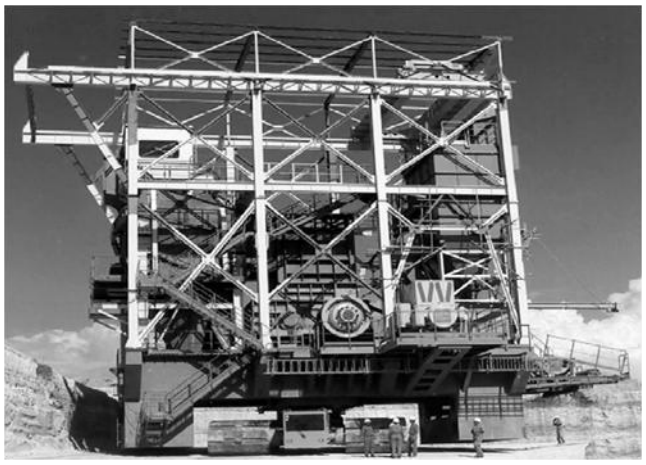
The Drive & Control Company

Rexroth
Bosch Group

Luffing cylinders

First Selection Bulk Material Handling & Mining



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Introduction

First selection
The First Selection is a range of brochures that provides information regarding the technical possibilities of Bosch Rexroth's large hydraulic cylinders' products. Each "First Selection" brochure provides you with necessary information that helps you determine the required specifications of your cylinder. Please note that your cylinder can only be produced with the correct input of these technical specifications.

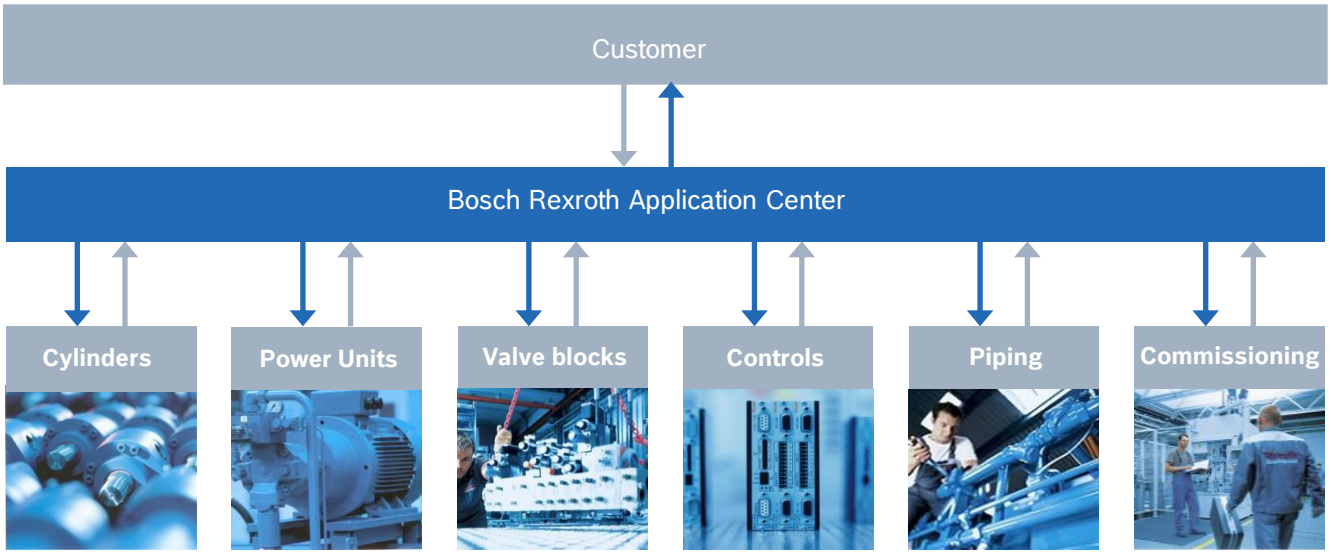
The perfect fit
At Bosch Rexroth, your project is our challenge. We design and manufacture custom built cylinders, high pressure piston accumulators and pressure vessels for your individual applications. Our large hydraulic cylinders are produced in The Netherlands, Brazil and China. They range from bore 200 mm up to 1.500 mm and strokes up to 24.000 mm. Our highly skilled specialists have a unique expertise in a large variety of industry sectors and understand the special requirements of your application.

Bosch Rexroth's large hydraulic cylinders are globally used in the following application fields:
- Civil engineering
- General industry & presses
- Heavy industry
- Bulk material handling & mining
- Offshore
- Marine and dredge
- Special projects

Engineering and production
Large hydraulic cylinders are used to transmit heavy forces in often extreme environments. Additionally, they must operate reliably and safely over a long period of time. Only systemized engineering and production processes can make sure that cylinders always meet the individual requirements. Bosch Rexroth has developed sophisticated design tools and unique in-house research facilities for a reliable and cost-efficient cylinder design.

Drive & control system integration

By means of our Bosch Rexroth Application Centers in Lohr Am Main, Germany and Boxtel, the Netherlands, all the integrated drive & control knowhow is available. Our Application Center consults in complete drive & control packages consisting of: cylinders, power packs, gear boxes, controls, piping, and installation & commissioning. This wide range of knowhow offers you the best complete drive system solution, specifically designed for your application.

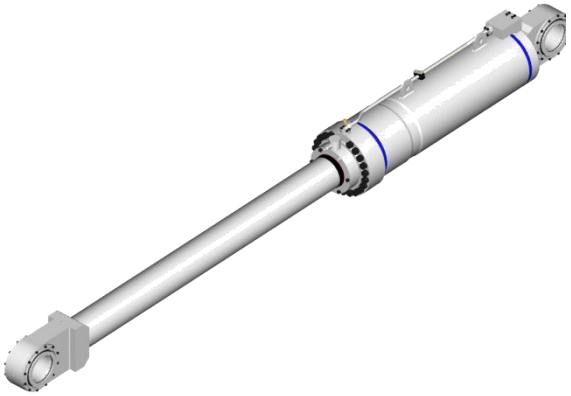


Life cycle management:

More than 90% of the life cycle costs are determined during the design phase. As a partner already involved in the engineering phase of the hydraulic installation, Bosch Rexroth can reduce your maintenance time and costs. This also leads to improved availability over the complete lifetime, further reducing your total costs of ownership. If however a problem occurs, Bosch Rexroth offers a wide range of repair and maintenance services. Our maintenance concept consists of: spare part management and delivery, field service, regular health checks and inspections, repair and overhaul services and technology upgrades. With numerous specialized service centers around the world, Bosch Rexroth is able to cover global support for your maintenance operations.

Luffing cylinder

Luffing cylinder
To accurately move a bucket wheel excavator, a reclaimer or stacker, luffing cylinders are used. The luffing cylinder enables the stick-slip free movement and positioning of the arm.
The luffing cylinders are used in continuous and sometimes dynamic operations.
In most cases the cylinder and piston rod are exposed to mechanically aggressive (abrasive) dust. This might even be in combination with a chemically hostile or maritime environment.
A full range of Bosch Rexroth Hydraulic Cylinders for bucket wheel excavators, reclaimers and stackers is available according to the Bosch Rexroth design. Bosch Rexroth installs complete hydraulic systems for these applications in close cooperation with our clients all over the world.



Technical data (most common projects)
Fluids: HL, HLP, HFD-R and HFA (Other on request)
Pressure range (nominal): 350 Bar
Operation temperature : -20 °C to +70°C
Stroke velocity: up to 0,1 m/s (higher velocities on request)

Type code

The following table shows the type code that creates the basis for your specific large hydraulic cylinder. Each code marks a basic specification. All specifications applicable in your cylinder are explained below.

For further questions, do not hesitate to contact your Bosch Rexroth country unit.

