actuator can be driven manually. The handle used is a Duroplast rotatable ball handle according DIN98E.





MOTOR ENCODER

Optionally the EMA is equipped with a multi-turn absolute encoder. The encoder is mounted on the back of the gearbox, mechanically connecting it to the screw. With the encoder the linear position of the rod can be measured as there is a direct correlation between rotations and linear movement. The following configurations are available:

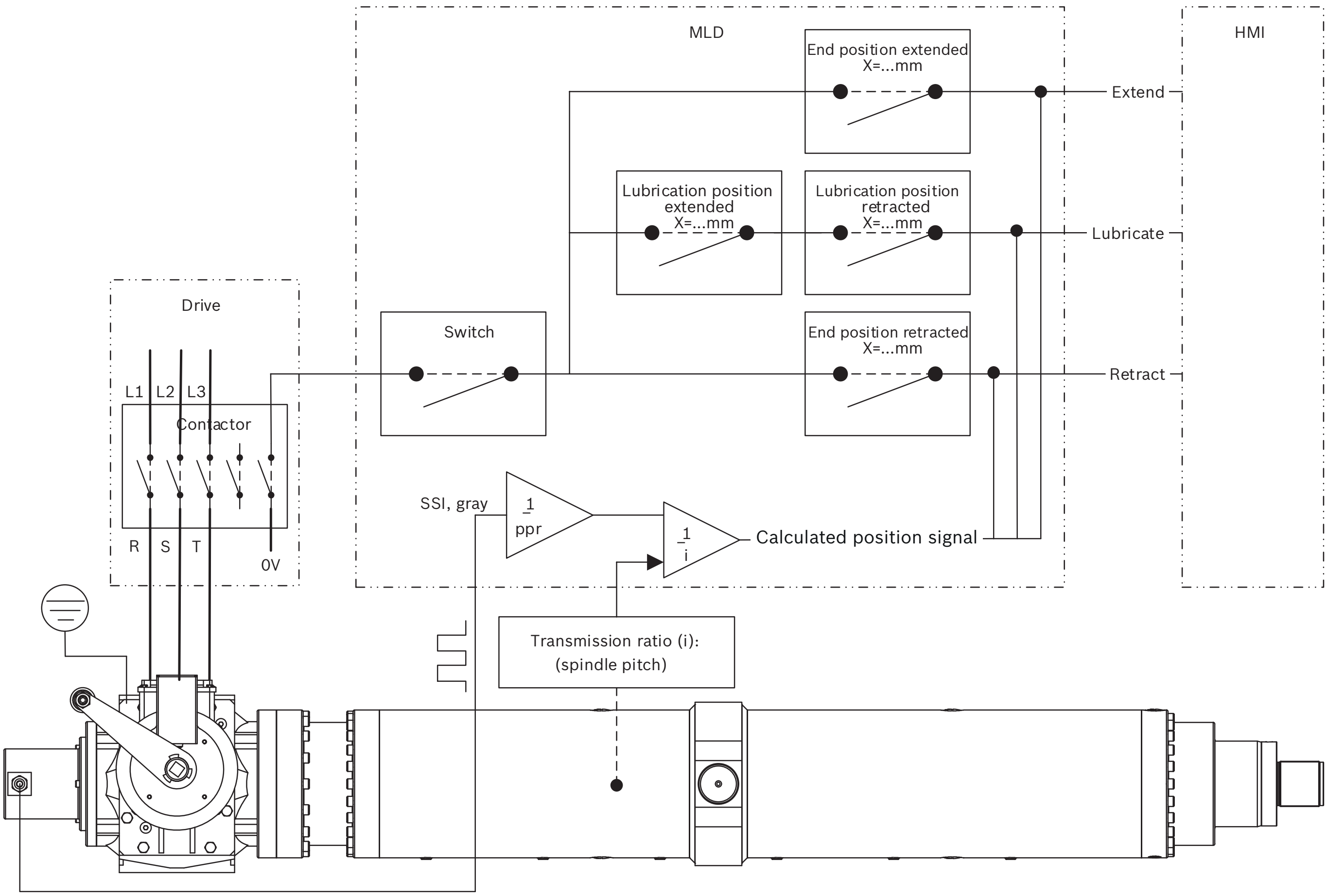
Encoder Design	Code	Safety	Power supply	Resolution	Interface
Without	W	-	-	-	-
Standard	B	-	10 ... 30V DC	13 bit	SSI, gray
Advanced	C	SIL2 / PL d			
Advanced	H	SIL3 / PL e			

The required type depends on the application and desired safety level. When using a CAB-X control cabinet, the encoder interface is standard based on SSI, gray. Other interfaces are optional e.g. absolute analog, fieldbus or Industrial Ethernet, please consult us.

☞ If a Shock absorber is applied: In an overload situation, the working stroke of the Shock absorber is not measured by the encoder. Meaning there is a deviation between the actual and measured position in an overload situation.

POSITION SWITCHES (DIGITAL)

To control your application position switches can be set in the drive software (MLD) using the optional encoder, refer to page 19. Since the encoder is an absolute device, mechanically connected to the screw. Multiple software switch points can be configured. In the example shown on this page, four software position switches are configured, two lubrication positions and two end (limit) positions for extended and retracted position of the actuator.

