

Slewing Drives by Liebherr

Series-production Gearboxes



LIEBHERR

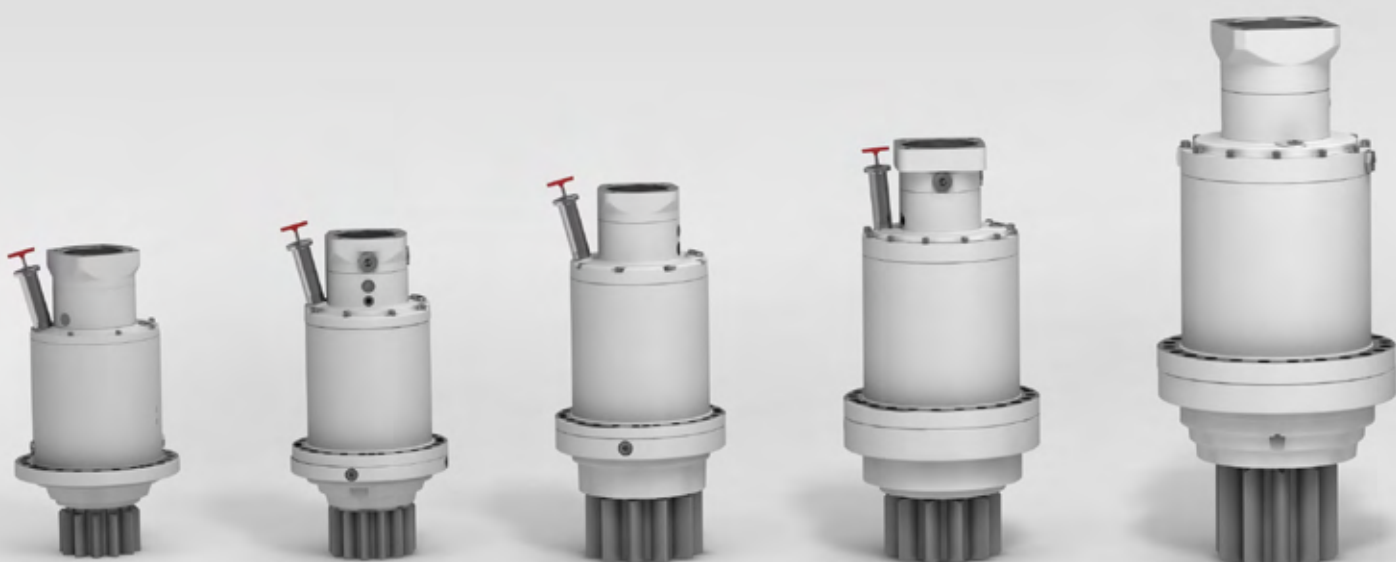
Slewing drives by Liebherr

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

With its slewing drives, Liebherr offers its customers a series-produced product range that covers many different application areas. 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 slewing drives are characterised by maximum torque density with low installation space requirements.

