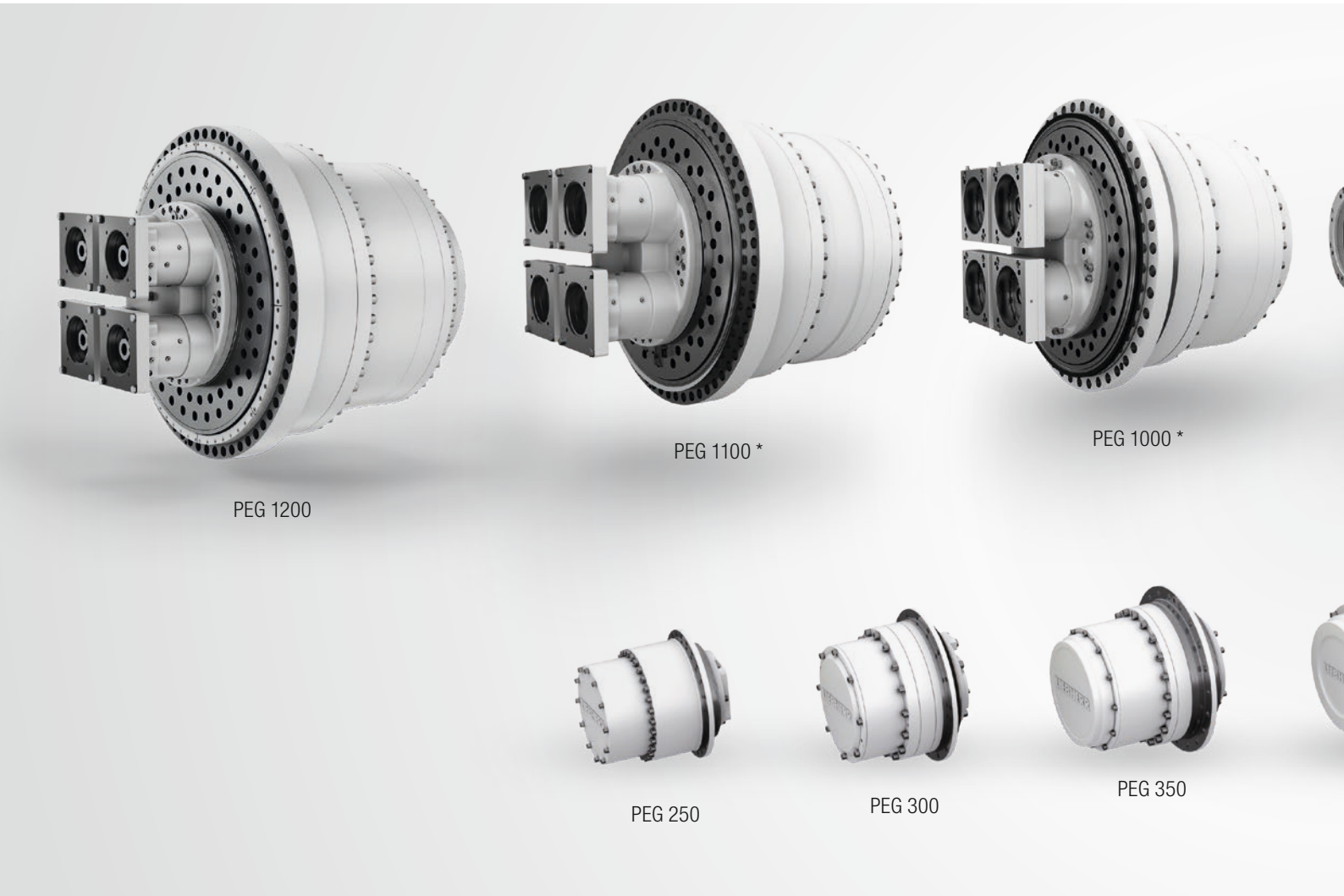
Powerful, versatile and reliable

Planetary Plug-in Gearboxes by Liebherr

LIEBHERR

Planetary plug-in gearboxes by Liebherr

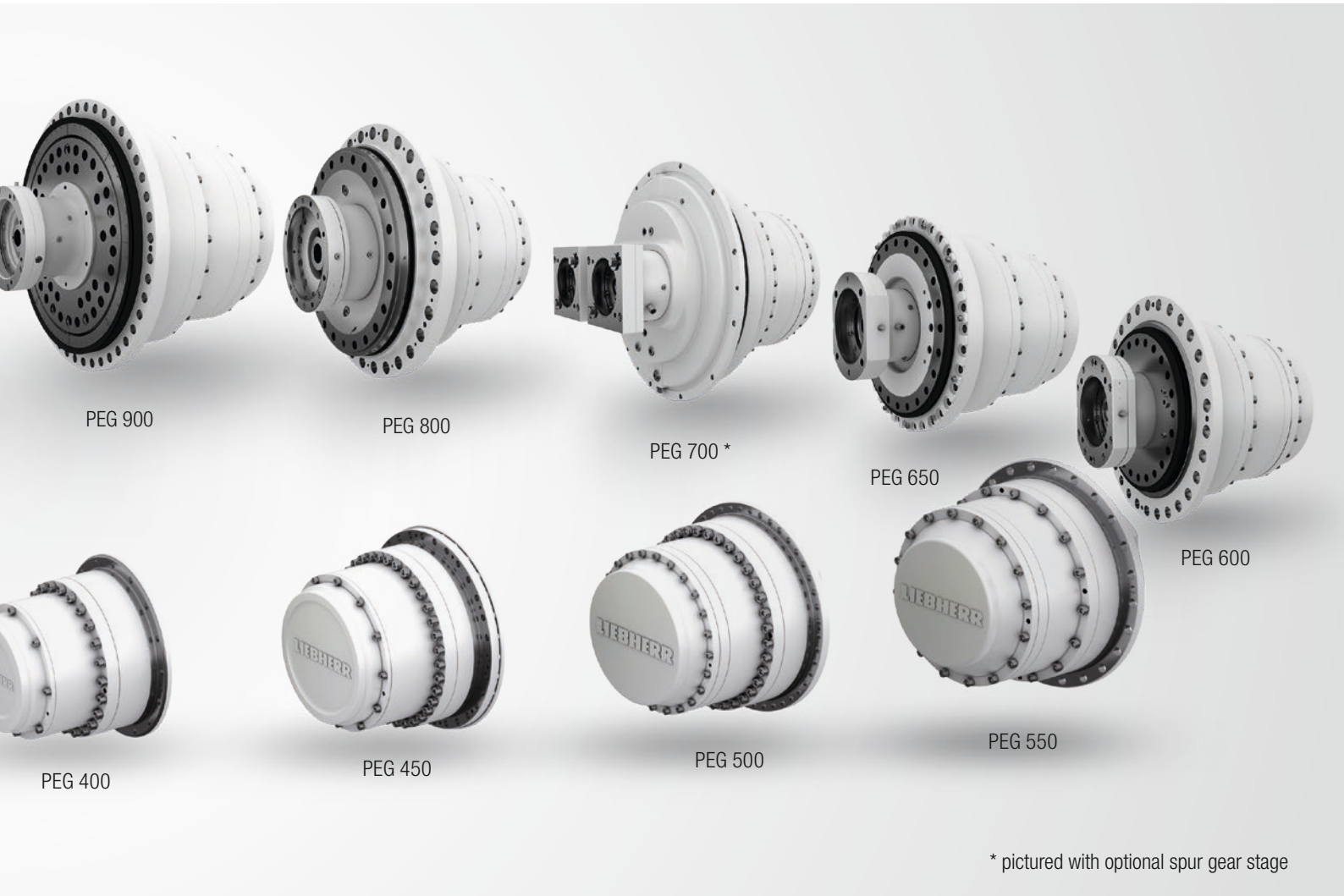


Liebherr has been developing, designing and manufacturing high-performance, versatile planetary plug-in gearboxes for over 60 years. They are characterised by their outstanding quality and excellent reliability. Tens of thousands of planetary gearboxes leave the Liebherr plant in Biberach/Riss, Germany, every year, and successfully stand up to the hostile operating conditions in machinery and equipment of customers both inside and outside the Liebherr group of companies.

Liebherr offers its customer a series-produced range of planetary plug-in gearboxes that can be used for a wide range of applications. Furthermore, individual solutions can also be produced to meet special requirements.

The gearboxes are designed using the very latest development and calculation methods. Extensive testing facilities and an in-house materials laboratory form the basis for ongoing development and even greater improvement.
As a result, Liebherr planetary plug-in gearboxes are characterised by maximum torque density with low installation space requirements. Liebherr planetary gearboxes are noted for very high torque density in a small space. The planetary plug-in gearboxes are also designed for simple installation and maximum ease of maintenance.