Type code																		
Field	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Type	CY	TEL						10										

Field 1 **Type designation**
CY Cylinders with a single rod

Field 2 **Application code**
TEL Luffing cylinder

Field 3 **External mounting shell side**
MP1 Female clevis on bottom
MP5 Clevis with spherical bearing on bottom

Field 4 **Bore dimension**
Bore range from 220 mm – 950 mm

Field 5 **Rod dimension**
Rod range from 125 mm – 670 mm
Specific dimensions on request

Field 6 **Stroke length**
On request

Field 7 **Cylinder construction**
A Bolted head and bolted bottom
B Bolted head and welded bottom

Field 8 **Revision index**
10

Field 9 **Oil connections rod side**
D SAE Flange (6.000 PSI)
X Other, on request

Field 10 **Position oil connection**
1 0°
X Other, on request

Field 11 **Piston rod surface**
C Chromium
N Nickel and hard chromium plated
Q Enduroq 2000
R Enduroq 2200

Field 12 **Mounting rod side**
L Male clevis with spherical bearing
R Female clevis

Field 13 **Cushioning**
U Not applicable
K Self adjusting cushioning bottom side
S Self adjusting cushioning rod side
D Self adjusting cushioning rod & bottom

Field 14 **Sealing system on rod side**
A Chevron seals
T Low friction seal system

Field 15 **Sealing system on piston**
A Chevron seals
T Low friction seal system

Field 16 **Positioning sensor system (option 1)**
C CIMS
T Other position sensor
W No position sensor

Field 17 **Option 2**
A Maintenance free bearing
Bellow and air breather
Sealing system of spherical bearings
Y Rod extension
W No option

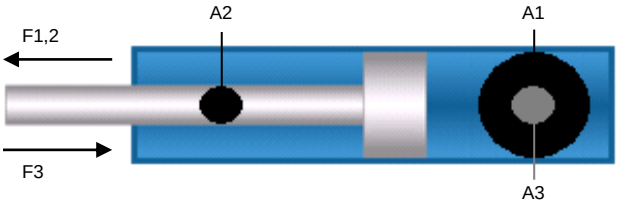
Field 18 **Country code**
N Netherlands
C China

Standard dimensions

Based on our technical knowhow and experience we have defined the table below to help you select the size of your cylinder. This table shows the approximate sizes of hydraulic cylinders along with the pulling force they can deliver at a nominal pressure of 350 bar. The results are applicable to trunnion mounted cylinders and bottom eye mounted cylinders and are independent of stroke- and built-in length.
Please note that this is not a catalogue. To calculate the sizes and forces of the hydraulic cylinder for your application, please contact your local Bosch Rexroth country unit.

Piston	Piston rod	Area ratio	Areas			Force at 350 bar[1]		
			Piston	Rod	Annulus	Pushing	Diff.	Pulling
Ø mm	Ø mm	φ A_1/A_3	A_1 mm²	A_2 mm²	A_3 mm²	F_1 kN	F_2 kN	F_3 kN
220	125	1,48	38.013	12.272	25.741	1.330	430	901
	160	2,12		20.106	17.907		704	627
250	140	1,46	49.087	15.394	33.694	1.718	539	1.179
	180	2,08		25.447	23.640		891	827
280	160	1,48	61.575	20.106	41.469	2.155	704	1.451
	200	2,04		31.416	30.159		1.100	1.056
320	180	1,46	80.425	25.447	54.978	2.815	891	1.924
	220	1,90		38.013	42.412		1.330	1.484
360	200	1,45	101.788	31.416	70.372	3.563	1.100	2.463
	250	1,93		49.087	52.700		1.718	1.845
400	220	1,43	125.664	38.013	87.650	4.398	1.330	3.068
	280	1,96		61.575	64.088		2.155	2.243
450	250	1,45	159.043	49.087	109.956	5.567	1.718	3.848
	320	2,02		80.425	78.618		2.815	2.752
500	280	1,46	196.350	61.575	134.774	6.872	2.155	4.717
	360	2,08		101.788	94.562		3.563	3.310
550	320	1,51	237.583	80.425	157.158	8.315	2.815	5.501
	380	1,91		113.411	124.171		3.969	4.346
600	360	1,56	282.743	101.788	180.956	9.896	3.563	6.333
	420	1,96		138.544	144.199		4.849	5.047
650	380	1,52	331.831	113.411	218.419	11.614	3.969	7.645
	450	1,92		159.043	172.788		5.567	6.048
700	420	1,56	384.845	138.544	246.301	13.470	4.849	8.621
	500	2,04		196.350	188.496		6.872	6.597
750	450	1,56	441.786	159.043	282.743	15.463	5.567	9.896
	520	1,93		212.372	229.415		7.433	8.030
800	480	1,56	502.655	180.956	321.699	17.593	6.333	11.259
	560	1,96		246.301	256.354		8.621	8.972
850	520	1,60	567.450	212.372	355.079	19.861	7.433	12.428
	600	1,99		282.743	284.707		9.896	9.965
900	540	1,56	636.173	229.022	407.150	22.266	8.016	14.250
	630	1,96		311.725	324.448		10.910	11.356
950	560	1,53	708.822	246.301	462.521	24.809	8.621	16.188
	670	1,99		352.565	356.257		12.340	12.469

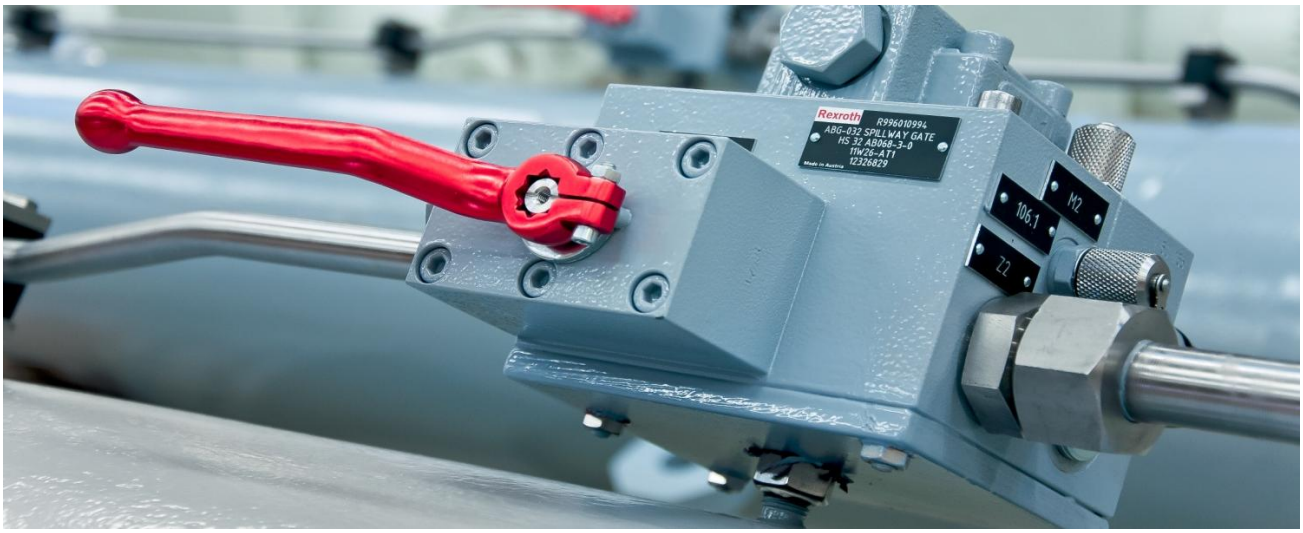
[1] Theoretical force (efficiency not taken into account)



Pressure: 350 bar

Scope of supply

In most cases the boom cylinder is delivered including manifold and steel piping, all produced and designed by Bosch Rexroth. Although the system and its components are reliable and robust, they also need care and attention after installation. Therefore, installation, operation and maintenance manuals are part of the standard delivery from Bosch Rexroth.

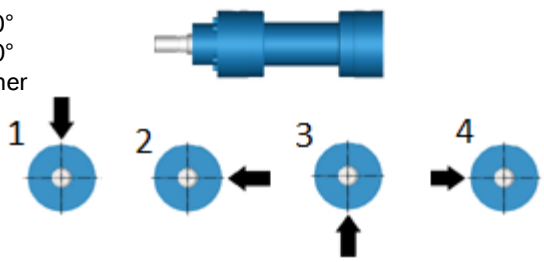


Oil connections

Transportation of hydraulic fluids into the cylinder is an important issue. The oil connection has to be suitable for the oil flow rate and pressure, required for the application.

Connection angle
Hydraulic piping is mounted on the cylinder on rod and shell side. The angle of the connection is adjusted to the customers wishes. The picture below shows the cylinder from rod-side. The angle of the connection can be filled in on the inquiry list.

1 0°
2 90°
3 180°
4 270°
X Other



Connection type
To install the hydraulic piping on the cylinder, Bosch Rexroth has a standard oil connection:
SAE 6000 PSI connection. This type of connection is reliable and highly serviceable. The best fit for your application depends on the pressure range and size of the oil connection.

Mounting style

The mounting style represents the cylinder's connection and interface with the structure. The mounting style and position have effect on the cylinder's behavior. Bosch Rexroth helps you optimize this behavior for the best fit in your application.

Mounting position optimization
With sophisticated design tools, Bosch Rexroth can support in an early design stage to optimize the position of cylinder mounting to the structure. We are able to determine the minimum required bore, rod and bearing diameters, the initial shell thickness, the best angles of rotation of all pivot points, including the involved frictional moments and reaction loads in pivot points, while maintaining the required built-in dimensions and associated stroke.

With the required input and available area for position of cylinder mounting in the structure, we are able to determine the maximum and minimum forces on the cylinder (at angle), calculate guide bearing pressure and deflection of the cylinder and thus optimize the complete design of the cylinder. This results in a cost effective design, from which we all benefit.