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



DAT 200

DAT 225

DAT 250

DAT 300

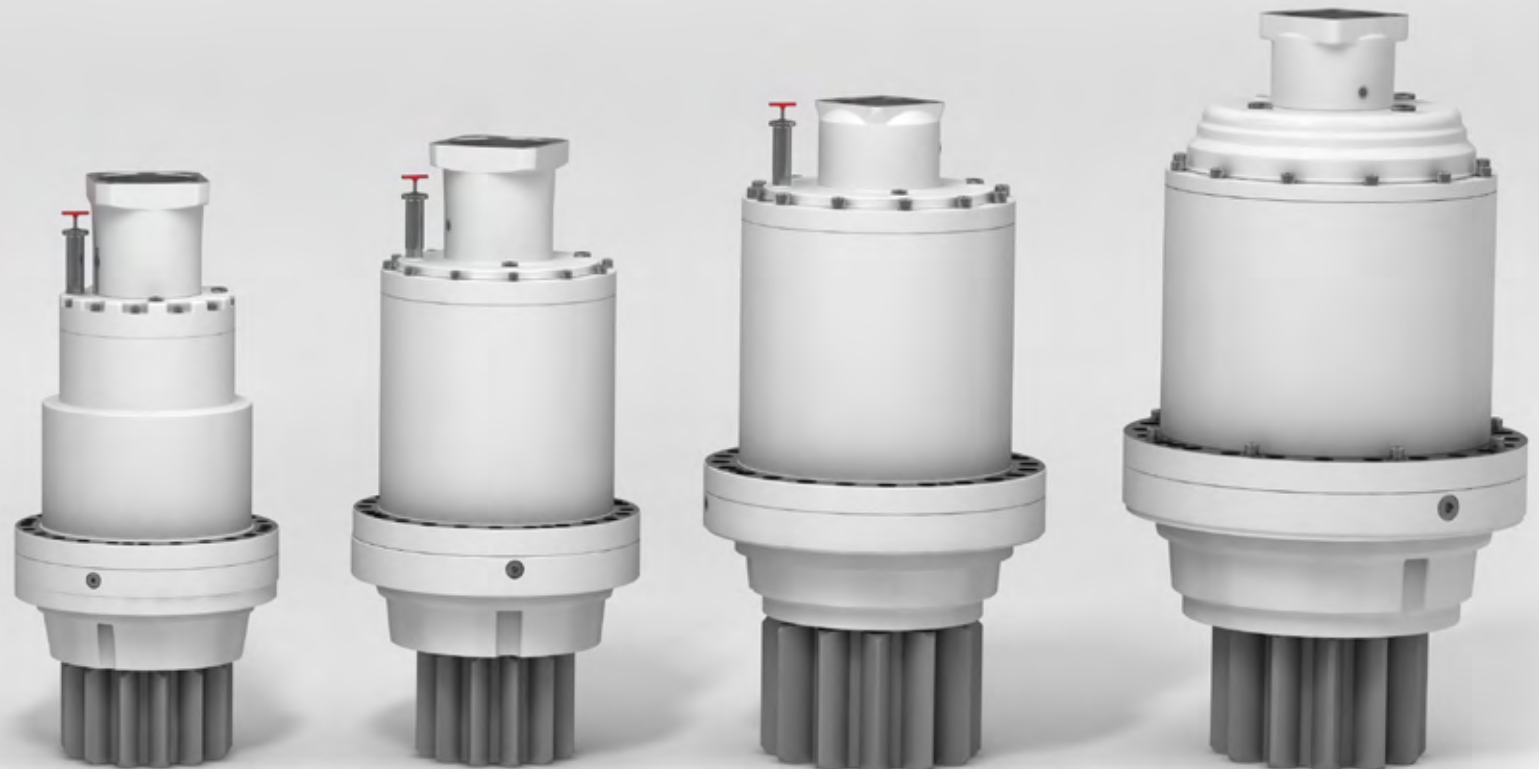
DAT 350

Product range

Eight gearbox sizes from the DAT 200 to the DAT 600 are available as series-production units. Further sizes are available on request. The coaxial planetary gearboxes are available as three-stage or four-stage units with a multitude of different gear ratios ranging from $i = 20$ to $i = 1,500$. The maximum dynamic torque is 142,000 Nm. Torques as high as 610,000 Nm have been implemented in special-design gearboxes. The series-production gearboxes with short output shaft can be adapted both for electric motors and for hydraulic motors.

Areas of application

- Construction machinery, e.g. hydraulic excavators and concrete pumps
- Cranes, e.g. construction and mobile cranes
- Material handling and recycling equipment
- Mining equipment, e.g. mining excavators
- Maritime applications, e.g. port and ship cranes, ship propulsion units
- Renewable energy, e.g. wind turbines
- Automotive engineering, e.g. turntable ladder vehicles
- Industry



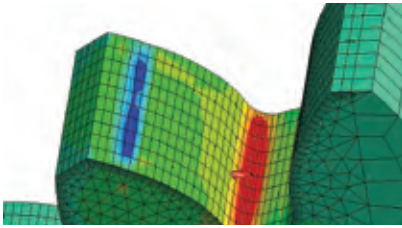
DAT 400

DAT 450

DAT 500

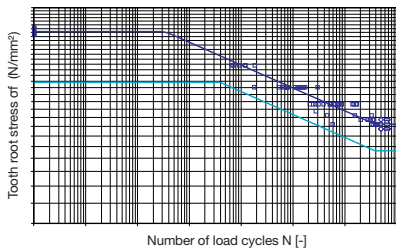
DAT 600

Technical design



Gearbox design

The slewing drives 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.

