From a single source, modular, versatile

Design Manual for Winch Systems

LIEBHERR

Contents

Design Results

Design basis	Nomenclature	Design basis
Lifting load	m_h [t]	
Lifting speed	v_h[m/min]	
Lifting height	H [m]	
Number of fixed deflection sheaves between drum and hoist or moving part	n_u [-]	
Required service life	t [h]	
Number of winding layers on a drum	n_l [-]	
Number of parallel hoists or ropes reeved on a drum	n_r [-]	
Hoist reeving	n_m [-]	
Installation altitude	Height above sea level [m]	
Ambient temperature winch	T [°C] (min./max.)	
Ambient temperature switch cabinet	T_{SRA} [°C] (min./max.)	

Design results	Nomenclature	Results of 1st calculation	If required Results for iteration
Rope drive efficiency	η_s [-]		
Rope tensile force	F_S [kN]		
Rope speed	v_S [m/min]		
Required usable winding capacity	L_W [m]		
Load spectrum	L_i [-]		
Operating class	T_i [-]		
Mechanism group	M [-]		
Rope diameter	d [mm]		
Gearbox size	PEG [-]		►
Drum diameter	D_T [mm]		
Max. winding diameter	D_{W_max} [mm]		
Mean winding diameter	D_{W_mean} [mm]		
Drum speed	n_T [rpm]		
Equivalent service life (only if iteration required)	t_{equ} [h]		
Redefinition of operating class (only if iteration required)	T_{i_PEG} [-]		
Redefinition of mechanism group (only if iteration required)	M_{PEG} [-]	-	
Required gear ratio @ 1500 rpm	$i_{@1500rpm}$ [-]		
Required gear ratio @ 750 rpm	$i_{@750rpm}$ [-]		
Rated motor speed 1500 or 750 rpm	n_B [rpm]		
Selected gear ratio	i [-]		
Gearbox efficiency	η_{PEG} [-]		
Motor speed	n_{Mot} [rpm]		
Required mechanical drive power	P_{Mech} [kW]		
Motor correction factor	k_M [-]		
Motor operation category	S [-]		
Required mechanical motor power	P_{Motor} [kW]		
Electric motor size	KGF [-]		
Motor length	L_{Mot} [mm]		
Motor current	I_{Motor} [A]		
Frequency converter correction factor	k_{FC} [-]		
Frequency converter output current	I_{FC} [A]		
Switch cabinet size	SRA [-]		
Switch cabinet dimensions	[mm]	W_{SRA} = D_{SRA} =	H_{SRA} =
Required switch cabinet apparent power	P_{SRA} [kW]		
Sheave diameter	D_S [mm]		
Rope length between winch and hoist	L_{SW} [m]		
Max. distance between upper and lower return pulley block of the hoist	L_1 [m]		
Required rope length	L_R [m]		
Groove width on the drum for one rope	W_V [mm]		
Drum variant	Tx [-]		
Drum width	W_T [mm]		
Winch system dimensions	[mm]	W_{WIS} = D_{WIS} =	H_{WIS} =

The input screen for the results and design basis and boundary conditions of the winch system can also be found at

www.liebherr.com/drive-systems

Design steps

Preamble and Imprint

This design manual is intended to provide a broad overview into the performance spectrum of Liebherr winch systems. It should guide the end user through the basic design steps of a winch within the modular system of Liebherr. The usual requirements for the definition of winch systems have been taken into account. Requirements not covered in this manual can of course be examined on request and customer-specific solutions can be provided.

The design procedure has been broken down and is shown in the adjacent table. Depending on the result, it can be necessary to iterate the calculation steps for the definition of the boundary conditions and the mechanism. Detailed information about the individual design steps can be found in the respective chapter. The intermediate results of the preliminary design can be entered in the table of the expanded cover sheet.

We expressly point out that only a preliminary design is possible using this manual in order to give the customer an impression of the required components and dimensions of the winch system. A detailed technical evaluation by Liebherr must always be carried out as the project progresses.

We reserve the right to make changes resulting from further development of the product range.

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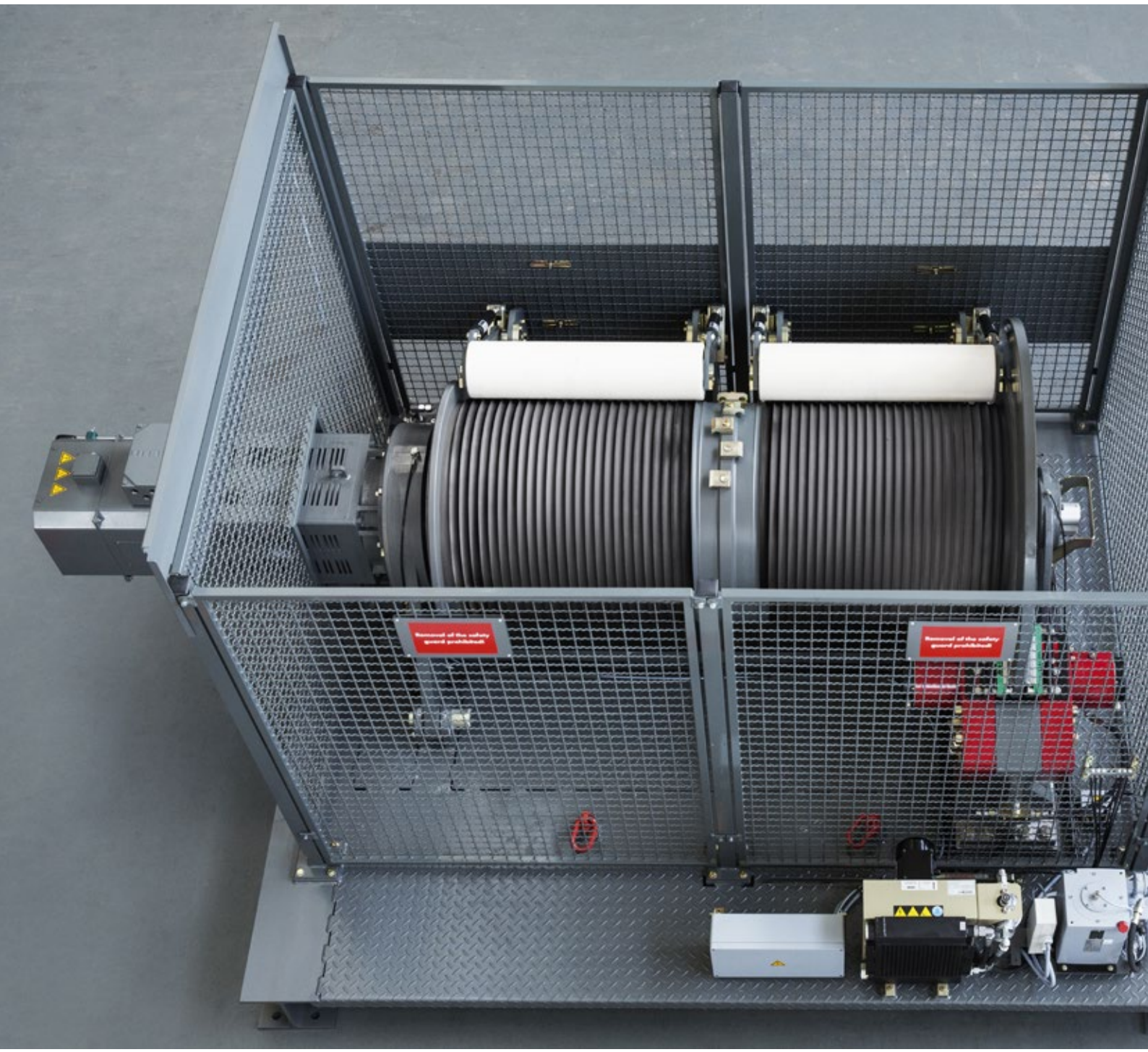
Winch systems from Liebherr

Liebherr has been producing all the relevant components required for a lifting system for many years and now also provides complete winch systems on the market. The components are perfectly matched in their function. This results in convincing system solutions that can be integrated into a variety of applications.



Safe, robust, powerful

Modular system
Liebherr provides customised system solutions based on standard components for lifting applications that are characterised by scalability and simple integration and commissioning at the customer site -"plug & lift".

Everything from a single source
All essential components of the winch systems such as drum, planetary plug-in gear, asynchronous motor and switch cabinet are developed and produced in-house. With this prerequisite, it is possible to provide a modular system in which the individual components are perfectly matched with each other. The modular winch system is designed to cover a wide range of customer requirements and convinces with short time for development.

Simple assembly
Winch systems from Liebherr score mainly due to their short assembly time at the customer site. The complete winch is supplied pre-assembled on a frame, eliminating the need for time-consuming individual on-site assembly. The switch cabinet according to the customer's requirements is mounted on the winch frame and pre-wired. Alternatively the switch cabinet will be supplied as a separate unit. The control and power electronics are prepared in the factory according to the "connect & use" principle.

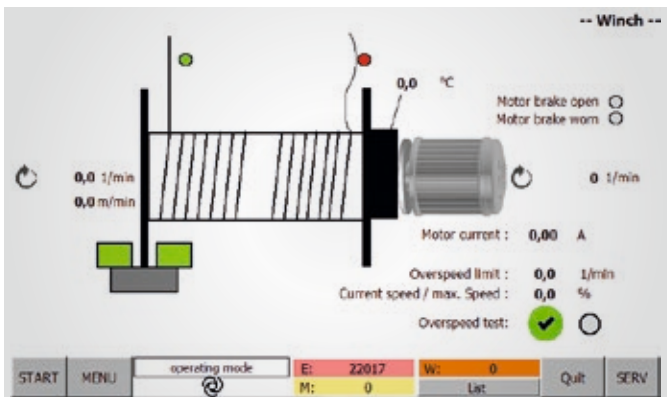
Service and Support
Liebherr Customer Service provides support as required when the winch system is installed and put into service at the customer site. For example, when the rope needs to be wound under pre-tension or the function of the system needs to be demonstrated for final acceptance.

Gearbox
The gearbox is selected from Liebherr's proven product range of planetary plug-in gearboxes (PEG). This is impressive due to a robust and at the same time compact design. Oil cooling and oil heating for the gearbox are available as options.

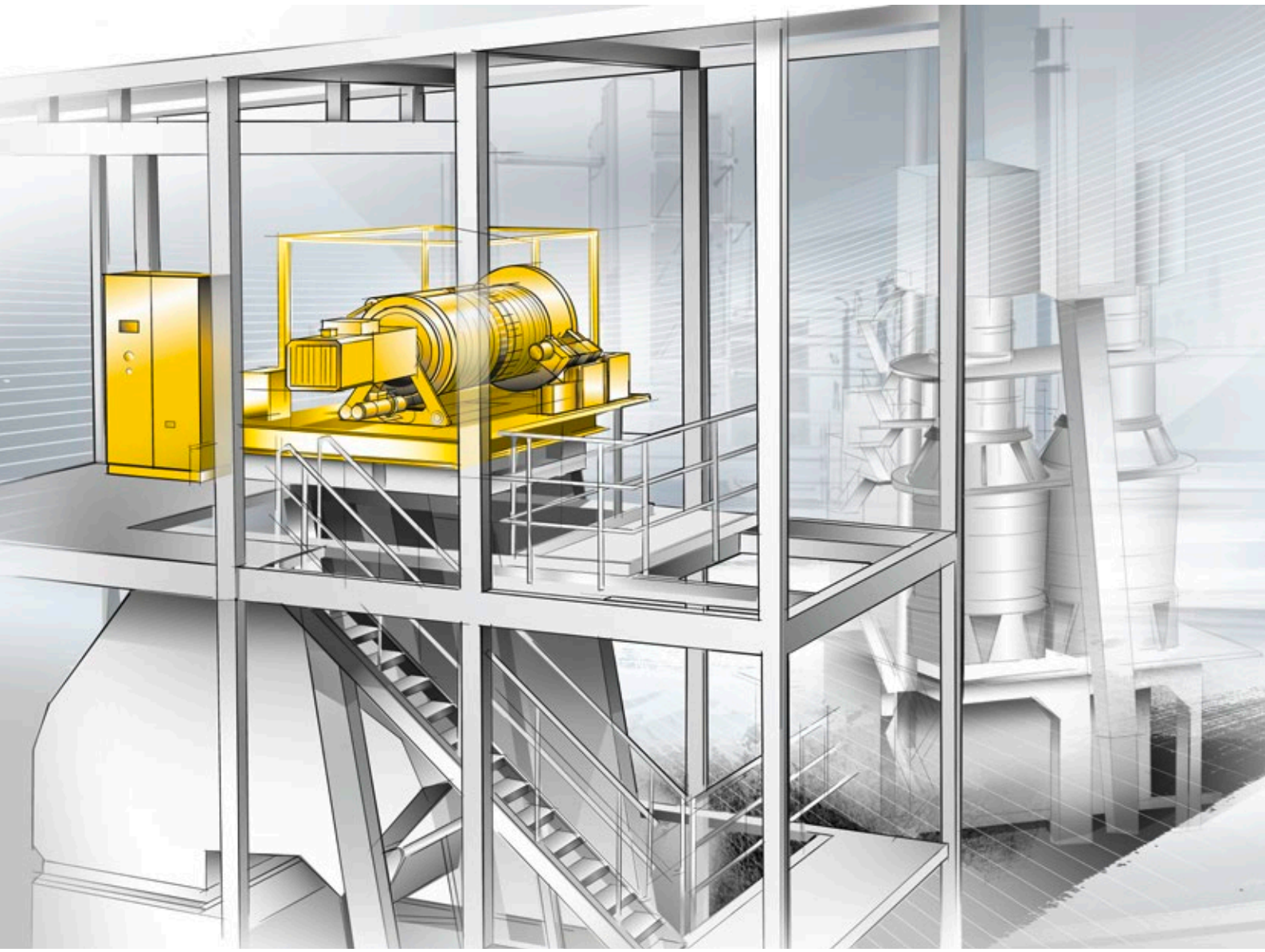
Electric motor
The winches are driven via compact, air-cooled asynchronous squirrel-cage motors. These are available in the power range up to 250 kW and are designed for use under the harshest conditions. Efficiency is standard at Liebherr: The motors meet the requirements of efficiency class IE2 or higher in continuous operation. In addition, the motors allow a high degree of spreading. This means that the motor can be operated up to 3 times the rated speed at constant power in partial load operation (e.g. no load running). This enables the end application to achieve optimum economic efficiency.

Switchgear and control system
The switchgear and the entire control system are designed according to the EN13849 standard. Only robust products from well-known manufacturers are used for power and control electronics. Optionally there is the possibility of active power regeneration. For applications with frequent load cycles, an energy storage system based on double-layer capacitors is optionally available in order to increase the overall cost-effectiveness. The range is rounded off with an innovative controller that ensures effective and safe operation of the respective system.

Safety
A secondary brake, various sensors and optional integrated slack rope detection ensure the safe operation of the winch system. The appropriate monitoring program developed by Liebherr is shown on the switch cabinet display. It can be transferred to the customer via an interface to the higher-level process control system.



Application examples



Lifting equipment for machinery and plant construction

Liebherr winch systems are configured or modified according to the customer application based on Liebherr standard components. They can be used for a wide range of tasks in the area of lifting and conveyor technology as well as in adjustment systems. Accordingly, the target industries are also varied. Examples include mechanical and plant engineering, offshore, mining and raw material industries, steel hydraulic engineering, bridge construction and the amusement sector.