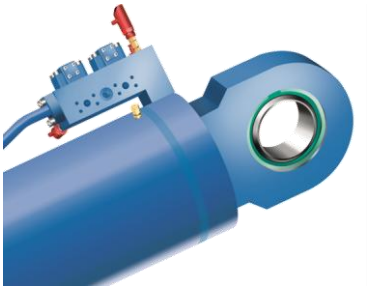
Rod side
The connection on rod side mounts your cylinders piston rod. Depending on the design, the cylinder is designed with a male or a female clevis.

Female clevis
The female clevis is a double bladed connection that requires a male clevis equipped with a spherical bearing to be mounted. This connection is locked with a pin.

Male clevis
The male clevis is a single bladed connection, mounted on a female clevis. This connection is locked with a pin.

Shell side
The connection on shell side mounts the cylinder shell to the structure. The most common mounting styles are:
- Clevis with spherical bearing (MP5)
- Double bladed clevis (MP1)

MP5 mounting
The MP5 mounting style is an clevis connection with a spherical bearing. The special bearings reduce side forces (introducing wear) caused by small misalignments. The cylinders will be equipped with spherical bearings from premium suppliers.



MP1 mounting
The female clevis is a double bladed connection that requires a male clevis equipped with a spherical bearing to be mounted. This connection is locked with a pin.

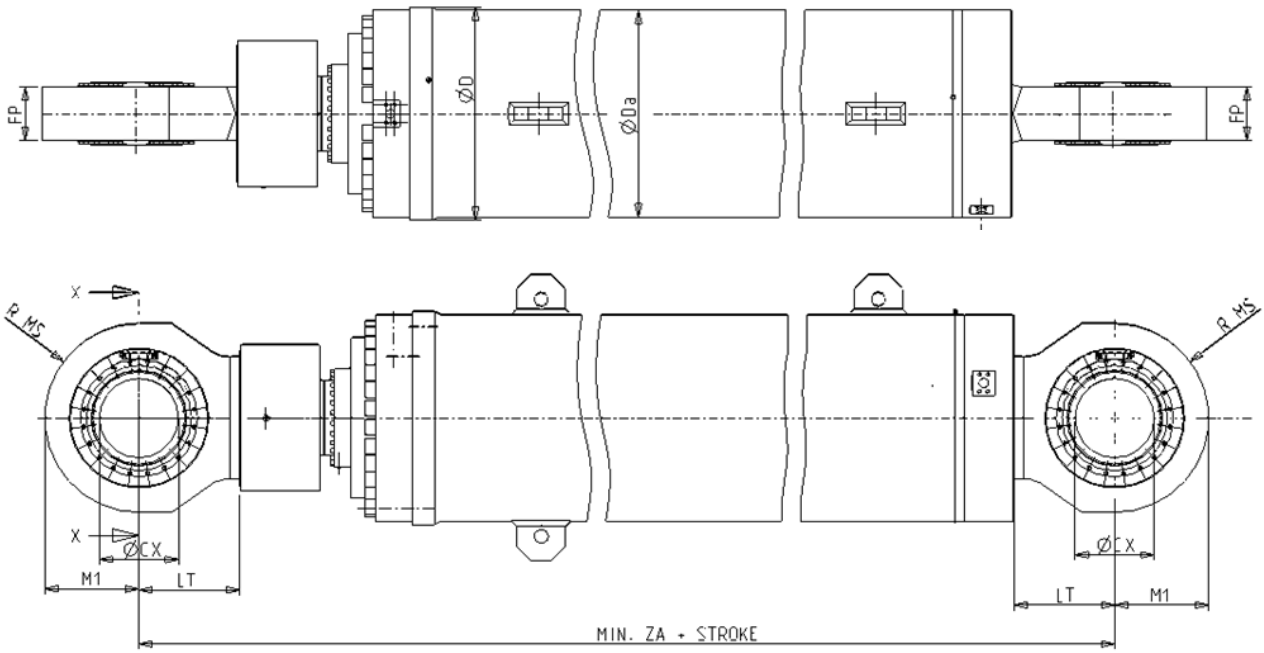
Self aligning clevis MP5

The following table shows the size of the hydraulic cylinder with forces they can deliver with a pressure of 350 bar. All sizes are calculated based on Bosch standards for semi static applications. For dynamic applications please contact Bosch Rexroth cylinders. Please note that this is not a catalogue. To calculate the sizes and forces of the hydraulic cylinder for your application, please contact your local sales department.

■ Safety factor of 1.25 is taken into account.

Bore	Rod	Za + stroke	øD	øDa	CX*	LT	M1	FP	MS
Ø mm	Ø mm	mm	mm	mm	mm	mm	mm	mm	mm
280	160/200	1276	360	343	120	222	202	100	190
320	180/220	1438	416	394	160	265	245	120	230
360	200/250	1588	480	445	180	302	282	120	265
400	220/280	1708	520	495	200	324	304	140	285
450	250/320	1887	594	559	220	366	346	150	325
500	280/360	2080	644	610	260	415	395	160	370
550	320/380	2239	718	690	280	447	427	170	400
600	360/420	2390	768	750	320	475	455	200	425
650	380/450	2599	842	830	360	532	512	200	480
700	420/500	2720	892	900	380	545	525	230	490
750	450/520	2917	-	990	400	596	576	230	540
800	480/560	3080	-	1080	440	630	610	250	570
850	520/600	3247	-	1170	460	666	646	250	605
900	540/630	3440	-	1270	500	715	695	280	650
950	560/670	3639	-	1380	530	767	747	280	700

*Note: The choice of the pin diameter is based on the bearing capacity of a maintenance free bearing only.
The construction of the counter part may lead to a bigger pin diameter. Then the Za dimension will change accordingly.



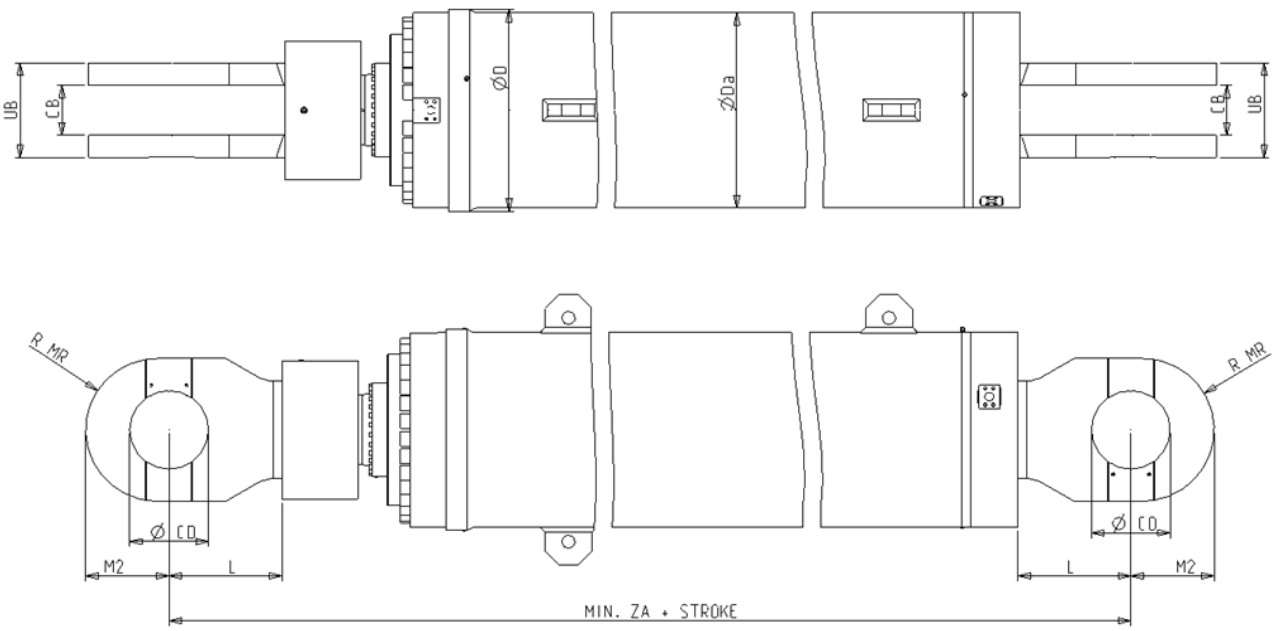
Double bladed clevis MP1

The following table shows the size of the hydraulic cylinder with forces they can deliver with a pressure of 350 bar. All sizes are calculated based on Bosch standards for semi static applications. For dynamic applications please contact Bosch Rexroth cylinders. Please note that this is not a catalogue. To calculate the sizes and forces of the hydraulic cylinder for your application, please contact your local sales department.

■ Safety factor of 1.25 is taken into account.

