Hydraulic Cylinders by Liebherr

380 bar Series-Production Range

LIEBHERR

380 bar Series-Production Range

Flexible, with High Load Capacity and fast Availability

The Liebherr 380 bar series-production range gives customers a broad choice of flexible cylinder variants which have been proven under the toughest operating conditions. The use of standardised components means that new hydraulic cylinders and spare parts are quickly available despite the high degree of flexibility. The 380 bar series includes 40 basic variants for nominal diameter combinations of piston and piston rod. Besides stroke, numerous options can be configured for each of these basic variants. Corresponding 3D models can be supplied for each variant. Through an improved pressure reduction system friction is decreased. This ensures a longer service life for the cylinder.

Area of application

The hydraulic cylinders of the 380 bar series-production range are employed in mobile applications. For example, they are used wherever durable and robust products are needed for highly dynamic applications. Such applications include construction machinery, e.g. as boom cylinder, stick cylinder or bucket cylinder for wheeled and crawler excavators.

Also interesting?

260 bar series-production range

With the 260 bar series Liebherr offers its customers a range of hydraulic cylinders optimised to what is essential, which can still also be used in demanding conditions – both in the mobile and stationary area. There is a broad range of mounting types as well as two alternative oil connections and piston rod coatings available. In order to be able to realise the most economical solution for the respective target application, no extended functions such as sensor technology or cushioning options are intended for this series.

Series-production range according to ISO 6022

The series developed specially for industry applications is designed and manufactured according to the applicable standards of ISO 6022. The products are used in various stationary applications such as steelworks, for example. There is a wide selection of mounting types available. Furthermore, the hydraulic cylinders can be equipped with a large portfolio of configurable additional optional equipment (e.g. position transducer, end of stroke cushioning, proximity switch or pressure sensor) as required.

Product range – overview

Type	Differential hydraulic cylinder
Operating pressure	max. 380 bar
Stroke	Up to 2,300 mm, larger lengths on request
Installation length	Up to 3,100 mm
Piston diameter	100 – 220 mm
Piston rod diameter	65 – 150 mm
Pin diameter	70 – 130 mm
Piston head width	90 – 150 mm
End of stroke cushioning	End of stroke cushioning on piston and / or rod side
Media port	SAE 3 / 4" – 1 1/2"
Operating fluid	Hydraulic fluids as per ISO 4406: 20 / 18 / 15
Coating	Chrome, nickel-chrome, special solutions for specific applications
Anti-corrosion	Standard paint finish, maritime paint finish
Operating temperature	-30 °C to +95 °C
Piston speed	Up to 1 m / s
Usage	Dynamic, static
Maintenance	Spare parts and sealing packages available worldwide through the Liebherr network
Applications	Mobile machinery e.g. construction machines, industrial applications

Technical Design
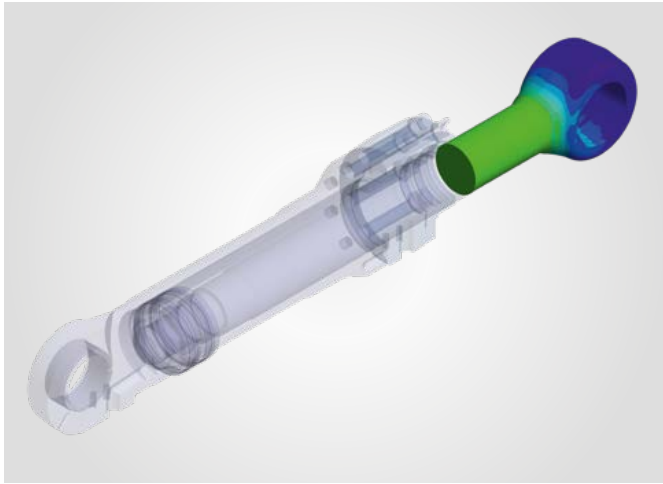
Hydraulic cylinder configuration