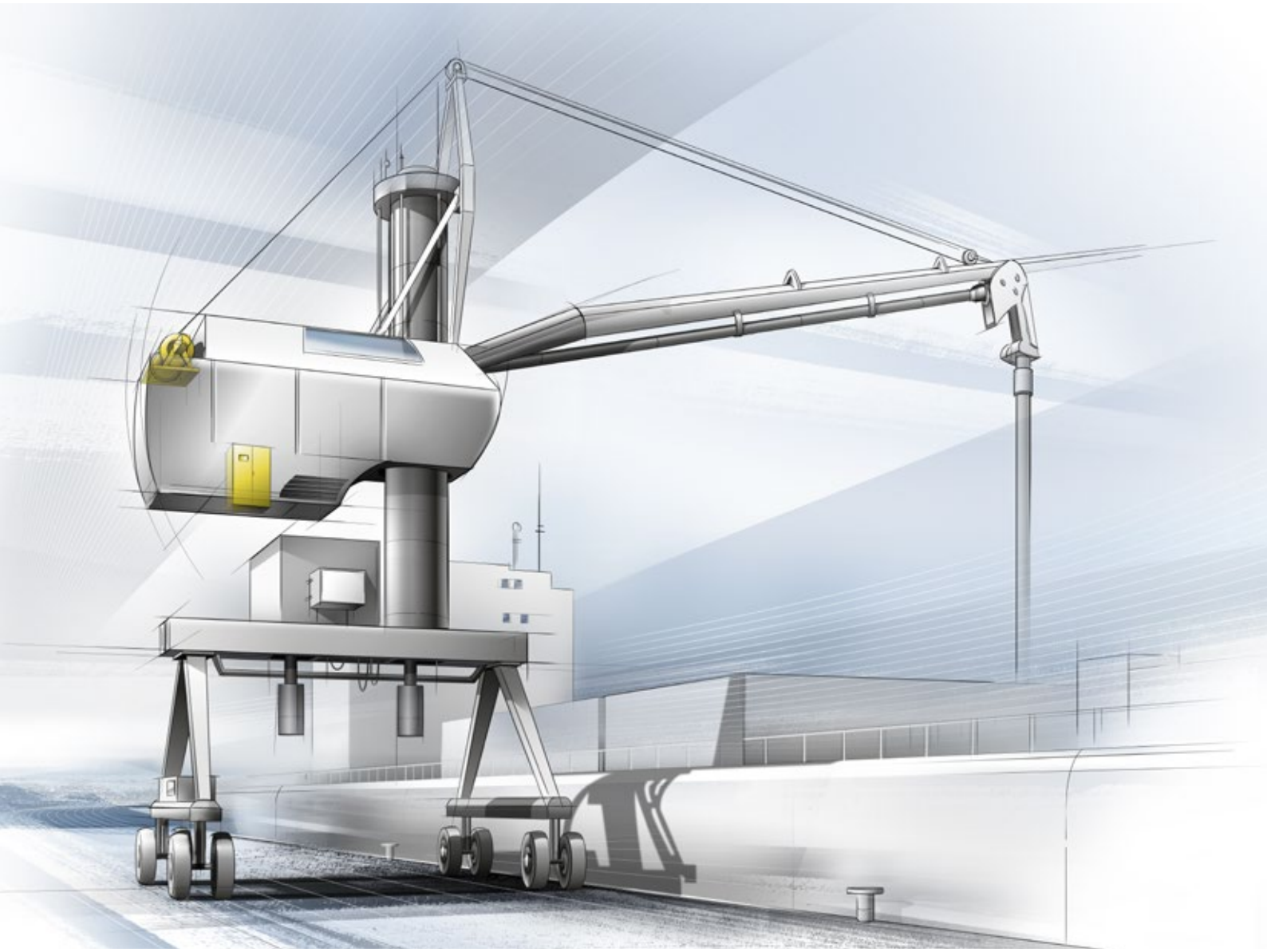
Loading system for lime kilns
When loading lime kilns, Liebherr winch systems increase the productivity of the plants by increasing the speed up to three times during the no-load return stroke. Reliability under continuous loads and high levels of dirt as well as the guarantee of operational safety are only some of the requirements that are met without compromise.

Bridge building
As a restraint or pulling winch, e.g. for the construction of suspension bridges or for the longitudinal insertion method of pre-assembled bridge segments, monitoring of the rope tensile force and the position ensures exact positioning and maximum safety.

Amusement Rides
The control and design of Liebherr winch systems ensure functional safety in every operating situation when used in free fall towers or as a hoist for roller coaster carriages.

Lifting of gondolas from free fall towers

Application examples



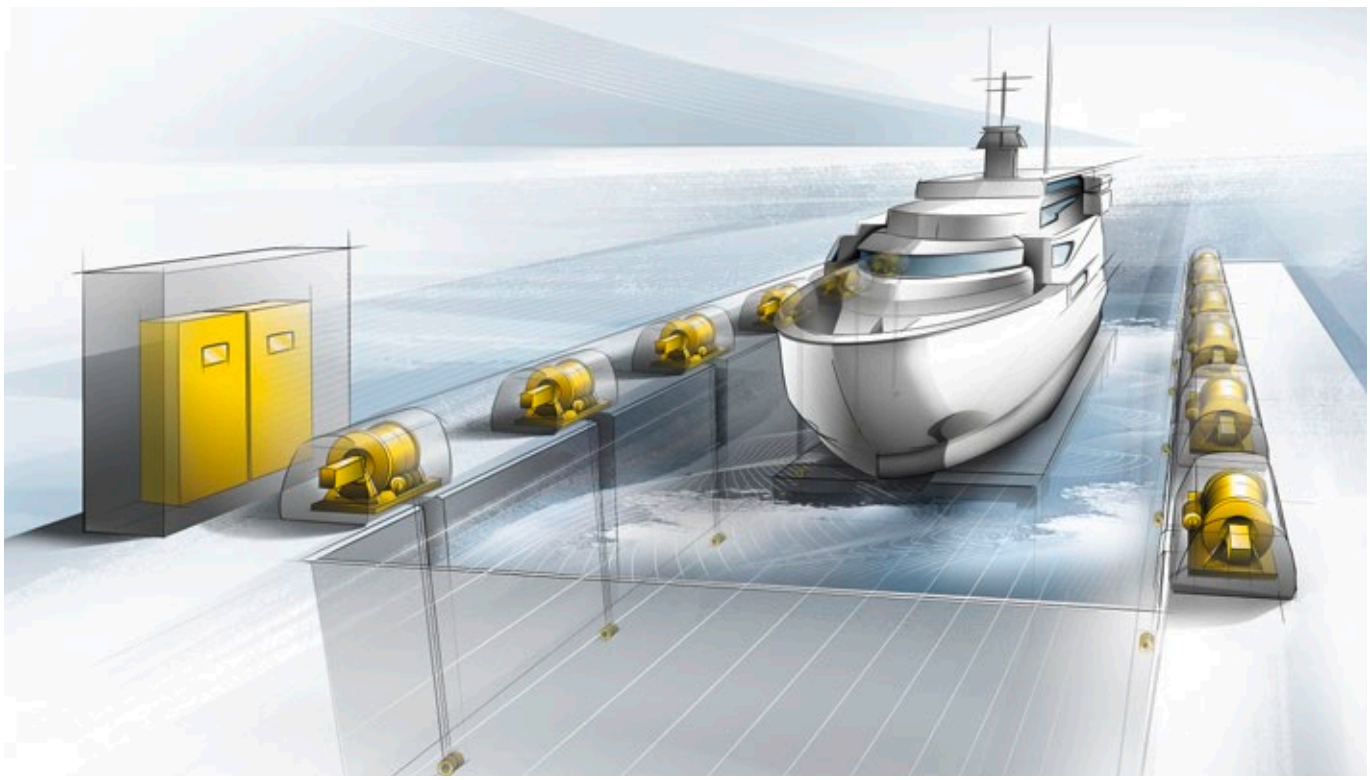
Boom height adjustment of ship unloaders

The adjustment of the boom using a modular Liebherr winch system provides our customers with the possibility of concentrating on the core competences and reducing the complexity of auxiliary functions. The controller of the winch system ensures sensitive height adjustment of the boom.

Gate control at hydro power plants
Vertically operated gates of hydro power plants can be operated with winch systems as a less expensive alternative to a solution with hydraulic cylinders. If more than one winch system is required for the actuation of a gate, the intelligent control system ensures perfect synchronisation of the rope drives to prevent the gate from tilting in its guide.

Screen cleaning system at hydro power plants
Winch systems as drives for screen cleaning systems provide our customers with the possibility of automation and the transfer of responsibility to one source. Furthermore, it is possible to integrate additional functions of the system into the control of the winch system.

Ship’s lift
Due to the use of many identical drives, the regulation and control of the position and orientation of the ship's dock are particularly important. The same applies to the force distribution. The integration of the individual drives into a higher-level control system is already completed in the delivery condition and thus allows simple commissioning for the customer.



Production sites

Liebherr-Components Biberach GmbH
Liebherr-Components Biberach GmbH develops and produces high-performance components – such as electrical machines, gearboxes, large diameter bearings, winches and switchgear systems – both for the group of companies and for external customers. In addition, the newly established business unit "Drive System Technology" ensures the integration of individual components into customer-specific systems. Some examples are winch systems, electric drive systems for tracked vehicles, diesel-electric drive systems for mining trucks and pitch systems for wind turbines.

Headquarters
Facts and figures:
- Liebherr-Werk Biberach GmbH was founded in 1954 (founding of Liebherr-Components Biberach GmbH in 2012)
- Headquarters of the business units "Drives" and "Large diameter bearings"
- Design and production of gearboxes, winches and large diameter bearings; assembly of winch systems
- Number of employees: 1,384
- Factory premises: 345,657 m^2

Biberach factory, Germany
Headquarters in Biberach an der Riss

Subsidiary
Facts and figures:
- Establishment of the subsidiary in 2015 to expand the design and production capacity of electrical machines and control technology
- Headquarters of the business units "Electric Drives and Control Technology" and "Drive System Technology"
- Number of employees: 335
- Factory premises: 145,657 m^2

Subsidiary in Biberach an der Riss

Contents

Overview and performance spectrum

Under the listed boundary conditions, the modular winch system covers a wide performance spectrum with matched Liebherr standard components.

Control electronics and monitoring

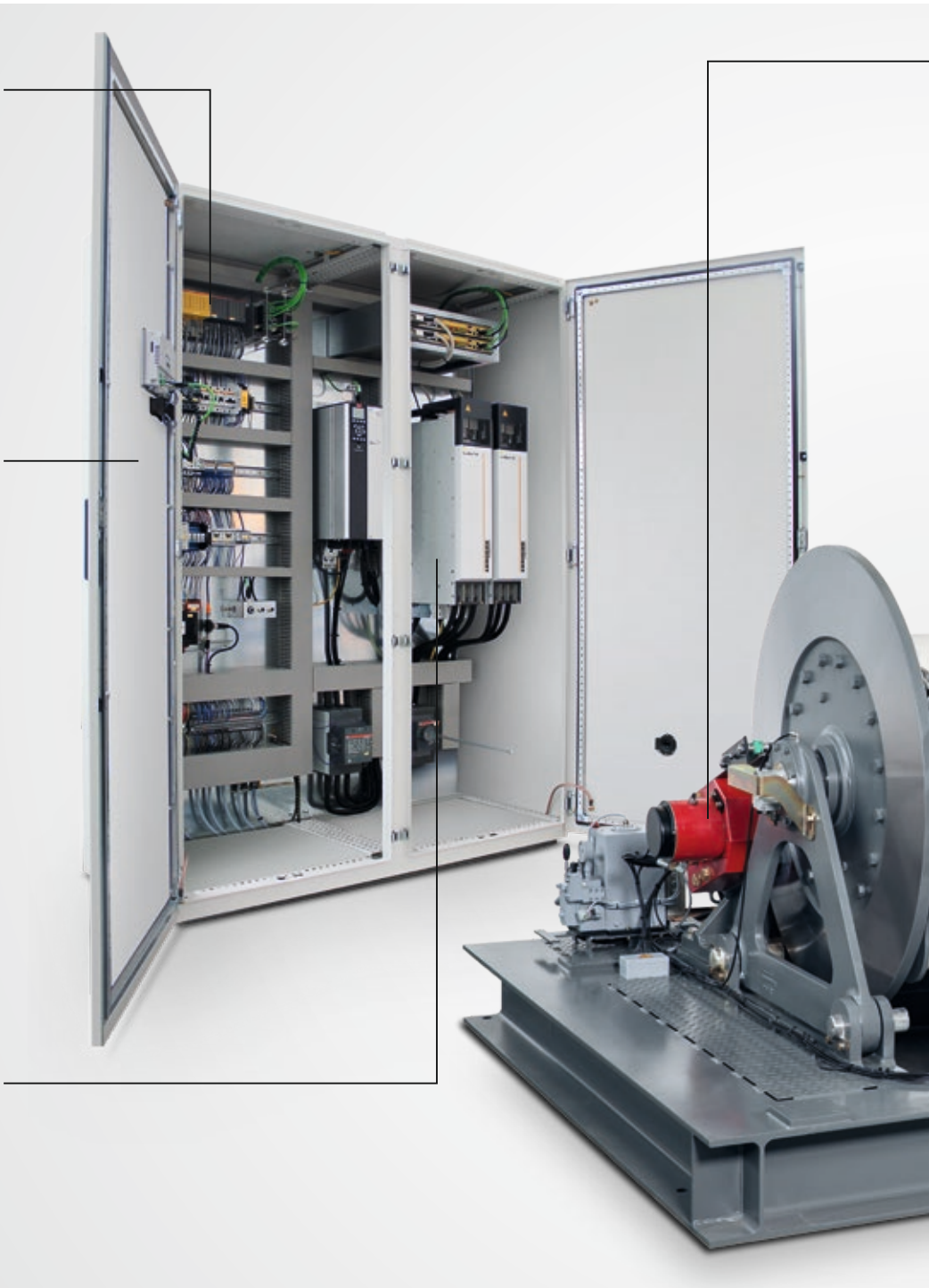
- Control system according to EN13849
- Proven and robust PLC
- Functional safety
- Automatic process data acquisition and system monitoring (data logger)
- Standard module functions such as oil cooling or motor heating can be added to the software
- Bus interface for higher-level control system

Switch cabinet

- 7" display shows operating states and errors
- External controls for 2 directions with 2 speed setpoints each
- Power supply: 3-phase 400 V AC 50…60 Hz
- Type of power grid: TN system
- Ambient temperature: -20…+45 °C

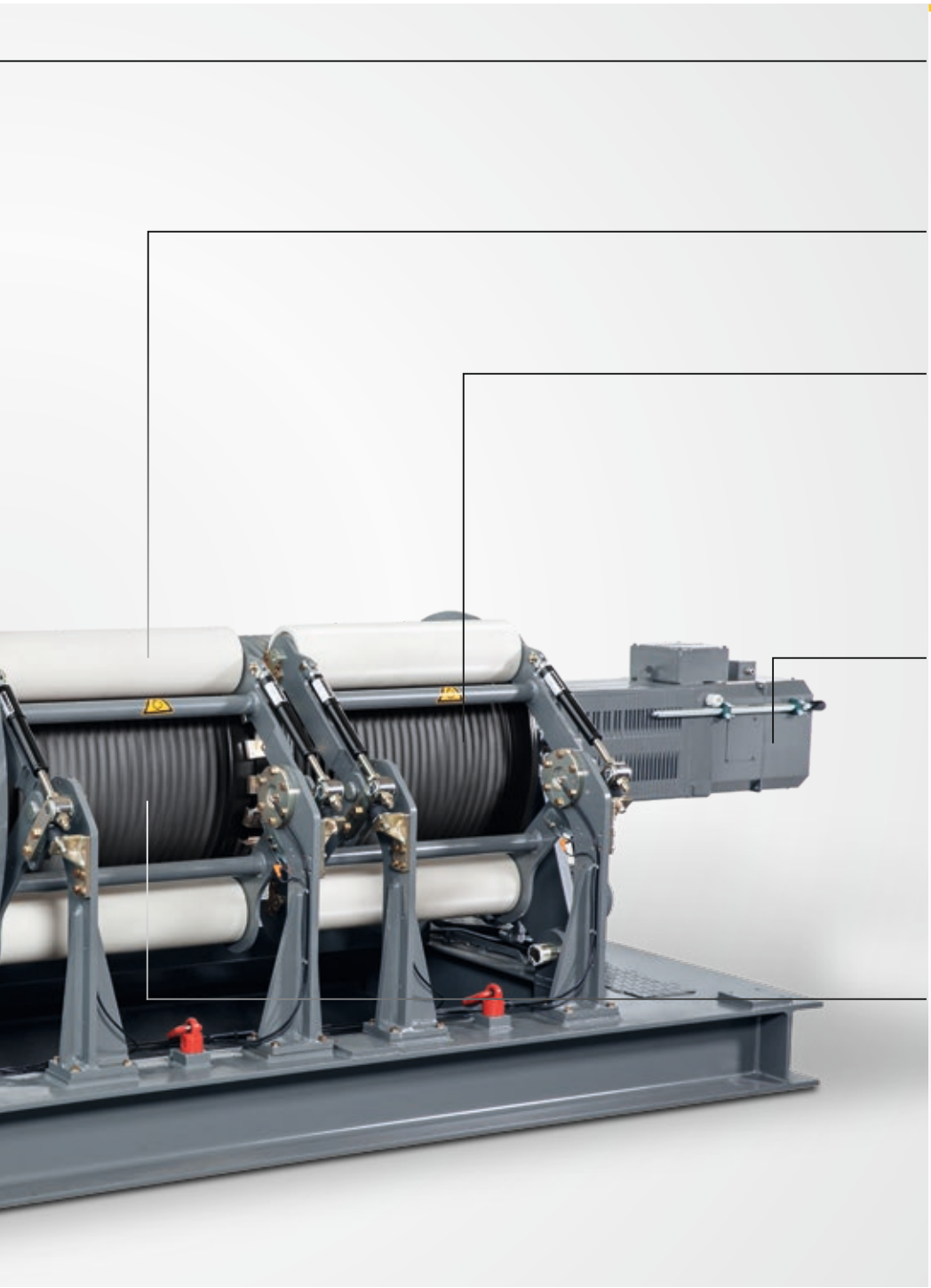
Power electronics

- Proven frequency converters from well-known manufacturers
- Special control of the asynchronous motor by the frequency converter for exact position and speed control even at zero speed passage
- Possibility of parametrisation for setting e.g. drum speed, start and stop ramps
- Possibility to synchronise multiple winch systems
- Optionally with regenerative unit (Active Front End)
- Possibility of connecting an energy storage device to cover power peaks



Customer-specific system solutions

In the case of different parameters or extended function requirements, a customer-specific solution can be realised on request in addition to the modular winch system. Liebherr provides customised development of the individual components as well as the control software to cover all customer needs.