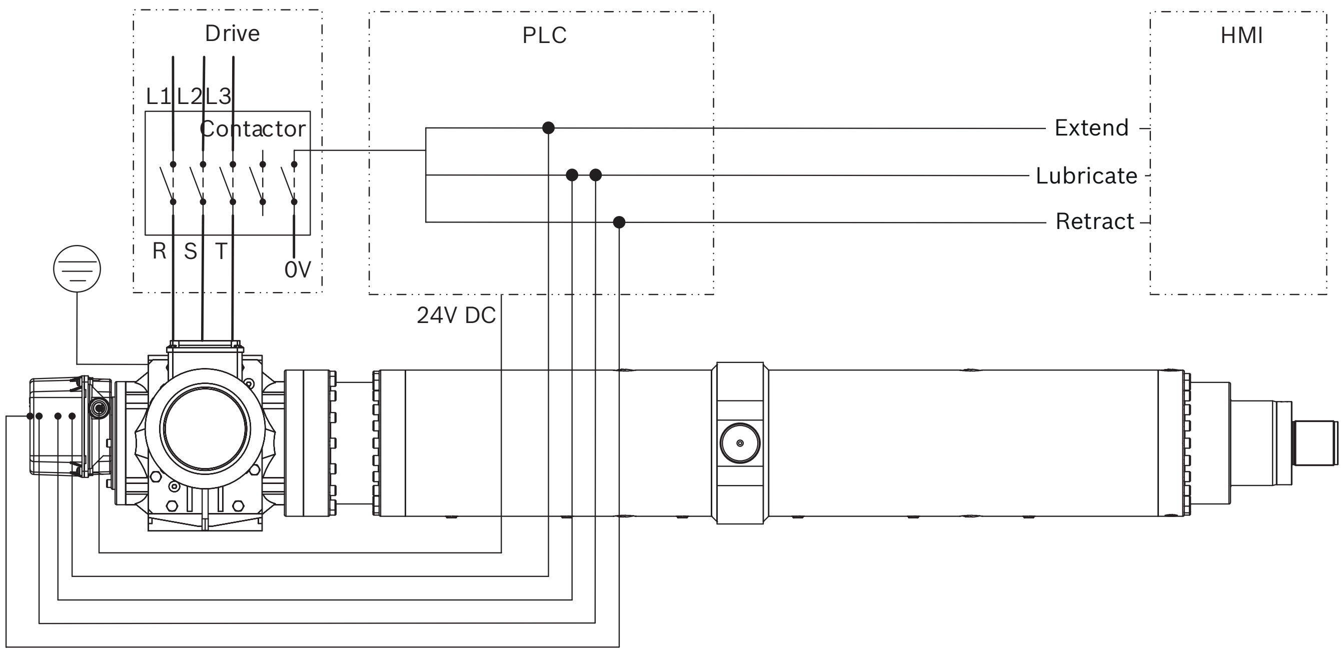


These position switches can be configured using the CAB-X Control cabinet, refer to page 23.

POSITION SWITCHES (MECHANICAL)

To control your application, optionally mechanical position switches can be selected. The switching mechanism is mounted to the back of the gearbox, in line with the screw shaft. The switch principle is based on a rotary cam switch. The cam rotates as the screw rotates. When the switch point is approached, the normally open contact closes resulting in a 24V DC output signal. The switch point can be adjusted to the required linear position of the rod.

The switching mechanism has four position switches which can be configured.



This option can be selected in combination with an encoder. The encoder is then built into the switching mechanism.

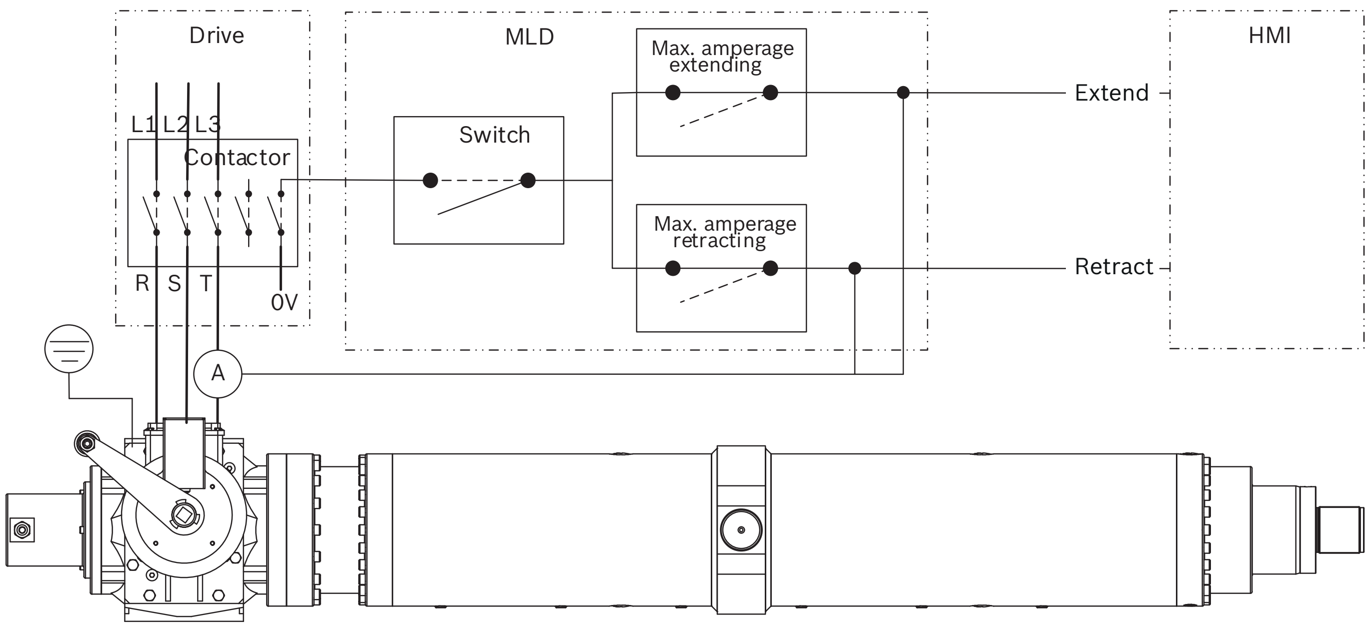
Consult us if the mechanical position switches need to detect the actual nut (piston) position. These type of switches are mounted to the shell of the actuator.

☞ If a Shock absorber is applied: In an overload situation, the working stroke of the Shock absorber influences the actual position of the rod. Meaning there is a deviation between the actual and set position of the switches in an overload situation.

FORCE LIMITING

Limiting the driving force of the EMA can be done using a control system by limiting the electrical power from a frequency converter to the electric motor. This option can be utilized when using the CAB-X Control cabinet, refer to page 23.

This function can be used to protect an external structure from experiencing overload.



If a load pin or another form of force or torque control is preferred then please consult us.