The hydraulic cylinders are computed and designed using state-of-the-art technology. Here, for example, the finite element method is used to help configure designs. The 380 bar series is designed for highly dynamic mobile applications. Extreme external forces of the kind encountered in construction machinery were assumed for the configuration of the hydraulic cylinders. Here, Liebherr sets a reliable standard with respect to durability and resilience in heavy operations.
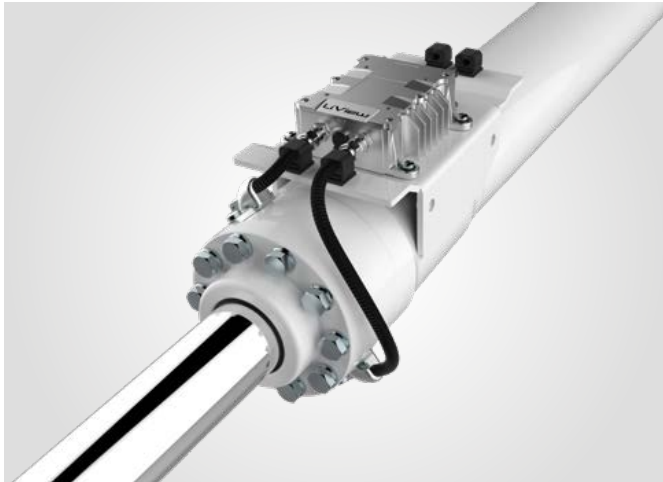
Sensor technology

In order to realise many different regulation tasks, the linear movements and the response of the hydraulic cylinders have to be exactly recorded, monitored and controlled. For this reason, Liebherr offers the own developed LiView® position transducer. This is the first length measuring system for cylinders, which is designed completely for highly dynamic applications. It is easy to integrate in the hydraulic cylinders of this series and can also be retrofitted.


Piston rod coating

High quality chrome and nickel-chrome coatings are used as standard. Depending on the application, either a coating with normal resilience (AASS acetic acid salt spray testing as per DIN EN ISO 9227 with 96 hrs.) is used or one with increased resilience (AASS with 240 hrs.). A sea water coating (AASS with 500 hrs.) is also available. Assessment basis for all coatings is rating 10 as per DIN EN ISO 10289.

Rating 10
AASS – 96 h
AASS – 240 h
AASS – 500 h
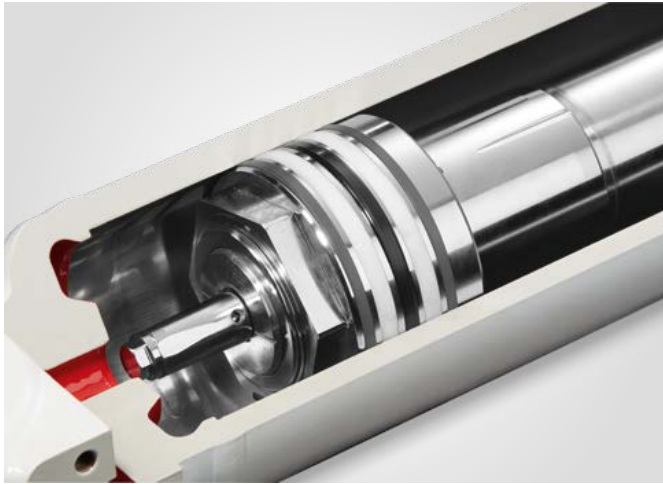
End of stroke cushioning

