# Material Handling Machine





# **The Perfect Solution for Every Application**





# Material Handling Machines Overview

#### Uppercarriage

- 2-circuit Liebherr-Synchron-Comfort-system (LSC) with LUDV technology for faster working speed at minimum fuel consumption
- 300 kW engine output and high pump flow for fast work cycles, convincing dynamics and maximum handling performance
- Electrical pilot control enables individual settings for the operator and new options such as load torque limitation
- Reduction in operating costs thanks to built-in maintenance advantages and optimum service accessibility
- Optimised hydraulics with closed slewing mechanism circuit for greater fuel efficiency and faster work cycles

#### Undercarriage

- Central lubrication system manually centralised or automatically for more productive working time at mobile undercarriage
- Large footprint for high stability and maximum lift capacities
- Variety of undercarriage variants for different applications available
- Low service costs thanks to travel drive without gearbox and cardan shafts at mobile undercarriage





#### Attachment

- High lift capacities and long reaches thanks to weight-optimised design for more handling capacity
- Energy recovery cylinder filled with nitrogen for maximum efficiency through less fuel consumption at more handling capacity
- Pipe fracture safety valves on hoist and stick cylinders and retract stick shut-off for maximum safety during every application
- Electro-hydraulic end position control extends the service life of the components
- Quick coupling systems and working tools made by Liebherr for maximum machine capacity utilisation and greater handling performance

#### **Operator's Cab**

- Hydraulic cab elevations for always the best view downwards as well as forwards
- Less strain on the operator, workers and reduced environmental pollution due to lower noise emissions
- Optimum visibility thanks to large glass surfaces and standard rear and side area monitoring with camera
- Joystick steering without steering column as standard for convenient operation, greater legroom and clear view of the working area at mobile undercarriage
- Proportional control as standard with 4-way minijoystick for greater precision, highprecision control and functions

# **Technical Data**

#### Diesel Engine

Rating per ISO 9249	300 kW (408 HP) at 1,800 RPM
Model	Liebherr D946
Туре	6 cylinder in-line
Bore/Stroke	130/150 mm
Displacement	11.95
Engine operation	4-stroke diesel
	Common-Rail
	turbo-charged and after-cooled
	reduced emissions
Air cleaner	dry-type air cleaner with pre-cleaner, primary and
	safety elements
Engine idling	sensor controlled
Electrical system	
Voltage	24 V
Batteries	2 x 180 Ah/12 V
Alternator	three-phase current 28 V/140 A
Stage IV	
Harmful emissions values	in accordance with 97/68/EG stage IV
Emission control	Liebherr-SCR technology
Fuel tank	1,350 l
Urea tank	180 I
Stage IIIA	
Harmful emissions values	in accordance with 97/68/EG stage IIIA
Fuel tank	1.350 l

#### Hydraulic System

Hydraulic pump	
for attachment	2 Liebherr axial piston variable displacement pumps
and travel drive	(double construction)
Max. flow	2 x 462 l/min.
Max. pressure	350 bar
for swing drive	reversible axial piston variable displacement pump, closed-loop circuit
Max. flow	355 I/min.
Max. pressure	370 bar
Hydraulic pump regulation and control	2 circuit Liebherr-Synchron-Comfort-system (LSC) with electronic engine speed sensing regulation, pressure and flow compensation, automatic oil flow optimizer
Hydraulic tank	455 I
Hydraulic system	1,175
Hydraulic oil filter	2 main return filters with integrated partial micro filtration (5 $\mu\text{m})$
MODE selection	adjustment of engine and hydraulic performance via a mode pre-selector to match application, e.g. for especially economical and environmentally friendly operation or for maximum material handling and heavy-duty jobs
S (Sensitive)	mode for precision work and lifting through very sensitive movements
E (Eco)	mode for especially economical and environmentally friendly operation
P (Power)	mode for high performance with low fuel consumption
P+ (Power-Plus)	mode for highest performance and for very heavy duty applications, suitable for continuous operation
Engine speed and performance setting	stepless alignment of engine output and hydraulic power via engine speed Tool Control: ten preadjustable pump flows and
Ομιστι	pressures for add on tools

### د در Cooling System

Diesel engine

water-cooled cooling system, consisting of a cooling unit for water and charge air and a 2<sup>nd</sup> cooler for hydraulic oil, each with an infinitely variable, thermostatically controlled fan drive system

#### C Swing Drive

Drive	Liebherr axial piston motor in a closed system, Liebherr planetary reduction gear
Swing ring	Liebherr, sealed race ball bearing swing ring, internal teeth
Swing speed	0 – 6.5 RPM stepless
Swing torque	200 kNm
Holding brake	wet multi-disc (spring applied, pressure released)

#### Hydraulic Controls

Power distribution	via control valves with integrated safety valves, simultaneous actuation of chassis and attachment. Swing drive in separate closed circuit
Servo circuit	
Attachment and swing	with electro-hydraulic pilot control and proportional joystick levers
Chassis	with electric proportionally functioning foot pedals or adjusted with plugable levers
Additional functions Proportional control	via switch or electroproportional foot pedals proportionally acting transmitters on the joysticks for additional hydraulic functions

#### Operator's Cab

Cab	safety cab structure with fixed built-in front and roof window made from impact-resistant laminated safety glass, work headlights integrated in the ceiling, a door with a sliding window (can be opened on both sides), large stowing and depositing possibilities, shock- absorbing suspension, sounddamping insulating, tinted laminated safety glass, separate shades for the sunroof window and windscreen
Operator's seat	
Comfort	air cushioned operator's seat with 3D-adjustable arm- rests, headrest, lap belt, seat heater, adjustable seat cushion inclination and length, lockable horizontal suspension, automatic weight adjustment, adjustable suspension stiffness, pneumatic lumbar vertebrae support and passive seat climatisation with active coal
Option	
Premium	in addition to operator's seat comfort: active electronic weight adjustment (automatic readjustment), pneu- matic low frequency suspension and active seat clima- tisation with active coal and ventilator
Control system	joysticks with arm consoles and swivel seat, folding left arm console
Operation and displays	large high-resolution operating unit, selfexplanatory, colour display with touchscreen, video-compatible, numerous setting, control and monitoring options, e.g. air conditioning control, fuel consumption, machine and tool parameters
Air-conditioning	automatic air-conditioning, recirculated air function, fast de-icing and demisting at the press of a button, air vents can be operated via a menu; recirculated air and fresh air filters can be easily replaced and are accessible from the outside; heating-cooling unit, designed for extreme out-side temperatures, sensors for solar radiation, inside and outside temperatures