Since the Group was established, Liebherr's strategy has been to focus on a high degree of vertical integration. For example, customers can be offered hydraulic and electric



* pictured with optional spur gear stage

motors which are matched to the drives and designed and manufactured at the company's own development and production departments.

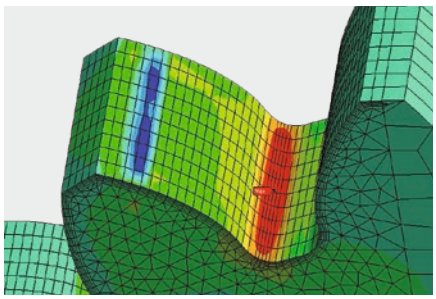
Product range

The series includes 15 gearbox sizes from the PEG 250 to the PEG 1200. The coaxial planetary gearboxes can be offered as two, three or four-stage models with a wide range of different gear ratios. The maximum dynamic torque is about 1,250,000 Nm. The standard gearboxes designed for installation in winches can be adapted both for electric and for hydraulic motors.

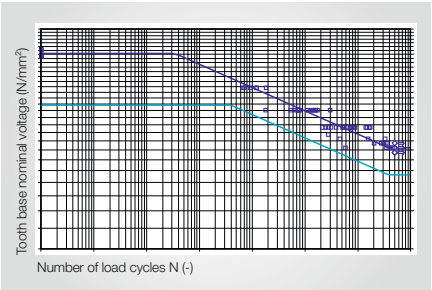
Areas of application

- Construction machinery, e.g. hydraulic excavators and drills
- Cranes, e.g. construction and mobile cranes
- Mining equipment, e.g. mining excavators
- Maritime applications, e.g. port, ship and offshore cranes
- Specialised machines and equipment

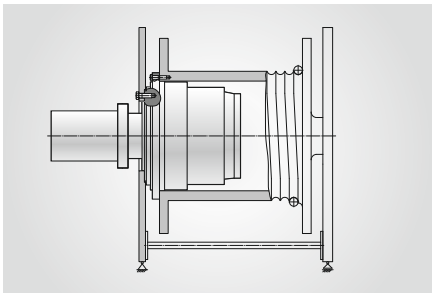
Technical design



Gearbox design
The plug-in gearboxes are calculated and designed on the basis of the usual standards. In addition to the decades of experience in transmission engineering, the designers at Liebherr are also supported by measurements made on the company's own high-frequency pulsator test stands and FZG-torque change devices.



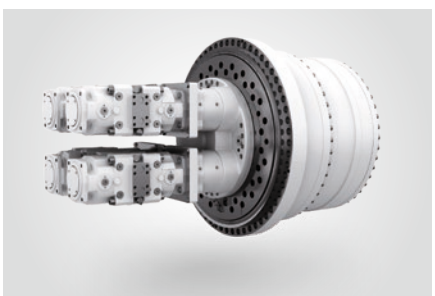
Materials
All torque-bearing gearbox components are made of top-quality case-hardened and tempered steels which are certified to the Liebherr works standard. This standard, which goes beyond the currently applicable industrial standards, is based on Liebherr's decades of experience in a broad range of different application areas. The works standard also includes “3.1” material certification to DIN EN 10204.



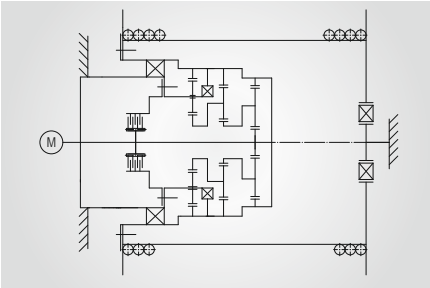
Assembly position and output
The gearboxes are designed for horizontal installation in winch drums. A redundant winch design with a gearbox inserted on both sides of the drum is also available on request. They are fixed to the framework and drum of the winch at defined fastening holes. The number of holes and the hole diameter can be found in the table of dimensions for every size. The torque is transmitted to the winch drum by the internal gear wheels.

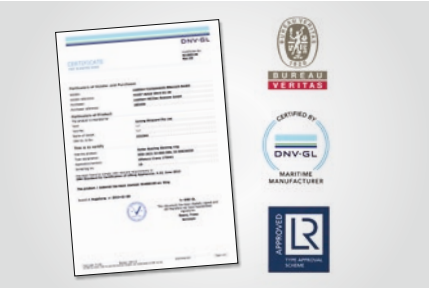
Motor attachment
Liebherr planetary plug-in gearboxes are designed for operation both with hydraulic motors and with electric motors. If requested by the customer, the gearboxes can be prepared for motor attachment or can be supplied as a complete unit with the drive already installed. Hydraulic or electric motors from Liebherr are recommended if a particularly compact design is required. The gearboxes can, however, be adapted to allow all motor types from other manufacturers to be fitted.