Bore	Rod	Za + stroke	øD	øDa	CD*	L	M2	CB	UB	MR
Ø mm	Ø mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
280	160/200	1226	360	343	120	197	177	145	245	165
320	180/220	1360	416	394	160	226	206	161	281	190
360	200/250	1588	480	445	180	302	248	170	290	230
400	220/280	1708	520	495	200	324	265	192	332	245
450	250/320	1887	594	559	220	366	302	213	363	280
500	280/360	2080	644	610	260	415	346	219	379	320
550	320/380	2239	718	690	280	447	378	234	404	350
600	360/420	2390	768	750	320	475	392	256	456	360
650	380/450	2599	842	830	360	532	451	256	456	415
700	420/500	2720	892	900	380	545	458	292	522	420
750	450/520	2917	974	990	400	596	500	292	522	460
800	480/560	3080	1024	1080	440	630	539	317	567	495
850	520/600	3247	1106	1170	460	666	576	317	567	530
900	540/630	3440	1156	1270	500	715	605	336	616	555
950	560/670	3639	1238	1380	530	767	663	348	628	610

*Note: The choice of the pin diameter is based on the bearing capacity of a maintenance free bearing only.
The construction of the counter part may lead to a bigger pin diameter. Then the Za dimension will change accordingly.

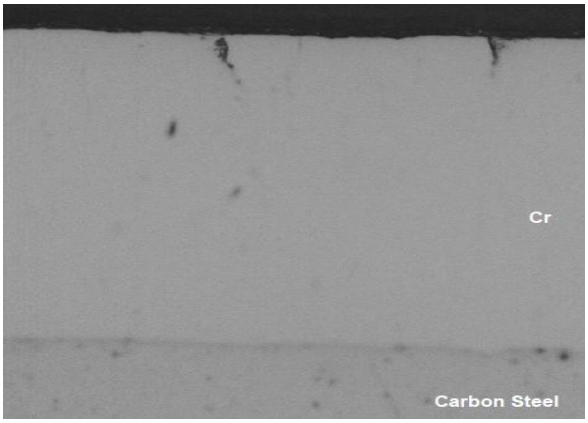


Chrome coatings

The piston rod surface of large hydraulic cylinders is one of the most essential parts of the hydraulic cylinder. If not good protected, exposure to harsh environments like high or low temperatures, (sea)water, chemicals, mechanical impacts or abrasive materials can influence the cylinders performance. Bosch Rexroth helps you choose the best surface layer for your application to minimize the total costs of ownership.

Chromium plating is the most used indoor industrial coating for piston rods. Bosch Rexroth only supplies chromium plated rods in applications where the coating has been proven, mainly in steel works, presses, noncorrosive mining and fresh water power dams. Bosch Rexroth cooperates with a select group of suppliers that meet the very high standards of Bosch to assure a consistent quality.

Bosch Rexroth has developed a combination of seals and bearings that the best tribolocal properties in combination with the chromium layer. This ensures a long lifetime, low friction and a minimum change of leakages.
Chromium plating can be provided on carbon steel and in specific applications on stainless steel. Different qualities (single or double layer) and layer thicknesses are available.

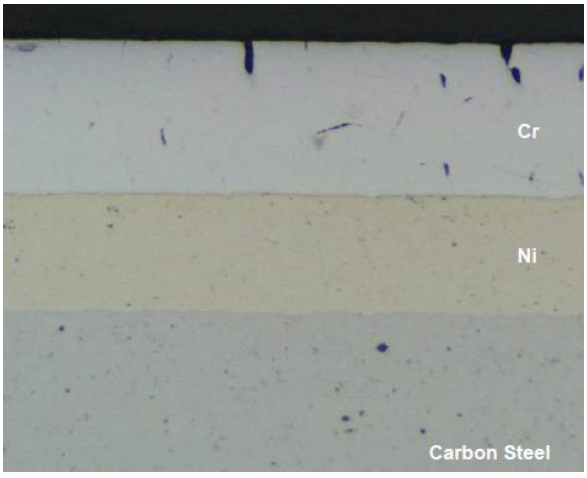


Characteristics
- Galvanic coating
- Layer thickness up to 50 µm
- Surface finish Ra 0,1 to 0,3 µm
- Hardness between 800 and 1050 HV
- Standard corrosion protection

Nickel – Hard Chrome coatings

Nickel – hard chrome
For improved corrosion protection, required in slightly corrosive industrial environments or sheltered marine applications, chromium plating onto a galvanic nickel intermediate layer can be provided.

Characteristics
- Duplex galvanic coating
- Ni-layer thickness up to 100µm (standard 60µm)
- Cr-layer thickness up to 50 µm (standard 40µm)
- 3.000 to 5.000 hours in DNVC1 corrosion testing



Enduroq 2000/2200

The piston rod surface of large hydraulic cylinders is one of the most essential parts of the hydraulic cylinder. With insufficient protection, water, chemicals, mechanical impacts or abrasive materials can influence the cylinder's performance. Bosch Rexroth helps you choose the best surface technology for your application to optimize reliability and to minimize your total costs of ownership.

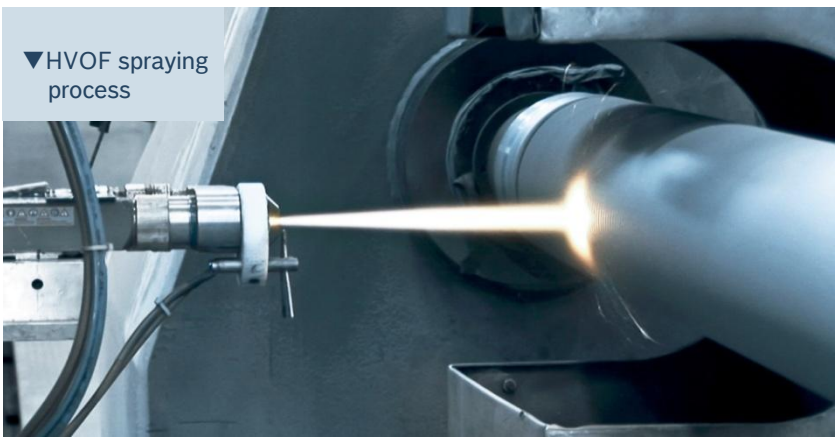
Enduroq
As world market leader in designing and manufacturing of customized large hydraulic cylinders, Bosch Rexroth is a prominent pioneer in the field of piston rod protection. With the introduction of the in-house developed Enduroq 2000/2200 surface layers, Bosch Rexroth has set a new global standard for piston rod surface technologies.
Worldwide, over 3,000 Large Hydraulic Cylinders with an Enduroq 2000 or 2200 coating are installed, performing in very diverse environmental situations. The Enduroq 2000 series have high corrosion- and extremely high wear resistance. They also have a low porosity level and zero permeability. Applying Enduroq surface technologies in the right circumstances considerably increases your cylinder lifetime and minimizes the chance of leakages. The HVOF process, used to spray the Enduroq 2000/2200 surface technology, has been continuously improved since its first release. These improvements ensure a consistent and durable surface coating. Enduroq can be sprayed as a single or dual layer.

Test program
Enduroq 2000 and Enduroq 2200 have undergone a series of tests at the in-house research facilities in Boxtel. Tests have pointed out the following characteristics.

Enduroq 2000
This thermal sprayed coating is a single layer surface coating with all the characteristics for an optimal cylinder functionality in extreme environments and intensive use. Enduroq 2000 offers a very high abrasive wear resistance, and the finished coating surface provides excellent sealing properties for low friction and maximal seal lifetime. Enduroq 2000 also offers a very high corrosion protection in neutral environments. The excellent high alloyed coating material combined with an extremely low porosity level and a suitable thickness create a lasting surface protection.

Enduroq 2200
To protect your piston rod against corrosion in most severe maritime circumstances Enduroq 2200 is the perfect choice. This dual layer coating combines the excellent properties of Enduroq 2000 with an extremely high corrosion protection.

Tested characteristic	Enduroq 2000	Enduroq 2200
Impact resistance	8J	8J
Layer thickness	250 µm	450 µm
Hardness (avg.)	650 HV	650 HV
Corrosion (hours to failure in DNV-c1 testing)	> 25.000	> 60.000
Max. coating stress	250 N/mm²	250 N/mm²
Roughness	Ra < 0,20 µm	Ra < 0,20 µm



▼HVOF spraying process

▼Testing facilities Bosch Rexroth Boxtel

Cylinder integrated measuring system

The Bosch Cylinder Integrated Measuring System (CIMS) provides a highly reliable solution to measure the position of the piston rod. For over 20 years, from the original system (Mk I) up to the latest generation (Mk IV), CIMS has been accurately and reliably measuring the piston rod's position in thousands of large hydraulic cylinders. The close cooperation between Bosch and Rexroth resulted in the latest version of CIMS. This version is based on the latest automotive measurement technologies. Fully integrated in Rexroth's large hydraulic cylinder, CIMS works in every environmental situation.