☞ Force limiting accuracy of the actuator depends on the mechanical efficiency of EMA. When a high accuracy is required, using a load pin in the clevis eye of the EMA could be preferred.

CONTROL CABINET

The EMA is ‘ready to use’ when combined with a Rexroth CAB-X control cabinet. Complete with firmware installed and parameters configured and optimized for your application. A drive (converter) is used to control the electric motor and thus the actuator. The size of the converter correlates to the required electric power and current. The standard cabinets are based on the size of the converter.

General		
Weight	kg	See page 31
Sheet steel cabinet (dimensions see page 31)	RAL	7035
Ambient (non-)operational temperature range	°C	–0 ... +35
Relative humidity (without condensation)	%	< 90
Ingress Protection class acc. EN 60034-5.	IP	54

EMA	Code	P_{motor} [kW]	Converter [HCS]	Max. current [A]
190	L	0.8	01.1E	8
	M	2.2	01.1E	28
	H	4.0	01.1E	54
210	L	1.5	01.1E	18
	M	4.0	01.1E	54
	H	7.5	03.1E	70
270	L	2.2	01.1E	28
	M	5.5	01.1E	54
	H	11.0	03.1E	100
325	L	4.0	01.1E	54
	M	11.0	03.1E	100
	H	18.5	03.1E	210

Electrical		
Power supply voltage	Netform TN-C/S	3x400V / PEN 50Hz
Control voltage	VDC	24

Standards	
EN60204-1	EN61439-1

Operation

- Main switch
- Emergency stop push button
- Start/Stop (local/remote)
- Indicator lights (fault/warning/operation)

Interfaces

Communication from an upper control level to CAB-X local control cabinet is possible via a Multi-Ethernet interface:

PROFINET® sercos the automation bus EtherNet/IP EtherCAT® ETHERNET POWERLINK Standardization Group

Safety functions

Several safety functions are available with Rexroth drives, the following can be fulfilled with the CAB-X:

Mode	Abbreviation	Safety function
Global	SMS	Safe Maximum Speed
	SSM	Safe Speed Monitor
	SCA	Safe CAM
Normal	SDI	Safe Direction
	SLE	Safe Limited End position
Special "Safe Standstill"	STO	Safe Torque Off
	SOS	Safe Operating Stop
	SBC	Safe Brake Control
	SBS	Safe Braking and holding System

Depending on what safety functions and communication is desired, the type of control unit is chosen (e.g. basic, advanced).

Options

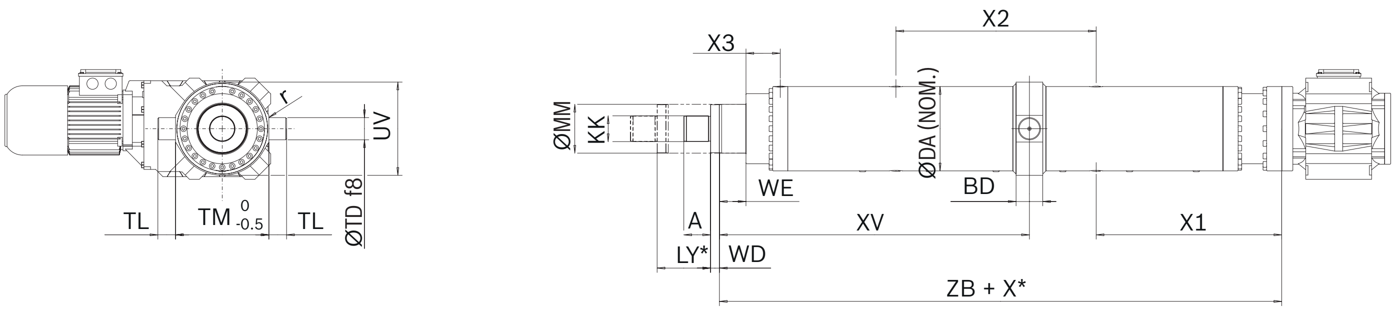
- Housing in special colors or made from stainless steel
- External filters in case of special requirements
- Protection class higher than IP54
- Reserve space for additional equipment
- Motor outlet for third-party fan
- Remote access

DIMENSIONS

ACTUATOR

Dimensions: Trunnion (MT4) & Threaded rod end (G)

All dimensions in millimeters.



EMA	ØMM [mm]	KK [mm]	A [mm]	ØDA [mm]	X1 [mm]	X3 [mm]	WE [mm]	WD [mm]
190	110	M58x1.5	60	190	417	77	32	20
210	130	M65x1.5	65	210	474	82	35	
270	170	M100x2	100	270	524	107	40	
325	210	M120x3	120	325	786	127	40	

EMA	ZB [mm]	ZB[1)] [mm]	BD [mm]	UV [mm]	ØTD [mm]	TL [mm]	TM [mm]	r [mm]
190	610	790	60	210	50	30	210	2
210	700	880	65	240	60	40	240	2.5
270	830	1010	75	310	75	52.5	310	2.5
325	980	1420	110	350	100	60	250	2.5

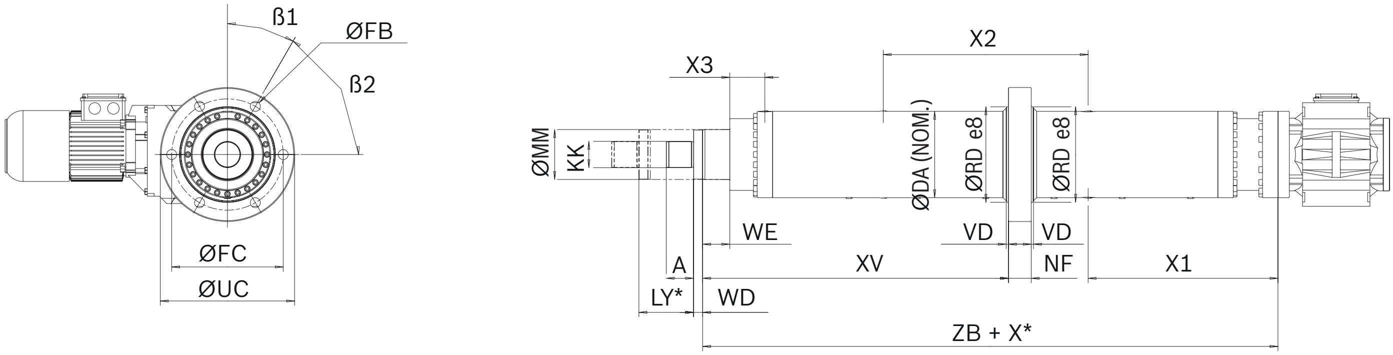
ØMM = Piston rod Ø
* = Adjustable parameter
X* = Stroke length
LY* = Additional rod extension
X2 = Depending on stroke length
1 = Dimension including shock absorption mechanism