### Attachment

Туре	weight-optimised design for bulk and general cargo handling at optimal handling capacity. Complex and stable mountings of attachment and cylinders
Hydraulic cylinders	Liebherr cylinders with special seal system as well as shock absorption
Energy recovering cylinder	Liebherr gas cylinder with special sealing and control system
Bearings	sealed, low maintenance

### Undercarriage

Mobile	
Versions	Standard, High Rise
Drive	one driven axle with transmission with Liebherr axial piston motor and functional brake valve on both sides
Travel speed	
Joystick steering	0 – 5.0 km/h stepless (creeper speed) 0 – 8.0 km/h stepless
Driving operation	automotive driving using accelerator pedal, cruise control function: storage of variable accelerator pedal positions
Axles	90 t drive axles; manual or automatic hydraulically controlled front axle oscillation lock
Service brake	two circuit travel brake system with accumulator; wet and backlash-free disc brake
Holding brake	wet multi-disc (spring applied, pressure released)
Stabilization	4 point outriggers
Crawler	
Versions	SW, High Rise
Drive	Liebherr compact planetary reduction gear with Liebherr axial piston motor per side of undercarriage
Travel speed	0 – 2.6 km/h stepless (creeper speed) 0 – 4.0 km/h stepless
Brake	functional brake valves on both sides
Holding brake	wet multi-disc (spring applied, pressure released)
Track pads	flat

#### Complete Machine

Lubrication	Liebherr central lubrication system for uppercarriage and attachment, automatically
Option	
Mobile	Liebherr central lubrication system for undercarriage, automatically
Steps system	safe and durable access system with anti-slip steps main components hot-galvanised
Noise emission	
ISO 6396	$L_{pA}$ (inside cab) = 71 dB(A)
2000/14/EC	$L_{WA}$ (surround noise) = 107 dB(A)

# LH 110 C – Dimensions

Port



## LH 110 C - Cab Elevation

Cab Elevation LHC (Hydraulic Elevation)



Increase type LHC 360-50 The hydraulically adjustable cab allows the driver, that he can choose his field of view freely and at any time within the stroke.

# **LH 110 C HR – Dimensions**

Port



### **LH 110 C HR – Choice of Cab Elevation**



Increase type LHC 360-50 The hydraulically adjustable cab allows the driver, that he can choose his field of view freely and at any time within the stroke. Cab Elevation LHC-D (Hydraulic Elevation)



Increase type

#### LHC-D 730

The hydraulically adjustable cab allows the driver, that he can choose his field of view freely and at any time within the stroke.

# **LH 110 M – Dimensions**

Port



## LH 110 M – Cab Elevation

Cab Elevation LHC (Hydraulic Elevation)



Increase type

LHC 360-50

The hydraulically adjustable cab allows the driver, that he can choose his field of view freely and at any time within the stroke.

#### Tyres 28.00-25

# **LH 110 M HR – Dimensions**

Port



## LH 110 M HR – Cab Elevation



Increase type LHC 360-50 The hydraulically adjustable cab allows the driver, that he can choose his field of view freely and at any time within the stroke.

# LH 110 C – Attachment GG23

Port – Kinematic 2A



#### Operating Weight and Ground Pressure

The operating weight includes the basic machine with hydr. cab elevation, straight boom 13.00 m, straight stick 10.50 m and grab model GMZ 120/6.00  $\rm m^3$  shells for loose material.