Holding brake / parking brake
Gearboxes with hydraulic drive are supplied with an integrated holding brake as standard. It is designed as a wet-running, hydraulically-released, springoperated multi disc brake. Gearboxes with electrical drive can also be supplied with an integrated holding brake, e.g. an electromagnetically actuated springloaded brake.



Optional:
Drive with multiple hydraulic motors
If the gearbox is to be driven by up to four smaller hydraulic motors instead of one larger motor, a spur gearbox can be added to the drive on request.





Gearbox structure
All sun gears and planet gears are case-hardened and ground. They have also been optimised to minimise circumferential backlash and have minimal play. The nitrided inner gears are made of high-strength tempered steel, which is also used for the forged planet carriers. Well-devised design principles ensure uniform load distribution of the individual stages, resulting in a high power density. In addition, the gearboxes are characterised by an integral design optimised to reduce the number of components to a minimum, thereby also minimising the number of sealing points.

Certification of gearbox
On request, acceptance by one of the standard certification organisations such as ABS (American Bureau of Shipping), Det Norske Veritas – Germanischer Lloyd (DNV GL) or Lloyds Register of Shipping (LRS) is available.

Lubrication
The gearbox components are protected against wear and corrosion by immersion lubrication. Oil changes, required at defined intervals, are easily carried out on the motor side.

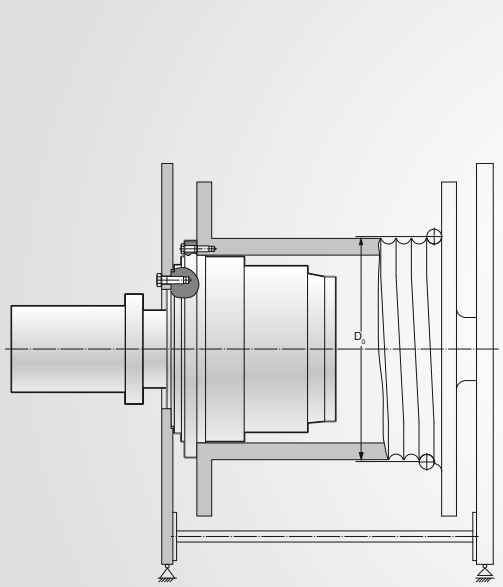
Permissible oil temperatures
Liebherr planetary plug-in gearboxes drives can be used at ambient temperatures down to -20°C. The oil temperature must not exceed +90°C. On request, gearboxes for lower or higher temperature ranges can also be supplied. Size PEG 500 and above are fitted with ports for external oil coolers as standard for very efficient cooling of the complete gearbox at high outside temperatures and/or extended operating time.

Seals
Permanent, proven sealing systems guarantee a long service life. If it is necessary to replace the shaft seal after long hours of operation, this is easily conducted externally with the larger gearboxes. It is not necessary to disassemble the gearbox.

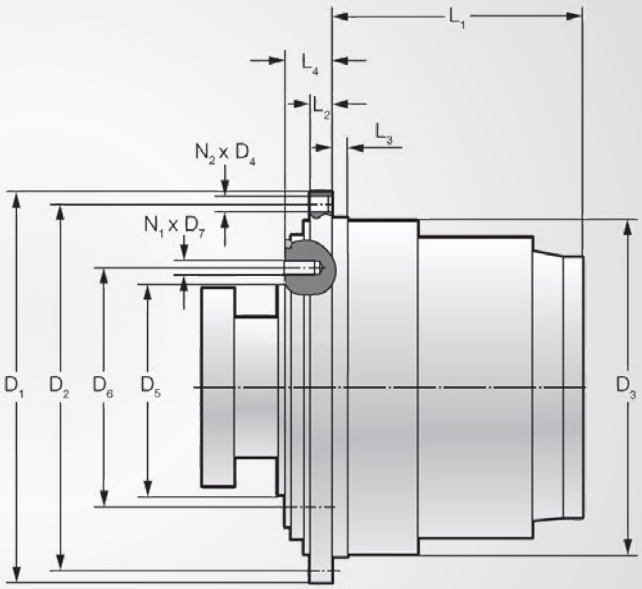
Efficiency
Liebherr planetary gearboxes have an efficiency of 0.98 per gear stage.