Function and Characteristics

The Cylinder Integrated Measuring System is a highly unified incremental position measuring system for use on hydraulic cylinders with Enduroq 2000 series surface technologies. Grooves underneath the piston rod coating cause a variation in the magnetic field from the permanent magnet inside the CIMS. The CIMS Hall-effect sensor elements measure the magnetic field and its variations resulting in precise measurements with an accuracy of less than 1 millimeter (linearity ≤ 1 mm). Their signals are fed into a micro controller which calculates the position inside the groove and generates the incremental RS-422 output signal (1024 pulses/cm). The sensor and electronics are protected by a robust stainless steel housing, which is installed into the head of the cylinder. CIMS can withstand almost any environment: low (-40°C) to high temperatures (70°C); high pressure when submerged in (sea)water (IP68, 10 bar); and even potentially explosive atmospheres (ATEX zone 1).

New CIMS features

• Contactless operation, no contact between sensor and cylinder rod: no-wear parts; no-slide pad; and no-rod diameter, depending on components and a completely closed housing.
• Easy commissioning/easy installation: plug & play and no (manual) calibration necessary; CIMS will automatically compensate for mounting tolerances, magnetic disturbances and temperature effects.
• Status CIMS can be monitored. Simplified failure analysis possible: diagnostic output, through a PC or PLC, can be retrieved for sensor status, error codes, sensor identification.
• Increased operating conditions: CIMS withstands tougher environmental conditions, larger temperature range (up to -40 °C), higher speeds.

Backward compatibility

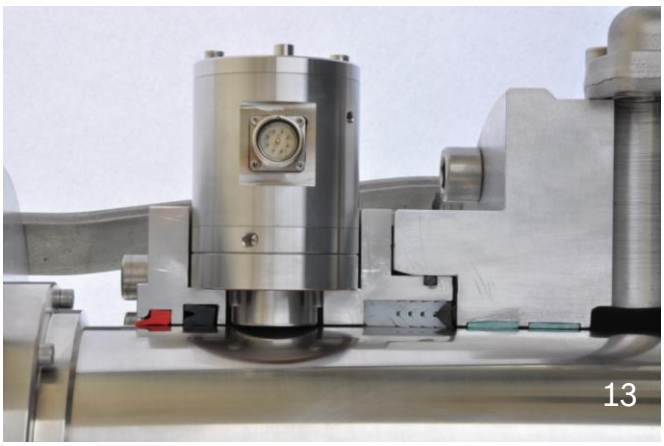
Previous CIMS versions (II & III) can be easily replaced. The system is backward compatible with CIMS II/III, apart from the standard connector which has changed from a 6-pin to a 9-pin connector.

General CIMS features

• High accuracy combined with unlimited stroke lengths.
• Can be used in every large hydraulic cylinder application as the very robust stainless steel housing protects the electronics from almost any environment.
• Easy installation or replacement possible without restricting the hydraulic integrity of the cylinder; sensor integrated in sealing flange, out of the pressure zone of the cylinder.
• Ensures reliable position measurement at all times, reliable redundancy possible with multiple CIMS sensors per cylinder; CIMS can be used while submerged in (sea) water up to 100 m – Waterproof, IP68 10 bar (depending on output connection type).
• Can be used in Ex zone 1 areas; optionally available for potentially explosive atmospheres; ATEX zone 1 certified.

Diagnostic output

With the CIMS Mk IV diagnostic output, it is possible to monitor statuses; see whether all CIMS in the hydraulic system are working correctly. Through a USB converter the CIMS can be connected to a PC and, with Rexroth diagnosis software, information about the CIMS Mk IV can be analysed. Information like sensor status, sensor identification, error codes, the current position (since last power up), etc. The diagnostic output can also be connected directly to a PLC, for example.

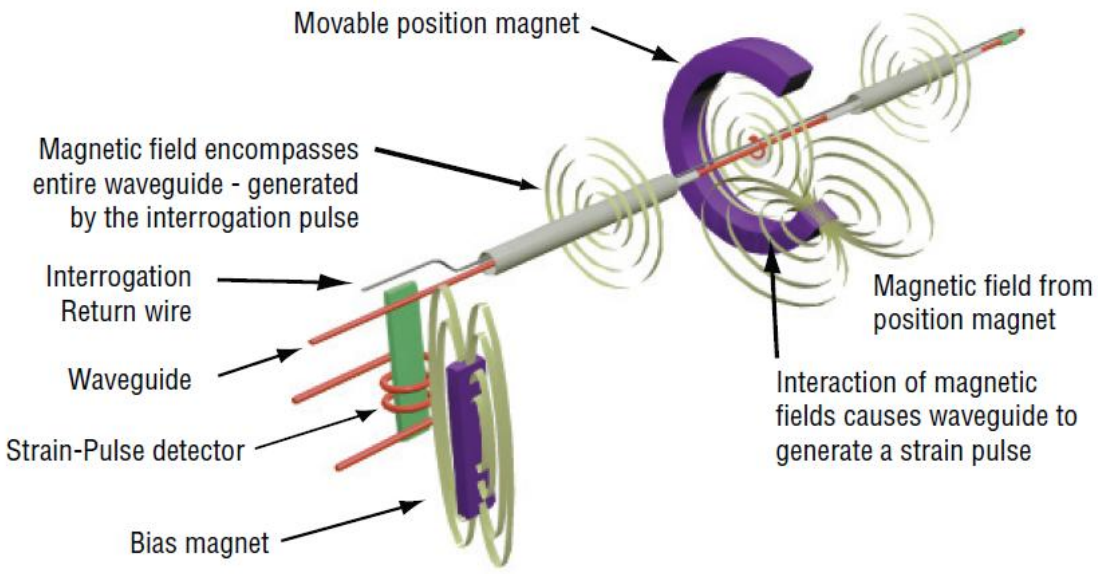


Alternative measuring systems

Flexible MTS for speed control

The heart of MTS sensors is the ferromagnetic measuring element, also known as the waveguide, and a movable position magnet that generates a direct-axis magnetic field in the waveguide.
When a current or interrogation pulse passes through the waveguide, a second magnetic field is created radially around the waveguide. The interaction between the magnetic field in the waveguide and the magnetic field produced by the position magnet generates a strain pulse which travels at a constant ultrasonic speed from its point of generation, the measurement point, to the end of the waveguide where it is transformed into an electric pulse in the sensor element. The resulting signal is processed by the specialized electronics of the Temposonics sensor.

If position measurement is required without speed control, Bosch Rexroth advises to use the Cylinder Integrated Measuring System (CIMS). The CIMS sensor is less space consuming, which allows Bosch Rexroth to deliver an hydraulic cylinder with a smaller shell diameter.
This results in a significant positive effect on the total price of the Bosch Rexroth hydraulic cylinder.



Sealing system of spherical bearings

Cylinders are often equipped with clevises to connect the cylinder to your application. To reduce stress on this connection, Bosch Rexroth can place a spherical bearing in the clevis. This bearing creates a movement margin for the cylinder. When cylinders are situated in a dirty environment or under water, it is vital to protect the spherical bearing from corrosion and dirt. Our extra protection system and the seals in the bearing itself, increase the service life time of your spherical bearing.

To shield the spherical bearings from elements that cause wear, extra friction or corrosion, we have developed a special sealing system.
Bosch Rexroth delivers maintenance free- and steel on steel bearings. The sealing system is optimized for both types of bearings.

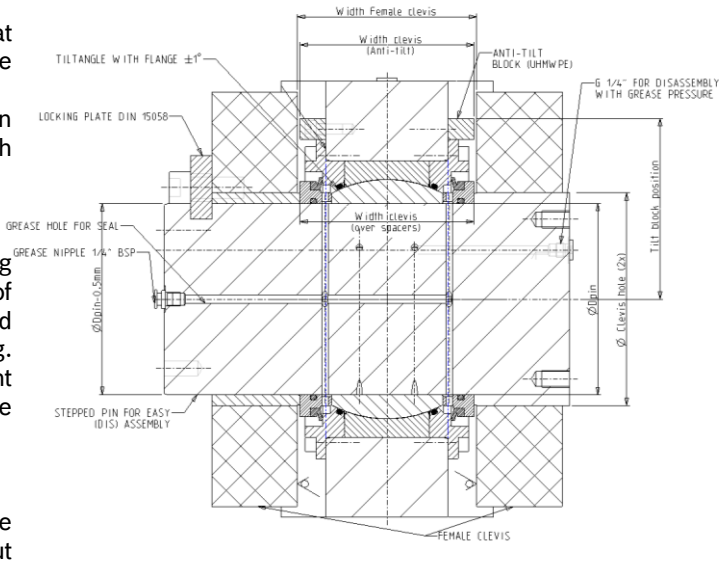
Maintenance free bearings
The sealing system on a maintenance free bearing consist of an O-ring that runs directly on the sphere of the inner ring. In front of this O-ring, a grease filled chamber is sealed off from the environment by a V-ring. The V-ring allows grease out of the bearing to prevent dirt from entering. Maintenance free bearings require additional grease holes in the pin to form a dirt barrier.