Weight	109,900 kg
Pad width	750 mm
Ground pressure	on request

#### Dimensions



			6.0 m		7.5 m		9.0 m		10.5 m		0 m	13.	5 m	15.0	) m	16.5 m		18.0 m		19.5 m		21.	0 m	22.5 m		n 24.0 m			20	
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m	Undercarriage				Ľ		Ľ		Ľ		Ľ		Ľ		2		Ľ		Ľ		Ľ		Ľ		2		Ľ	5	Ľ	m
25.5	SW																													
24.0	SW					16.9*	16.9*																					15.9*	15.9*	9.4
22.5	SW							17.3*	17.3*	14.2*	14.2*																	13.4*	13.4*	12.3
21.0	SW							18.6*	18.6*	17.0*	17.0*	14.5*	14.5*															12.0*	12.0*	14.4
19.5	SW									16.5*	16.5*	15.3*	15.3*	14.3*	14.3*													11.1*	11.1*	16.2
18.0	SW									16.2*	16.2*	15.0*	15.0*	14.0*	14.0*	13.2*	13.2*											10.5*	10.5*	17.6
16.5	SW									16.1*	16.1*	14.9*	14.9*	13.9*	13.9*	13.1*	13.1*	12.4*	12.4*									10.1*	10.1*	18.8
15.0	SW									16.1*	16.1*	14.9*	14.9*	13.8*	13.8*	13.0*	13.0*	12.3*	12.3*	10.9*	10.9*							9.8*	9.8*	19.8
13.5	SW									16.2*	16.2*	14.9*	14.9*	13.9*	13.9*	13.0*	13.0*	12.2*	12.2*	11.6*	11.6*							9.5*	9.5*	20.6
12.0	SW									16.5*	16.5*	15.1*	15.1*	14.0*	14.0*	13.1*	13.1*	12.3*	12.3*	11.6*	11.6*	10.8*	10.8*					9.4*	9.4*	21.3
10.5	SW							18.6*	18.6*	16.9*	16.9*	15.4*	15.4*	14.2*	14.2*	13.2*	13.2*	12.4*	12.4*	11.6*	11.6*	10.9*	10.9*					9.3*	9.3*	21.9
9.0	SW					21.8*	21.8*	19.3*	19.3*	17.3*	17.3*	15.8*	15.8*	14.5*	14.5*	13.4*	13.4*	12.5*	12.5*	11.7*	11.7*	10.9*	10.9*					9.3*	9.3*	22.4
7.5	SW			24.2*	24.2*	22.9*	22.9*	20.1*	20.1*	17.9*	17.9*	16.2*	16.2*	14.8*	14.8*	13.6*	13.6*	12.6*	12.6*	11.8*	11.8*	10.9	11.0*	9.6	10.2*			9.3*	9.3*	22.7
6.0	SW	29.3*	29.3*	28.8*	28.8*	24.2*	24.2*	21.0*	21.0*	18.5*	18.5*	16.6*	16.6*	15.1*	15.1*	13.8*	13.8*	12.8*	12.8*	11.8*	11.8*	10.8	11.0*	9.5	10.1*			9.2	9.4*	23.0
4.5	SW	39.1*	39.1*	30.8*	30.8*	25.5*	25.5*	21.9*	21.9*	19.2*	19.2*	17.1*	17.1*	15.4*	15.4*	14.1*	14.1*	12.9*	12.9*	11.9*	11.9*	10.6	11.0*	9.4	10.0*			9.0	9.5*	23.1
3.0	SW	17.0*	17.0*	32.7*	32.7*	26.8*	26.8*	22.7*	22.7*	19.8*	19.8*	17.5*	17.5*	15.7*	15.7*	14.3*	14.3*	13.0*	13.0*	11.8	12.0*	10.5	11.0*	9.4	9.9*			8.9	9.3*	23.1
1.5	SW	8.8*	8.8*	24.7*	24.7*	27.7*	27.7*	23.4*	23.4*	20.2*	20.2*	17.8*	17.8*	16.0*	16.0*	14.4*	14.4*	13.0	13.1*	11.6	11.9*	10.3	10.8*	9.3	9.6*			8.9	9.0*	23.1
0	SW	7.6*	7.6*	16.6*	16.6*	28.2*	28.2*	23.8*	23.8*	20.5*	20.5*	18.1*	18.1*	16.1*	16.1*	14.5*	14.5*	12.8	13.1*	11.4	11.8*	10.2	10.6*	9.2*	9.2*			8.6*	8.6*	22.9
-1.5	SW	8.1*	8.1*	14.6*	14.6*	28.0*	28.0*	23.8*	23.8*	20.6*	20.6*	18.1*	18.1*	16.0*	16.0*	14.2	14.3*	12.6	12.9*	11.2	11.6*	10.1	10.2*	8.5*	8.5*			8.2*	8.2*	22.7
-3.0	SW	9.2*	9.2*	14.5*	14.5*	24.5*	24.5*	23.4*	23.4*	20.3*	20.3*	17.8*	17.8*	15.8*	15.8*	14.0	14.0*	12.4	12.5*	11.1*	11.1*	9.5*	9.5*					8.2*	8.2*	22.0
-4.5	SW	10.6*	10.6*	15.3*	15.3*	23.6*	23.6*	22.5*	22.5*	19.6*	19.6*	17.2*	17.2*	15.2*	15.2*	13.4*	13.4*	11.9*	11.9*	10.3*	10.3*							8.8*	8.8*	20.7
-6.0	SW					23.9*	23.9*	20.9*	20.9*	18.3*	18.3*	16.1*	16.1*	14.2*	14.2*	12.5*	12.5*	10.8*	10.8*									9.9*	9.9*	18.8
-7.5	SW											14.5*	14.5*															13.5*	13.5*	14.3
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1/2- Height 🛁 Can be slewed through 360° 🖞 In longitudinal position of undercarriage

Max. reach \* Limited by hydr. capacity

The lift capacities on the stick end without attachment are stated in metric tons (t) and can be slewed through 360° on a firm, level supporting surface. Capacities are valid for 750 mm wide flat pads. Indicated loads based on the ISO 10567 standard and do not exceed 75% of tipping or 87% of hydraulic capacity. The lift capacity values indicated are attained at the corresponding operating temperature. This operating temperature is ensured by continuous movement of the boom. Weights of fitted working tools (grabs, load hooks, etc.) and load accommodation equipment are to be deducted from the lift capacity values. The lift capacity of the unit is limited by its stability, the lifting capability of the hydraulic elements, or the maximum permissible lifting capacity of the load hook.

In accordance with the harmonised European Standard EN 474-5, hydraulic excavators used for lifting operations must be equipped with pipe fracture safety valves, an overload warning device, a load hook and a lift capacity chart.

### LH 110 C HR – Attachment AG24

Port – Kinematic 2D



#### Operating Weight and Ground Pressure

The operating weight includes the basic machine with hydr. cab elevation, angled boom 13.00 m, straight stick 12.00 m and grab model GMZ 120/6.00 m<sup>3</sup> shells for loose material.