Bearings
The main bearings for the winch drum are integrated into the planetary plugin gearboxes. They offer maximum support in a very small space. The thrust bearings of the winch drum can be designed as a simple floating bearing with spherical roller bearings.

Sizes and dimensions



General diagram



Fit (winch frame)

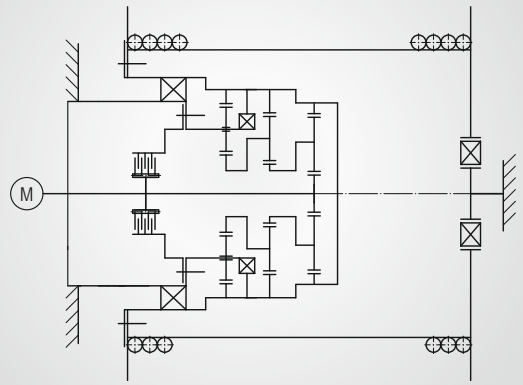
Technical data of the series model range

	Output torques		Rated data for winch drum					Connection dimensions for winch drum	
	$T_{dyn, r}$ 1)	T_{stat}	D_0	F_{max}	D_1	D_2	D_3	N_2 x D_4 3)	L_1
			Approx. value				Centering Ø		
	[Nm]	[Nm]	[mm]	[kN]	[mm]	[mm]	[mm]	1 x [mm]	[mm]
PEG 250	6,000	9,600	Ø 360	33	Ø 335	Ø 310	Ø 295 j6	24 x Ø 11.0	249.5
PEG 300	9,000	14,400	Ø 410	44	Ø 395	Ø 367	Ø 345 j6	16 x Ø 13.5	226
PEG 350	23,000	36,800	Ø 450	102	Ø 432	Ø 395	Ø 360 j6	20 x Ø 17.5	281
PEG 400	33,000	52,800	Ø 500	132	Ø 480	Ø 445	Ø 410 j6	16 x Ø 17.5	358
PEG 450	50,000	80,000	Ø 560	179	Ø 530	Ø 500	Ø 470 js6	30 x Ø 17.5	347.5
PEG 500	73,000	116,800	Ø 600	243	Ø 570	Ø 540	Ø 505 js6	44 x Ø 17.5	398
PEG 550	103,000	164,800	Ø 680	303	Ø 645	Ø 605	Ø 560 js6	24 x Ø 26	418
PEG 600	127,000	203,200	Ø 720	353	Ø 685	Ø 630	Ø 570 js6	30 x Ø 33	460.5
PEG 650	151,000	241,600	Ø 730	414	Ø 685	Ø 650	Ø 610 js6	36 x Ø 22	500
PEG 700	218,000	348,800	Ø 820	532	Ø 785	Ø 743	Ø 670 h6	46 x Ø 26	434
PEG 800	286,000	457,600	Ø 960	596	Ø 920	Ø 850	Ø 760 js6	30 x Ø 44	546
PEG 900	445,000	712,000	Ø 1,050	848	Ø 1,010	Ø 950	Ø 860 h6	45 x Ø 33	643.5
PEG 1000	631,000	1,009,600	Ø 1,110	1,137	Ø 1,065	Ø 1,010	Ø 960 h6	56 x Ø 36	725
PEG 1100	944,000	1,510,400	Ø 1,210	1,560	Ø 1,158	Ø 1,100	Ø 1,045 h6	60 x Ø 36	821.5
PEG 1200	1,250,000	2,000,000	Ø 1,350	1,852	Ø 1,260	Ø 1,200	Ø 1,140 h7	60 x Ø 39	867.5

1) Reference torque based on M5/L2/T5 at an output speed of 15 rpm and a dynamic load (application: rope winch)

2) Always note the dimensions in the installation drawing sent before the order. They are decisive.