Steel on steel bearings
The steel on steel bearings require lubrication in the sliding surface of the bearing. This lubricant comes out of the bearing sideways. Using an O-ring would cause pressure to build up in the seals, leading to defects in the retaining flanges. Therefore the bearings are equipped with a labyrinth groove. This lets the pressure off if necessary. The rest of the system is identical to the maintenance free bearing sealing system.

Our sealing system of spherical bearings is designed to maintain a tilt angle of +/- 1° available for the cylinder. We advise you to design your system with a stepped pin for easy assembly and disassembly.

Anti tilt blocks
Since the tilting of the bearing seal system is limited to +/- 1° in all directions, rotation of the bearing in the female clevis must also be limited. To accomplish this, Anti tilt blocks fill the gap between the bodies of the male and female clevis to prevent rotation over 1°. Anti tilt blocks are always required, even if no pin and spacers are delivered. Design your female clevis accordingly.

The added table shows reference sizes for your cylinders design.



Dpin [mm]	Clevis Hole H8 [mm]	Width Clevis [mm]	Width female clevis ± 1 [mm]	Tilt block position [mm]
45	50	66	69	68.5
50	55	71	74	72.5
60	66	83.6	87	81
70	77	88	91	84.5
80	89	95	99	92
90	98	109	113	101
100	109	119	123	111
110	121	119	124	116
120	135	139	144	130
140	155	143	149	145
160	170	154	160	155
180	198	163	169	170
200	213	184	191	195
220	239	204	212	214
240	265	199	207	224
260	288	210	219	239
280	313	224	233	254
300	336	234	244	269
320	344	261	271	284
340	366	261	272	294
360	388	261	272	304

Chevron sealing technology

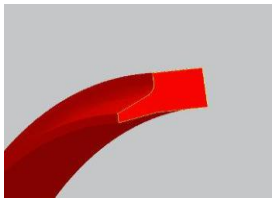
Bosch Rexroth has developed in-house technologies to reduce wear in situations of tribological interactions decrease abrasion, friction, erosion and corrosion. Part of this technology is selecting the most efficient sealing system for your cylinder.

Bosch Rexroth has developed a Seal Matrix for all kind of applications and piston rod surfaces. This matrix is the result of an extensive ´tribology´ development program in co-operation with world leading seal manufacturers. Tribology analyzes friction, lubrication and wear of interacting surfaces in motion, aiming to increase the cylinders lifetime and reduce the risk of failing. A good tribological system improves the sealing properties and lowers wear, friction and the chance of friction problems.
Bosch Rexroth's customized sealing solutions are available for all piston rod surface technologies and fields of applications .

To form the large hydraulic cylinders tribological system, each cylinder is equipped with a scraper, seals and bearing strips.

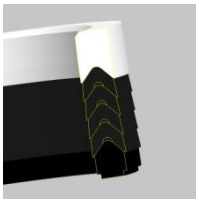
Scraper
Scrapers prevent dirt from being dragged into the hydraulic cylinder. Bosch Rexroth offers two types of scrapers: standard and special self lubricated. Self lubricating scrapers are used in applications with insufficient lubrication properties of the hydraulic fluid.


Self lubricated scraper


Standard scraper

Chevron seals
Chevron seals are used to seal off piston rods and pistons in hydraulic cylinders, preventing oil loss from the hydraulic system. With its robust design, Chevron Seals have been developed to withstand heavily damaged surfaces of the counter parts.
Chevron seals are designed for applications with a long lifetime and few movement. Performing best at medium speeds (>0,05 m/sec - <0,5 m/sec), the minimum life time under normal circumstances is 500 km of piston rod movement. Finally, Chevron seals are maintenance friendly. Bosch Rexroth uses two different types of materials to get the best fit with your application:

NBR Fabrics
NBR-fabric material is designed for piston rods with chromium surface technology. It provides very good wear resistance and has no delamination.



UHMWPE 1000
UHMWPE material is developed for the piston rods with Enduroq 2000 series surface technology. Produced with a special process which provides very good wear and creep resistance.

Bearing strips
Bearing strips are used to ensure low friction between the moving parts in the cylinder. They reduce wear and increase the cylinder's lifetime.


Self lubricated


Standard

The Bosch Rexroth tribological system has the following properties:

- Heavy duty performance
- High allowable compressive strength in the bearings
- Extreme chemical resistance
- Extreme wear/tear resistance
- Low friction

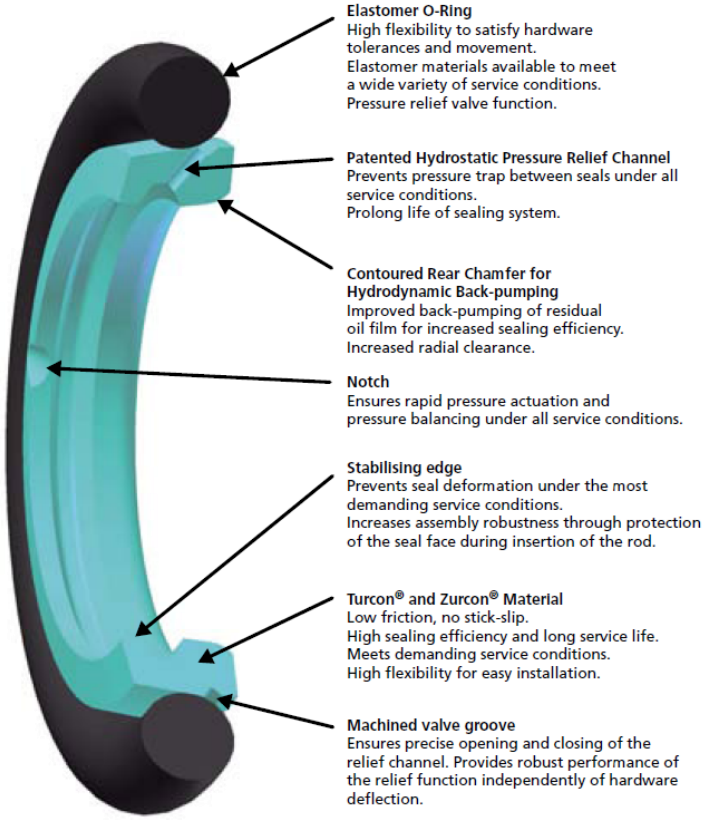
Stepseal technology

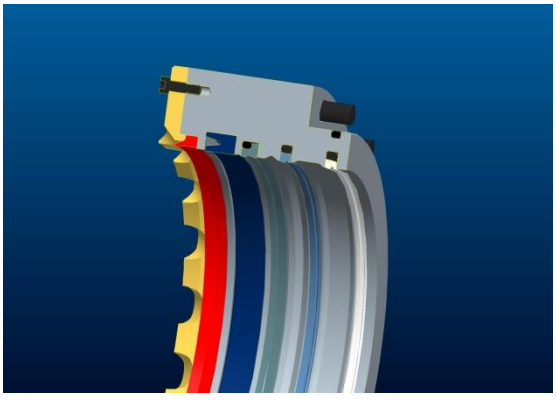
Rexroth's technologies to reduce wear in situations of tribological interactions decrease abrasion, friction, erosion and corrosion.

Seal configuration
Rexroth has developed a Seal Matrix for all kind of applications and piston rod surfaces. This matrix is the result of an extensive ´tribology´ development program in co-ooperation with world leading seal manufacturers. Tribology analyzes friction, lubrication and wear of interacting surfaces in motion.
Bosch Rexroth sealing solutions are the result of a large development program between Bosch Rexroth, Bosch Corporate Research and world leading seal manufacturers. Therefore, customized sealing solutions are available for all piston rod surface technologies and fields of applications .

Standard low friction, glydring
- Low friction, no stick-slip
- Very good static leak-tightness
- Less leakage then standard glydrings
- Extrusion resistance, also with large extrusion gaps

Gas/oil system, AQ seal-stepseal®
- Media separation in combination with DC roughness
- Double security due to the combination low friction material and elastomeric seals
- Low friction, no stick-slip effect





The Stepseal system consist of two Stepseals and an Excluder 5. The excluder 5 is a double acting wiper with a sealing function towards the oil side of the seal system. Stepseal Seal systems are used in circumstances with the following demands:
- Low friction
- Stick-slip is unwanted
- High speed
- High moving frequency
- Small amplitude
- Minimum leakage

The leak tightness of the Stepseal is based on the shape of the sealing element. The O-ring generates the pre stress of the seal and thus the initial tightness. The seals shape is designed to drag the thin oil film on the rod surface back into the retracting stroke.