Weight	117,600 kg
Pad width	750 mm
Ground pressure	on request

#### Dimensions



+		6.0 m 7.5 m		i m	9.0	) m	10.	10.5 m   12.0 m		13.	5 m	15.	0 m	16.	5 m	18.	0 m	19.5	5 m	21.0	) m	22.5	5 m	24.0	) m					
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m	Undercarriage					<b>-</b>		- <del>-</del> 2													2									m
25.5	SW																											10.8*	10.8*	11.9
24.0	SW											11.0*	11.0*															9.7*	9.7*	14.2
22.5	SW											12.0*	12.0*	11.0*	11.0*													9.1*	9.1*	16.0
21.0	SW													11.1*	11.1*	10.7*	10.7*											8.6*	8.6*	17.6
19.5	SW													10.9*	10.9*	10.4*	10.4*	10.1*	10.1*									8.3*	8.3*	18.8
18.0	SW													10.8*	10.8*	10.3*	10.3*	10.0*	10.0*	9.1*	9.1*							8.1*	8.1*	19.9
16.5	SW													10.8*	10.8*	10.3*	10.3*	9.9*	9.9*	9.6*	9.6*							8.0*	8.0*	20.8
15.0	SW													10.9*	10.9*	10.4*	10.4*	10.0*	10.0*	9.6*	9.6*	9.3*	9.3*					7.9*	7.9*	21.6
13.5	SW											11.8*	11.8*	11.1*	11.1*	10.6*	10.6*	10.1*	10.1*	9.7*	9.7*	9.3*	9.3*					7.9*	7.9*	22.2
12.0	SW											12.2*	12.2*	11.4*	11.4*	10.8*	10.8*	10.2*	10.2*	9.8*	9.8*	9.4*	9.4*	8.6*	8.6*			7.9*	7.9*	22.7
10.5	SW									13.6*	13.6*	12.6*	12.6*	11.8*	11.8*	11.0*	11.0*	10.4*	10.4*	9.9*	9.9*	9.5*	9.5*	9.1*	9.1*			7.9*	7.9*	23.2
9.0	SW							15.8*	15.8*	14.3*	14.3*	13.1*	13.1*	12.2*	12.2*	11.4*	11.4*	10.7*	10.7*	10.1*	10.1*	9.6*	9.6*	9.2*	9.2*			8.0*	8.0*	23.5
7.5	SW					19.1*	19.1*	16.9*	16.9*	15.1*	15.1*	13.7*	13.7*	12.6*	12.6*	11.7*	11.7*	11.0*	11.0*	10.3*	10.3*	9.8*	9.8*	9.3*	9.3*			8.2*	8.2*	23.7
6.0	SW	30.7*	30.7*	24.7*	24.7*	20.8*	20.8*	18.0*	18.0*	16.0*	16.0*	14.4*	14.4*	13.1*	13.1*	12.1*	12.1*	11.3*	11.3*	10.6*	10.6*	10.0*	10.0*	9.4*	9.4*			8.3*	8.3*	23.8
4.5	SW	34.7*	34.7*	27.2*	27.2*	22.4*	22.4*	19.2*	19.2*	16.8*	16.8*	15.0*	15.0*	13.6*	13.6*	12.5*	12.5*	11.6*	11.6*	10.8*	10.8*	10.1*	10.1*	9.5*	9.5*			8.6*	8.6*	23.8
3.0	SW	23.1*	23.1*	29.4*	29.4*	24.0*	24.0*	20.3*	20.3*	17.7*	17.7*	15.7*	15.7*	14.1*	14.1*	12.9*	12.9*	11.9*	11.9*	11.0*	11.0*	10.3*	10.3*	9.6*	9.6*			8.9*	8.9*	23.7
1.5	SW	15.1*	15.1*	29.6*	29.6*	25.3*	25.3*	21.3*	21.3*	18.4*	18.4*	16.3*	16.3*	14.6*	14.6*	13.2*	13.2*	12.1*	12.1*	11.2*	11.2*	10.4*	10.4*	9.7*	9.7*			9.1	9.2*	23.5
0	SW	13.1*	13.1*	21.7*	21.7*	26.3*	26.3*	22.1*	22.1*	19.0*	19.0*	16.8*	16.8*	15.0*	15.0*	13.5*	13.5*	12.4*	12.4*	11.4*	11.4*	10.5*	10.5*	9.6*	9.6*			9.2*	9.2*	23.2
-1.5	SW	12.7*	12.7*	19.0*	19.0*	27.0*	27.0*	22.7*	22.7*	19.5*	19.5*	17.1*	17.1*	15.3*	15.3*	13.7*	13.7*	12.5*	12.5*	11.4*	11.4*	10.5*	10.5*	9.5*	9.5*			9.2*	9.2*	22.8
-3.0	SW	13.0*	13.0*	18.1*	18.1*	27.2*	27.2*	22.9*	22.9*	19.8*	19.8*	17.3*	17.3*	15.4*	15.4*	13.8*	13.8*	12.5*	12.5*	11.4*	11.4*	10.3*	10.3*					9.2*	9.2*	22.4
-4.5	SW	13.5*	13.5*	18.0*	18.0*	25.8*	25.8*	22.8*	22.8*	19.7*	19.7*	17.3*	17.3*	15.4*	15.4*	13.7*	13.7*	12.4*	12.4*	11.1*	11.1*	9.9*	9.9*					9.2*	9.2*	21.7
-6.0	SW	14.2*	14.2*	18.4*	18.4*	25.4*	25.4*	22.3*	22.3*	19.3*	19.3*	17.0*	17.0*	15.0*	15.0*	13.4*	13.4*	12.0*	12.0*	10.6*	10.6*							9.3*	9.3*	20.8
-7.5	SW					24.7*	24.7*	21.3*	21.3*	18.5*	18.5*	16.3*	16.3*	14.4*	14.4*	12.7*	12.7*	11.2*	11.2*									10.6*	10.6*	18.5
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#### 🎶 Height 🛛 📲 Can be slewed through 360° 📙 In longitudinal position of undercarriage

Max. reach \* Limited by hydr. capacity

The lift capacities on the stick end without attachment are stated in metric tons (t) and can be slewed through 360° on a firm, level supporting surface. Capacities are valid for 750 mm wide flat pads. Indicated loads based on the ISO 10567 standard and do not exceed 75% of tipping or 87% of hydraulic capacity. The lift capacity values indicated are attained at the corresponding operating temperature. This operating temperature is ensured by continuous movement of the boom. Weights of fitted working tools (grabs, load hooks, etc.) and load accommodation equipment are to be deducted from the lift capacity values. The lift capacity of the unit is limited by its stability, the lifting capability of the hydraulic elements, or the maximum permissible lifting capacity of the load hook. In accordance with the harmonised European Standard EN 474-5, hydraulic excavators used for lifting operations must be equipped with pipe fracture safety values, an overload warning device, a load hook and a lift capacity chart.

## LH 110 M – Attachment GG25

Port – Kinematic 2A



#### Operating Weight

The operating weight includes the basic machine with 4 point outriggers, hydr. cab elevation, 4 solid tyres, straight boom 13.00 m, straight stick 12.00 m and grab model GMZ 120/6.00 m^3 shells for loose material.