Secondary Brake
- Second safety brake with “fail-safe closed” function to protect the electric-mechanical drive train

Slack Rope Detection (optional)
- Activates the winch safety shut-off if slack rope is detected

Planetary Plug-in Gearboxes (PEG)
- Standard series from PEG 300 to PEG 700
- Max. dynamic torque up to approx. 218.000 Nm
- Standard gear ratios for rope speeds from 4 to 120 m/min (< 4 and > 120 m/s on request)

Electric motor
- Asynchronous motors from in-house development and production
- Power range up to 124 kW in S1 operation according to IE2; short time up to 250 kW
- High spreading: up to 3 times the rated speed possible
- Ambient temperatures from -20 to +45 °C
- Motor brake and encoder as standard

Rope drum
- Wire rope hoist from 1 to 30 t
- Rope diameter from 10 to 40 mm
- Drum diameter from 420 to 820 mm
- Multilayer winding up to 7 layers
- Standard DIN groove for single layer winding
- Special groove for multilayer winding

Contents

Design basis

For the rough layout of a winch system based on this manual, certain parameters and requirements of the winch system must be known for the calculation. If this is not yet the case, assumptions must be made instead, which must be corrected in an iteration depending on the result of the first layout.

Lifting load (m_h)
In addition to the maximum mass of the object to be lifted, the mass of the load handling equipment (e.g. crane hook, cross member) as well as the mass of the pulley block and the mass of the rope length, which hangs freely above the object to be lifted, must also be taken into account.

Lifting speed (v_h)
The speed at which the object should be lifted should be taken into account.

Lifting height (H)
Maximum height difference by which the object should be lifted.

Number of deflection sheaves (n_u)
Sheaves that are required for deflection of the rope between winch and pulley block.

Required service life (t)
The service life is defined as the sum of the time in which the mechanism is in motion (load-independent).

Number of winding layers on the drum (n_l)
For large rope lengths to be wound (e.g. high hoist reeving, high lifting height), it makes sense to wind multiple layers on the drum.

- Advantage: High winding capacity for compact drum
- Disadvantage: Reduction of rope service life

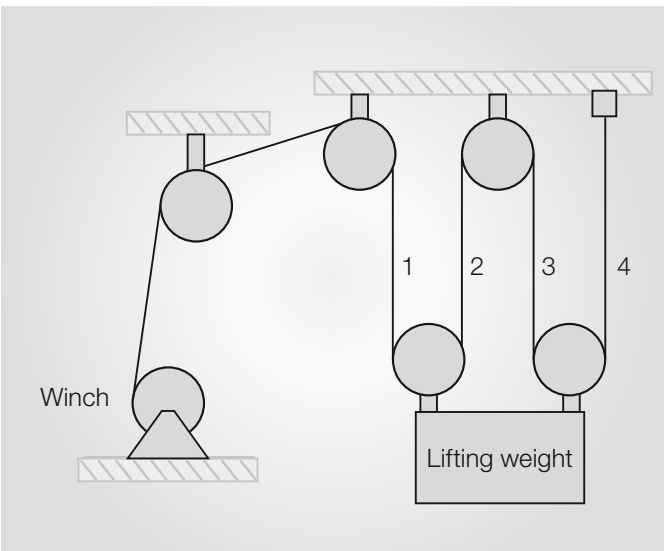
If the number of winding layers is completely unknown, it is recommended to assume as start value one layer per 50 m rope length to be wound, for the first calculation cycle (max. 7 layers). Please carry out an iteration of the calculation depending on the result of the drum width or the winding capacity.

Number of reeved ropes per drum (n_r)
In the case of limited rope lengths to be wound (e.g. loading winches), it may be advisable to wind two ropes (single layer) on one drum.

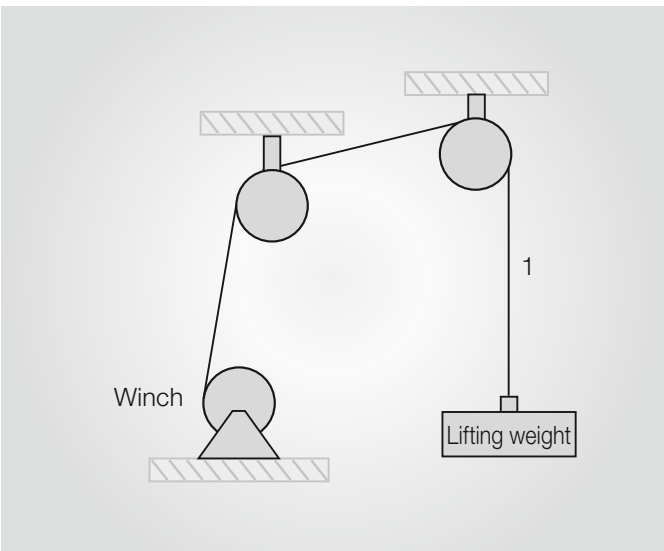
- Advantage: Smaller rope diameter
- Disadvantage: Limited winding capacity
  Large drum width

Hoist reeving (n_m) and number of deflection sheaves (n_u)
The reeving of a pulley block corresponds to the number of rope strands in a pulley block on which the moving object is attached (see figure below). Increasing these is particularly advisable if the lifting load is high at moderate lifting speeds.

- Advantage: Reduction of the size of the rope diameter, drum diameter and gearbox
- Disadvantage: Reduction of rope service life
  Requires higher winding capacity and rope length



Number of deflection sheaves n_u= 2; hoist reeving n_m= 4



Number of deflection sheaves n_u= 2; hoist reeving n_m= 1

Design basics and boundary conditions

Calculation of rope drive efficiency (η_s)

$$\eta_s = \eta_r^{n_u} \times \frac{1 - \eta_r^{n_m}}{n_m \times (1 - \eta_r)}$$ (according to DIN 15020-1)

η_r [-]: Efficiency of one rope sheave with $\eta_r = 0.96$ for friction bearing and $\eta_r = 0.98$ for roller bearing

n_u [-]: Number of fixed deflection sheaves between drum and hoist or moving part

n_m [-]: Hoist reeving

Calculation of rope tensile force (F_S)

$$F_s = m_h \times 9{,}81 \ \frac{m}{s^2} \times \frac{1}{n_m \times n_r \times \eta_s}$$

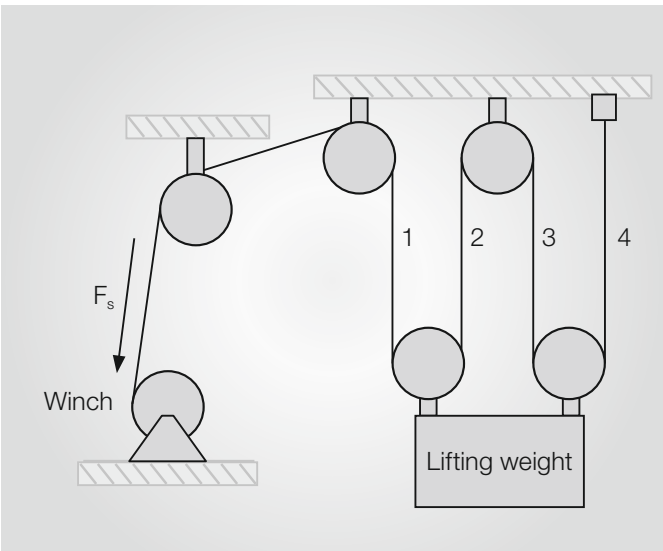
F_s [kN]: Rope tensile force

m_h [t]: Lifting load that the winch should be loaded with equipment

n_m [-]: Hoist reeving

n_r [-]: Number of ropes per drum

η_s [-]: Pulley block efficiency



Calculation of required rope speed (v_s)

$$v_s = v_h \times n_m$$

v_s [m/min]: Rope speed

v_h [m/min]: Lifting speed

n_m [-]: Hoist reeving

Calculation of required usable winding capacity (L_W)

$$L_W = H \times n_m$$

L_W [m]: Required usable winding capacity per rope

H [m]: Lifting height

n_m [-]: Hoist reeving

Determination of the mechanism group (M)

The classification of the application into the appropriate mechanism group depends on the load spectrum (L_i) as well as on the operating class (T_i) that takes account of the service life accordingly. The service life is defined as the sum of the time in which the mechanism is in motion (load-independent).

Operating class* T_i

	T1	T2	T3	T4	T5	T6	T7	T8
Required service life [h]	Up to 400	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 **Mechanism group* M**

		T1	T2	T3	T4	T5	T6	T7	T8
L1	Maximum load is the exception, otherwise usually low loads	M1	M1	M2	M3	M4	M5	M6	M7
L2	About the same proportions of low, medium and high loads, e.g. many types of cranes	M1	M2	M3	M4	M5	M6	M7	M8
L3	Loads are frequently close to the maximum load, e.g. loading winches in plant construction: maximum load during lifting / no load run during lowering	M2	M3	M4	M5	M6	M7	M8	M9
L4	Always maximum load, e.g. winch for adjusting the belt tension on belt conveyors; gate actuation	M3	M4	M5	M6	M7	M8	M9	

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

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Determination of mechanism

Using the parameters defined in the "Design basics and boundary conditions" chapter, such as rope tensile force (F_S), mechanism group (M), number of ropes per drum (n_r) and the number of layers of a winding (n_l), the mechanical part of the winch will be defined. The rope diameter (d), the gearbox size (PEG), the drum diameter (D_T) and the maximum winding diameter (D_{W_max}) are determined using the selection tables on the following pages.

The calculation of the gearbox size and the drum diameter is relatively complex. On the one hand, a large number of parameters need to be taken into account, on the other hand, several iterations of the calculation can be necessary. For example, the load torque of the gearbox depends, amongst other things, on the drum diameter; which in turn depends, among other things, on the gearbox size. The results of the iteration are shown in the selection tables on the following pages and have been calculated on the basis of the following:

- Rotation-free steel cable with the strength of 1960 N/mm^2 and a cross section related minimum breaking force of 1.05 kN/mm^2.
- Rope breakage safety (S_B) and minimum D_T/d ratio (h_1) according to the table below. This is based on the ISO 16625 standard. However, based on experience, the values for multi-layer windings are limited downwardly, deviating from the standard, in order to guarantee long service life despite increased rope wear.

	Rope breakage safety S_B		**D_T/d ratio h_1**	
Mechanism group M	one layer	multi-layer	one layer	multi-layer
M1		4		20
M2		4		20
M3		4		20
M4		4		20
M5	4.5	4.5	18	20
M6	5.6		20	
M7	7.1		22.4	
M8	9		25	
M9	9		25	

- The influence of the secondary brake is taken into account for the structural design of the gearbox. The maximum static load case is defined by the application of the secondary brake during lifting of the load.

Depending on the number of layers and number of ropes per drum, the corresponding tables can be found on the following pages:

Please do not hesitate to contact us if your requirements are not covered by the selection tables.

1 layer, 1 rope

1 layer, 1 rope

	M5				M6				M7				M8				M9			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
10									10	300	420	420	11	300	420	420	11	300	420	420
11.2									10	300	420	420	12	300	420	420	12	300	420	420
12.5					10	300	420	420	11	300	420	420	12	300	420	420	12	300	420	420
14					10	300	420	420	11	300	420	420	13	300	420	420	13	300	420	420
16	10	300	420	420	11	300	420	420	12	300	420	420	14	300	420	420	14	300	420	420
18	10	300	420	420	12	300	420	420	13	300	420	420	15	300	420	420	15	300	420	420
20	11	300	420	420	12	300	420	420	14	300	420	420	15	300	420	420	15	300	420	420
22.4	12	300	420	420	13	300	420	420	14	300	420	420	16	300	420	420	16	300	420	420
25	12	300	420	420	14	300	420	420	15	300	420	420	18	300	455	455	18	350	455	455
28	13	300	420	420	14	300	420	420	16	300	420	420	18	300	455	455	18	350	455	455
31.5	14	300	420	420	15	300	420	420	18	300	420	420	20	350	505	505	20	350	505	505
35.5	14	300	420	420	16	300	420	420	18	350	455	455	20	350	505	505	20	350	505	505
40	15	300	420	420	18	350	455	455	20	350	455	455	22	350	580	580	22	350	580	580
45	16	350	455	455	18	350	455	455	20	350	455	455	24	350	630	630	24	400	630	630
50	18	350	455	455	20	350	455	455	22	350	505	505	24	350	630	630	24	400	630	630
56	18	350	455	455	20	350	455	455	22	350	505	505	26	400	690	690	26	400	690	690
63	20	350	455	455	22	350	455	455	24	400	580	580	28	400	750	750	28	450	750	750
71	20	350	455	455	22	350	455	455	26	400	630	630	28	450	750	750	28	450	750	750
80	22	350	455	455	24	350	505	505	28	400	630	630	30	450	750	750	30	500	750	750
90	24	350	455	455	26	400	580	580	28	450	630	630	32	500	820	820	32	500	820	820
100	24	350	455	455	28	400	580	580	30	450	690	690								
112	26	400	505	505	28	450	580	580	32	500	750	750								
125	28	400	505	505	30	450	630	630	36	500	820	820								
140	28	450	580	580	32	500	690	690	36	500	820	820								
160	30	450	580	580	36	500	750	750												
180	32	500	630	630	36	550	750	750												
200	36	500	690	690	40	550	820	820												
224	36	550	690	690	40	650	820	820												
250	40	550	750	750																
280	40	650	750	750																
250	40	550	750	750																
280	40	650	750	750																

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1 layer, 2 ropes

1 layer, 2 ropes

	M5				M6				M7				M8				M9			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
8													10	300	420	420	10	300	420	420
9													10	300	420	420	10	300	420	420
10									10	300	420	420	11	300	420	420	11	300	420	420
11.2									10	300	420	420	12	300	420	420	12	300	420	420
12.5					10	300	420	420	11	300	420	420	12	300	420	420	12	300	420	420
14					10	300	420	420	11	300	420	420	13	300	420	420	13	350	455	455
16	10	300	420	420	11	300	420	420	12	300	420	420	14	350	455	455	14	350	455	455
18	10	300	420	420	12	300	420	420	13	350	455	455	15	350	455	455	15	350	455	455
20	11	300	420	420	12	350	455	455	14	350	455	455	15	350	455	455	15	350	455	455
22.4	12	350	455	455	13	350	455	455	14	350	455	455	16	350	455	455	16	350	455	455
25	12	350	455	455	14	350	455	455	15	350	455	455	18	350	455	455	18	350	455	455
28	13	350	455	455	14	350	455	455	16	350	455	455	18	350	455	455	18	350	455	455
31.5	14	350	455	455	15	350	455	455	18	350	455	455	20	350	505	505	20	400	505	505
35.5	14	350	455	455	16	350	455	455	18	350	455	455	20	400	505	505	20	400	505	505
40	15	350	455	455	18	350	455	455	20	400	505	505	22	400	580	580	22	450	580	580
45	16	350	455	455	18	400	505	505	20	400	505	505	24	450	630	630	24	450	630	630
50	18	350	455	455	20	400	505	505	22	400	505	505	24	450	630	630	24	500	630	630
56	18	400	505	505	20	400	505	505	22	450	580	580	26	500	690	690	26	500	690	690
63	20	400	505	505	22	450	580	580	24	450	580	580	28	500	750	750	28	550	750	750
71	20	450	580	580	22	450	580	580	26	500	630	630	28	550	750	750	28	550	750	750
80	22	450	580	580	24	500	630	630	28	500	630	630	30	550	750	750	30	550	750	750
90	24	500	630	630	26	500	630	630	28	500	630	630	32	550	820	820	32	650	820	820
100	24	500	630	630	28	500	630	630	30	550	690	690								
112	26	500	630	630	28	550	690	690	32	650	750	750								
125	28	550	690	690	30	550	690	690	36	650	820	820								
140	28	550	690	690	32	650	750	750	36	650	820	820								
160	30	650	750	750	36	650	750	750												
180	32	650	750	750	36	700	820	820												
200	36	650	750	750	40	700	820	820												
224	36	700	820	820	40	700	820	820												
250	40	700	820	820																