Recent developments have improved the Stepseals features:
- The allowable extrusion gap is largely increased.
- The leakage is reduced to almost zero.
- The build up of pressure between primary and secondary seals is prevented by applying a pressure relieved primary Stepseal. Because of this space in between, the seals have become far less important than before. Calculation of the distance between Stepseal grooves has not changed with regard to previous issues.

Deflection simulation

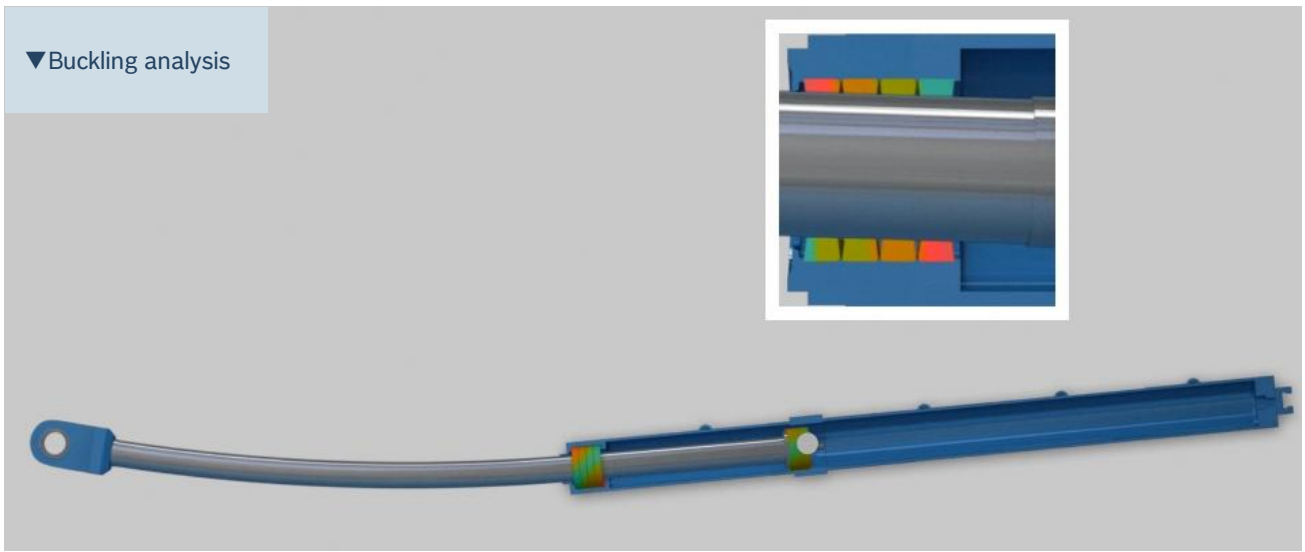
Large hydraulic cylinders are typically used to transfer immense forces. To prevent a cylinder malfunction, all forces that the cylinder will encounter in its application are calculated in the engineering phase. To speed up this engineering process, our experts use our in-door developed Deflection and Buckling Routine (DBR) tool.

The DBR is used to calculate the deflection and buckling safety of hydraulic cylinders. All typical mounting styles, friction moments in spherical bearings, transverse loads, accelerations of its own weight and eccentric loads are taken into account. The calculations also encompass typical phenomena as ballooning of the shell, fabrication clearances in the cylinder guiding and identification of the bearing material. The result is a precise prediction of the cylinder under pushing as well as pulling loads during its complete stroke.

The eccentric position of the rod in the head, as well as the piston in the shell, is thoroughly analyzed. Local stresses in the rod, shell and bearings are precisely calculated. In several cases a force diagram is required. These advances and detailed calculations are the basis for a reliable and cost effective cylinder design.

Due to years of experience and our professional designing tools, Bosch Rexroth can calculate the forces working on the cylinder and adjust the cylinders design and material to avoid any malfunctions during its lifetime.

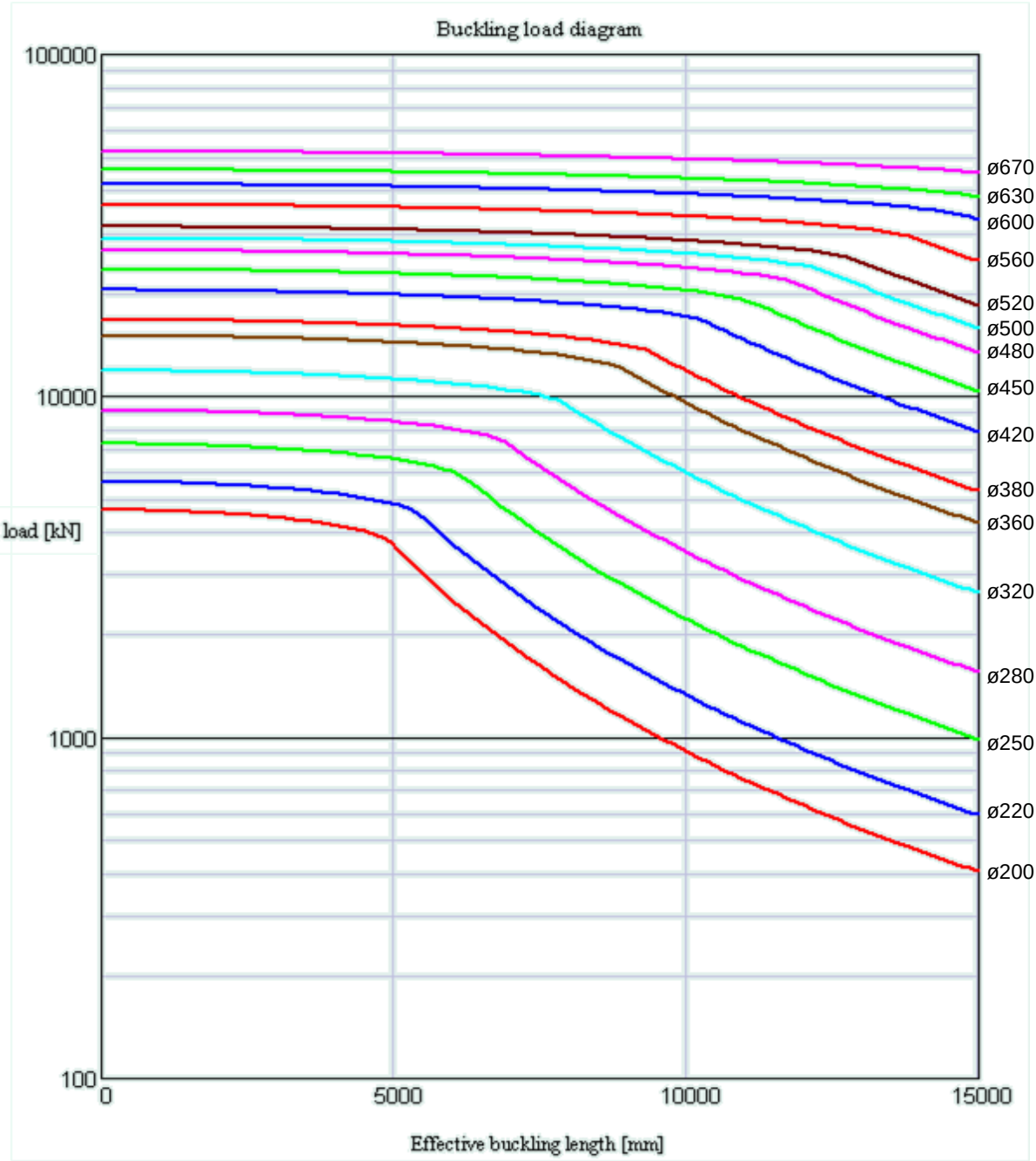
▼Buckling analysis



Buckling load diagram

The diagram represent the permissible pushing force *F* as a function of the free buckling length L_K for the piston rod Ø of the series. The diagram only refer to vertical installation.
For horizontal installation please consult us with the technical specifications. The specifications can be completed on page 20 – 23.

- Safety factor 3.0 buckling for the cylinder as a whole.
- Piston rod without radial loading



Inquiry list: General data

The inquiry list below provides Bosch Rexroth with all the necessary information to design your specific hydraulic cylinder and make a quotation. Please complete the inquiry list carefully and clearly.
For further questions, do not hesitate to contact your local sales department.