Output shaft and bearing

The material from which the single-piece forged output shaft is made is case-hardened and ground in order to withstand the highest possible loads. Every size of series-production gearbox has a standard output pinion. This pinion can be adapted to the specific requirements of the customer. For example, a profile-corrected version of the gearing is possible as an option. Pretensioned tapered roller bearings in an O-shaped arrangement prevent the output shaft from tilting when it is supported by the bearings, and ensure precise tooth meshing.

The outer tapered roller bearing has lifetime lubrication. The durable, field-tested outward seal ensures a long service life.

Adjustment of tooth backlash

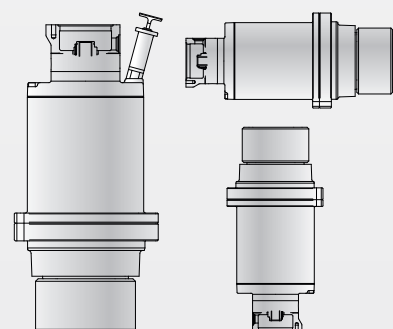
The eccentricity of the gearbox allows simple adjustment of the optimum circumferential backlash between the large diameter bearing and the slewing drive.

Efficiency

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

Assembly position

As standard the gearboxes are designed for vertical installation, with the output pinion at the bottom. Other installation positions are also possible on request.



Gear structure

All sun gears and planet gears are case-hardened and ground. They have also been optimised to minimise circumferential backlash and have minimum 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.



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, spring-operated multi disc brake.

Motor attachment

Liebherr slewing drives 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.



Lubrication

Liebherr slewing drives can be used at ambient temperatures down to -20°C . The oil temperature must not exceed $+90^{\circ}\text{C}$.

According to the application the following oils are recommended:

- For low temperature application from -40°C to $+50^{\circ}\text{C}$: Liebherr Syntogear Plus 75W-90. For an optimal gear box adaptation, consultation is necessary.
- For application in an ambient temperature range from -20°C to $+50^{\circ}\text{C}$: Liebherr Gear Basic 90 LS.
- For application in highly-stressed gear boxes in an ambient temperature range up to -40°C : Liebherr Gear PG 220. For an optimal gear box adaptation, consultation is necessary.

The types of lubricants used must comply with the indications in the installation drawing respectively in the maintenance manual.

For further information about technical data, qualifications and characteristics of the oils refer to www.liebherr.com, in the section 'lubricants and operating liquids'.



Selection of gearbox size

The dynamic torques specified in the reference table refer to the load spectrum L2 and the operating class T5 given in the directives published by the FEM*. They were calculated for a rotational speed of 10 rpm at the output pinion.

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 the right. 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 spectrum in accordance with the FEM directives.

$T_{FEM,max} \times k \leq T_{FEM,r}$	
$T_{FEM,max}$	Required maximum dynamic output torque
k	Application factor
$T_{FEM,r}$	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