Controlled and gentle approach to the end positions is also important with highly dynamic movements. Here, Liebherr offers the option of an optimised cushioning system, which has proven its worth in practice on many occasions. The customer is able to choose between cushioning on piston and/or rod-side. Alternatively, the hydraulic cylinder can also be configured so that the cushioning can be retrofitted if necessary. The system ensures a smooth and stutter-free acting of the hydraulic cylinder.
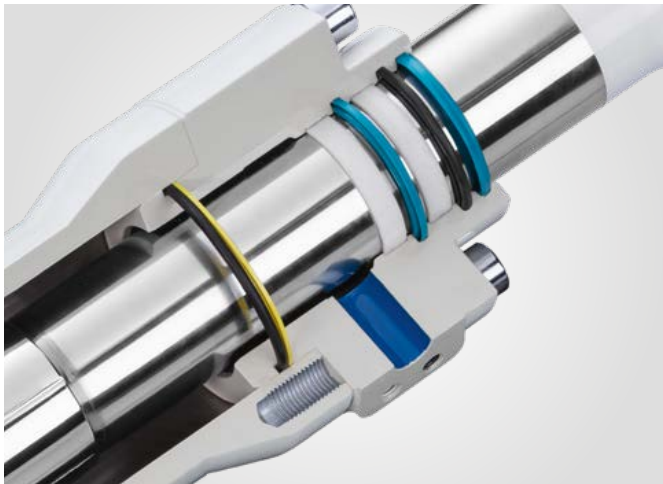
Seals

Seals are extremely important for the reliability of hydraulic cylinders. Only if they are suitably chosen to the specific application will they be long-lasting and leak-free. Liebherr uses a compact arrangement of seals and an innovative sealing system in this series to satisfy the most exacting of standards. A tandem sealing system consisting of a primary and a secondary seal is used for the rod seal. This relieves intermediate pressure and reduces the stick-slip effect.
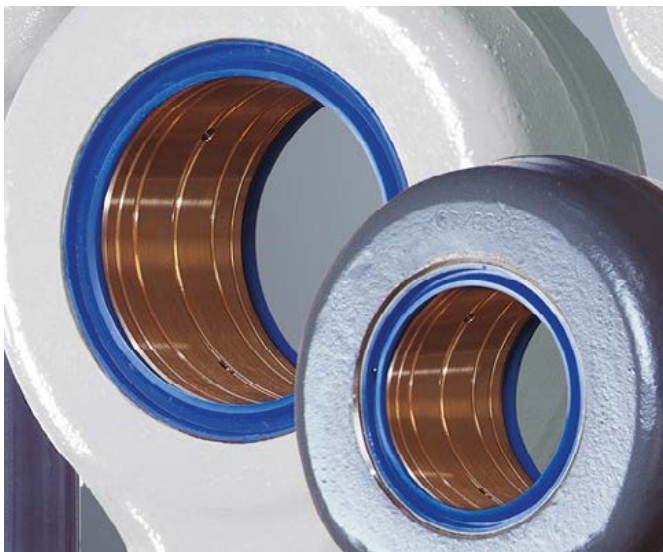
Bearing positions

To guarantee optimal operation of the hydraulic cylinders, Liebherr has designed the bearing positions for maximum loads in both static and dynamic applications. The 380 bar series-production range employs bearing bushes with optimised lubrication surfaces to guarantee good emergency running characteristics. Each bearing position is equipped with a thread M10x1 for lubrication.