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2 layers, 1 rope

2 layers, 1 rope

	M1				M2				M3				M4				M5			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
16																	10	300	420	437
18	10	300	420	437	10	300	420	437	10	300	420	437	10	300	420	437	10	300	420	437
20	10	300	420	437	10	300	420	437	10	300	420	437	10	300	420	437	11	300	420	439
22.4	11	300	420	439	11	300	420	439	11	300	420	439	11	300	420	439	12	300	420	440
25	12	300	420	440	12	300	420	440	12	300	420	440	12	300	420	440	12	300	420	440
28	12	300	420	440	12	300	420	440	12	300	420	440	12	300	420	440	13	300	420	442
31.5	13	300	420	442	13	300	420	442	13	300	420	442	13	300	420	442	14	300	420	444
35.5	14	300	420	444	14	300	420	444	14	300	420	444	14	300	420	444	14	300	420	444
40	14	300	420	444	14	300	420	444	14	300	420	444	14	300	420	444	15	300	420	446
45	15	300	420	446	15	300	420	446	15	300	420	446	15	300	420	446	16	350	455	482
50	16	300	420	447	16	300	420	447	16	350	455	482	16	350	455	482	18	350	455	486
56	18	350	455	486	18	350	455	486	18	350	455	486	18	350	455	486	18	350	455	486
63	18	350	455	486	18	350	455	486	18	350	455	486	18	350	455	486	20	350	455	489
71	20	350	455	489	20	350	455	489	20	350	455	489	20	350	455	489	20	350	455	489
80	20	350	455	489	20	350	455	489	20	350	455	489	20	350	455	489	22	350	455	492
90	22	350	455	492	22	350	455	492	22	350	455	492	22	350	455	492	24	400	505	546
100	24	400	505	546	24	400	505	546	24	400	505	546	24	400	505	546	24	400	505	546
112	24	400	505	546	24	400	505	546	24	400	505	546	24	400	505	546	26	450	580	624
125	26	450	580	624	26	450	580	624	26	450	580	624	26	450	580	624	28	450	580	628
140	28	450	580	628	28	450	580	628	28	450	580	628	28	450	580	628	28	450	580	628
160	28	450	580	628	28	450	580	628	28	450	580	628	28	450	580	628	30	500	630	681
180	30	500	630	681	30	500	630	681	30	500	630	681	30	500	630	681	32	500	690	744
200	32	550	690	744	32	550	690	744	32	550	690	744	32	550	690	744	36	550	750	811
224	36	550	750	811	36	550	750	811	36	550	750	811	36	550	750	811	36	550	750	811
250	36	550	750	811	36	550	750	811	36	550	750	811	36	550	750	811	40	650	820	888
280	40	650	820	888	40	650	820	888	40	650	820	888	40	650	820	888	40	650	820	888
315	40	650	820	888	40	650	820	888	40	650	820	888	40	650	820	888				

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3 layers, 1 rope

3 layers, 1 rope

	M1				M2				M3				M4				M5			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
16																	10	300	420	454
18	10	300	420	454	10	300	420	454	10	300	420	454	10	300	420	454	10	300	420	454
20	10	300	420	454	10	300	420	454	10	300	420	454	10	300	420	454	11	300	420	457
22.4	11	300	420	457	11	300	420	457	11	300	420	457	11	300	420	457	12	300	420	461
25	12	300	420	461	12	300	420	461	12	300	420	461	12	300	420	461	12	300	420	461
28	12	300	420	461	12	300	420	461	12	300	420	461	12	300	420	461	13	300	420	464
31.5	13	300	420	464	13	300	420	464	13	300	420	464	13	300	420	464	14	300	420	468
35.5	14	300	420	468	14	300	420	468	14	300	420	468	14	300	420	468	14	300	420	468
40	14	300	420	468	14	300	420	468	14	300	420	468	14	300	420	468	15	350	455	506
45	15	300	420	471	15	300	420	471	15	300	420	471	15	350	455	506	16	350	455	509
50	16	350	455	509	16	350	455	509	16	350	455	509	16	350	455	509	18	350	455	516
56	18	350	455	516	18	350	455	516	18	350	455	516	18	350	455	516	18	350	455	516
63	18	350	455	516	18	350	455	516	18	350	455	516	18	350	455	516	20	350	455	523
71	20	350	455	523	20	350	455	523	20	350	455	523	20	350	455	523	20	350	455	523
80	20	350	455	523	20	350	455	523	20	350	455	523	20	350	455	523	22	350	455	530
90	22	350	455	530	22	350	455	530	22	350	455	530	22	350	455	530	24	400	505	587
100	24	400	505	587	24	400	505	587	24	400	505	587	24	400	505	587	24	400	505	587
112	24	400	505	587	24	400	505	587	24	400	505	587	24	400	505	587	26	450	580	669
125	26	450	580	669	26	450	580	669	26	450	580	669	26	450	580	669	28	450	580	675
140	28	450	580	675	28	450	580	675	28	450	580	675	28	450	580	675	28	450	580	675
160	28	450	580	675	28	450	580	675	28	450	580	675	28	450	580	675	30	500	630	732
180	30	500	630	732	30	500	630	732	30	500	630	732	30	500	630	732	32	500	690	799
200	32	550	690	799	32	550	690	799	32	550	690	799	32	550	690	799	36	550	750	873
224	36	550	750	873	36	550	750	873	36	550	750	873	36	550	750	873	36	550	750	873
250	36	650	750	873	36	650	750	873	36	650	750	873	36	650	750	873	40	650	820	956
280	40	650	820	956	40	650	820	956	40	650	820	956	40	650	820	956	40	650	820	956
315	40	650	820	956	40	650	820	956	40	650	820	956	40	650	820	956				

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4 layers, 1 rope

4 layers, 1 rope

	M1				M2				M3				M4				M5			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
16																	10	300	420	471
18	10	300	420	471	10	300	420	471	10	300	420	471	10	300	420	471	10	300	420	471
20	10	300	420	471	10	300	420	471	10	300	420	471	10	300	420	471	11	300	420	476
22.4	11	300	420	476	11	300	420	476	11	300	420	476	11	300	420	476	12	300	420	481
25	12	300	420	481	12	300	420	481	12	300	420	481	12	300	420	481	12	300	420	481
28	12	300	420	481	12	300	420	481	12	300	420	481	12	300	420	481	13	300	420	486
31.5	13	300	420	486	13	300	420	486	13	300	420	486	13	300	420	486	14	300	420	491
35.5	14	300	420	491	14	300	420	491	14	300	420	491	14	300	420	491	14	300	420	491
40	14	300	420	491	14	300	420	491	14	300	420	491	14	300	420	491	15	350	455	532
45	15	300	420	497	15	300	420	497	15	350	455	532	15	350	455	532	16	350	455	537
50	16	350	455	537	16	350	455	537	16	350	455	537	16	350	455	537	18	350	455	547
56	18	350	455	547	18	350	455	547	18	350	455	547	18	350	455	547	18	350	455	547
63	18	350	455	547	18	350	455	547	18	350	455	547	18	350	455	547	20	350	455	557
71	20	350	455	557	20	350	455	557	20	350	455	557	20	350	455	557	20	350	455	557
80	20	350	455	557	20	350	455	557	20	350	455	557	20	350	455	557	22	350	455	567
90	22	350	455	567	22	350	455	567	22	350	455	567	22	350	455	567	24	400	505	628
100	24	400	505	628	24	400	505	628	24	400	505	628	24	400	505	628	24	400	505	628
112	24	400	505	628	24	400	505	628	24	400	505	628	24	400	505	628	26	450	580	713
125	26	450	580	713	26	450	580	713	26	450	580	713	26	450	580	713	28	450	580	723
140	28	450	580	723	28	450	580	723	28	450	580	723	28	450	580	723	28	500	630	773
160	28	500	630	773	28	500	630	773	28	500	630	773	28	500	630	773	30	500	630	783
180	30	500	630	783	30	500	630	783	30	500	630	783	30	500	630	783	32	550	690	853
200	32	550	690	853	32	550	690	853	32	550	690	853	32	550	690	853	36	550	750	934
224	36	650	750	934	36	650	750	934	36	650	750	934	36	650	750	934	36	650	750	934
250	36	650	750	934	36	650	750	934	36	650	750	934	36	650	750	934	40	650	820	1,024
280	40	650	820	1,024	40	650	820	1,024	40	650	820	1,024	40	650	820	1,024	40	650	820	1,024
315	40	700	820	1,024	40	700	820	1,024	40	700	820	1,024	40	700	820	1,024				

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5 layers, 1 rope

5 layers, 1 rope

	M1				M2				M3				M4				M5			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
16																	10	300	420	488
18	10	300	420	488	10	300	420	488	10	300	420	488	10	300	420	488	10	300	420	488
20	10	300	420	488	10	300	420	488	10	300	420	488	10	300	420	488	11	300	420	495
22.4	11	300	420	495	11	300	420	495	11	300	420	495	11	300	420	495	12	300	420	502
25	12	300	420	502	12	300	420	502	12	300	420	502	12	300	420	502	12	300	420	502
28	12	300	420	502	12	300	420	502	12	300	420	502	12	300	420	502	13	300	420	509
31.5	13	300	420	509	13	300	420	509	13	300	420	509	13	300	420	509	14	300	420	515
35.5	14	300	420	515	14	300	420	515	14	300	420	515	14	300	420	515	14	350	455	550
40	14	300	420	515	14	300	420	515	14	300	420	515	14	350	455	550	15	350	455	557
45	15	350	455	557	15	350	455	557	15	350	455	557	15	350	455	557	16	350	455	564
50	16	350	455	564	16	350	455	564	16	350	455	564	16	350	455	564	18	350	455	578
56	18	350	455	578	18	350	455	578	18	350	455	578	18	350	455	578	18	350	455	578
63	18	350	455	578	18	350	455	578	18	350	455	578	18	350	455	578	20	350	455	591
71	20	350	455	591	20	350	455	591	20	350	455	591	20	350	455	591	20	350	455	591
80	20	350	455	591	20	350	455	591	20	350	455	591	20	350	455	591	22	400	505	655
90	22	400	505	655	22	400	505	655	22	400	505	655	22	400	505	655	24	400	505	668
100	24	400	505	668	24	400	505	668	24	400	505	668	24	400	505	668	24	450	580	743
112	24	450	580	743	24	450	580	743	24	450	580	743	24	450	580	743	26	450	580	757
125	26	450	580	757	26	450	580	757	26	450	580	757	26	450	580	757	28	450	580	771
140	28	450	580	771	28	450	580	771	28	450	580	771	28	450	580	771	28	500	630	821
160	28	500	630	821	28	500	630	821	28	500	630	821	28	500	630	821	30	500	630	834
180	30	550	690	894	30	550	690	894	30	550	690	894	30	550	690	894	32	550	690	908
200	32	550	690	908	32	550	690	908	32	550	690	908	32	550	690	908	36	550	750	995
224	36	650	750	995	36	650	750	995	36	650	750	995	36	650	750	995	36	650	750	995
250	36	650	750	995	36	650	750	995	36	650	750	995	36	650	750	995	40	650	820	1,092
280	40	700	820	1,092	40	700	820	1,092	40	700	820	1,092	40	700	820	1,092	40	700	820	1,092
315	40	700	820	1,092	40	700	820	1,092	40	700	820	1,092	40	700	820	1,092				

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6 layers, 1 rope

6 layers, 1 rope

	M1				M2				M3				M4				M5			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
16																	10	300	420	505
18	10	300	420	505	10	300	420	505	10	300	420	505	10	300	420	505	10	300	420	505
20	10	300	420	505	10	300	420	505	10	300	420	505	10	300	420	505	11	300	420	514
22.4	11	300	420	514	11	300	420	514	11	300	420	514	11	300	420	514	12	300	420	522
25	12	300	420	522	12	300	420	522	12	300	420	522	12	300	420	522	12	300	420	522
28	12	300	420	522	12	300	420	522	12	300	420	522	12	300	420	522	13	300	420	531
31.5	13	300	420	531	13	300	420	531	13	300	420	531	13	300	420	531	14	300	420	539
35.5	14	300	420	539	14	300	420	539	14	300	420	539	14	300	420	539	14	350	455	574
40	14	300	420	539	14	300	420	539	14	300	420	539	14	350	455	574	15	350	455	583
45	15	350	455	583	15	350	455	583	15	350	455	583	15	350	455	583	16	350	455	591
50	16	350	455	591	16	350	455	591	16	350	455	591	16	350	455	591	18	350	455	608
56	18	350	455	608	18	350	455	608	18	350	455	608	18	350	455	608	18	350	455	608
63	18	350	455	608	18	350	455	608	18	350	455	608	18	350	455	608	20	350	455	625
71	20	350	455	625	20	350	455	625	20	350	455	625	20	350	455	625	20	350	455	625
80	20	350	455	625	20	350	455	625	20	350	455	625	20	350	455	625	22	400	505	692
90	22	400	505	692	22	400	505	692	22	400	505	692	22	400	505	692	24	400	505	709
100	24	400	505	709	24	400	505	709	24	400	505	709	24	400	505	709	24	450	580	784
112	24	450	580	784	24	450	580	784	24	450	580	784	24	450	580	784	26	450	580	801
125	26	450	580	801	26	450	580	801	26	450	580	801	26	450	580	801	28	500	630	868
140	28	500	630	868	28	500	630	868	28	500	630	868	28	500	630	868	28	500	630	868
160	28	500	630	868	28	500	630	868	28	500	630	868	28	500	630	868	30	500	630	885
180	30	550	690	945	30	550	690	945	30	550	690	945	30	550	690	945	32	550	690	962
200	32	550	690	962	32	550	690	962	32	550	690	962	32	550	690	962	36	650	750	1,056
224	36	650	750	1,056	36	650	750	1,056	36	650	750	1,056	36	650	750	1,056	36	650	750	1,056
250	36	650	750	1,056	36	650	750	1,056	36	650	750	1,056	36	650	750	1,056	40	650	820	1,160
280	40	700	820	1,160	40	700	820	1,160	40	700	820	1,160	40	700	820	1,160	40	700	820	1,160
315	40	700	820	1,160	40	700	820	1,160	40	700	820	1,160	40	700	820	1,160				

Continued on page 36

7 layers, 1 rope

7 layers, 1 rope

	M1				M2				M3				M4				M5			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
16																	10	300	420	522
18	10	300	420	522	10	300	420	522	10	300	420	522	10	300	420	522	10	300	420	522
20	10	300	420	522	10	300	420	522	10	300	420	522	10	300	420	522	11	300	420	532
22.4	11	300	420	532	11	300	420	532	11	300	420	532	11	300	420	532	12	300	420	543
25	12	300	420	543	12	300	420	543	12	300	420	543	12	300	420	543	12	300	420	543
28	12	300	420	543	12	300	420	543	12	300	420	543	12	300	420	543	13	300	420	553
31.5	13	300	420	553	13	300	420	553	13	300	420	553	13	300	420	553	14	300	420	563
35.5	14	300	420	563	14	300	420	563	14	300	420	563	14	300	420	563	14	350	455	598
40	14	300	420	563	14	300	420	563	14	350	455	598	14	350	455	598	15	350	455	608
45	15	350	455	608	15	350	455	608	15	350	455	608	15	350	455	608	16	350	455	618
50	16	350	455	618	16	350	455	618	16	350	455	618	16	350	455	618	18	350	455	639
56	18	350	455	639	18	350	455	639	18	350	455	639	18	350	455	639	18	350	455	639
63	18	350	455	639	18	350	455	639	18	350	455	639	18	350	455	639	20	350	455	659
71	20	350	455	659	20	350	455	659	20	350	455	659	20	350	455	659	20	400	505	709
80	20	400	505	709	20	400	505	709	20	400	505	709	20	400	505	709	22	400	505	730
90	22	400	505	730	22	400	505	730	22	400	505	730	22	400	505	730	24	450	580	825
100	24	450	580	825	24	450	580	825	24	450	580	825	24	450	580	825	24	450	580	825
112	24	450	580	825	24	450	580	825	24	450	580	825	24	450	580	825	26	450	580	846
125	26	450	580	846	26	450	580	846	26	450	580	846	26	450	580	846	28	500	630	916
140	28	500	630	916	28	500	630	916	28	500	630	916	28	500	630	916	28	500	630	916
160	28	550	690	976	28	550	690	976	28	550	690	976	28	550	690	976	30	550	690	996
180	30	550	690	996	30	550	690	996	30	550	690	996	30	550	690	996	32	550	690	1,017
200	32	550	690	1,017	32	550	690	1,017	32	550	690	1,017	32	550	690	1,017	36	650	750	1,118
224	36	650	750	1,118	36	650	750	1,118	36	650	750	1,118	36	650	750	1,118	36	650	750	1,118
250	36	650	750	1,118	36	650	750	1,118	36	650	750	1,118	36	650	750	1,118	40	700	820	1,229
280	40	700	820	1,229	40	700	820	1,229	40	700	820	1,229	40	700	820	1,229	40	700	820	1,229
315	40	700	820	1,229	40	700	820	1,229	40	700	820	1,229	40	700	820	1,229				

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Contents

Iteration for deviating drum speeds

During the previous design of the gearbox, it was checked whether the occurring dynamic as well as the maximum static torques are below the permissible values. The calculated permissible dynamic reference torque depends on the rated output speed of the gearbox which is 15 rpm. If the actual output speed (drum speed (n_T)) deviates significantly, this can have an influence on the dimensioning of the gearbox and thus also on the drum. A significantly higher speed could reduce the service life of the gearbox. On the other hand, a very slow output speed can result in an over dimensioned system. Therefore, the influence of the speed on the design of the gearbox will be checked in this chapter, if necessary, an additional design step must be carried out to check the size of the drum and the gearbox.