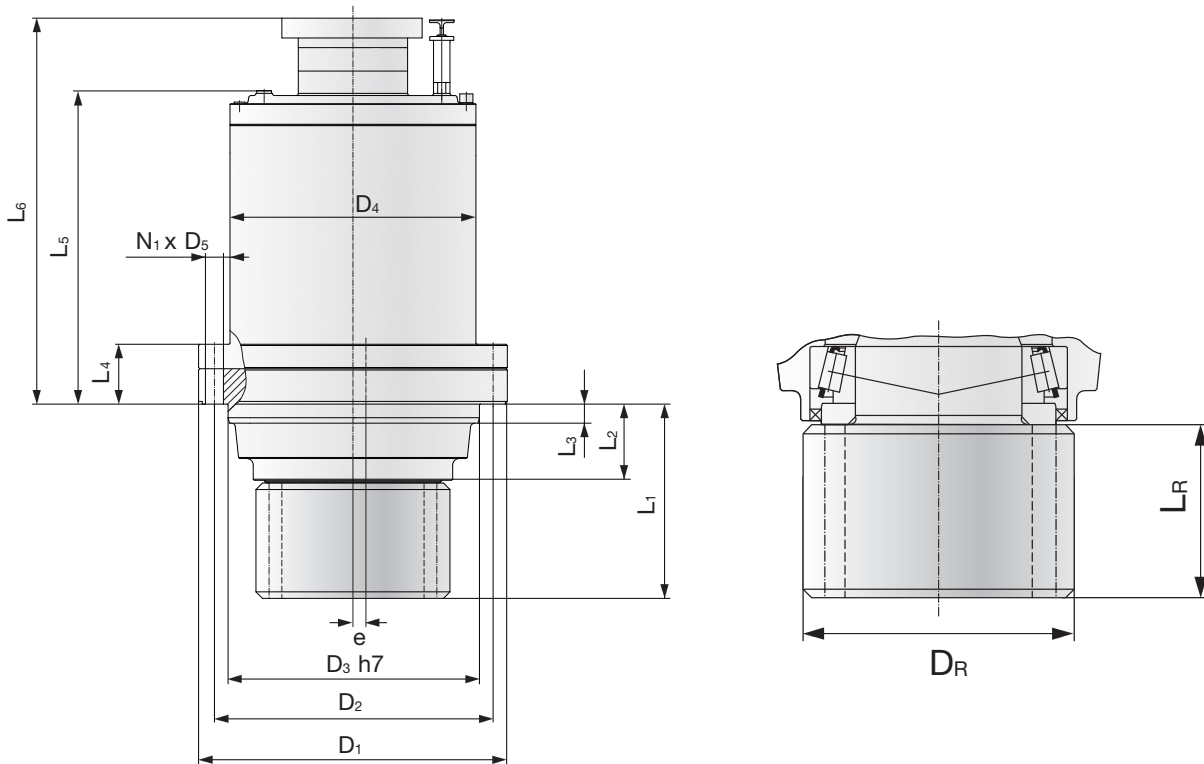
* FEM-Federation Europeenne de la Manutention Section I, Rules for the design of hoisting appliances, 3rd edition (1998)

Selection of gear ratios

Gear ratios																
DAT 200	63.91	66.52	79.00													
DAT 225	59.89	70.00	76.56	83.74	92.97	105.27	116.88	136.00	154.00	179.20						
DAT 250	67.20	78.87	86.45	94.76	105.45	119.70	133.20	155.40	176.40	205.80	249.90					
DAT 300	66.67	78.24	85.76	95.44	104.61	118.75	132.14	154.17	175.00	204.17	247.92					
DAT 350	35.42	57.89	66.67	79.17	94.01	104.61	118.75	132.14	154.17	175.00	204.17	247.92				
DAT 400	66.67	78.24	85.76	94.01	104.61	118.75	132.14	154.17	175.00	204.17	247.92					
DAT 450	29.17	66.67	78.24	85.76	95.44	104.61	118.75	138.54	154.17	175.00	204.17	247.92				
DAT 500	29.17	57.89	66.67	72.22	79.17	88.10	95.44	108.33	126.39	132.14	154.17	175.00	204.17	212.50	247.92	
DAT 600	19.79	22.02	29.17	35.42	66.67	72.22	85.76	95.44	104.61	118.75	132.14	154.17	175.00	204.17	247.92	301.04
DAT 700	On request															
DAT 800	On request															
DAT 1000	On request															

Note: Gear ratios from 20 to 1,500 are possible. Other gear ratios on request.