Weight

104,000 kg

#### Dimensions



•		6.0	) m	7.5	m	9.0	) m	10.	5 m	12.	0 m	13.5	5 m	15.0	) m	16.5	5 m	18.0	) m (	19.5	5 m	21.0	) m	22.5	5 m	24.0	) m	-		
↓ <i>/</i> /	Undoroarriago		j,	<b></b>	j,		ս	<b></b>	դ	<b></b>	դ	<b></b>	դ	<b></b>	ե		ե	<b></b>	ս		դ	<b></b>	սե	<b></b>	J,		ĥ		ե	m
07.0	Unuercarriage	- 4		- 🥁		- 4		- 4	-	- 4	<b>_</b>	- 4	-	- 4		- 4	-	- 4	-	- 4	-	- 4	<b>_</b>	- 4	-	- 4	-	- 🥁	-	
27.0	4 pt. outriggers down					10.5+	10.51	10.01	10.01																			10.01	10.01	10.7
25.5	4 pt. outriggers down				_	16.5	16.5	13.8	13.8"	11.01	11.01														_		_	13.3"	13.3"	10.7
24.0	4 pt. outriggers down							16.3^	16.3	14.3*	14.3	11.01	11.01	44.04	44.04													11.4^	11.4^	13.4
22.5	4 pt. outriggers down				_				_	15.9*	15.9^	14.2	14.2	11.6*	11.6								_		_		_	10.3*	10.31	15.5
21.0	4 pt. outriggers down											14.5^	14.5	13.6*	13.6*	11.4^	11.4^											9.6*	9.6^	17.2
19.5	4 pt. outriggers down											14.2*	14.2*	13.3*	13.3*	12.6*	12.6*	10.7*	10.7*									9.0*	9.0*	18.6
18.0	4 pt. outriggers down											14.0*	14.0*	13.1*	13.1*	12.4*	12.4*	11./*	11./*	9.7*	9.7*							8.7*	8.7*	19.8
16.5	4 pt. outriggers down											14.0*	14.0*	13.1*	13.1*	12.3*	12.3*	11.6*	11.6*	11.1*	11.1*							8.4*	8.4*	20.9
15.0	4 pt. outriggers down											14.0*	14.0*	13.1*	13.1*	12.3*	12.3*	11.6*	11.6*	11.0*	11.0*	10.4*	10.4*					8.2*	8.2*	21.7
13.5	4 pt. outriggers down											14.1*	14.1*	13.2*	13.2*	12.3*	12.3*	11.6*	11.6*	11.0*	11.0*	10.5*	10.5*					8.0*	8.0*	22.5
12.0	4 pt. outriggers down									15.6*	15.6*	14.4*	14.4*	13.3*	13.3*	12.5*	12.5*	11.7*	11.7*	11.1*	11.1*	10.5*	10.5*	9.9*	9.9*			7.9*	7.9*	23.1
10.5	4 pt. outriggers down									16.0*	16.0*	14.7*	14.7*	13.6*	13.6*	12.6*	12.6*	11.8*	11.8*	11.1*	11.1*	10.5*	10.5*	9.9*	9.9*			7.9*	7.9*	23.6
9.0	4 pt. outriggers down							18.3*	18.3*	16.5*	16.5*	15.1*	15.1*	13.9*	13.9*	12.9*	12.9*	12.0*	12.0*	11.2*	11.2*	10.6*	10.6*	9.9*	9.9*			7.9*	7.9*	24.0
7.5	4 pt. outriggers down					20.4*	20.4*	19.1*	19.1*	17.1*	17.1*	15.5*	15.5*	14.2*	14.2*	13.1*	13.1*	12.2*	12.2*	11.4*	11.4*	10.6*	10.6*	10.0*	10.0*	9.0*	9.0*	7.9*	7.9*	24.3
6.0	4 pt. outriggers down			21.9*	21.9*	23.0*	23.0*	20.0*	20.0*	17.8*	17.8*	16.0*	16.0*	14.6*	14.6*	13.4*	13.4*	12.4*	12.4*	11.5*	11.5*	10.7*	10.7*	10.0*	10.0*	9.2*	9.2*	8.0*	8.0*	24.5
4.5	4 pt. outriggers down	34.6*	34.6*	29.2*	29.2*	24.4*	24.4*	21.0*	21.0*	18.4*	18.4*	16.5*	16.5*	14.9*	14.9*	13.6*	13.6*	12.5*	12.5*	11.6*	11.6*	10.8*	10.8*	10.0*	10.0*	9.1*	9.1*	8.1*	8.1*	24.6
3.0	4 pt. outriggers down	39.8*	39.8*	31.2*	31.2*	25.7*	25.7*	21.9*	21.9*	19.1*	19.1*	17.0*	17.0*	15.3*	15.3*	13.9*	13.9*	12.7*	12.7*	11.7*	11.7*	10.8*	10.8*	9.9*	9.9*	8.9*	8.9*	8.2*	8.2*	24.6
1.5	4 pt. outriggers down	14.6*	14.6*	32.8*	32.8*	26.8*	26.8*	22.7*	22.7*	19.7*	19.7*	17.4*	17.4*	15.6*	15.6*	14.1*	14.1*	12.8*	12.8*	11.8*	11.8*	10.8*	10.8*	9.8*	9.8*	8.7*	8.7*	8.2*	8.2*	24.5
0	4 pt. outriggers down	10.1*	10.1*	22.5*	22.5*	27.6*	27.6*	23.3*	23.3*	20.1*	20.1*	17.7*	17.7*	15.8*	15.8*	14.2*	14.2*	12.9*	12.9*	11.7*	11.7*	10.7*	10.7*	9.6*	9.6*	8.3*	8.3*	7.9*	7.9*	24.3
-1.5	4 pt. outriggers down	9.5*	9.5*	17.3*	17.3*	27.9*	27.9*	$23.5^{*}$	23.5*	20.3*	20.3*	17.8*	17.8*	15.8*	15.8*	14.2*	14.2*	12.8*	12.8*	11.6*	11.6*	10.4*	10.4*	9.2*	9.2*	7.6*	7.6*	7.5*	7.5*	24.0
-3.0	4 pt. outriggers down	9.9*	9.9*	15.8*	15.8*	27.6*	27.6*	23.4*	23.4*	20.2*	20.2*	17.7*	17.7*	15.7*	15.7*	14.1*	14.1*	12.6*	12.6*	11.3*	11.3*	10.0*	10.0*	8.6*	8.6*			7.4*	7.4*	23.4
-4.5	4 pt. outriggers down	10.8*	10.8*	15.8*	15.8*	24.9*	24.9*	22.9*	22.9*	19.8*	19.8*	17.4*	17.4*	15.4*	15.4*	13.7*	13.7*	12.2*	12.2*	10.8*	10.8*	9.3*	9.3*					7.9*	7.9*	22.3
-6.0	4 pt. outriggers down	11.9*	11.9*	16.4*	16.4*	24.2*	24.2*	21.7*	21.7*	18.9*	18.9*	16.6*	16.6*	14.7*	14.7*	13.0*	13.0*	11.4*	11.4*	9.9*	9.9*							8.6*	8.6*	20.7
-7.5	4 pt. outriggers down					22.8*	22.8*	19.9*	19.9*	17.5*	17.5*	15.4*	15.4*	13.5*	13.5*	11.8*	11.8*	10.2*	10.2*									10.0*	10.0*	18.2

1/2 Height 🛁 Can be slewed through 360° 💾 In longitudinal position of undercarriage

Max. reach \* Limited by hydr. capacity

The lift capacities on the stick end without attachment are stated in metric tons (t) and are valid on a firm, level supporting surface with blocked oscillating axle. These capacities can be slewed through 360° with the undercarriage in the transverse position. Capacities in the longitudinal position of the undercarriage (+/- 15°) are specified over the rigid axle with the stabilizers down. Indicated loads based on the ISO 10567 standard and do not exceed 75 % of tipping or 87% of hydraulic capacity. The lift capacity values indicated are attained at the corresponding operating temperature. This operating temperature is ensured by continuous movement of the boom. Weights of fitted working tools (grabs, load hooks, etc.) and load accommodation equipment are to be deducted from the lift capacity values. The lift capacity of the unit is limited by its stability, the lifting capability of the hydraulic elements, or the maximum permissible lifting capacity of the unit is limited by its stability.