Sizes and Dimensions
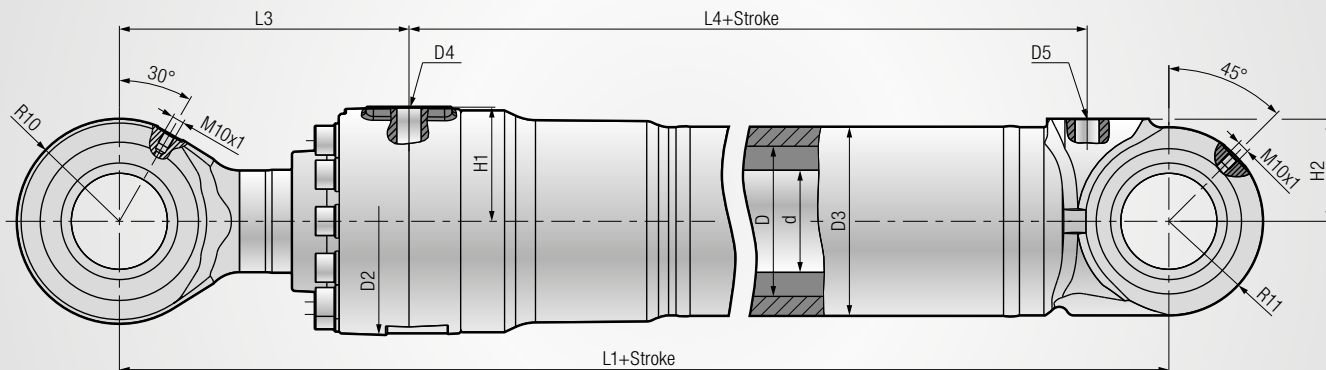
| Basic dimensions							Oil connection at piston rod end			Oil connection at base			
D	d	D2	D3 max,	L1	Hub min,	Hub max,*	L3	D4**	H1	L4	D5**	H2	
100	65	175	126	480	310	2,300	207	3/4"	88	213	3/4"	73	
100	70	175	126	480	310	2,300	207	3/4"	88	213	3/4"	73	
105	70	175	132	480	310	2,300	203	3/4"	88	217	3/4"	73	
105	75	175	132	480	310	2,300	203	3/4"	88	217	3/4"	73	
110	70	175	138	480	310	2,300	199	3/4"	88	221	3/4"	73	
110	75	175	138	480	310	2,300	199	3/4"	88	221	3/4"	73	
115	75	180	144	520	315	2,300	231	3/4"	92	221	3/4"	81	
115	80	180	144	520	315	2,300	231	3/4"	92	221	3/4"	81	
120	80	190	150	520	315	2,300	234	3/4"	95	218	3/4"	81	
120	85	190	150	520	315	2,300	234	3/4"	95	218	3/4"	81	
125	80	190	157	520	315	2,300	231	3/4"	95	221	3/4"	85	
125	85	190	157	520	315	2,300	231	3/4"	95	221	3/4"	85	
130	85	211	162	560	340	2,300	247	1"	106	237	1"	90	
130	90	211	162	560	340	2,300	247	1"	106	237	1"	90	
135	85	211	168	560	340	2,300	243	1"	106	241	1"	90	
135	95	211	168	560	340	2,300	243	1"	106	241	1"	90	
140	90	223	174	600	340	2,300	268	1"	112	252	1"	95	
140	100	223	174	600	340	2,300	268	1"	112	252	1"	95	
145	95	223	180	600	340	2,300	261	1"	112	259	1"	95	
145	100	223	180	600	340	2,300	261	1"	112	259	1"	95	
150	95	234	186	610	340	2,300	262	1"	118	263	1"	102	
150	105	234	186	610	340	2,300	262	1"	118	263	1"	102	
155	100	234	194	620	340	2,300	268	1 1/4"	118	267	1 1/4"	102	
155	110	234	194	620	340	2,300	268	1 1/4"	118	267	1 1/4"	102	
160	105	249	198	620	340	2,300	264	1 1/4"	125	271	1 1/4"	102	
160	110	249	198	620	340	2,300	264	1 1/4"	126	271	1 1/4"	102	
165	105	249	204	620	340	2,300	261	1 1/4"	126	274	1 1/4"	103	
165	115	249	204	620	340	2,300	261	1 1/4"	126	274	1 1/4"	103	
170	110	264	210	710	350	2,300	320	1 1/4"	133	290	1 1/4"	118	
170	120	264	210	710	350	2,300	320	1 1/4"	133	290	1 1/4"	118	
180	115	264	219	730	350	2,300	321	1 1/2"	133	304	1 1/2"	135	
180	125	264	223	730	350	2,300	321	1 1/2"	133	304	1 1/2"	135	
190	125	307	235	750	350	2,300	334	1 1/2"	154	311	1 1/2"	135	
190	140	307	236	720	350	2,300	304	1 1/2"	154	311	1 1/2"	135	
200	125	307	248	770	350	2,300	331	1 1/2"	154	329	1 1/2"	142	
200	140	307	248	750	350	2,300	311	1 1/2"	154	329	1 1/2"	142	
210	140	325	262	760	360	2,300	314	1 1/2"	163	336	1 1/2"	142	
210	150	325	262	780	360	2,300	334	1 1/2"	163	336	1 1/2"	142	
220	140	325	274	765	360	2,300	312	1 1/2"	163	343	1 1/2"	142	
220	150	325	274	785	360	2,300	332	1 1/2"	163	343	1 1/2"	142	

* Reduction of maximum stroke can be necessary depending on the load and the result of the buckling calculation.