- When ordering specify the "XV" dimension. Preferred XV dimension in horizontal installation position is at the Centre of Gravity of the actuator.
- The specified dimension for UV is a nominal value, tolerance classes 342 according to ISO 9013 Thermal cutting from plate.
- X1, X2 & X3 show lubrication point locations, for more information see page 32.

☞ During installation, it must be ensured that the trunnion bearings are installed up to the trunnion shoulders. Any non-compliance may reduce the product's service life.

Dimensions: Mid flange (ME4) & Threaded rod end (G)

All dimensions in millimeters.



EMA	ØMM [mm]	KK [mm]	A [mm]	ØDA [mm]	X1 [mm]	X3 [mm]	ØRD [mm]	WE [mm]	WD [mm]
190	110	M58x1.5	60	190	417	77	210	32	
210	130	M65x1.5	65	210	474	82	230	35	20
270	170	M100x2	100	270	524	107	300	40	
325	210	M120x3	120	325	786	127	370	40	

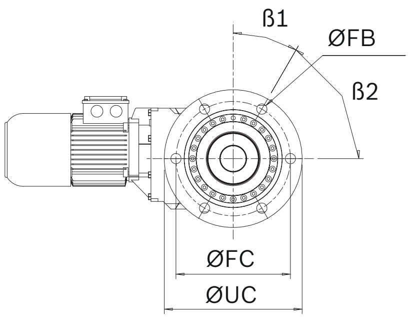
EMA	VD [mm]	NF [mm]	ZB [mm]	ZB[1] [mm]	ØFB [mm]	ØFC [mm]	ØUC [°]	ß1 [°]	ß2 [°]
190	5	50	610	790	22	245	295	30	60
210	5	50	700	880	22	265	315	30	60
270	10	70	830	1010	30	360	420	30	60
325	10	85	980	1420	33	430	490	30	60

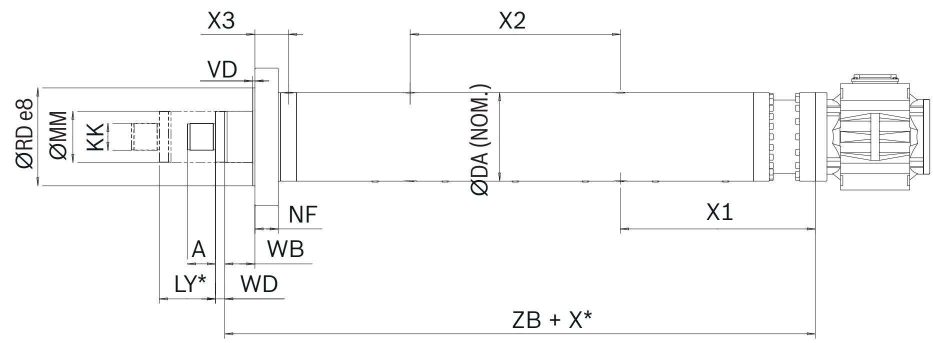
ØMM = Piston rod Ø
* = Adjustable parameter
X* = Stroke length
LY* = Additional rod extension
X2 = Depending on stroke length
[1] = Dimension including shock absorption mechanism

- When ordering specify the "XV" dimension. Preferred XV dimension in horizontal installation position is at the Centre of Gravity of the actuator.
- X1, X2 & X3 show lubrication point locations, for more information see page 32.

Dimensions: Front flange (ME7) & Threaded rod end (G)

All dimensions in millimeters.





EMA	ØMM [mm]	KK [mm]	A [mm]	ØDA [mm]	X1 [mm]	X3 [mm]	ØRD [mm]	WB [mm]	WD [mm]
190	110	M58x1.5	60	190	417	77	210	37	20
210	130	M65x1.5	65	210	474	82	230	40	
270	170	M100x2	100	270	524	107	300	50	
325	210	M120x3	120	325	786	127	370	50	

EMA	VD [mm]	NF [mm]	ZB [mm]	ZB[1] [mm]	ØFB [mm]	ØFC [mm]	ØUC [°]	ß1 [°]	ß2 [°]
190	5	50	610	790	22	245	295	30	60
210	5	50	700	880	22	265	315	30	60
270	10	70	830	1010	30	360	420	30	60
325	10	85	980	1420	33	430	490	30	60

ØMM = Piston rod Ø
* = Adjustable parameter
X* = Stroke length
LY* = Additional rod extension
X2 = Depending on stroke length
[1] = Dimension including shock absorption mechanism

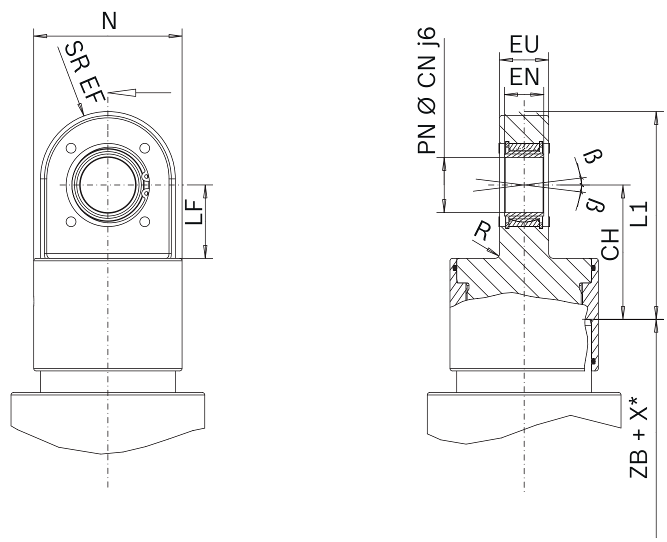
▶ X1, X2 & X3 show lubrication point locations, for more information see page 32.