Sizes and dimensions



Technical data of the series model range

	Output torques		Main dimensions											Output pinion				Weight	Backlash
	T_{FEM}	T_{MAX}	D_1	D_2	$D_3 h7$	D_4	$N_1 \times D_5^1$	L_1	L_2	L_3	L_4	L_5	L_6	z	m	D_R	L_R	3-stage design	Angular minute
	[Nm]	[Nm]	[mm]	[mm]	[mm]	[mm]	1 x [mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]			[mm]	[mm]	[kg]	[arc min]
DAT 200	5,000	10,000	ø270	ø240	ø210	ø212	24 x ø14	135	50	12	24	250	Depends on motor size	12	9	133	75	71	10
DAT 225	8,000	16,000	ø260	ø235	ø210	ø205	24 x ø14	135	55	15	44	280		13	9	156	75	75	10
DAT 250	11,000	22,000	ø282	ø258	ø230	ø228	24 x ø14	180	70	19	55	316		11	14	187	105	117	8
DAT 300	18,000	36,000	ø326	ø296	ø265	ø260	24 x ø18	182	72	55	83	364		11	14	187	105	165	8
DAT 350	30,000	60,000	ø400	ø362	ø325	ø315	24 x ø22	230	100	43	84	430		12	18	252	125	312	-
DAT 400	44,000	88,000	ø437	ø400	ø365	ø350	24 x ø22	265	100	22	115	501		13	18	273	160	405	-
DAT 450	60,000	120,000	ø480	ø435	ø395	ø390	24 x ø26	300	110	30	110	526		12	18	252	185	497	-
DAT 500	82,000	164,000	ø565	ø510	ø460	ø450	24 x ø33	375	140	35	110	571		12	24	324	230	785	-
DAT 600	142,000	284,000	ø660	ø600	ø550	ø540	24 x ø33	404	174	40	128	675		12	24	324	230	1,170	-
DAT 700	210,000	420,000	On request																
DAT 800	310,000	620,000	On request																
DAT 1000	610,000	1,220,000	On request																

¹ Strength class 10.9 for fastening screws

Eccentricity of output pinion $e=1,5$

Profile offset factor $x=0,5$

Backlash: Reference values. Backlash at the output with blocked drive in new condition of the gear.

T_{FEM} = Reference torque T_{FEM} based on M5/L2/T5 at 10 rpm at output pinion

T_{MAX} = Safety $\geq 1,5$ against fracture

m = gear module

D_{1-5} = diameter

D_R = tip diameter

$L_{1-6,R}$ = length

N_1 = number of screws

Liebherr-Component Technologies

Liebherr-Component Technologies AG, based in Bulle, Switzerland, is responsible for all activities of the components division of the Liebherr group. The companies and business areas belonging to this division are specialised in the development, design, manufacture and reconditioning of high-performance components in the field of mechanical, hydraulic and electrical drives and control technology. The sale of components to customers outside the Liebherr group of companies is managed centrally by Liebherr-Components AG in Nussbaumen, Switzerland.

Many Years of Experience

Liebherr has decades of experience in the manufacture of high-quality components used in cranes and construction machines, in the mining industry, maritime applications, wind turbines, in vehicle technology or in aerospace and transportation technology.

The Right Solution for Every Need

A high degree of vertical integration and the use of flexible, state-of-the-art production systems allow Liebherr to offer its customers tailor-made solutions. Liebherr is your partner for joint success – from the product idea to development, manufacture and first installation right through to series production. For the various components of the drivetrain, Liebherr also offers remanufacturing in various degrees in a dedicated factory.

System Solutions from a Single Source

Components from Liebherr are perfectly matched to each other with regard to operation. Depending on the requirement, individual components from the wide product range can be expanded through to the complete drivetrain. This results in impressive system solutions which can be integrated into a variety of applications.

Highest Quality Standards and Long Service Life

All components meet the very highest demands for functional reliability and durability, even under extreme loads and harsh conditions. Elaborate quality management and extensive analysis and test procedures are practised throughout the entire development and production process, guaranteeing reliability and long component service life.

www.liebherr.com



Biberach/Riss (Germany): large diameter bearings, gearboxes, rope winches, switchgear, electronics, electrical machines



Bulle (Switzerland): diesel engines, gas engines, splitter boxes, axial piston units, injection systems



Kirchdorf (Germany): hydraulic cylinders



Lindau (Germany): electronics, power electronics



Ettlingen (Germany): remanufactured components



Monterrey (Mexico): large diameter bearings



Dalian (China): gearboxes

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