3) Strength class 10.9 for fastening screws



Gearbox design diagram

			Connection dimensions for winch frame				Weight
	L_2	L_3	**D_5**	D_6	N_1 x D_7 [2) 3)]	L_4	3-stage design
			Centering Ø				Approx. value
	[mm]	[mm]	**[mm]**	[mm]	1 x [mm]	[mm]	[kg]
	15	10	**Ø 200 h7**	Ø 225	28 x M12	45	100
	14	10	**Ø 240 h7**	Ø 265	22 x M12	46	130
	16	17	**Ø 240 h7**	Ø 270	14 x M16	62	170
	21	16	**Ø 280 h7**	Ø 310	22 x M16	45	260
	27.5	10	**Ø 330 h7**	Ø 375	22 x M20	57.5	360
	25	18	**Ø 330 h7**	Ø 370	28 x M20	59	430
	24	18	**Ø 460 j6**	Ø 395	27 x M24	59	550
	30	25	**Ø 520 h11**	Ø 390	22 x M30	72	700
	51	12	**Ø 340 h7**	Ø 410 Ø 520	20 x M30 26 x M24	87	840
	64	20	**Ø 445 h7**	Ø 485 Ø 545	26 x M24 26 x M24	98	1,100
	55	40	**Ø 400 h7**	Ø 454 Ø 550	14 x M30 28 x M36	107	1,500
	55	54	**Ø 400 h7**	Ø 510 Ø 640	14 x M36 25 x M36	98	2,300
	59	60	**Ø 600 h7**	Ø 726 Ø 780	18 x M36 17 x M36	100	2,600
	101	40.5	**Ø 650 h6**	Ø 730 Ø 840	23 x M42 22 x M42	144	3,600
	110	48	**Ø 700 h7**	Ø 800 Ø 930	30 x M42 29 x M42	161	4,800

T_{stat} = Static output torque
D_0 = Minimum winding diameter for the first rope layer
F_{max} = Maximum possible rope tension force

D_{0-7} = Diameter
L_{1-4} = Length
$N_{1,2}$ = Number of fastening holes

Selection of gearbox size

The dynamic torques specified in the reference table are based on the load spectrum L2 and operating class T5 in accordance with the guidelines issued by FEM*. They were calculated for a rotational speed of 15 rpm at the winch drum.

To select the appropriate gearbox size, the torque required for the application in question must be multiplied by the application factor k given below. The result is used to select the appropriate gearbox size from the table on page 6, 7. The reference torque of the gearbox must be greater than the calculated torque. It is recommended to select both the operating class appropriate to the application, and the correct load condition in accordance with the FEM directives.

$T_{dyn,max} \times k \leq T_{dyn,r}$

$T_{dyn,max}$	Required maximum dynamic output torque
k	Application factor
$T_{dyn,r}$	Reference torque (dynamic)

Operating class T_i*

	T_2	T_3	T_4	T_5	T_6	T_7	T_8
Mean running time per day in hours (h) in relation to one year	0.25 – 0.5	0.5 – 1	1 – 2	2 – 4	4 – 8	8 – 16	> 16
Life-time in hours (h) when operating for 8 years with 200 days per year	up to 800	up to 1,600	up to 3,200	up to 6,300	up to 12,500	up to 25,000	up to 50,000

Load spectrum L_i*

Drive unit class with application factor k

L_1 light	Maximum load is the exception, otherwise low loads	M_1 0.66	M_2 0.73	M_3 0.81	M_4 0.89	M_5 1.00	M_6 1.13	M_7 1.27
L_2 medium	About the same proportions of low, medium and high loads	M_2 0.73	M_3 0.81	M_4 0.89	M_5 1.00	M_6 1.13	M_7 1.27	M_8 1.39
L_3 heavy	Loads are always close to the maximum load	M_3 0.81	M_4 0.89	M_5 1.00	M_6 1.13	M_7 1.27	M_8 1.39	M_8 1.70
L_4 very heavy	Always maximum load	M_4 0.89	M_5 1.00	M_6 1.13	M_7 1.27	M_8 1.39	M_8 1.70	M_8 2.10

* FEM-Federation Europeenne de la Manutention Section I, Rules for the design of hoisting appliances, 3rd edition 1998

Selection of gear ratios

Gear ratios – 2-stage version

PEG 250		20	23	26	30	35	43
PEG 300		20	23	26	30	35	43
PEG 350				20	23	27	33
PEG 400	20	22	24	26	29	33	39
PEG 450		21	23	26	29	33	40
PEG 500					21	24	28
PEG 550				13	21	24	28
PEG 600	On request						
PEG 650							
PEG 700					24	28	34
PEG 800	On request						
PEG 900							
PEG 1000							
PEG 1100							
PEG 1200							