In accordance with the harmonised European Standard EN 474-5, hydraulic excavators used for lifting operations must be equipped with pipe fracture safety valves, an overload warning device, a load hook and a lift capacity chart.

# LH 110 M HR – Attachment AG25

Port - Kinematic 2D



#### Operating Weight

The operating weight includes the basic machine with 4 point outriggers, hydr. cab elevation, 4 solid tyres, angled boom 14.50 m, straight stick 12.00 m and grab model GMZ 120/ 6.00 m<sup>3</sup> shells for loose material.

111,700 kg

Weight

#### Dimensions



•		6.0	) m	7.5	m	9.0	m	10.	5 m	12.0	0 m	13.	5 m	15.0	) m	16.5	5 m	18.0	0 m	19.5	5 m	21.0	) m	22.5	5 m	24.0	) m			<b>1</b>
<b>↓</b> ∕∕			L.		1		J		1		1		1		J.		J		3		1		1		1		<b>_</b>		្ប	•
m	Undercarriage		Ľ		Ľ	5	Ľ	5	Ľ	5	Ľ		Ľ		2		Ľ	5	2		L"	5	Ľ1		Ľ		Ľ	5	<u>"</u>	m
27.0	4 pt. outriggers down																											10.4*	10.4*	13.0
25.5	4 pt. outriggers down											11.9*	11.9*	9.9*	9.9*													9.5*	9.5*	15.2
24.0	4 pt. outriggers down													10.8*	10.8*	10.0*	10.0*											9.0*	9.0*	17.1
22.5	4 pt. outriggers down													10.6*	10.6*	10.0*	10.0*	9.5*	9.5*									8.6*	8.6*	18.6
21.0	4 pt. outriggers down													10.5*	10.5*	9.9*	9.9*	9.4*	9.4*	9.0*	9.0*							8.3*	8.3*	19.9
19.5	4 pt. outriggers down													10.5*	10.5*	9.9*	9.9*	9.3*	9.3*	8.9*	8.9*							8.1*	8.1*	20.9
18.0	4 pt. outriggers down													10.5*	10.5*	9.9*	9.9*	9.3*	9.3*	8.9*	8.9*	8.5*	8.5*					8.0*	8.0*	21.9
16.5	4 pt. outriggers down													10.6*	10.6*	9.9*	9.9*	9.4*	9.4*	8.9*	8.9*	8.5*	8.5*	8.2*	8.2*			7.9*	7.9*	22.7
15.0	4 pt. outriggers down											11.6*	11.6*	10.8*	10.8*	10.1*	10.1*	9.5*	9.5*	8.9*	8.9*	8.5*	8.5*	8.2*	8.2*			7.9*	7.9*	23.4
13.5	4 pt. outriggers down											11.9*	11.9*	11.0*	11.0*	10.2*	10.2*	9.6*	9.6*	9.0*	9.0*	8.6*	8.6*	8.2*	8.2*			7.9*	7.9*	23.9
12.0	4 pt. outriggers down									13.5*	13.5*	12.3*	12.3*	11.3*	11.3*	10.4*	10.4*	9.8*	9.8*	9.2*	9.2*	8.7*	8.7*	8.3*	8.3*	7.9*	7.9*	7.8*	7.8*	24.4
10.5	4 pt. outriggers down							15.7*	15.7*	14.0*	14.0*	12.7*	12.7*	11.6*	11.6*	10.7*	10.7*	10.0*	10.0*	9.3*	9.3*	8.8*	8.8*	8.3*	8.3*	8.0*	8.0*	7.8*	7.8*	24.7
9.0	4 pt. outriggers down			22.5*	22.5*	19.0*	19.0*	16.5*	16.5*	14.6*	14.6*	13.1*	13.1*	11.9*	11.9*	11.0*	11.0*	10.2*	10.2*	9.5*	9.5*	8.9*	8.9*	8.4*	8.4*	8.0*	8.0*	7.8*	7.8*	25.0
7.5	4 pt. outriggers down	30.9*	30.9*	24.5*	24.5*	20.3*	20.3*	17.4*	17.4*	15.3*	15.3*	13.6*	13.6*	12.3*	12.3*	11.3*	11.3*	10.4*	10.4*	9.7*	9.7*	9.1*	9.1*	8.5*	8.5*	8.1*	8.1*	7.8*	7.8*	25.1
6.0	4 pt. outriggers down	31.0*	31.0*	26.4*	26.4*	21.6*	21.6*	18.3*	18.3*	15.9*	15.9*	14.1*	14.1*	12.7*	12.7*	11.6*	11.6*	10.7*	10.7*	9.9*	9.9*	9.2*	9.2*	8.7*	8.7*	8.2*	8.2*	7.8*	7.8*	25.2
4.5	4 pt. outriggers down	12.3*	12.3*	28.2*	28.2*	22.8*	22.8*	19.2*	19.2*	16.6*	16.6*	14.6*	14.6*	13.1*	13.1*	11.9*	11.9*	10.9*	10.9*	10.1*	10.1*	9.4*	9.4*	8.8*	8.8*	8.2*	8.2*	7.8*	7.8*	25.2
3.0	4 pt. outriggers down	9.1*	9.1*	17.4*	17.4*	23.9*	23.9*	20.0*	20.0*	17.2*	17.2*	15.1*	15.1*	13.5*	13.5*	12.2*	12.2*	11.1*	11.1*	10.3*	10.3*	9.5*	9.5*	8.8*	8.8*	8.2*	8.2*	7.8*	7.8*	25.1
1.5	4 pt. outriggers down	8.5*	8.5*	14.0*	14.0*	24.3*	24.3*	20.6*	20.6*	17.7*	17.7*	15.5*	15.5*	13.8*	13.8*	12.4*	12.4*	11.3*	11.3*	10.4*	10.4*	9.6*	9.6*	8.9*	8.9*	8.2*	8.2*	7.8*	7.8*	24.9
0	4 pt. outriggers down	8.8*	8.8*	13.0*	13.0*	20.2*	20.2*	21.1*	21.1*	18.1*	18.1*	15.8*	15.8*	14.1*	14.1*	12.6*	12.6*	11.5*	11.5*	10.5*	10.5*	9.6*	9.6*	8.9*	8.9*	8.1*	8.1*	7.8*	7.8*	24.6
-1.5	4 pt. outriggers down	9.4*	9.4*	12.9*	12.9*	18.6*	18.6*	21.3*	21.3*	18.3*	18.3*	16.0*	16.0*	14.2*	14.2*	12.8*	12.8*	11.6*	11.6*	10.5*	10.5*	9.6*	9.6*	8.8*	8.8*	7.9*	7.9*	7.8*	7.8*	24.2
-3.0	4 pt. outriggers down	10.1*	10.1*	13.2*	13.2*	18.1*	18.1*	21.2*	21.2*	18.3*	18.3*	16.0*	16.0*	14.2*	14.2*	12.8*	12.8*	11.5*	11.5*	10.4*	10.4*	9.5*	9.5*	8.6*	8.6*			7.8*	7.8*	23.7
-4.5	4 pt. outriggers down	10.9*	10.9*	13.7*	13.7*	18.1*	18.1*	20.8*	20.8*	18.0*	18.0*	15.8*	15.8*	14.1*	14.1*	12.6*	12.6*	11.3*	11.3*	10.2*	10.2*	9.2*	9.2*	8.1*	8.1*			7.7*	7.7*	23.1
-6.0	4 pt. outriggers down			14.4*	14.4*	18.5*	18.5*	20.0*	20.0*	17.4*	17.4*	15.4*	15.4*	13.7*	13.7*	12.2*	12.2*	10.9*	10.9*	9.8*	9.8*	8.6*	8.6*					7.9*	7.9*	21.9
-7.5	4 pt. outriggers down							18.7*	18.7*	16.5*	16.5*	14.6*	14.6*	13.0*	13.0*	11.6*	11.6*	10.3*	10.3*									9.2*	9.2*	19.3
_																														