Before calculating the drum speed (n_T), the mean winding diameter must be determined first. With 1 layer winding, this step can be omitted as the mean winding diameter in this case is equal to the drum diameter (D_T).

$$D_{W\_mean} = \frac{D_T + D_{W\_max}}{2}$$

D_{W_mean} [mm]: Mean winding diameter

D_T [mm]: Drum diameter

D_{W_max} [mm]: Max. winding diameter

The drum speed (n_T) is calculated from:

$$n_T = \frac{v_s \text{ x } 1000 \text{ mm/m}}{D_{W\_mean} \text{ x } \pi}$$

n_T [rpm]: Drum speed

v_s [m/min]: Rope speed

D_{W_mean} [mm]: Mean winding diameter

If the drum speed is not between 11 and 17 rpm, this must be taken into account for the determination of the operating class. This starts by calculating the equivalent operating time which is calculated from the product of the required service life and the ratio of drum speed to reference output speed. If the operating class on the basis of the equivalent operating time changes, the mechanism group will also change. This in turn can have an influence on the dimensioning of the gearbox and the drum which is why they have to be checked and, if necessary, redefined. The detailed steps of the iteration can be seen in the diagrams on the following pages.

This procedure has no influence on the already determined rope diameter as the rope breakage safety of the initially defined mechanism group is still applicable. The classification of the load spectrum also remains unchanged.

Iteration for deviating drum speeds

Check: 11 rpm < n_T < 17 rpm

↓

No

↓

Calculation of equivalent operating time (t_{equ})

$$t_{equ} = \frac{t \times n_T}{15\ rpm}$$

t_{equ} [h]: Equivalent operating time
t [h]: Required service life
n_T [rpm]: Drum speed

↓

Determination of operating class (T_{i_PEG}) and of the mechanism group (M_{PEG})
If t_{equ} > 50,000 h or if the M10 mechanism group is reached, this can no longer be covered by this design manual; please contact us. The same applies if an increase of more than 2 mechanism groups results.

Operating class T_{i_PEG}	**T0**	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**
Equivalent operating time t_{equ} (h)	Up to 200	Up to 400	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	**Mechanism group M_{PEG}**								
	T0	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**
L1 - Maximum load is the exception, otherwise low loads	M1	M1	M1	M2	M3	M4	M5	M6	M7
L2 - About the same proportions of low, medium and high loads	M1	M1	M2	M3	M4	M5	M6	M7	M8
L3 - Loads are always close to the maximum load	M1	M2	M3	M4	M5	M6	M7	M8	M9
L4 - Always maximum load	M2	M3	M4	M5	M6	M7	M8	M9	M10

↓

Do the operating class (T_{i_PEG}) and mechanism group (M_{PEG}) change in comparison with T_i and M?

↓

Yes

↓

On the basis of mechanism group (M_{PEG}) check / redefinition of:

Gearbox size; drum diameter; winding diameter
The already determined rope diameter remains unchanged.

	Change of mechanism group compared with the initial determination in the "Design basics and boundary conditions" chapter			
	Reduction of 2 or more mechanism groups e.g. M6->M4	Reduction of 1 mechanism group e.g. M6->M5	Increase of 1 mechanism group e.g. M6->M7	Increase of 2 mechanism groups e.g.M6->M8
1 layer - 1 rope	Page 78	Page 79	Page 80	Page 81
1 layer - 2 ropes	Page 82	Page 83	Page 84	Page 85
2 layers -1 rope	Page 86	Page 87	Page 88	Page 89
3 layers -1 rope	Page 90	Page 91	Page 92	Page 93
4 layers -1 rope	Page 94	Page 95	Page 96	Page 97
5 layers -1 rope	Page 98	Page 99	Page 100	Page 101
6 layers -1 rope	Page 102	Page 103	Page 104	Page 105
7 layers -1 rope	Page 106	Page 107	Page 108	Page 109

Yes

No

If required: recalculation of the mean winding diameter (D_{W_mean}) and the drum speed (n_T)

$$D_{W\_mean} = \frac{D_T + D_{W\_max}}{2}$$

$$n_T = \frac{v_s \times 1{,}000 \ \frac{mm}{m}}{D_{W\_mean} \times \pi}$$

D_{W_mean}	[mm]:	Mean winding diameter
D_T	[mm]:	Drum diameter
D_{W_max}	[mm]:	Max. winding diameter
n_T	[rpm]:	Drum speed
v_s	[m/min]:	Rope speed

Chapter 6
Determination of gear ratio

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Contents

Determination of the gear ratio (i) and calculation of the mechanical drive power (P_{Mech})

The optimum working range of the 4-pole Liebherr asynchronous motors at max. load is between 1,500 and 2,100 rpm, and between 750 and 1,050 rpm with special winding. Therefore, these speeds are used as reference for the determination of the required gear ratio.

The required ratio when using the motor with standard winding and the rated speed (n_B) of 1,500 rpm is calculated as follows:

$$i_{@1,500\ rpm} = \frac{n_B}{n_T} = \frac{1{,}500\ rpm}{n_T}$$

$i_{@1,500\ rpm}$ [-]: Required gear ratio at motor speed of 1,500 rpm

n_B [rpm]: Rated motor speed = 1,500 rpm

n_T [rpm]: Drum speed

Using the calculated ratio ($i_{@1,500\ rpm}$) and depending on the gearbox size (PEG), the actual gear ratio (i) can be selected from the table below and must be $i > i_{@1,500\ rpm}$. If the required ratio is above the available gear ratio variants, it must be recalculated on the basis of the rated speed of 750 rpm of the motor with special winding:

$$i_{@750\ rpm} = \frac{n_B}{n_T} = \frac{750\ rpm}{n_T}$$

$i_{@750\ rpm}$ [-]: Required gear ratio at motor speed of 750 rpm

n_B [rpm]: Rated motor speed = 750 rpm

n_T [rpm]: Drum speed

If $i_{@750rpm}$ is also above the available gear ratios, please contact us for an individual design.

PEG	Gear ratio i					
300	20	30	43	67	104	162
350	31	50	83	135	224	
400	29	48	71	106	170	280
450	33	50	80	128	200	315
500	44	66	107	175	250	380
550		66	105	174	288	432
650		96	138	200	303	486
700		116	183	270	378	534

Efficiency:	
	2 stages: $\eta_{PEG} = 0.96$
	3 stages: $\eta_{PEG} = 0.94$
	4 stages: $\eta_{PEG} = 0.92$

The colour of the gear ratios is used for determining the number of gear stages and thus the gearbox efficiency; these are needed for the calculation of the required mechanical drive power.

Calculation of motor speed (n_{Mot})

Depending on the selected gear ratio (i), the actual motor speed (n_{Mot}) is calculated as follows:

$$n_{Mot} = n_T \times i$$

n_{Mot} [rpm]: Motor speed

n_T [rpm]: Drum speed

i [-]: Gear ratio

Calculation of required mechanical drive power (P_{Mech})

The required mechanical drive power (P_{Mech}) at the desired rope speed (v_S) and rope tensile force (F_S) is calculated as follows. The efficiency for the plug-in gearbox (η_{PEG}) can be found in the selection sheet for the gear ratio:

$$P_{Mech} = F_s \times \frac{v_s}{\eta_{PEG} \times 60 \ \frac{s}{min}}$$

P_{Mech} [kW]: Required mechanical drive power

F_s [kN]: Rope tensile force

v_s [m/min]: Rope speed

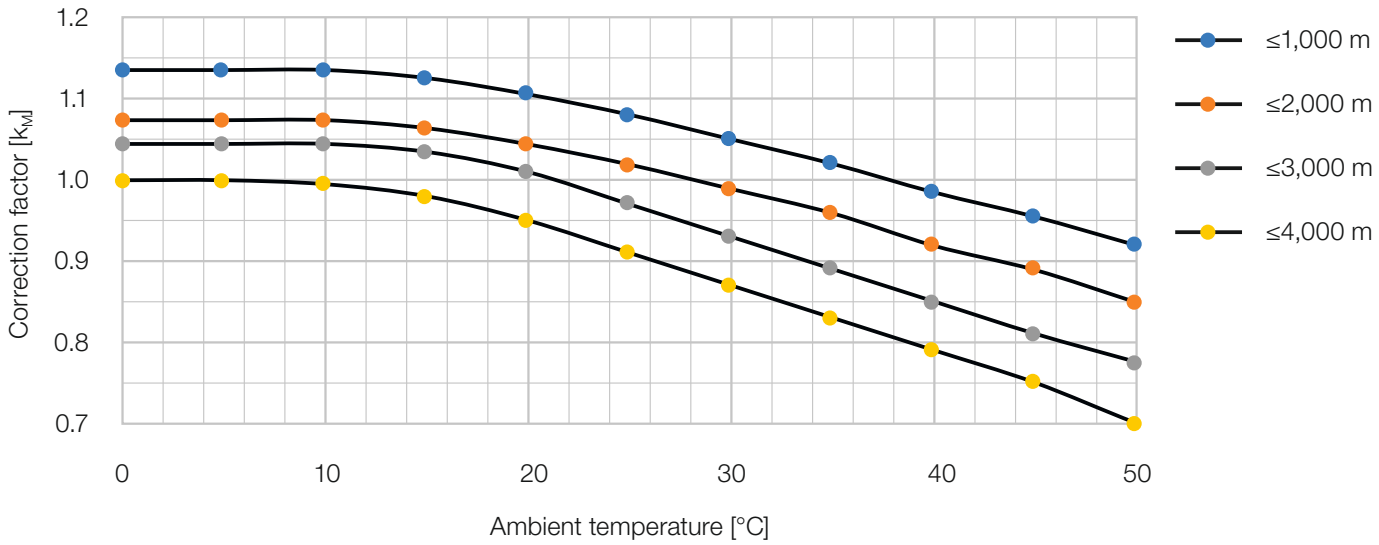
η_{PEG} [-]: Planetary gearbox efficiency

Contents

Determination of motor size

Determination of correction factor (k_M)

Depending on the installation altitude and the maximum expected ambient temperature of the motor, a correction factor (k_M) can be read from the graph below, based on which the required motor power is calculated. It is assumed that the motor is not exposed to direct sunlight. If this would be the case, please contact us for the further thermal design of the motor.



Determination of operation category (S)

Liebherr asynchronous motors in the standard series are designed according to the standard requirements for continuous operation at constant power (S1) and efficiency class IE2. If a system is not operated continuously, the permissible power of a motor can be significantly higher due to the thermal design.

Operation category	Description
S1	Continuous operation
S3 - 25%	Periodic intermittent operation with relative duty cycle in % based on a 10 minute interval
S3 - 40%	
S3 - 60%	
S3 - 75%	

Determination of motor size (KGF)

The correction factor (k_M) and the required mechanical drive power (P_{Mech}) are used to calculate the required mechanical motor power (P_{Motor}). The required motor size is determined on the basis of this, the operation category and the selected motor version (n_B= 1,500 or 750 rpm). The required mechanical motor power must be smaller than the respective value for the rated mechanical motor power in the selection table.

$$P_{Motor} = \frac{P_{Mech}}{k_M}$$

P_{Motor} [kW]: Required mechanical motor power

P_{Mech} [kW]: Required mechanical drive power

k_M [-]: Correction factor for taking account of the installation altitude and the ambient temperature

Rated mechanical motor power where n_B = 1,500 rpm

	KGF61X L_{Mot} = 813 mm	KGF66X L_{Mot} = 893 mm	KGF69X L_{Mot} = 993 mm	KGF86X L_{Mot} = 928 mm	KGF87X L_{Mot} = 978 mm	KGF89X L_{Mot} = 1,083 mm	KGF93X L_{Mot} = 1,346 mm	KGF97X L_{Mot} = 1,471 mm
Operation category	[kW]	[kW]	[kW]	[kW]	[kW]	[kW]	[kW]	[kW]
S1 - IE2	12	15	19	39	50	60	100	124
S3 - 75%	13.4	16.8	26.8	43.6	57.7	69.3	115.5	138.6
S3 - 60%	15.5	19.4	30	50.3	64.5	77.5	129.1	160.1
S3 - 40%	19	23.7	36.7	61.7	79.1	94.9	158.1	196.1
S3 - 25%	24	30	46.4	78	100	120	200	248

Rated mechanical motor power where n_B = 750 rpm

	KGF61X L_{Mot} = 813 mm	KGF66X L_{Mot} = 893 mm	KGF69X L_{Mot} = 993 mm	KGF86X L_{Mot} = 928 mm	KGF87X L_{Mot} = 978 mm	KGF89X L_{Mot} = 1,083 mm	KGF93X L_{Mot} = 1,346 mm	KGF97X L_{Mot} = 1,471 mm
Operation category	[kW]	[kW]	[kW]	[kW]	[kW]	[kW]	[kW]	[kW]
S3 - 75%	6.7	9.8	17	21.5	26.8	40.2	66.2	89.4
S3 - 60%	7.5	11	19	24	30	45	74	100
S3 - 40%	9.2	13.5	23.3	29.4	36.7	55.1	90.6	122.5
S3 - 25%	11.6	17	29.4	37.2	46.5	69.7	114.6	154.9

Calculation of motor current (I_{Motor})

The apparent current absorbed by the motor (I_{Motor}) is calculated as follows. This is the main parameter for the dimensioning of the frequency converter.

$$I_{Motor} = \frac{P_{Mech} \times 1{,}000\ \frac{W}{kW}}{\sqrt{3} \times U_{Mot} \times \cos(\varphi^{Mot}) \times \eta_{Mot}} = \frac{P_{Mech} \times 1{,}000\ \frac{W}{kW}}{1.732 \times 380\ V \times 0.82 \times 0.92} = \frac{P_{Mech} \times 1{,}000\ \frac{W}{kW}}{496.53\ V}$$

I_{Motor} [A]: Motor current (absorbed motor current = apparent current)

P_{Mech} [kW]: Required mechanical drive power

U_{Mot} [V]: Rated motor voltage (= 380 V)

$\cos(\varphi^{Mot})$ [-]: Minimum phase difference factor between apparent current and active current across all operation categories and motor sizes (= 0.82) (conservative assumption)

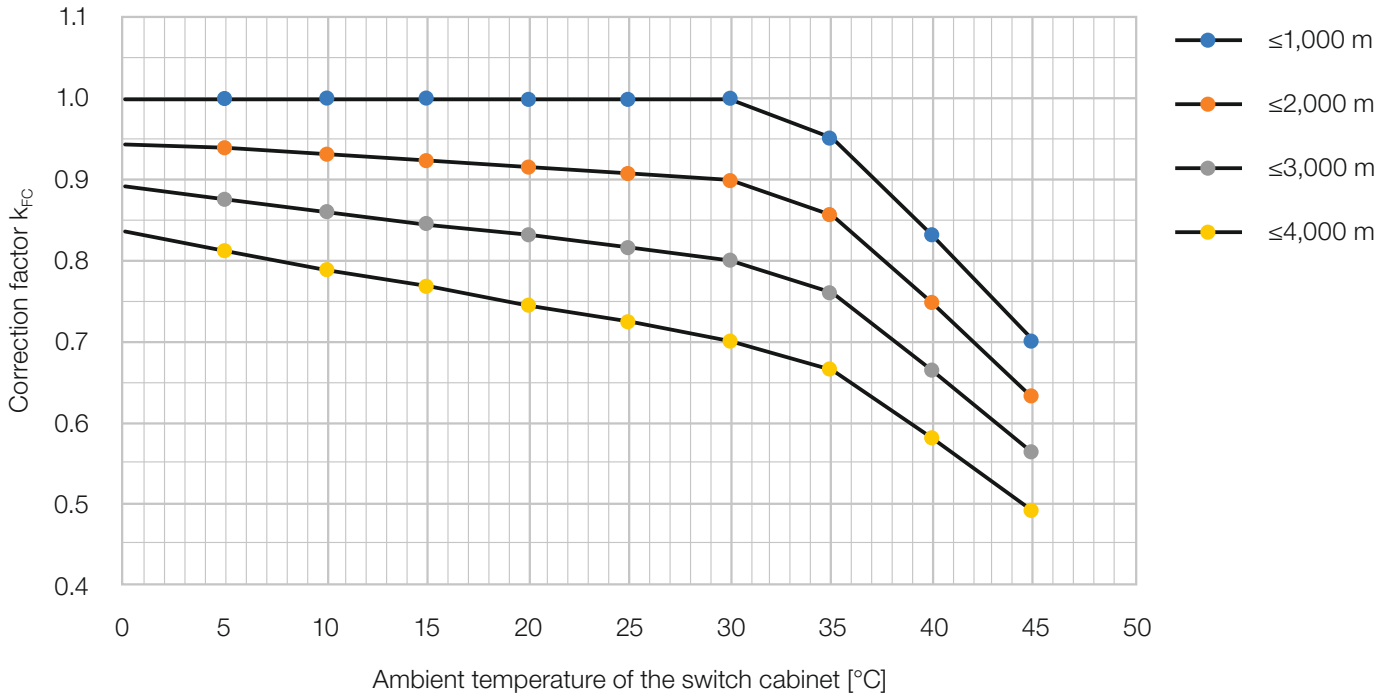
η_{Mot} [-]: Minimum motor efficiency across all operation categories and motor sizes (= 0.92) (conservative assumption)

Contents

Determination of switch cabinet size

Determination of the correction factor (k_{FC})

Based on the installation altitude and the maximum expected ambient temperature of the switch cabinet a correction factor (k_{FC}) can be read from the graph below. It is assumed that the switch cabinet will not be exposed to direct sunlight. If this would be the case, please contact us for the further thermal design of the frequency converter and switch cabinet.