** SAE-connection according to ISO 6162 6000 PSI-line.
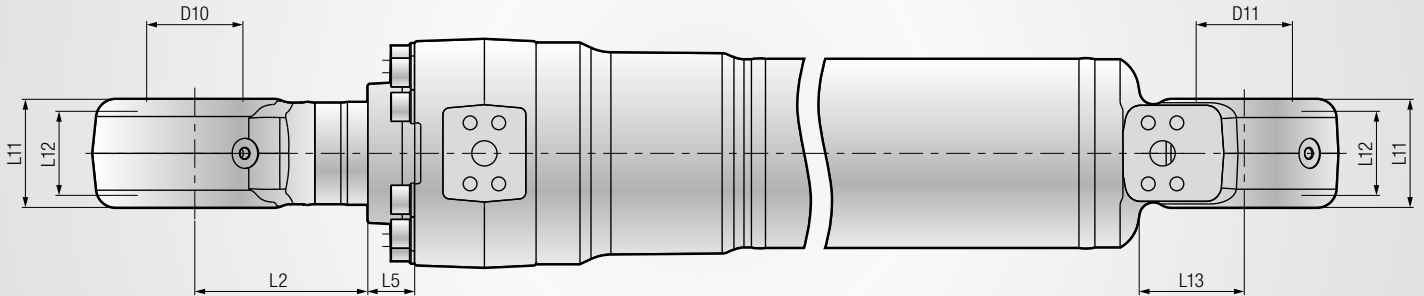
Specific dimensions regarding mounting type									Other details					Volume flow at 0,1 m/s	
L11	L12	D10 (H9)	D11 (H9)	L2	L5	L13	R10	R11	Compr, [kN]	Tension [kN]	Piston area [mm²]	Annular area [mm²]	Area ratio	V_{Extend} [l/min]	$V_{Retract}$ [l/min]
90	70	70	70	122	30	87	72	72	298	172	7,854	4,536	1.7	47	27
90	70	70	70	122	30	87	72	72	298	152	7,854	4,006	2.0	47	24
90	70	70	70	118	30	87	72	72	329	183	8,659	4,811	1.8	52	29
90	70	70	70	118	30	87	72	72	329	161	8,659	4,241	2.0	52	25
90	70	70	70	114	30	87	72	72	361	215	9,503	5,655	1.7	57	34
90	70	70	70	114	30	87	72	72	361	193	9,503	5,085	1.9	57	31
90	70	80	80	136	34	89	85	80	395	227	10,387	5,969	1.7	62	36
90	70	80	80	136	34	89	85	80	395	204	10,387	5,360	1.9	62	32
90	70	80	80	137	39	89	85	80	430	239	11,310	6,283	1.8	68	38
90	70	80	80	137	39	89	85	80	430	214	11,310	5,635	2.0	68	34
90	70	80	80	134	39	85	85	78	466	275	12,272	7,245	1.7	74	43
90	70	80	80	134	39	85	85	78	466	251	12,272	6,597	1.9	74	40
90	70	90	90	150	35	101	97	86	504	289	13,273	7,599	1.7	80	46
90	70	90	90	150	35	101	97	86	504	263	13,273	6,912	1.9	80	41
90	70	90	90	146	35	101	97	86	544	328	14,314	8,639	1.7	86	52
90	70	90	90	146	35	101	97	86	544	275	14,314	7,226	2.0	86	43
100	80	90	90	146	40	111	92	90	585	343	15,394	9,032	1.7	92	54
100	80	90	90	146	40	111	92	90	585	287	15,394	7,540	2.0	92	45
100	80	90	90	139	40	111	92	90	627	358	16,513	9,425	1.8	99	57
100	80	90	90	139	40	111	92	90	627	329	16,513	8,659	1.9	99	52
110	90	100	100	140	40	121	97	97	672	402	17,671	10,583	1.7	106	63
110	90	100	100	140	40	121	97	97	672	342	17,671	9,012	2.0	106	54
110	90	100	100	146	40	121	97	97	717	419	18,869	11,015	1.7	113	66
110	90	100	100	146	40	121	97	97	717	356	18,869	9,366	2.0	113	56
110	90	100	100	142	46	121	97	97	764	435	20,106	11,447	1.8	121	69
110	90	100	100	142	46	121	97	97	764	403	20,106	10,603	1.9	121	64
110	90	100	100	139	45	121	97	97	813	483	21,382	12,723	1.7	128	76
110	90	100	100	139	45	121	97	97	813	418	21,382	10,996	1.9	128	66
130	105	120	120	195	46	128	120	125	863	501	22,698	13,195	1.7	136	79
130	105	120	120	195	46	128	120	125	863	433	22,698	11,388	2.0	136	68
130	105	120	120	196	46	126	120	125	967	572	25,447	15,060	1.7	153	90
130	105	120	120	196	46	126	120	125	967	501	25,447	13,175	1.9	153	79
130	105	120	120	194	51	126	120	125	1,077	611	28,353	16,081	1.8	170	96
130	105	120	120	164	51	126	118	125	1,077	492	28,353	12,959	2.2	170	78
150	124	130	130	191	51	159	136	135	1,194	727	31,416	19,144	1.6	188	115
150	124	130	130	171	51	159	136	135	1,194	609	31,416	16,022	2.0	188	96
150	124	130	130	174	51	159	136	135	1,316	731	34,636	19,242	1.8	208	115
150	124	130	130	194	51	159	136	135	1,316	645	34,636	16,965	2.0	208	102
150	124	130	130	172	51	159	136	135	1,445	860	38,013	22,619	1.7	228	136
150	124	130	130	192	51	159	136	135	1,445	773	38,013	20,342	1.9	228	122