Max. reach \* Limited by hydr. capacity 1/2 🖞 In longitudinal position of undercarriage Height 🛛 📇 Can be slewed through 360° The lift capacities on the stick end without attachment are stated in metric tons (t) and are valid on a firm, level supporting surface with blocked oscillating axle. These capacities can be slewed through 360° with the undercarriage in the transverse position. Capacities in the longitudinal position of the undercarriage (+/- 15°) are specified over the rigid axle with the stabilizers down. Indicated loads based on the ISO 10567 standard and do not exceed 75% of tipping or 87% of hydraulic capacity. The lift capacity values indicated are attained at the corresponding operating temperature. This operating temperature is ensured by continuous movement of the boom. Weights of fitted working tools (grabs, load hooks, etc.) and load accommodation equipment are to be deducted from the lift capacity values. The lift capacity of the unit is limited by its stability, the lifting capability of the hydraulic elements, or the maximum permissible lifting capacity of the load hook

In accordance with the harmonised European Standard EN 474-5, hydraulic excavators used for lifting operations must be equipped with pipe fracture safety valves, an overload warning device, a load hook and a lift capacity chart.

# **Kinematic Variants**





#### Kinematic Variant 2D/2C



Altered range curve with additional reach depth, e.g. for unloading from ships

# **Working Tools**



#### Shells for Loose Material

Grab model GMZ 50								
Width of shells	mm	1,400	1,600	1,800	2,000	2,200	2,400	3,200
Capacity	m <sup>3</sup>	3.50	4.00	4.50	5.00	5.50	6.00	8.00
Loose material, specific weight up to	t/m³	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Weight	kg	2,695	2,830	2,905	3,035	3,170	3,300	3,830
Grab model GMZ 80								
Width of shells	mm	1,300	1,500	1,750	2,000	2,200	2,600	
Capacity	m <sup>3</sup>	3.00	3.50	4.00	4.50	5.00	6.00	
Weight	kg	2,515	2,630	2,775	2,920	3,040	3,275	
Grab model GMZ 120								
Width of shells	mm	1,600	1,800	2,000	2,200	2,400	2,800	3,200
Capacity	m <sup>3</sup>	4.00	4.50	5.00	5.50	6.00	7.00	8.00
Weight	kg	3,040	3,135	3,295	3,425	3,545	3,825	4,100

Shells for loose material with cutting edge (without teeth)

3.00



E	
Â	AR
LAK	TH
All	Z

Multi-Tine Grab	closed			
Grab model GMM 80-5 (5 tines)				
Capacity	m <sup>3</sup> 1.10*	1.40*	1.70*	
Weight	kg 2,440	2,580	2,740	
Grab model GMM 120-5 (5 tines)				
Capacity	m³ 1.70	2.00	2.50	
heart-shaned				



#### Wood Grab

Grab model GMH 50 round-shaped (	overlapping, h	norizontal cylinders)				
Size	m <sup>2</sup>	2.50	2.50	2.80	3.20	3.60
Cutting width	mm	870	1,000	1,000	1,000	1,000
Height of grab, closed	mm	2,520	2,531	2,642	2,772	2,942
Weight	kg	2,115	2,190	2,270	2,330	2,390
Grab model GMH 80 round-shaped (	complete over	rlapping, vertical cylind	ders)			
Size	m <sup>2</sup>	1.60	1.90	2.20	2.50	
Cutting width	mm	870	870	870	870	
Height of grab, closed	mm	3,202	3,332	3,487	3,582	
Weight	kg	2,195	2,240	2,255	2,315	
Grab model GMH 120 round-shaped	(complete ov	erlapping, vertical cylir	nders)			
Size	m <sup>2</sup>	2.80	3.20			
Cutting width	mm	870	870			
Height of grab, closed	mm	3,851	4,007			
Weight	kg	2,405	2,765			



#### Load Hook with Suspension

•	
Max. load t	25
Weight kg	255



#### Magnet Devices/Lifting Magnets

Generator k	W 30
Electromagnets with suspension	
Power k	W 22
Diameter of magnet m	m 1,900
Weight	(g 5,090*
* only means also	

only magnet plate

# Equipment

😇 Undercarriage	110 M	110 C	110 M HR	110 C HR
Track pads, variants		+		+
Individual control outriggers	+		٠	
Three-piece chain guide		•		•
Shuttle axle lock, automatic	٠		٠	
Outrigger monitoring system	+		+	
Tyres, variants	+		+	
Protection for piston rods, outriggers	+		+	
Two lockable storage boxes	٠			