Calculation of the required frequency converter output current (I_{FC})

The required frequency converter output current (I_{FC}) is calculated from the motor current (I_{Motor}) and the previously determined correction factor (k_{FC}).

$$I_{FC} = \frac{I_{Motor}}{k_{FC}}$$

I_{FC} [A]: Required frequency converter output current

I_{Motor} [A]: Motor current

k_{FC} [-]: Correction factor for taking account of the installation altitude and ambient temperature

Determination of the switch cabinet and frequency converter size (SRA)

The switch cabinet size and its dimensions can be determined using the required frequency converter output current (I_{FC}). The rated output current of the frequency converter must be greater than the required frequency converter output current (I_{FC}).

	Switch cabinet size						
	SRA1a	**SRA1b**	**SRA1c**	**SRA2a**	**SRA2b**	**SRA3a**	**SRA3b**
Rated frequency converter output current [A]	34	52	77	124	180	260	414
Dimensions [mm] (W_{SRA} x H_{SRA} x D_{SRA})	800 x 2,250 x 500			1,000 x 2,300 x 500		1,200 x 2,400 x 500	

The height of the switch cabinet includes the height of the brake resistor placed on the switch cabinet.

Required apparent power input of switch cabinet (P_{SRA})

The required apparent power input of the switch cabinet (P_{SRA}) is calculated as follows:

$$P_{SRA} = \frac{P_{Mech}}{\cos(\varphi^{FC}) \times \eta_{Mot} \times \eta_{FC}} = \frac{P_{Mech}}{0.95 \times 0.92 \times 0.98} = \frac{P_{Mech}}{0.857}$$

P_{SRA} [kW]: Required apparent power input of the switch cabinet

P_{Mech} [kW]: Required mechanical drive power

$\cos(\varphi^{FC})$ [-]: Minimum size-independent phase difference factor between apparent current and active current (= 0.95) (conservative assumption)

η_{Mot} [-]: Minimum motor efficiency across all operation categories and motor sizes (= 0.92) (conservative assumption)

η_{FC} [-]: Minimum frequency converter efficiency across all sizes (= 0.98) (conservative assumption)

Depending on the number and size of the optional auxiliary equipment such as heating / cooling for gear oil, motor and switch cabinet, the power input of the switch cabinet can increase in the range of a few kW.

Contents

Calculation of required rope length (L_R)

In order to calculate the required rope length (L_R), the design of the rope drive from the rope drum to the load attachment must be known.

The rope length in the hoist depends on the one hand on the maximum distance (L_I) between the upper and lower return pulley station of the hoist, the hoist reeving (n_m) and on the rope sheave diameter (D_S). The latter depends on the mechanism group (M) defined in the chapter "Design basics and boundary conditions", as this defines a minimum ratio (h_2) of rope sheave diameter (D_S) to rope diameter (d) according to the ISO 16625 standard (see table below).

Mechanism group M	Ratio of sheave to rope diameter D_s/d h_2
M1	12.5
M2	14
M3	16
M4	18
M5	20
M6	22.4
M7	25
M8	28
M9	28

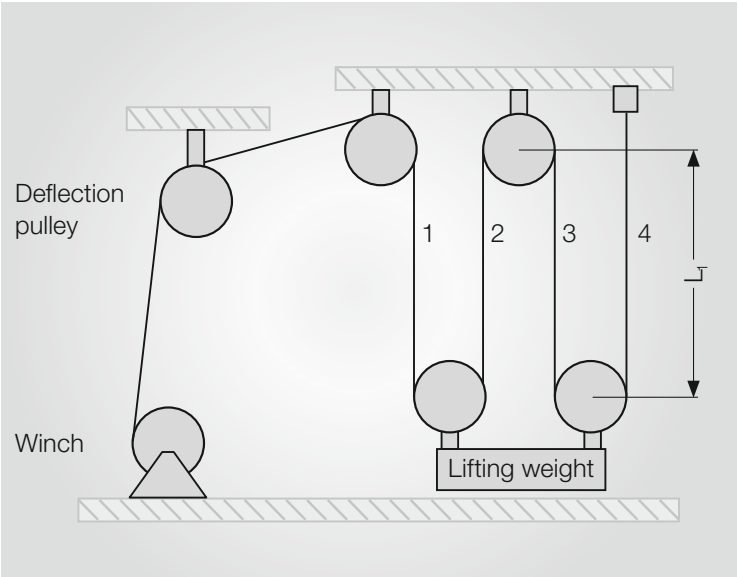
The sheave diameter (D_S) is calculated as follows:

$$D_S = h_2 \times d$$

D_S [mm]: Sheave diameter

h_2 [-]: Ratio of sheave to rope diameter

d [mm]: Rope diameter



The required rope length is calculated as follows:

$$L_R = \overbrace{L_{Si}}^{} + \overbrace{L_{SW} + L_{FI}}^{} + L_{KI}$$

$$L_R = 3 \times \pi \times \frac{D_T}{1{,}000\ \frac{mm}{m}} + L_{SW} + n_m \times \left(L_1 + \frac{D_S \times \pi}{2 \times 1{,}000\ \frac{mm}{m}} \right) + 2\ m$$

L_R [m]: Required rope length

L_{Si} [m]: 3 safety windings in the first layer of the winding on the drum

L_{SW} [m]: Rope length between winch and hoist

L_{FI} [m]: Rope length in the hoist

L_{KI} [m]: Required rope length for the clamping of both rope ends (standard 2 m)

L_1 [m]: Max. distance between upper and lower return pulley block of the hoist

D_T [mm]: Drum diameter

n_m [-]: Hoist reeving

D_S [mm]: Sheave diameter

Contents

Determination of drum width (W_T)

Using the required usable winding capacity (L_W), determined in the chapter "Design basics and boundary conditions", the appropriate drum variant, depending on the drum and rope diameter and the number of winding layers, is selected in this chapter.

The values given in the tables are "usable winding capacity" in metres, as the rope length of 3 safety windings in the first layer, as well as the plastic and elastic rope elongation to be expected during the service life, have already been subtracted. Therefore, it must only be checked which of the drum variants for the given mechanism has the required usable winding capacity.

The drum grooves are designed as standard with a pitch of 105 % of the rope diameter. In the case of multi-layer winding, the drum is equipped with a special groove to ensure optimum winding of the individual layers.

In addition to the winding capacity, the tables for the selection of the drum variant show the values of the groove width (W_V).

The drum width (W_T) equals the groove width (W_V) if only 1 rope is reeved on the drum.

$$W_T = W_v$$

If 2 ropes are reeved on the drum, the distance between both grooves (W_R) must also be added to the double groove width (2 x W_V) to calculate the drum width (W_T):

$$W_T = 2 \times W_v + W_R$$

W_T [mm]: Drum width

W_V [mm]: Groove width on the drum for one rope

W_R [mm]: Distance between grooves (customer-specific; min. 200 mm)

Selection table for drum variant and groove width (W_V) on the basis of usable winding capacity (L_W)

		Usable winding capacity (L_w) for drum variant T15 (15 windings)								Usable winding capacity (L_w) for drum variant T20 (20 windings)							
Drum diameter D_t [mm]	Rope diameter d [mm]	**Groove width W_v [mm]**	Number of winding layers n_l							**Groove width W_v [mm]**	Number of winding layers n_l						
			1	2	3	4	5	6	7		1	2	3	4	5	6	7
420	10	**158**	16	36	57	79	101	125	148	**210**	22	50	78	107	137	167	199
	11	**173**	16	36	58	79	102	126	150	**231**	22	50	78	107	138	169	201
	12	**189**	16	36	58	80	103	126	151	**252**	22	50	78	108	138	170	203
	13	**205**	16	36	58	80	103	127	152	**273**	22	50	79	108	139	171	204
	14	**221**	16	37	58	81	104	128	154	**294**	22	50	79	109	140	173	206
	15	**236**	16	37	58	81	105	129	155	**315**	22	50	79	109	141	174	208
	16	**252**	16	37	59	81	105	130	156	**336**	22	50	79	110	142	175	210
455	10	**158**	17	39	62	85	109	134	159	**210**	24	54	84	115	147	180	214
	11	**173**	17	39	62	86	110	135	161	**231**	24	54	84	116	148	182	216
	12	**189**	17	39	62	86	111	136	162	**252**	24	54	85	116	149	183	218
	13	**205**	17	39	63	87	111	137	164	**273**	24	54	85	117	150	184	219
	14	**221**	17	40	63	87	112	138	165	**294**	24	54	85	117	151	185	221
	15	**236**	17	40	63	87	113	139	166	**315**	24	54	85	118	152	187	223
	16	**252**	17	40	63	88	113	140	168	**336**	24	54	86	118	153	188	225
	18	**284**	17	40	64	88	115	142	170	**378**	24	54	86	119	154	191	229
	20	**315**	17	40	64	89	116	144	173	**420**	24	55	87	120	156	193	232
	22	**347**	17	40	64	90	117	146	176	**462**	24	55	87	121	158	196	236
	24	**378**	17	40	65	91	119	148	179	**504**	24	55	88	123	159	198	239
505	12	**189**	19	44	69	95	122	150	178	**252**	27	60	94	128	164	201	239
	13	**205**	19	44	69	95	123	151	180	**273**	27	60	94	129	165	203	241
	14	**221**	19	44	69	96	123	152	181	**294**	27	60	94	129	166	204	243
	15	**236**	19	44	70	96	124	153	182	**315**	27	60	94	130	167	205	245
	16	**252**	19	44	70	97	125	154	184	**336**	27	60	95	130	168	206	246
	18	**284**	19	44	70	97	126	156	186	**378**	27	60	95	132	169	209	250
	20	**315**	19	44	71	98	127	158	189	**420**	27	60	96	133	171	212	254
	22	**347**	19	44	71	99	129	159	192	**462**	27	61	96	134	173	214	257
	24	**378**	19	44	71	100	130	161	195	**504**	27	61	97	135	175	217	261
	26	**410**	19	45	72	101	131	163	197	**546**	27	61	97	136	176	219	265
	28	**441**	19	45	72	101	132	165	200	**588**	27	61	98	137	178	222	268
580	15	**236**	22	50	79	110	141	173	206	**315**	31	69	108	148	190	233	277
	16	**252**	22	50	80	110	142	174	208	**336**	31	69	108	149	191	234	279
	18	**284**	22	50	80	111	143	176	210	**378**	31	69	109	150	192	237	282
	20	**315**	22	50	80	112	144	178	213	**420**	31	69	109	151	194	239	286
	22	**347**	22	51	81	112	145	180	216	**462**	31	69	110	152	196	242	290
	24	**378**	22	51	81	113	147	182	219	**504**	31	69	110	153	198	244	293
	26	**410**	22	51	82	114	148	184	221	**546**	31	70	111	154	199	247	297
	28	**441**	22	51	82	115	149	186	224	**588**	31	70	111	155	201	250	301
	30	**473**	22	51	82	116	151	188	227	**630**	31	70	112	156	203	252	304
	32	**504**	22	51	83	116	152	190	230	**672**	31	70	112	157	204	255	308

		Usable winding capacity (L_w) for drum variant T25 (25 windings)								Usable winding capacity (L_w) for drum variant T30 (30 windings)							
Drum diameter D_t [mm]	Rope diameter d [mm]	Groove width W_v [mm]	Number of winding layers n_l							Groove width W_v [mm]	Number of winding layers n_l						
			1	2	3	4	5	6	7		1	2	3	4	5	6	7
420	10	**263**	29	63	98	134	172	210	250	**315**	36	77	119	162	207	253	300
	11	**289**	29	63	99	135	173	212	252	**347**	36	77	119	163	208	255	303
	12	**315**	29	63	99	136	174	213	254	**378**	36	77	119	164	210	257	306
	13	**341**	29	63	99	136	175	215	257	**410**	36	77	120	165	211	259	309
	14	**368**	29	64	100	137	176	217	259	**441**	36	77	120	165	212	261	311
	15	**394**	29	64	100	138	177	218	261	**473**	36	77	121	166	213	263	314
	16	**420**	29	64	100	138	178	220	263	**504**	36	77	121	167	215	265	317
455	10	**263**	31	68	106	145	185	226	269	**315**	39	83	128	175	223	272	323
	11	**289**	31	68	106	146	186	228	271	**347**	39	83	129	176	224	274	326
	12	**315**	31	68	107	146	187	230	273	**378**	39	83	129	177	226	276	329
	13	**341**	31	69	107	147	188	231	275	**410**	39	83	129	177	227	278	331
	14	**368**	31	69	107	148	190	233	278	**441**	39	83	130	178	228	280	334
	15	**394**	31	69	108	148	191	234	280	**473**	39	83	130	179	230	282	337
	16	**420**	31	69	108	149	192	236	282	**504**	39	84	131	180	231	284	340
	18	**473**	31	69	109	150	194	239	287	**567**	39	84	131	181	234	288	345
	20	**525**	31	69	109	152	196	243	291	**630**	39	84	132	183	236	292	350
	22	**578**	31	70	110	153	198	246	296	**693**	39	84	133	184	239	296	356
	24	**630**	31	70	111	154	200	249	300	**756**	39	85	134	186	241	300	361
505	12	**315**	35	76	118	162	207	253	300	**378**	43	92	143	195	249	304	361
	13	**341**	35	76	118	162	208	254	302	**410**	43	92	143	196	250	306	364
	14	**368**	35	76	119	163	209	256	305	**441**	43	92	143	197	251	308	367
	15	**394**	35	76	119	164	210	258	307	**473**	43	92	144	197	253	310	369
	16	**420**	35	76	119	164	211	259	309	**504**	43	93	144	198	254	312	372
	18	**473**	35	77	120	166	213	262	314	**567**	43	93	145	200	257	316	378
	20	**525**	35	77	121	167	215	266	318	**630**	43	93	146	201	259	320	383
	22	**578**	35	77	121	168	217	269	323	**693**	43	93	147	203	262	324	388
	24	**630**	35	77	122	169	220	272	327	**756**	43	94	147	204	264	328	394
	26	**683**	35	77	123	171	222	275	332	**819**	43	94	148	206	267	331	399
	28	**735**	35	78	123	172	224	279	337	**882**	43	94	149	207	270	335	405
580	15	**394**	40	87	136	186	239	292	348	**473**	49	106	164	225	287	352	418
	16	**420**	40	87	136	187	240	294	350	**504**	49	106	165	226	289	354	421
	18	**473**	40	88	137	188	242	297	354	**567**	49	106	166	227	291	358	426
	20	**525**	40	88	138	190	244	300	359	**630**	49	106	166	229	294	361	432
	22	**578**	40	88	138	191	246	304	363	**693**	49	107	167	230	296	365	437
	24	**630**	40	88	139	192	248	307	368	**756**	49	107	168	232	299	369	443
	26	**683**	40	88	140	194	250	310	373	**819**	49	107	169	233	302	373	448
	28	**735**	40	89	140	195	253	313	377	**882**	49	107	169	235	304	377	454
	30	**788**	40	89	141	196	255	317	382	**945**	49	108	170	237	307	381	459
	32	**840**	40	89	142	198	257	320	386	**1,008**	49	108	171	238	309	385	464

Selection table for drum variant and groove width (W_V) on the basis of usable winding capacity (L_W)