ROD CLEVIS

Dimensions: Clevis with spherical bearing

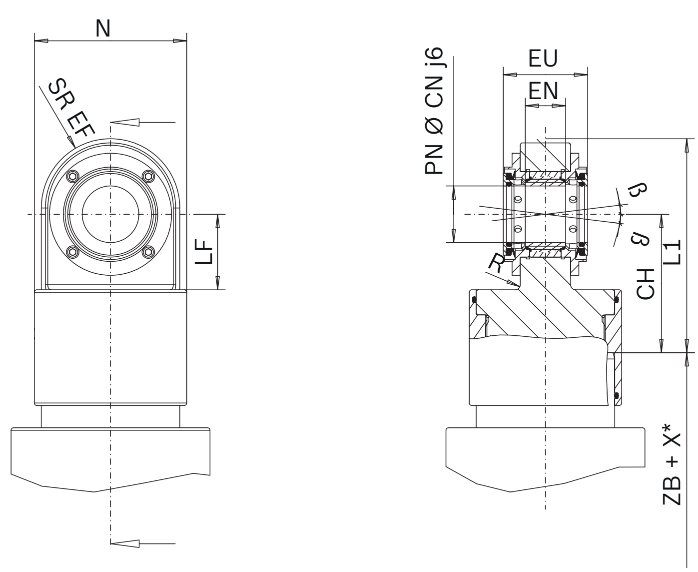
All dimensions in millimeters.

Standards clevis eye with spherical bearing (L)



EMA	N [mm]	CH [mm]	SR EF [mm]	PINØCN j6 [mm]	EN [mm]	EU [mm]	LF [mm]	L1 [mm]	ß [°]
190	121	110	55	45	32	40	60	170	7
210	153	120	70	60	44	53	70	195	6
270	194	120	85	80	55	65	100	210	6
325	273	195	130	120	85	94	120	335	6

Clevis eye with spherical bearing, additionally protected for underwater applications (P)

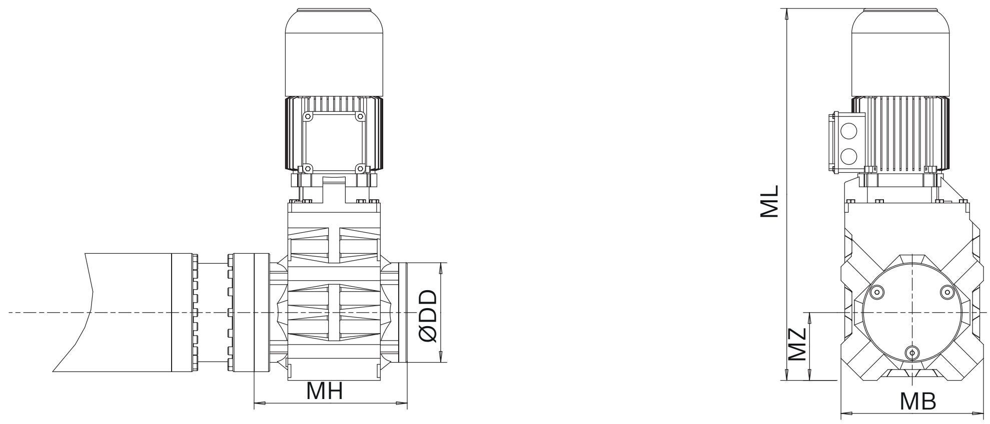


EMA	N [mm]	CH [mm]	SR EF [mm]	PINØCN j6 [mm]	EN [mm]	EU [mm]	LF [mm]	L1 [mm]	ß [°]
190	121	110	55	45	32	40	60	170	1
210	153	120	70	60	44	53	70	195	1
270	194	120	85	80	55	65	100	210	1
325	273	195	130	120	85	94	120	335	1

MOTOR

Dimensions: Asynchronous gearmotor (P)

All dimensions in millimeters.



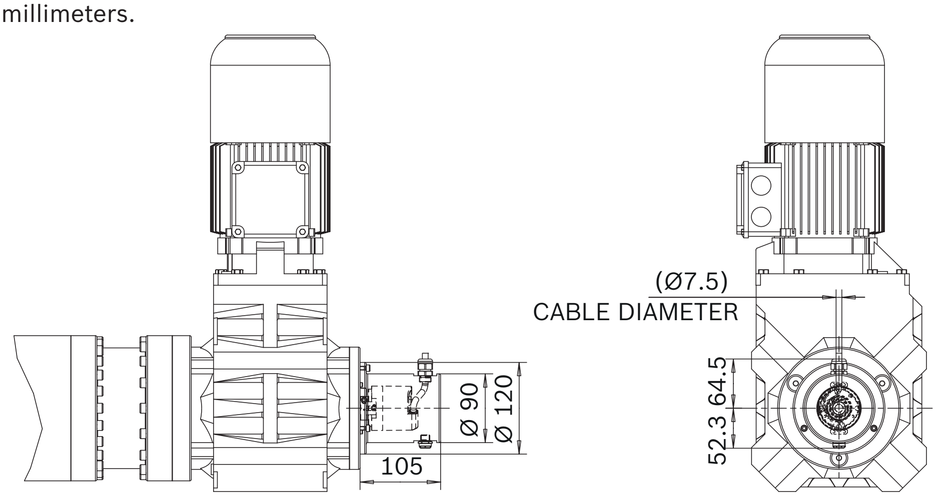
EMA	Code	MH [mm]	ØDD [mm]	ML [mm]	MB [mm]	MZ [mm]
190	L	253	160	598	228	109
	M			690.5		
	H			770		
210	L	314	200	792.5	310	150
	M			872		
	H			972		
270	L	332	210	761.5	346	135
	M			941		
	H			1024		
325	L	387	250	907	424	170
	M			1090		
	H			1216		

☞ Dimensions include holding brake. For dimensions of other types of motors please consult us!