<b>固</b> Hydraulic System	110 M	110 C	110 M HR	110 C HR
Electronic pump regulation	•	٠	•	٠
Liebherr hydraulic oil from -20 °C to +40 °C	•	٠	•	•
Liebherr hydraulic oil, biologically degradable	+	+	+	+
Liebherr hydraulic oil, specially for warm or cold regions	+	+	+	+
Magnetic rod in hydraulic tank	•	٠	•	٠
Bypass filter	+	+	+	+
Preheating hydraulic oil	+	+	+	+

□- Uppercarriage	110 M	110 C	110 M HR	110 C HR
Uppercarriage right side light, 1 piece, LED	•	٠	٠	٠
Uppercarriage rear light, 2 pieces, LED	+	+		
Uppercarriage underneath rear light, 1 piece, LED			+	+
Refuelling system with filling pump	+	+	+	+
Railing on uppercarriage	•	•	•	•
Generator	+	+	+	+
Main battery switch for electrical system	٠	٠	٠	٠
Warning beacon on uppercarriage, LED	+	+	+	+
Protection for headlights	+	+		
Tool equipment, extended	•	•	•	•

🖤 Engine	110 M	110 C	110 M HR	110 C HR
Fuel anti-theft device	+	+	+	+
Air pre-filter with dust discharge	+	+	+	+
Preheating fuel	+	+	+	+
Preheating coolant*	+	+	+	+
Preheating engine oil *	+	+	+	+

دیا۔ Cooling System	110 M	110 C	110 M HR	110 C HR
Reversible fan drive, fully automatic	+	+	+	+
Protective grid in front of cooler intake	٠	٠	٠	٠

Operator's Cab	110 M	110 C	110 N	110 C
Stabilizer, proportional control on left joystick	•		٠	
Cab lights rear, LED	+	+	+	+
Cab lights front, LED	+	+	+	+
Cab lights front, LED (under rain cover)	٠	٠	٠	•
Left arm console, folding	•	•	•	•
Armrest adjustable	٠	٠	٠	•
Circular bubble level	٠	٠	٠	٠
Driver profile, personalised (max. 5 drivers)	+	+	+	+
Operator's seat Comfort	•	•	•	•
Operator's seat Premium	+	+	+	+
Driving alarm				
(acoustic signal is emitted during travel, can be switched ON/OFF)	+	+	+	+
Fire extinguisher	+	+	+	+
Horn, button on left joystick	٠	٠	٠	٠
Joystick steering	٠		٠	
Cab elevation, hydraulic (LHC)	•	•	•	•
Cab elevation, hydraulic with double parallelogram (LHC-D)			+	+
Cab elevation, rigid (LFC)	+	+		
Automatic air conditioning	•	٠	٠	•
Wheel steering (slim version)	+		+	
LiDAT, vehicle fleet management	٠	٠	٠	•
Automatic engine shut-down (time adjustable)	+	+	+	+
Proportional control	٠	٠	٠	•
Radio Comfort, control via display with handsfree set	+	+	+	+
Preparation for radio installation	٠	•	٠	•
Back-up alarm (acoustic signal is emitted traveling backward,				
can not be switched off)	+		+	
Warning beacon on cab, LED	+	+	+	+
Windows made from impact-resistant laminated safety glass	•	•	•	•
Windscreen wiper, roof	+	+	+	+
Windshield wiper, entire windscreen	•	٠	٠	•
Top guard	+	+	+	+
Front guard, adjustable	+	+	+	+
Sun visor	+	+	+	+
Flashing light (xenon)	+	+	+	+

H H

Attachment	110 M	110 C	110 M HR	110 C HR
Boom lights, 2 pieces, LED	•	٠	•	٠
Stick lights, 4 pieces, LED	٠	٠	•	•
Boom shutoff (retract/extend), electronically	•	٠	•	•
Attachment with electro-hydraulic end position control	٠	٠	•	•
AutoLift	+	+	+	+
Pressure warning mechanism hoist cylinder	٠	٠	•	٠
ERC system	•	٠	•	•
Boom cylinder cushioning	•	٠	•	٠
Stick camera (with separate monitor), bottom side, with protection	+	+	+	+
Load torque limitation	+	+	+	+
Liebherr multi coupling system	+	+	+	+
Pipe fracture safety valves hoist cylinders	٠	٠	•	•
Pipe fracture safety valve stick cylinder	•	٠	•	•
Protection for piston rod, energy recovering cylinder	+	+	+	+
Protection for piston rods, hoist cylinder	+	+	+	+
Stick shutoff (retract/extend), electronically	٠	٠	•	٠
Retract stick without pressure	•	٠	•	٠
Sticks with quick coupling	+	+	+	+
Overload warning device	+	+	+	+

Complete Machine	110 M	110 C	110 M HR	110 C HR
Lubrication				
Lubrication undercarriage, manually – centralised				
(one grease point)	•		•	
Central lubrication system for uppercarriage and attachment,				
automatically	•	•	•	•
Central lubrication system for undercarriage, automatically	+		+	
Special coating, variants	+	+	+	+
Monitoring				
Rear view monitoring with camera*	•	•	•	•
Side view monitoring with camera	•	•	•	•

• = Standard, + = Option \* = country-dependent

Options and/or special attachments, supplied by vendors other than Liebherr, are only to be installed with the knowledge and approval of Liebherr in order to retain warranty.

# **Liebherr ERC-System**



#### ERC System – More performance, less consumption

Lowering the equipment stores energy in the ERC system. This stored energy is then made available to the machine to provide additional engine power. When the equipment is raised the stored energy is released and is reflected in powerful, homogeneous operating cycles. The result is a clear saving on fuel – and, at the same time, even greater performance.



#### System power

The energy recovery cylinder is a storage system which is independent of the diesel engine. The system performance of material handling machines fitted with the ERC system is composed of the installed engine power and the energy recovery cylinder. When the equipment is raised, energy from the ERC system is supplied in addition to the power from the diesel engine.

 lower running costs

 reduced pollutant and noise emissions



Liebherrstraße 12, D-88457 Kirchdorf/Iller 2 +49 7354 80-0, Fax +49 7354 80-72 94 www.liebherr.com, E-Mail: info.lhb@liebherr.com www.facebook.com/LiebherrConstruction