		Usable winding capacity (L_w) for drum variant T15 (15 windings)								Usable winding capacity (L_w) for drum variant T20 (20 windings)							
Drum diameter D_t [mm]	Rope diameter d [mm]	**Groove width W_V [mm]**	Number of winding layers n_l							**Groove width W_V [mm]**	Number of winding layers n_l						
			1	2	3	4	5	6	7		1	2	3	4	5	6	7
630	18	**284**	24	55	87	120	154	190	226	**378**	34	75	117	162	208	255	304
	20	**315**	24	55	87	121	155	192	229	**420**	34	75	118	163	209	258	308
	22	**347**	24	55	87	121	157	194	232	**462**	34	75	119	164	211	260	311
	24	**378**	24	55	88	122	158	196	235	**504**	34	75	119	165	213	263	315
	26	**410**	24	55	88	123	159	198	237	**546**	34	75	120	166	215	265	318
	28	**441**	24	55	89	124	161	199	240	**588**	34	76	120	167	216	268	322
	30	**473**	24	55	89	125	162	201	243	**630**	34	76	121	168	218	271	326
	32	**504**	24	56	89	125	163	203	246	**672**	34	76	121	169	220	273	329
	36	**567**	24	56	90	127	166	207	251	**756**	34	76	122	171	223	278	337
690	24	**378**	26	60	96	133	172	212	254	**504**	37	82	130	179	231	285	341
	26	**410**	26	60	96	134	173	214	257	**546**	37	82	130	180	233	287	344
	28	**441**	26	60	96	134	174	216	259	**588**	37	83	131	181	235	290	348
	30	**473**	26	60	97	135	176	218	262	**630**	37	83	131	183	236	293	352
	32	**504**	26	61	97	136	177	220	265	**672**	37	83	132	184	238	295	355
	36	**567**	26	61	98	138	179	224	270	**756**	37	83	133	186	241	300	362
	40	**630**	26	61	99	139	182	228	276	**840**	37	84	134	188	245	306	370
750	28	**441**	28	65	104	145	188	232	279	**588**	40	90	142	196	253	312	374
	30	**473**	28	66	105	146	189	234	281	**630**	40	90	142	197	255	315	377
	32	**504**	28	66	105	147	190	236	284	**672**	40	90	143	198	256	317	381
	36	**567**	28	66	106	148	193	240	289	**756**	40	90	144	200	260	322	388
	40	**630**	28	66	107	150	196	244	295	**840**	40	91	145	202	263	328	396
820	28	**441**	31	71	114	158	204	251	301	**588**	44	98	154	213	274	338	404
	30	**473**	31	72	114	159	205	253	304	**630**	44	98	155	214	276	340	407
	32	**504**	31	72	114	159	206	255	306	**672**	44	98	155	215	278	343	411
	36	**567**	31	72	115	161	209	259	312	**756**	44	98	156	217	281	348	418
	40	**630**	31	72	116	162	211	263	317	**840**	44	99	157	219	285	353	426

Drum diameter D_t [mm]	Rope diameter d [mm]	**Usable winding capacity (L_w) for drum variant T25 (25 windings)**								**Usable winding capacity (L_w) for drum variant T30 (30 windings)**							
		Groove width W_v [mm]	Number of winding layers n_l							**Groove width W_v [mm]**	Number of winding layers n_l						
			1	2	3	4	5	6	7		1	2	3	4	5	6	7
630	18	**473**	44	95	148	204	261	320	381	**567**	53	115	179	246	314	385	459
	20	**525**	44	95	149	205	263	323	386	**630**	53	115	180	247	317	389	464
	22	**578**	44	95	150	206	265	327	390	**693**	53	116	181	249	320	393	470
	24	**630**	44	96	150	208	267	330	395	**756**	53	116	182	250	322	397	475
	26	**683**	44	96	151	209	270	333	400	**819**	53	116	182	252	325	401	481
	28	**735**	44	96	152	210	272	336	404	**882**	53	116	183	253	327	405	486
	30	**788**	44	96	152	211	274	340	409	**945**	53	117	184	255	330	409	492
	32	**840**	44	96	153	213	276	343	413	**1,008**	53	117	185	257	333	413	497
	36	**945**	44	97	154	215	280	349	422	**1,134**	53	117	186	260	338	420	508
690	24	**630**	48	104	164	226	290	358	427	**756**	59	127	198	272	350	430	514
	26	**683**	48	105	165	227	293	361	432	**819**	59	127	199	274	352	434	520
	28	**735**	48	105	165	228	295	364	437	**882**	59	127	200	275	355	438	525
	30	**788**	48	105	166	230	297	367	441	**945**	59	127	200	277	358	442	531
	32	**840**	48	105	166	231	299	371	446	**1,008**	59	128	201	279	360	446	536
	36	**945**	48	106	168	234	303	377	455	**1,134**	59	128	203	282	365	454	547
	40	**1,050**	48	106	169	236	308	384	464	**1,260**	59	129	204	285	371	462	558
750	28	**735**	52	114	179	247	318	392	469	**882**	64	138	216	297	383	472	564
	30	**788**	52	114	179	248	320	395	473	**945**	64	138	217	299	385	476	570
	32	**840**	52	114	180	249	322	398	478	**1,008**	64	138	217	301	388	479	575
	36	**945**	52	115	181	252	326	405	487	**1,134**	64	139	219	304	393	487	586
	40	**1050**	52	115	183	255	331	411	496	**1,260**	64	139	221	307	398	495	597
820	28	**735**	57	124	195	268	345	424	507	**882**	70	150	235	323	415	511	610
	30	**788**	57	124	195	269	347	427	511	**945**	70	151	236	325	418	514	615
	32	**840**	57	125	196	271	349	431	516	**1,008**	70	151	237	326	420	518	621
	36	**945**	57	125	197	273	353	437	525	**1,134**	70	152	238	329	425	526	631
	40	**1,050**	57	125	198	276	358	444	534	**1,260**	70	152	240	333	431	534	642

Contents

Determination of basic dimensions

The main dimensions of the winch system can be roughly calculated using the completed dimensioning of the drum, the motor and the switch cabinet.

Option 1: Switch cabinet placed separately from winch

$W_{WIS} = W_T + L_{Mot} + D_T$

$D_{WIS} = D_{W\_max} + 2 \times 230\ mm + 100\ mm + 240\ mm$
$= D_{W\_max} + 800\ mm$

$H_{WIS} = D_{WIS}$

W_{WIS} [mm]: Width of the winch system

H_{WIS} [mm]: Height of the winch system

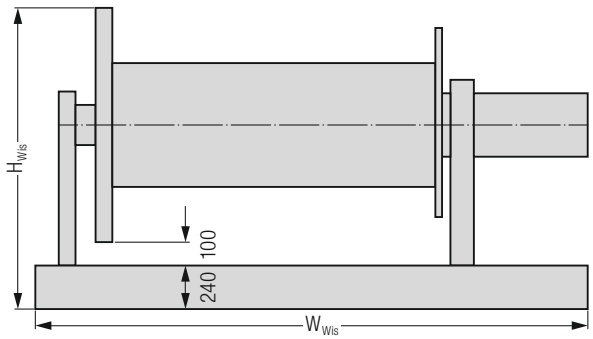
D_{WIS} [mm]: Depth of the winch system

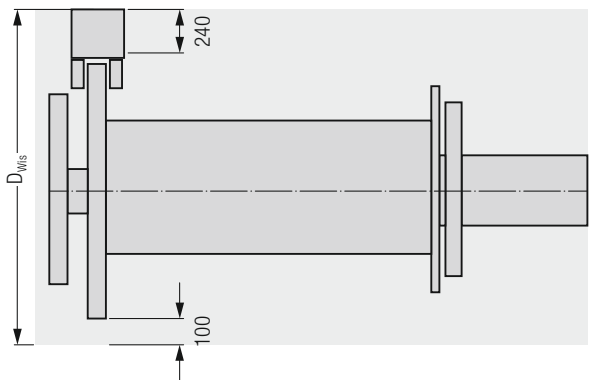
W_T [mm]: Drum width

L_{Mot} [mm]: Motor length

D_T [mm]: Drum diameter

D_{W_max} [mm]: Max. winding diameter





Option 2: Switch cabinet placed on the frame of the winch system

$W_{WIS} = W_T + W_{SRA} + D_T$

$D_{WIS} = D_{W\_max} + 2 \times 230\,mm + 100\,mm + 240\,mm$
$= D_{W\_max} + 800\,mm$

$H_{WIS} = H_{SRA} + 240\,mm$

W_{WIS} [mm]: Width of the winch system

H_{WIS} [mm]: Height of the winch system

D_{WIS} [mm]: Depth of the winch system

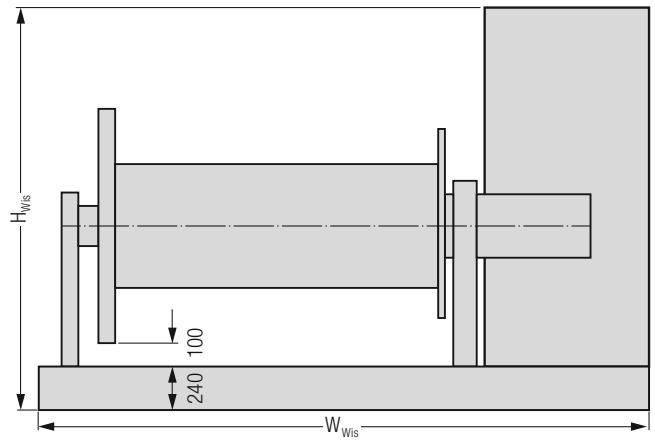
W_T [mm]: Drum width

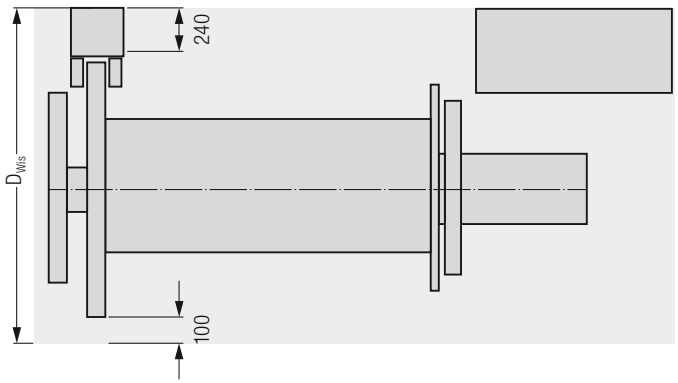
W_{SRA} [mm]: Switch cabinet width

D_T [mm]: Drum diameter

H_{SRA} [mm]: Switch cabinet height

D_{W_max} [mm]: Max. winding diameter





Contents

Features and optional functions

Standard equipment

Winch:
- Secondary brake
- Brake pad monitoring of the secondary brake
- Brake condition monitoring "open" of the secondary brake
- Absolute rotary encoder on the drum
- Position monitoring via absolute rotary encoder on the drum
- External fan for motor cooling
- Motor temperature monitoring by sensor for external cooling fan
- Motor brake
- Brake pad monitoring of the motor brake
- Brake condition monitoring "open" of the motor brake
- Motor rotary encoder
- Motor protection rating IP 54

Switch cabinet
- Power supply 3-phase 400 V AC
- Frequency 50-60 Hz
- Network form TN
- IP 23 protection rating
- EMC interference emission – category C3 (industry)
- Reserve space per SRA control unit 20 % for additional customer-specific equipment
- Safety control according to EN 13849
- 7“ display for indication of operating states and errors (languages German and English)
- Buttons on the switch cabinet to operate the winch (2 speeds can be set)
- Event counter and data logger
- Ambient temperature range 0 °C ... +35 °C
- Brake resistor
- UDP and Profinet interface to host computer
- Up to 20 m cable length between switch cabinet and winch

Functions:
- Adjustable acceleration ramps
- Adjustable shape of acceleration ramps

Optional equipment

Winch:
- Slack rope monitoring
- Load measurement using measuring axis
- Travel limitation via inductive proximity switches
- Oil cooling
- Oil heating
- Motor maintenance switch
- Without secondary brake

Switch cabinet
- Radio remote control with feedback, Profinet interface
- Cable based remote control
- External movable emergency stop switch with magnetic holder
- Emergency stop via mechanical limit switches
- Temperature measurement and monitoring of the switch cabinet
- Remote maintenance via modem
- Switch cabinet lighting
- Regenerative unit (Active Front End)
- Energy storage for covering power peaks
- Design according to UL508A
- Ambient temperature range: -20 °C … +35 °C
- Ambient temperature range: 0 °C … +45 °C
- Profinet or CAN interface to host computer
- Up to 100 m cable length between switch cabinet and winch

Functions:
- Drum sensors for teaching of intermediate positions (8 points), e.g. for adjustment of speeds
- Field weakening operation of the motor to realise higher speeds in the partial load range (max. 3 times spreading from 1,500 to 4,500 rpm)

Further options and special equipment are available on request.

Contents

Request Data

Winch Systems

General Information

Request Data		Telephone	
Company		E-Mail	
Contact Person		Application	
Road		Machine / Type	
Postcode	Location	Required quantity / Annual quantity	
Country		Requested delivery data	

Inquiry Winch Systems

Operational Data

Load case / description	Rope tensile force F_s [kN]	Lifting speed v_h [m/min]	Time share [%]
1			
2			
3			
4			
			100 %
Required service life* t [h]			

* Sum of time while mechanism in movement

Technical Data

Lifting height H [m]	m	Ambient temperature winch T [°C]	°C
Number of winding layer on a drum n_l [-]		Ambient temperature switch cabinet T_{SRA} [°C]	°C
Number of ropes per drum n_r [-]		Installation altitude ma.s.l. [m]	
Hoist reeving n_m [-]		Required protection class of motor	IP___
Number of fixed deflection sheaves between drum and hoist or moving part n_u [-]		Operation category of motor	S ___
Secondary brake required [yes / no]		Required protection class of motor	IP___

Further Comments / Requirements

Description of application / operation

For further questions,
please do not hesitate to contact us.
Please return completed form to:

Reset all Settings
Print Form
E-mail to: components@liebherr.com

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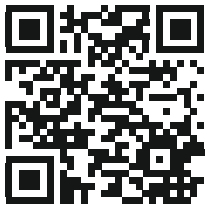
Contact, enquiry and further Information

Would you like a quotation for a winch system or could this manual not cover your specifications? Please do not hesitate to contact us. We look forward to your enquiry.



This design manual, the enquiry data sheet and further information can be found at our website:

www.liebherr.com/drive-systems

You can also send the completed result sheet stating your contact details as an enquiry to the following e-mail address:

components@liebherr.com

Contents

1 layer, 1 rope
Reduction by 2 or more mechanism groups

1 layer, 1 rope

	M3				M4				M5				M6				M7			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
10									10	300	420	420	11	300	420	420	11	300	420	420
11.2									10	300	420	420	12	300	420	420	12	300	420	420
12.5					10	300	420	420	11	300	420	420	12	300	420	420	12	300	420	420
14					10	300	420	420	11	300	420	420	13	300	420	420	13	300	420	420
16	10	300	420	420	11	300	420	420	12	300	420	420	14	300	420	420	14	300	420	420
18	10	300	420	420	12	300	420	420	13	300	420	420	15	300	420	420	15	300	420	420
20	11	300	420	420	12	300	420	420	14	300	420	420	15	300	420	420	15	300	420	420
22.4	12	300	420	420	13	300	420	420	14	300	420	420	16	300	420	420	16	300	420	420
25	12	300	420	420	14	300	420	420	15	300	420	420	18	300	455	455	18	300	455	455
28	13	300	420	420	14	300	420	420	16	300	420	420	18	300	455	455	18	300	455	455
31.5	14	300	420	420	15	300	420	420	18	300	420	420	20	300	505	505	20	350	505	505
35.5	14	300	420	420	16	300	420	420	18	300	420	420	20	350	505	505	20	350	505	505
40	15	300	420	420	18	300	420	420	20	350	455	455	22	350	580	580	22	350	580	580
45	16	300	420	420	18	300	420	420	20	350	455	455	24	350	630	630	24	350	630	630
50	18	300	420	420	20	350	455	455	22	350	505	505	24	350	630	630	24	350	630	630
56	18	350	455	455	20	350	455	455	22	350	505	505	26	350	690	690	26	400	690	690
63	20	350	455	455	22	350	455	455	24	350	580	580	28	400	750	750	28	400	750	750
71	20	350	455	455	22	350	455	455	26	350	630	630	28	400	750	750	28	450	750	750
80	22	350	455	455	24	350	505	505	28	400	630	630	30	450	750	750	30	450	750	750
90	24	350	455	455	26	400	580	580	28	400	630	630	32	450	820	820	32	450	820	820
100	24	350	455	455	28	400	580	580	30	450	690	690								
112	26	400	505	505	28	400	580	580	32	450	750	750								
125	28	400	505	505	30	450	630	630	36	500	820	820								
140	28	400	505	505	32	450	690	690	36	500	820	820								
160	30	450	580	580	36	500	750	750												
180	32	450	580	580	36	500	750	750												
200	36	500	690	690	40	550	820	820												
224	36	550	690	690	40	550	820	820												
250	40	550	750	750																
280	40	650	750	750																