Gear ratios – 3-stage version

PEG 250	104	114	128	137	148	162	180	204	237	287		
PEG 300	104	114	128	137	148	162	180	204	237	287		
PEG 350	61	66	73	83	89	97	106	118	135			
PEG 400	51	53	58	62	66	71	77	84	94	106		
PEG 450	44	50	54	60	64	68	74	80	88	99	113	128
PEG 500	44	50	57	61	66	73	81	92				
PEG 550	45	51	56	62	71	76	84	93	104	121		
PEG 600	56	62	70	81	89	99	112	129				
PEG 650	61	68	76	88	96	107	120	138	161			
PEG 700	53	59	66	70	76	82	91	101	116	138	154	
PEG 800	63	70	79	85	93	102	114	130	157			
PEG 900	60	63	67	71	76	82	89	98	110	125	147	180
PEG 1000	63	70	74	78	84	90	98	108	121	138	164	
PEG 1100	58	63	71	82	98	110	125	146				
PEG 1200	60	63	67	71	76	82	89	98	110	125	147	180

Gear ratios – 4-stage version

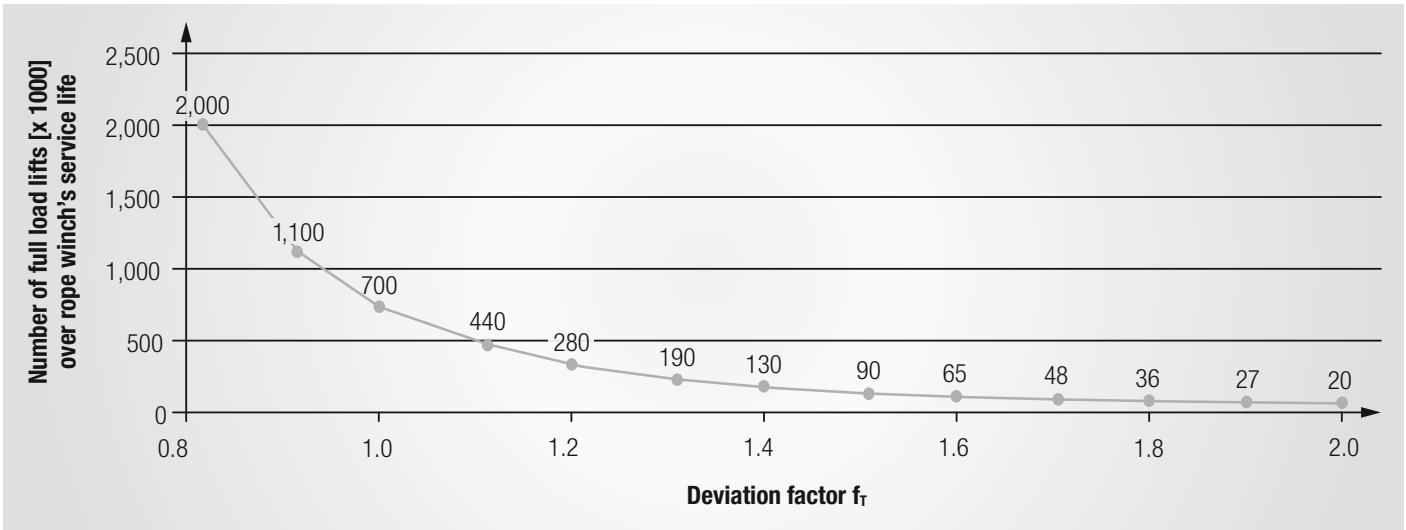
PEG 250	On request											
PEG 300												
PEG 350												
PEG 400												
PEG 450												
PEG 500												
PEG 550	226	238	252	268	288	312	342	381				
PEG 600	On request											
PEG 650												
PEG 700	175	192	216	248	270	297	332	426	477	545		
PEG 800	232	252	278	313	337	365	400	445	505			
PEG 900	280	292	306	321	339	360	385	414	450	496	554	631
PEG 1000	255	302	330	368	420	455	498	552	624	723		
PEG 1100	178	195	216	244	286	314	351	400	440	575	693	889
PEG 1200	280	292	306	321	339	360	385	414	450	496	554	631

Other gear ratios available on request

Possible number of lifts under load

When choosing the gearbox size, not only are the torque required for the application and the drive mechanism group important, but also the number of lifts under full load, which the rope winch is expected to cope with throughout its anticipated service life. The full load lifts themselves do not have an influence on the gearing and bearings of the gearbox, but they have an effect on the structural components, such as the planetary supports, bolts and drive shaft. In order to determine the maximum possible number of full load lifts, the required torque must be multiplied by the lift load coefficient for the respective application. The result has to be put into relation to the reference torque of the selected gearbox size. If the calculated deviation factor is lower than 0.8, the structural components of the gearbox are fatigue resistant and an infinite number of full load lifts can be executed. If the result is higher, the maximum number of full load lifts must be taken into consideration. Should the result be lower than the number of lifts during service life and the damage-equivalent number of full load lifts, derived from load spectrum, a larger gearbox must be selected.