ENCODER

Dimensions: Asynchronous gearmotor (P)

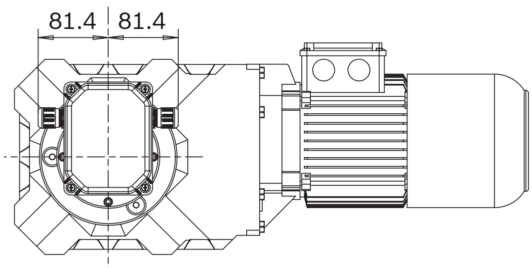
All dimensions in millimeters.

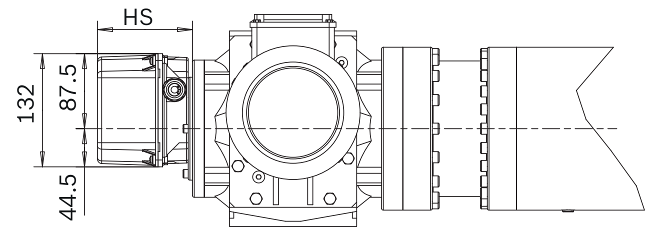


POSITION SWITCHES (MECHANICAL)

Dimensions: Mechanical position switches (M)

All dimensions in millimeters.



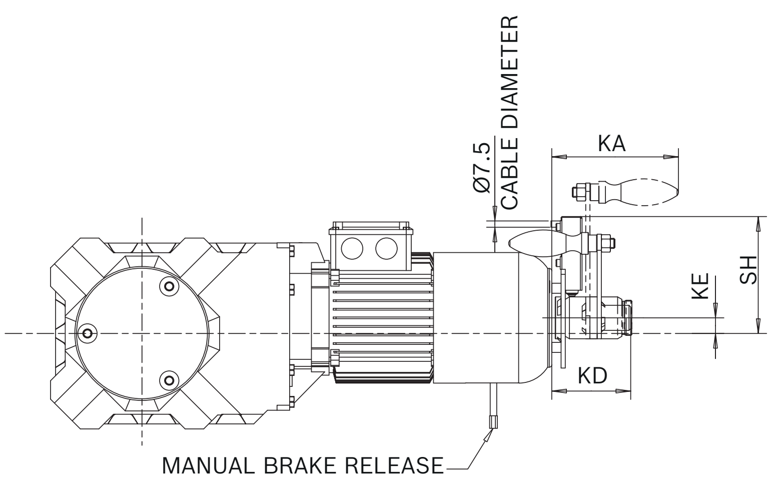


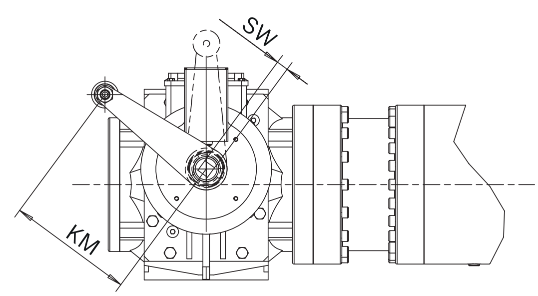
Encoder Design	Code	HS [mm]
Without	W	110.5
Standard	B	160.5
Advanced C	C	160.5
Advanced H	H	160.5

MANUAL OPERATION

Dimensions: Manual operation (M)

All dimensions in millimeters.

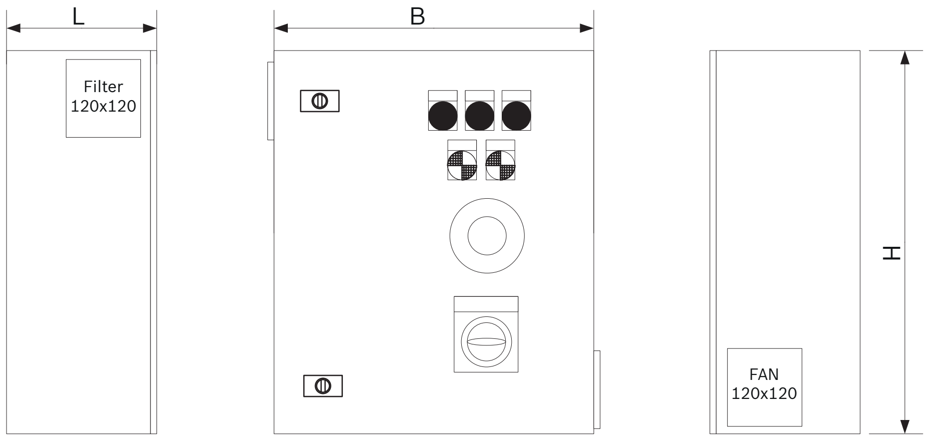




EMA	CONFIG	KD [mm]	KA [mm]	KE [mm]	SH [mm]	KM [mm]	SW [mm]
	L	94.1				150	14
190	M	94.1	151	18.7	139.7	150	14
	H	94.1				150	14
	L	94.1				150	14
210	M	94.1	151	21	139.7	150	14
	H	109.1				220	22
	L	94.1				150	14
270	M	109.1	151	25.5	139.7	220	22
	H	109.1				220	22
	L	94.1				150	14
325	M	109.1	151	41.8	139.7	220	22
	H	109.1				220	22

CONTROL CABINET

All dimensions in millimeters.