Note: If not otherwise indicated, all information are provided in millimetres.

Cylinder Selection

The table on the left gives an overview of the 380 bar series-production range. Each combination of piston and piston rod diameter defines a basic variant.

Starting with the necessary tensile and compression forces, the required combination of piston and piston rod diameter can be determined. The surface ratio, cylinder force and volume flow can be taken from the table for any given piston/piston rod combination.

Calculation of Buckling and Volume Flow

Buckling calculation

Buckling describes the change in shape that can be caused by a certain load. To ensure the safe design of hydraulic cylinders, they are examined for buckling resistance. The prevailing compression force (F_C) must be less than or equal to the buckling force (F_B) of the hydraulic cylinder. This buckling calculation is an approximate calculation. This can be verified by Liebherr when a cylinder is inquired about.

Force and volume flow calculations

These calculations provide information about the relationship between cylinder geometry, volume flow and stroke speed. The different sizes are essentially depending on each other. Please note that the volume flow calculations below do not take into account all efficiency levels.

Calculation of buckling force as per Euler	$F_K = \dfrac{\pi^2 \times E \times I}{s_K \times L^2 \times 1{,}000}$ [kN]

Only the second Euler case is considered for this series:

Case 2
$l_K = L$
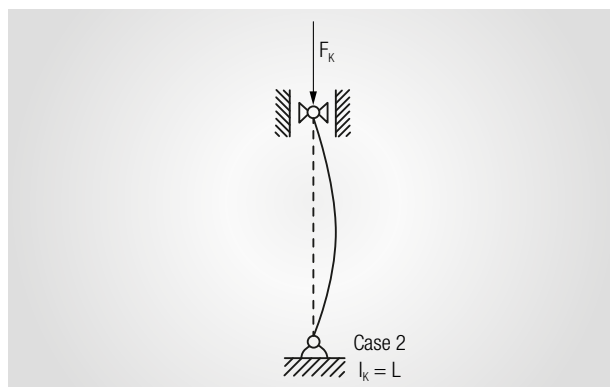
Piston surface area	$A_K = \dfrac{D^2 \times \pi}{400}$ [mm²]
Ring surface area	$A_R = (D^2 - d^2) \times \dfrac{\pi}{4}$ [mm²]
Compressive force	$F_D = \dfrac{p \times A_K}{10{,}000}$ [kN]
Tensile force	$F_Z = \dfrac{p \times A_R}{10{,}000}$ [kN]
Volume flow	$Q = 0.06 \times A \times v = \dfrac{V}{t} \times 60 \left[\dfrac{l}{\min}\right]$
Volume flow	$V = \dfrac{A \times h}{10^6}$ [l]
Stroke time	$t = \dfrac{A \times h \times 60}{Q \times 10^6}$ [s]
Stroke speed	$v = \dfrac{h}{t \times 1{,}000} = \dfrac{Q}{0.06 \times A} \left[\dfrac{m}{s}\right]$

D = Piston diameter [mm]
d = Piston rod diameter [mm]
p = Operating pressure [bar]
h = Stroke [mm]