*Liebherr recommends the FEM guideline FEM 1.001 2.2.2.1.1 or EN 13001-2 4.2.2.2.1 for calculation of the lift load coefficient Ψ



$$fT = \frac{T_{dyn,max} \times \Psi}{T_{dyn,r}}$$

f_T	Deviation factor from reference torque $T_{dyn,r}$
Ψ	Lift load coefficient (vibration coefficient)*

Consideration of full load lifts to the allowed, dynamic load torque.

Enquiry Data

Planetary Plug-in Gearboxes

General Information

Request Date:		Telephone:	
Company:		E-Mail:	
Contact Person:		Application:	
Road:		Machine / Type:	
Postcode:	Location:	Required quantity:	
Country:		Requested delivery date:	

Design data

Operating data

	Nominal dyn. output torque $T_{dyn,nom}$	Max. output torque** $T_{dyn,max}$	Static output torque T_{stat}
Torque [Nm]			
Speed [rpm]			

Classification according to FEM*

Max. cable pull F_{max} [kN]	
at rope layer diameter D_L [mm]	
Rope speed at max. cable pull v_F [m/min]	

* Liebherr recommends to design according to the guidelines of the FEM (Fédération Européenne de la Manutention) Section I, Rules for the design of hoisting appliances
** incl. all influencing factors

Design size selection

Size	**PEG 250**	**PEG 300**	**PEG 350**	**PEG 400**	**PEG 450**	**PEG 500**	**PEG 550**	**PEG 600**	**PEG 650**	**PEG 700**	**PEG 800**	**PEG 900**	**PEG 1000**	**PEG 1100**	**PEG 1200**
Reference torque $T_{dyn,r}$ [Nm]	6.000	9.000	23.000	33.000	50.000	73.000	103.000	127.000	151.000	218.000	286.000	445.000	631.000	944.000	1.250.000
Please tick selected size	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Selected ratio															

Motor data hydraulic motor

Manufacturer		
Type		
Displacement [l/min]		
Pressure differential [bar]		
Holding brake (for hydraulic motor)*		
Include in delivery	yes ☐	no ☐
Min. air pressure [bar]		
Max. air pressure [bar]		
Max. accumulation pressure [bar]		

*Designed as wet-running, hydraulically-released, spring-loaded multiple disc brake

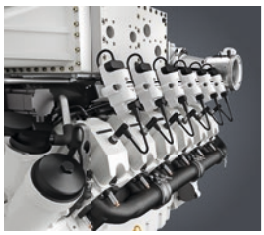
Motor data electric motor

Manufacturer	
Type	
Power [kW]	
Speed [U/min]	
Starting torque [Nm]	
Duty cycle [%]	

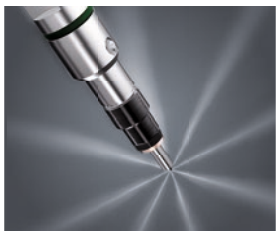
Comments / Additional requirements

Please return completed form to:
Liebherr-Components AG
Postfach 222, CH-5415 Nussbaumen / AG
Fax +41 56 296 43 01, components@liebherr.com

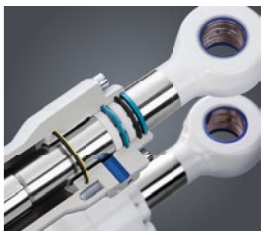
Liebherr Components


Gas engines


Diesel engines

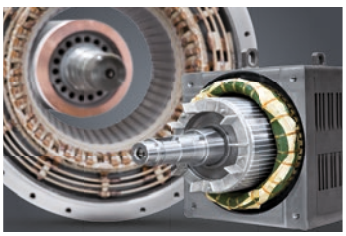

Fuel injection systems

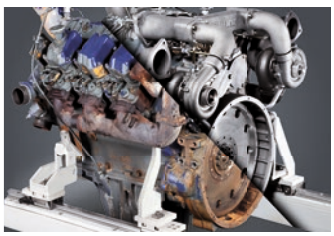

Axial piston hydraulics


Hydraulic cylinders

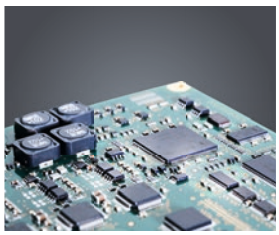

Slewing bearings


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.

components.liebherr.com

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