Country unit/region _____ _____

Name _____ Name _____

Phone _____ Fax. _____

Company/customer _____

Contact (technical) _____ Phone _____ Fax. _____

Contact (commercial) _____ Phone _____ Fax. _____

Customer-No. _____

Inquiry-No. _____ Order-No. _____

Project name _____ Project-No. _____

Customer has order ☐ Yes ☐ No

Customers idea of price _____ EUR

Quotation prepared as ☐ Budget price ☐ Detailed price

Quotation required before _____ **Delivery data** _____

Order will be placed on _____

Type of business ☐ Components
☐ System/projects
☐ Batch Qty/ _____ /Year OI _____ TEUR/Year

Type of application

☐ Bulk Material Handling ☐ Offshore ☐ Heavy Industry
☐ Mining ☐ Dredge ☐ General Industry & Presses
☐ Civil Engineering ☐ Other _____

Competition _____

Coat of paint

☐ Bosch Rexroth standard coating

1 layer epoxy Sigmacover 280	50 µm
1 layer epoxy SigmaCover 435	75 µm
1 layer polyurethaan SigmaDur RAL 5010	75 µm
Total	200 µm

☐ Special coating

1 layer	µm
1 layer	µm
1 layer	µm
Total	µm

*Long-term storage ☐ No ☐ Yes _____ Years / Months

***Material test certification** ☐ No ☐ to EN 10204/2.1*[1] ☐ to EN 10204/3.1*[1]
☐ to EN 10204/2.2*[1] ☐ to EN 10204/3.2*[1,2]
☐ 1 Please state which pa _____
☐ 2 Acceptance company _____

***Function test certificate** ☐ No ☐ to EN 10204/2.1* ☐ to EN 10204/3.1*[2]
☐ to EN 10204/2.2* ☐ to EN 10204/3.2*[2]
☐ [2] Acceptance company _____

***Customer acceptance test** ☐ No ☐ Yes Designation _____

*Other certificate ☐ No ☐ Yes Designation _____

*Instruction manual ☐ Yes (Bosch Rexroth standard)
☐ Special requirements _____

Databook ☐ Yes (Bosch Rexroth standard)
☐ Special requirements _____

Additional requirements/ Remarks _____

Date _____ **Signature** _____

Must be filled out

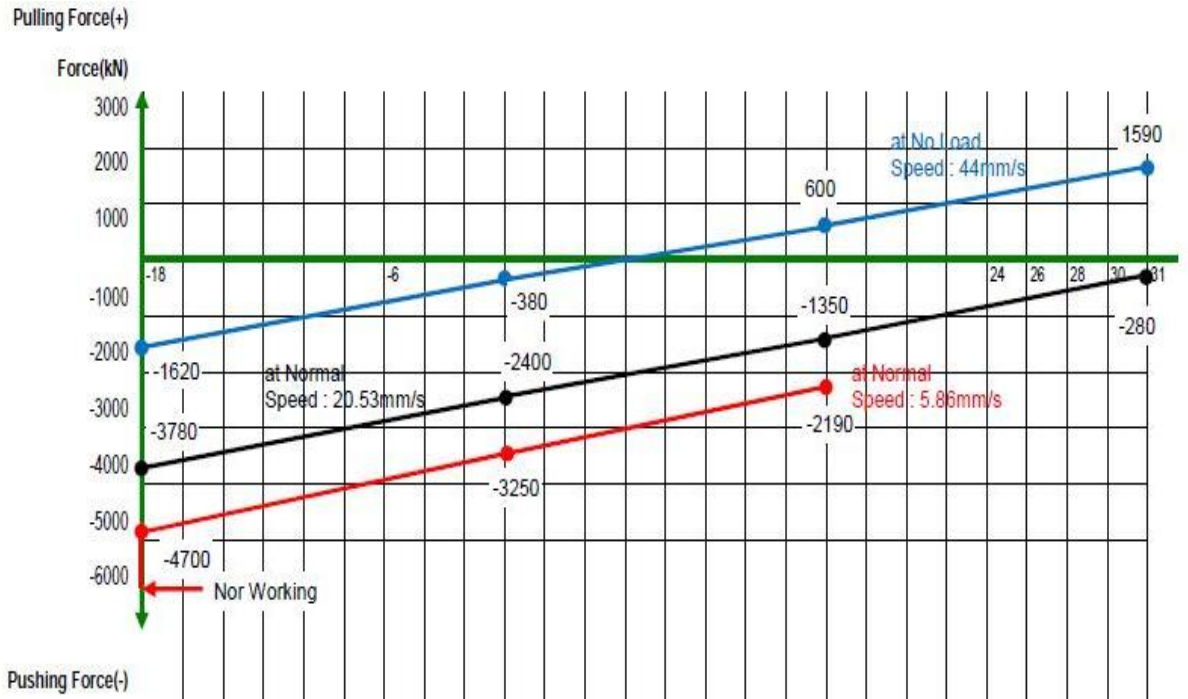
*Attention: extra cost

Inquiry list: Technical data

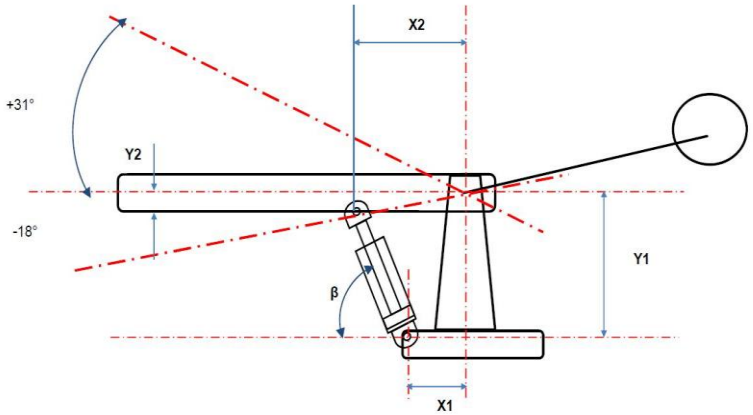
Quantity								
Type code								
Type denomination	CY							
Application code	TEL							
External mounting shell side			☐	MP1	☐	MP5	☐	Other
Other external mounting shell side								
Bore dimension		mm						
Rod dimension		mm						
Stroke length		mm						
Cylinder construction			☐	A	☐	B	☐	Other
Other cylinder construction								
Revision index	10							
Oil connections								
Position oil connections								
Piston rod surface			☐	C	☐	N	☐	Q ☐ R
Other piston rod surface								
Mounting rod side			☐	L	☐	R	☐	Other
Other mounting rod side								
Cushioning			☐	U	☐	K	☐	S ☐ D
Sealing system rod side			☐	A	☐	T		
Sealing system bottom side			☐	A	☐	T		
Position sensor system (option 1)			☐	C	☐	T	☐	W
Option 2			☐	Special requirement				
Maintenance free bearing			☐	Yes	☐	No		
Bellow and air breather			☐	Yes	☐	No		
Sealing system of spherical bearings			☐	Yes	☐	No		
Rod extension		mm						
Country code								
Medium		cSt						(Brand, oil composition)
Position sensory system			☐	CIMS	☐	MTS	☐	None
Output signal			☐	4-20 mA	☐	0-10 V	☐	SSI
Others								
Piping & manifold								
Piping			☐	Yes	☐	No		
Material			☐	Steel	☐	Stainless steel		
Dimensions outher diameter		mm						
Wall thickness		mm						
Manifold block			☐	Yes	☐	No		
Base plate for manifold block			☐	Yes	☐	No		
Delivery manifold block by BoxP			☐	Yes	☐	No, delivery free of charge to BoxP		
Pressures/forces/operating conditions								
Max. force enstending		kN						
Max. force retracting		kN						
Moving mass (kg)		kg						
Side load	0	kN						
Bending moment		kNm	Should be avoided					
Working pressure		bar						
Design pressure		bar						
Test pressure		bar						
Medium temperature				min. ˚C				max. ˚C
Piston rod velocity				min. mm/s				max. mm/s
Expected lifetime hydraulic cylinder		years						
Cycles number in lifetime								
Others								
Environmental conditions								
Environmental temperature				min. ˚C				max. ˚C
Humidity				min. %				max. %
Seaport conditions			☐	Yes	☐	No		
Location			Seaport					
			Country					
Dirt (dust, ice, tinder…)								
Moisture, others								
Date			**Signature**					
Must be filled out								

Example: Load Stroke Angle Cylinder Diagram

Example inquiry list: Load stroke cylinder angle diagram



Load (kN)																												
	5.86mm/s	-4700									-3250								-2190								
	20.53mm/s	-3780									-2400								-1350								-280
	44mm/s	-1620									-280								600								1590
Cyl. Angle from Horizontal plane(°)		1.6									24.1								40.2								83
BoomAngle(°)		-18	-16	-14	-12	-10	-8	-6	-4	-2	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	31
Cylinder Stroke(mm)		64									2496								4804								6900
Pin to Pin Distance		10160									12556								14964								17060
Cylinder Speed(mm/s)																											



Inquiry list: Load Stroke Angle Cylinder Diagram

Cylinder stroke (mm)	0 mm									
Cyl. Angle from Horizontal Plane (°)										
Boom angle (°)										
Cylinder Speed (mm/s)										

Sketch

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