L = Installation length [mm]
s_K = Buckling safety factor (3 to 6)

I = Geometrical moment of inertia in mm⁴,
for circular cross-section $= \dfrac{d^4 \times \pi}{64} = 0.0491 \times d^4$

E = Elasticity module in $\dfrac{N}{mm^2} = 210{,}000$ for steel

General Information

The maximum operating pressures must be less than or equal to the rated pressure of 380 bar. With increased loads such as pressure peaks or a high running frequency, the hydraulic cylinder design needs to be checked.

For the installation, commissioning, safe use, as well as the maintenance of the hydraulic cylinders in the 380 bar series-production range, the relevant instruction and maintenance manual in its most up-to-date version must be observed.

Generelly the selected seals of the hydraulic cylinders are suitable for the operation with mineral oils. The usability of the requested oil need to be verified by Liebherr in detail.

All graphic representations serve as an example and do not necessarily correspond to the configured product.

Liebherr Components
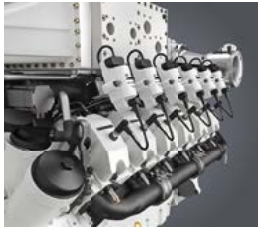
Gas engines

Diesel engines

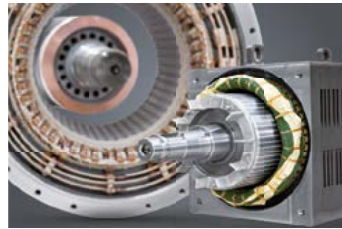Fuel injection systems

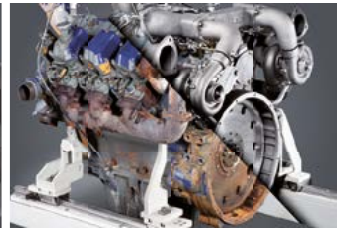Axial piston hydraulics

Hydraulic cylinders

Slewing bearings

Gearboxes and winches

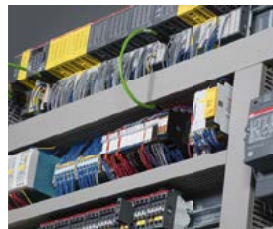Electric machines

Remanufacturing

Human-machine interfaces and gateways

Control electronics and sensor technology

Power electronics

Control cabinets

Software

From A to Z – the components division of the Liebherr Group offers a broad range of solutions in the area of mechanical, hydraulic, electric and electronic drive system and control technology. The efficient components and systems are produced at a total of ten production sites around the world to the highest standards of quality. Central contact persons for all product lines are available to our customers at Liebherr-Components AG and the regional sales and distribution branches.

Liebherr is your partner for joint success: from the product idea to development, manufacture and commissioning right through to customer service solutions like remanufacturing.

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