Cabinet size	Converter	L [mm]	B [mm]	H [mm]
S	HCS01.1E		800	1200
M	HCS02.1E	400	800	1200
L	HCS03.1E		1000	1400

MASS

All masses in kilograms. The masses are indicative, actual mass is subsequent to customer selection.

	m_0			m_s ()		m_m			m_r		m_{sa}
EMA	**MT4 [kg]**	**ME4 [kg]**	**ME7 [kg]**	**Q / R [kg/m]**	**C / D [kg/m]**	**L [kg]**	**M [kg]**	**H [kg]**	**L [kg]**	**P [kg]**	**[kg]**
190	114	126	128	104	114	48,2	56	79,6	5	7	22
210	163	172	175	137	148	102	135,6	153,2	9	11	28
270	298	327	335	242	267	118,2	165,2	206	14	16	49
325	606	654	663	341	378	224,6	289	354	58	66	143

m_0 = Mass of the actuator's body excluding stroke dependent parts (m_s)
m_s = Added mass of the actuator's body of the stroke dependent parts, attention kg/m!
m_m = Added mass of the motor group

Optional items

m_r = Mass of rod mounting with clevis
m_{sa} = Mass of Shock absorber
m_e = Mass of encoder assembly (3.5kg)
m_h = Mass of manual operation assembly (4kg)

Total mass actuator

m = Total mass actuator assembly
s = Stroke actuator in meters

$$m = m_0 + (m_s \cdot s) + m_m + m_r + m_{sa} + m_e + m_h$$

SERVICE AND INFORMATION

For more information about intended use and safety, see "Safety for Linear Motion Systems R320103152". For more information on installation/start-up see "Instructions EMC R320103102". PDF files of these documents can be found on the Internet at: www.boschrexroth.com/mediadirectory

LUBRICATION AND MAINTENANCE

The EMA requires greasing to increase the lifetime of the components and to maintain the efficiency level. The advantage of grease lubrication is that screw assemblies can run for prolonged periods without needing relubrication. The axial bearings are greased for life and internally sealed, therefore they do not require relubrication. When relubricating the actuator please note the recommendations below.

Standard grease
The preferred grease is Dynalub 510 / Dynalub 520. All other greases in accordance with DIN 51825 K2K and, for higher loads, KP2K of NLGI grade 2 in accordance with DIN 51818 are recommended.

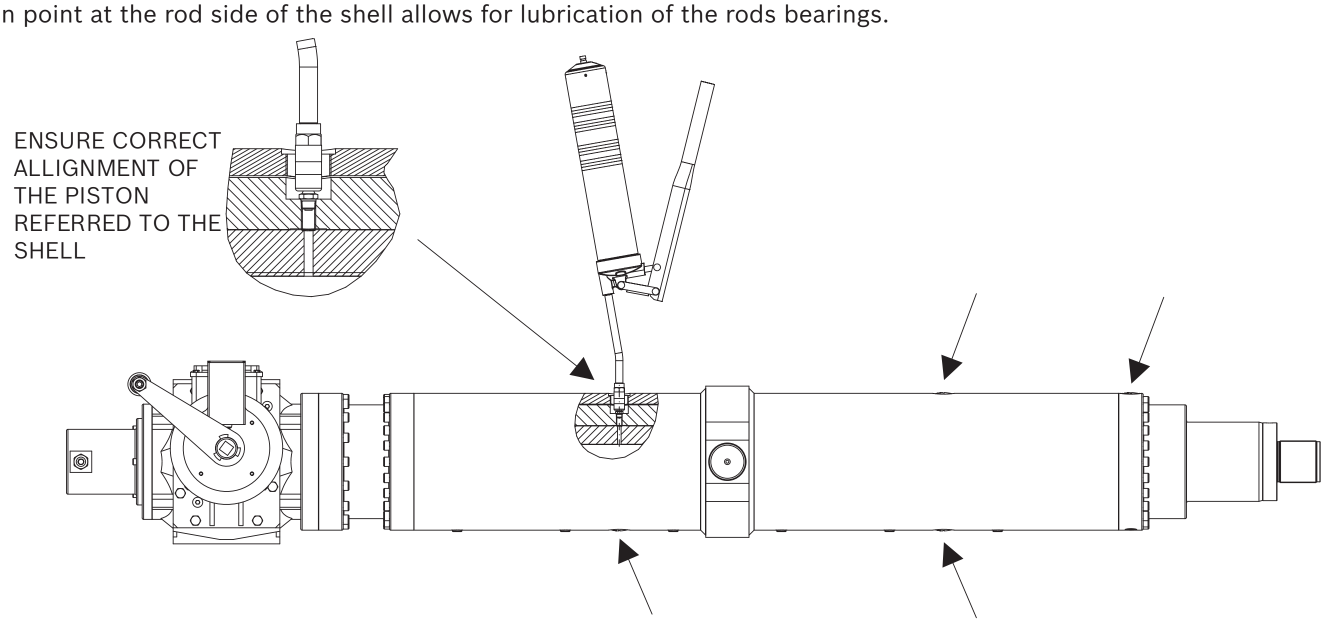
Dynalub	510	520
Cartride 0.4 (kg)	R341603700	R341604300
Bucket 5 (kg)	R341603500	R341604200

☞ Do not use greases with solid lubricant components (e.g., graphite or MoS2 additives). Dynalub 520 is recommended for central lubrication systems.

Biodegradable greases
Biodegradable greases are possible however far more aggressive to seals, which decreases the lifetime of these components. When biodegradable grease is required then LGEP2 is recommended. This grease will meet WGK 1 (water hazard class) acc. BGBI 2017.

Lubrication position and notes on lubrication
Basic lubrication with Dynalub 510 is applied in-factory before shipment. When ordering the actuator, the desired grease is selected. The EMA is designed for grease lubrication using a manual grease gun with a lubricating pin, or for connecting to a central lubrication system (with fluid grease). Do not mix different greases, specify the grease if this deviates from the factory standard.

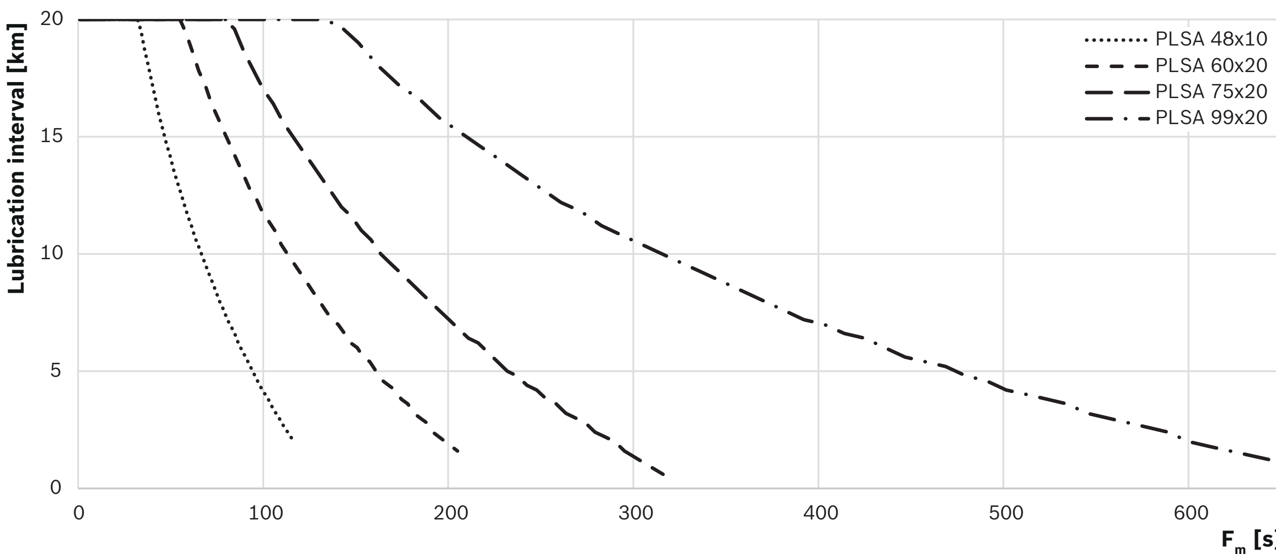
The actuator has lubrication points at the retracted position and extended position. The nut of the screw assembly needs to be aligned with the hole in the cylinder shell to be able to connect to the lubrication tap, see picture below. A lubrication point at the rod side of the shell allows for lubrication of the rods bearings.



When lubricating the actuator, the following quantity of grease needs to be inserted into the actuator each interval.

EMA	**190**	**210**	**270**	**325**
Lubrication quantity (cm³)	25	75	125	175

The next graph show the lubrication intervals in traveled distance based on the mean load [F_m] of the actuator.



☞ The actuator must be lubricated each year if the lubrication interval is not reached within one year after the last lubrication interval.

DOCUMENTATION & TESTING

Option 00 – Standard

The standard report confirms the listed checks have performed, proofing the measured values are within the permissible tolerances. The checks listed in the standard report:

- Functional check of mechanical components
- Functional check of electrical components
- Design as per order confirmation:
  - Dimensional Control
  - Visual inspection
  - Preservation Inspection
- Documentation:
  - Electrical interface
  - Manual
- IIB Declaration of Conformity according the EC Machinery Directive 2006/42/EC

Option 01 – Witnessing standard

Performing all tests according option 00 witnessed by the customer or a third party as selected by the customer. The witness signs as confirmation of being present during these tests and witnessing the results.

Option 10 – Performance

The performance report confirms the listed checks have performed, proofing the measured values are within the permissible tolerances. The checks listed in the extensive report:

- Tests according option 00
- Load test
- Linear velocity test

Option 11 – Witnessing performance

Performing all tests according option 10 witnessed by the customer or a third party as selected by the customer. The witness signs as confirmation of being present during these tests and witnessing the results.

FINDING A SOLUTION

Project description with picture

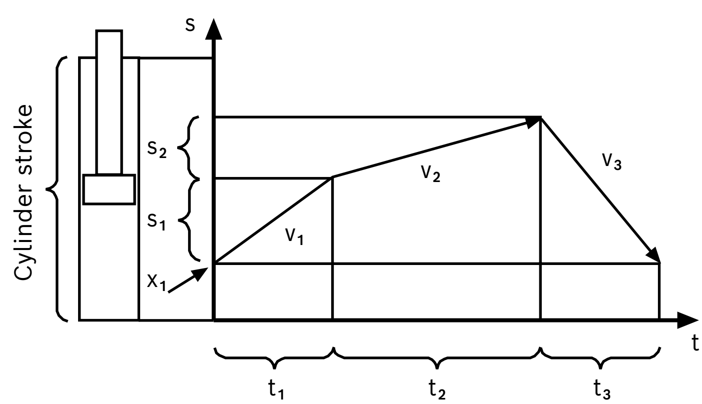
For target-oriented engineering, the following information must be available completely:

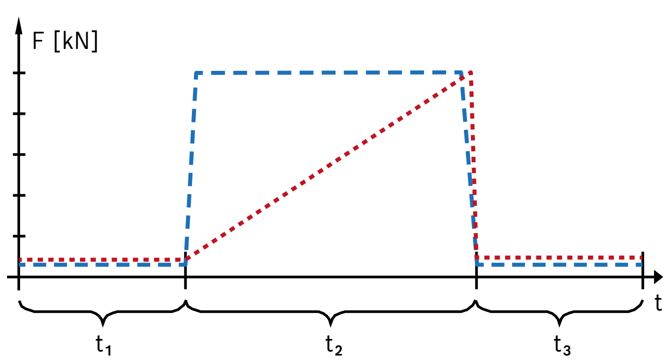
- Brief project description with picture(s)
- Cylinder orientation within the machine
- Additional boundary conditions
- Process sequence in the form of an F/s/t or F/v/t profile
- For complex multiple-step movements the table must be extended accordingly.

Please send inquiries to large.cylinders@boschrexroth.com

Boundary conditions			**Options**	
Ambient temperature (non-)operational		°C	Encoder	Standard / SIL2 / SIL3
Protection class		IP	Motor brake	
Cable length from actuator to cabinet		m	Manual operation	
Requested lifetime		years	Shock absorber	
Safety functions		-	Limit switches	
Piston Rod Coating		-	Torque or force control	

Symbol	Parameter	Value	Unit
x_1	Start point		mm
v_1	Advance velocity		mm/s
s_1	Advance distance		mm
t_1	Advance time		s
F_1	Advance Force		kN
v_2	Feed velocity		mm/s
s_2	Feed distance		mm
t_2	Feed time		s
F_2	Feed Force		kN
v_3	Return velocity		mm/s
s_3	Return distance		mm
t_3	Return time		s
F_3	Return Force		kN
t_4	Stop until restart		s
a_1	Max. acceleration		mm/s^2
a_2	Max. acceleration		mm/s^2
C	Cycled duration		s





Additional requirements:

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