1 layer, 1 rope
Reduction by 1 mechanism group

1 layer, 1 rope

	M4				M5				M6				M7				M8			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
10									10	300	420	420	11	300	420	420	11	300	420	420
11.2									10	300	420	420	12	300	420	420	12	300	420	420
12.5					10	300	420	420	11	300	420	420	12	300	420	420	12	300	420	420
14					10	300	420	420	11	300	420	420	13	300	420	420	13	300	420	420
16	10	300	420	420	11	300	420	420	12	300	420	420	14	300	420	420	14	300	420	420
18	10	300	420	420	12	300	420	420	13	300	420	420	15	300	420	420	15	300	420	420
20	11	300	420	420	12	300	420	420	14	300	420	420	15	300	420	420	15	300	420	420
22.4	12	300	420	420	13	300	420	420	14	300	420	420	16	300	420	420	16	300	420	420
25	12	300	420	420	14	300	420	420	15	300	420	420	18	300	455	455	18	300	455	455
28	13	300	420	420	14	300	420	420	16	300	420	420	18	300	455	455	18	300	455	455
31.5	14	300	420	420	15	300	420	420	18	300	420	420	20	350	505	505	20	350	505	505
35.5	14	300	420	420	16	300	420	420	18	300	420	420	20	350	505	505	20	350	505	505
40	15	300	420	420	18	300	420	420	20	350	455	455	22	350	580	580	22	350	580	580
45	16	300	420	420	18	350	455	455	20	350	455	455	24	350	630	630	24	350	630	630
50	18	350	455	455	20	350	455	455	22	350	505	505	24	350	630	630	24	350	630	630
56	18	350	455	455	20	350	455	455	22	350	505	505	26	400	690	690	26	400	690	690
63	20	350	455	455	22	350	455	455	24	350	580	580	28	400	750	750	28	400	750	750
71	20	350	455	455	22	350	455	455	26	400	630	630	28	450	750	750	28	450	750	750
80	22	350	455	455	24	350	505	505	28	400	630	630	30	450	750	750	30	450	750	750
90	24	350	455	455	26	400	580	580	28	400	630	630	32	450	820	820	32	500	820	820
100	24	350	455	455	28	400	580	580	30	450	690	690								
112	26	400	505	505	28	400	580	580	32	450	750	750								
125	28	400	505	505	30	450	630	630	36	500	820	820								
140	28	400	505	505	32	450	690	690	36	500	820	820								
160	30	450	580	580	36	500	750	750												
180	32	450	580	580	36	500	750	750												
200	36	500	690	690	40	550	820	820												
224	36	550	690	690	40	550	820	820												
250	40	550	750	750																
280	40	650	750	750																

1 layer, 1 rope
Increase by 1 mechanism group

1 layer, 1 rope

	M6				M7				M8				M9			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
10									10	300	420	420	11	300	420	420
11.2									10	300	420	420	12	300	420	420
12.5					10	300	420	420	11	300	420	420	12	300	420	420
14					10	300	420	420	11	300	420	420	13	300	420	420
16	10	300	420	420	11	300	420	420	12	300	420	420	14	300	420	420
18	10	300	420	420	12	300	420	420	13	300	420	420	15	300	420	420
20	11	300	420	420	12	300	420	420	14	300	420	420	15	300	420	420
22.4	12	300	420	420	13	300	420	420	14	300	420	420	16	300	420	420
25	12	300	420	420	14	300	420	420	15	300	420	420	18	350	455	455
28	13	300	420	420	14	300	420	420	16	300	420	420	18	350	455	455
31.5	14	300	420	420	15	300	420	420	18	350	455	455	20	350	505	505
35.5	14	300	420	420	16	350	455	455	18	350	455	455	20	350	505	505
40	15	350	455	455	18	350	455	455	20	350	455	455	22	350	580	580
45	16	350	455	455	18	350	455	455	20	350	455	455	24	400	630	630
50	18	350	455	455	20	350	455	455	22	350	505	505	24	400	630	630
56	18	350	455	455	20	350	455	455	22	350	505	505	26	400	690	690
63	20	350	455	455	22	350	455	455	24	400	580	580	28	450	750	750
71	20	350	455	455	22	350	455	455	26	400	630	630	28	450	750	750
80	22	350	455	455	24	400	505	505	28	450	630	630	30	500	750	750
90	24	400	505	505	26	450	580	580	28	450	630	630	32	500	820	820
100	24	400	505	505	28	450	580	580	30	450	690	690				
112	26	400	505	505	28	450	580	580	32	500	750	750				
125	28	450	580	580	30	500	630	630	36	500	820	820				
140	28	450	580	580	32	500	690	690	36	550	820	820				
160	30	500	630	630	36	550	750	750								
180	32	500	630	630	36	550	750	750								
200	36	550	690	690	40	650	820	820								
224	36	550	690	690	40	650	820	820								
250	40	650	750	750												
280	40	650	750	750												

1 layer, 1 rope
Increase by 2 mechanism groups

1 layer, 1 rope

	M7				M8				M9			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
10									10	300	420	420
11.2									10	300	420	420
12.5					10	300	420	420	11	300	420	420
14					10	300	420	420	11	300	420	420
16	10	300	420	420	11	300	420	420	12	300	420	420
18	10	300	420	420	12	300	420	420	13	300	420	420
20	11	300	420	420	12	300	420	420	14	300	420	420
22.4	12	300	420	420	13	300	420	420	14	300	420	420
25	12	300	420	420	14	300	420	420	15	300	420	420
28	13	300	420	420	14	300	420	420	16	350	455	455
31.5	14	300	420	420	15	350	455	455	18	350	455	455
35.5	14	350	455	455	16	350	455	455	18	350	455	455
40	15	350	455	455	18	350	455	455	20	350	455	455
45	16	350	455	455	18	350	455	455	20	350	455	455
50	18	350	455	455	20	350	455	455	22	350	505	505
56	18	350	455	455	20	350	455	455	22	400	505	505
63	20	350	455	455	22	350	455	455	24	400	580	580
71	20	350	455	455	22	350	455	455	26	450	630	630
80	22	400	505	505	24	400	505	505	28	450	630	630
90	24	400	505	505	26	450	580	580	28	450	630	630
100	24	400	505	505	28	450	580	580	30	500	690	690
112	26	450	580	580	28	450	580	580	32	500	750	750
125	28	450	580	580	30	500	630	630	36	550	820	820
140	28	500	630	630	32	500	690	690	36	550	820	820
160	30	500	630	630	36	550	750	750				
180	32	500	630	630	36	550	750	750				
200	36	550	690	690	40	650	820	820				
224	36	550	690	690	40	650	820	820				
250	40	650	750	750								
280	40	650	750	750								

1 layer, 2 ropes
Reduction by 2 or more mechanism groups

1 layer, 2 ropes

	M3				M4				M5				M6				M7			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
8													10	300	420	420	10	300	420	420
9													10	300	420	420	10	300	420	420
10									10	300	420	420	11	300	420	420	11	300	420	420
11.2									10	300	420	420	12	300	420	420	12	300	420	420
12.5					10	300	420	420	11	300	420	420	12	300	420	420	12	300	420	420
14					10	300	420	420	11	300	420	420	13	300	420	420	13	300	420	420
16	10	300	420	420	11	300	420	420	12	300	420	420	14	300	420	420	14	300	420	420
18	10	300	420	420	12	300	420	420	13	300	420	420	15	300	420	420	15	350	455	455
20	11	300	420	420	12	300	420	420	14	300	420	420	15	350	455	455	15	350	455	455
22.4	12	300	420	420	13	300	420	420	14	350	455	455	16	350	455	455	16	350	455	455
25	12	300	420	420	14	350	455	455	15	350	455	455	18	350	455	455	18	350	455	455
28	13	350	455	455	14	350	455	455	16	350	455	455	18	350	455	455	18	350	455	455
31.5	14	350	455	455	15	350	455	455	18	350	455	455	20	350	505	505	20	350	505	505
35.5	14	350	455	455	16	350	455	455	18	350	455	455	20	350	505	505	20	350	505	505
40	15	350	455	455	18	350	455	455	20	350	455	455	22	400	580	580	22	400	580	580
45	16	350	455	455	18	350	455	455	20	350	455	455	24	400	630	630	24	450	630	630
50	18	350	455	455	20	350	455	455	22	400	505	505	24	450	630	630	24	450	630	630
56	18	350	455	455	20	350	455	455	22	400	505	505	26	450	690	690	26	450	690	690
63	20	400	505	505	22	400	505	505	24	450	580	580	28	500	750	750	28	500	750	750
71	20	400	505	505	22	400	505	505	26	450	630	630	28	500	750	750	28	500	750	750
80	22	450	580	580	24	450	580	580	28	500	630	630	30	500	750	750	30	550	750	750
90	24	450	580	580	26	450	580	580	28	500	630	630	32	550	820	820	32	550	820	820
100	24	500	630	630	28	500	630	630	30	500	690	690								
112	26	500	630	630	28	500	630	630	32	550	750	750								
125	28	550	690	690	30	550	690	690	36	550	820	820								
140	28	550	690	690	32	550	690	690	36	650	820	820								
160	30	650	750	750	36	650	750	750												
180	32	650	750	750	36	650	750	750												
200	36	650	750	750	40	700	820	820												
224	36	700	820	820	40	700	820	820												
250	40	700	820	820																

1 layer, 2 ropes
Reduction by 1 mechanism group

1 layer, 2 ropes

	M4				M5				M6				M7				M8			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
8													10	300	420	420	10	300	420	420
9													10	300	420	420	10	300	420	420
10									10	300	420	420	11	300	420	420	11	300	420	420
11.2									10	300	420	420	12	300	420	420	12	300	420	420
12.5					10	300	420	420	11	300	420	420	12	300	420	420	12	300	420	420
14					10	300	420	420	11	300	420	420	13	300	420	420	13	300	420	420
16	10	300	420	420	11	300	420	420	12	300	420	420	14	300	420	420	14	350	455	455
18	10	300	420	420	12	300	420	420	13	300	420	420	15	350	455	455	15	350	455	455
20	11	300	420	420	12	300	420	420	14	350	455	455	15	350	455	455	15	350	455	455
22.4	12	300	420	420	13	350	455	455	14	350	455	455	16	350	455	455	16	350	455	455
25	12	350	455	455	14	350	455	455	15	350	455	455	18	350	455	455	18	350	455	455
28	13	350	455	455	14	350	455	455	16	350	455	455	18	350	455	455	18	350	455	455
31.5	14	350	455	455	15	350	455	455	18	350	455	455	20	350	505	505	20	350	505	505
35.5	14	350	455	455	16	350	455	455	18	350	455	455	20	350	505	505	20	400	505	505
40	15	350	455	455	18	350	455	455	20	350	455	455	22	400	580	580	22	400	580	580
45	16	350	455	455	18	350	455	455	20	400	505	505	24	450	630	630	24	450	630	630
50	18	350	455	455	20	350	455	455	22	400	505	505	24	450	630	630	24	450	630	630
56	18	350	455	455	20	400	505	505	22	400	505	505	26	450	690	690	26	500	690	690
63	20	400	505	505	22	400	505	505	24	450	580	580	28	500	750	750	28	500	750	750
71	20	400	505	505	22	450	580	580	26	500	630	630	28	500	750	750	28	550	750	750
80	22	450	580	580	24	450	580	580	28	500	630	630	30	550	750	750	30	550	750	750
90	24	450	580	580	26	500	630	630	28	500	630	630	32	550	820	820	32	550	820	820
100	24	500	630	630	28	500	630	630	30	550	690	690								
112	26	500	630	630	28	500	630	630	32	550	750	750								
125	28	550	690	690	30	550	690	690	36	650	820	820								
140	28	550	690	690	32	550	690	690	36	650	820	820								
160	30	650	750	750	36	650	750	750												
180	32	650	750	750	36	650	750	750												
200	36	650	750	750	40	700	820	820												
224	36	700	820	820	40	700	820	820												
250	40	700	820	820																

1 layer, 2 ropes
Increase by 1 mechanism group

1 layer, 2 ropes

	M6				M7				M8				M9			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_t [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_t [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_t [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_t [mm]	Max. winding diameter D_{W_max} [mm]
8													10	300	420	420
9													10	300	420	420
10									10	300	420	420	11	300	420	420
11.2									10	300	420	420	12	300	420	420
12.5					10	300	420	420	11	300	420	420	12	300	420	420
14					10	300	420	420	11	300	420	420	13	350	455	455
16	10	300	420	420	11	300	420	420	12	350	455	455	14	350	455	455
18	10	300	420	420	12	350	455	455	13	350	455	455	15	350	455	455
20	11	350	455	455	12	350	455	455	14	350	455	455	15	350	455	455
22.4	12	350	455	455	13	350	455	455	14	350	455	455	16	350	455	455
25	12	350	455	455	14	350	455	455	15	350	455	455	18	350	455	455
28	13	350	455	455	14	350	455	455	16	350	455	455	18	350	455	455
31.5	14	350	455	455	15	350	455	455	18	350	455	455	20	400	505	505
35.5	14	350	455	455	16	350	455	455	18	350	455	455	20	400	505	505
40	15	350	455	455	18	400	505	505	20	400	505	505	22	450	580	580
45	16	400	505	505	18	400	505	505	20	400	505	505	24	450	630	630
50	18	400	505	505	20	400	505	505	22	450	580	580	24	500	630	630
56	18	400	505	505	20	450	580	580	22	450	580	580	26	500	690	690
63	20	450	580	580	22	450	580	580	24	500	630	630	28	550	750	750
71	20	450	580	580	22	500	630	630	26	500	630	630	28	550	750	750
80	22	500	630	630	24	500	630	630	28	500	630	630	30	550	750	750
90	24	500	630	630	26	500	630	630	28	550	690	690	32	650	820	820
100	24	500	630	630	28	550	690	690	30	550	690	690				
112	26	550	690	690	28	550	690	690	32	650	750	750				
125	28	550	690	690	30	650	750	750	36	650	820	820				
140	28	650	750	750	32	650	750	750	36	700	820	820				
160	30	650	750	750	36	700	820	820								
180	32	700	820	820	36	700	820	820								
200	36	700	820	820	40	700	820	820								
224	36	700	820	820												

1 layer, 2 ropes
Increase by 2 mechanism groups

1 layer, 2 ropes

	M7				M8				M9			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
8												
9												
10									10	300	420	420
11.2									10	300	420	420
12.5					10	300	420	420	11	300	420	420
14					10	300	420	420	11	350	455	455
16	10	300	420	420	11	350	455	455	12	350	455	455
18	10	350	455	455	12	350	455	455	13	350	455	455
20	11	350	455	455	12	350	455	455	14	350	455	455
22.4	12	350	455	455	13	350	455	455	14	350	455	455
25	12	350	455	455	14	350	455	455	15	350	455	455
28	13	350	455	455	14	350	455	455	16	350	455	455
31.5	14	350	455	455	15	350	455	455	18	400	505	505
35.5	14	350	455	455	16	350	455	455	18	400	505	505
40	15	400	505	505	18	400	505	505	20	450	580	580
45	16	400	505	505	18	400	505	505	20	450	580	580
50	18	400	505	505	20	450	580	580	22	450	580	580
56	18	450	580	580	20	450	580	580	22	500	630	630
63	20	450	580	580	22	500	630	630	24	500	630	630
71	20	500	630	630	22	500	630	630	26	550	690	690
80	22	500	630	630	24	500	630	630	28	550	690	690
90	24	500	630	630	26	550	690	690	28	650	750	750
100	24	550	690	690	28	550	690	690	30	650	750	750
112	26	550	690	690	28	650	750	750	32	650	750	750
125	28	650	750	750	30	650	750	750	36	700	820	820
140	28	650	750	750	32	650	750	750	36	700	820	820
160	30	700	820	820	36	700	820	820				
180	32	700	820	820	36	700	820	820				
200	36	700	820	820								

2 layers, 1 rope
Reduction by 2 or more mechanism groups

2 layers, 1 rope

	M1				M2				M3			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
16									10	300	420	437
18	10	300	420	437	10	300	420	437	10	300	420	437
20	10	300	420	437	10	300	420	437	11	300	420	439
22.4	11	300	420	439	11	300	420	439	12	300	420	440
25	12	300	420	440	12	300	420	440	12	300	420	440
28	12	300	420	440	12	300	420	440	13	300	420	442
31.5	13	300	420	442	13	300	420	442	14	300	420	444
35.5	14	300	420	444	14	300	420	444	14	300	420	444
40	14	300	420	444	14	300	420	444	15	300	420	446
45	15	300	420	446	15	300	420	446	16	300	420	447
50	16	300	420	447	16	300	420	447	18	350	455	486
56	18	350	455	486	18	350	455	486	18	350	455	486
63	18	350	455	486	18	350	455	486	20	350	455	489
71	20	350	455	489	20	350	455	489	20	350	455	489
80	20	350	455	489	20	350	455	489	22	350	455	492
90	22	350	455	492	22	350	455	492	24	350	505	546
100	24	400	505	546	24	400	505	546	24	400	505	546
112	24	400	505	546	24	400	505	546	26	400	580	624
125	26	450	580	624	26	450	580	624	28	450	580	628
140	28	450	580	628	28	450	580	628	28	450	580	628
160	28	450	580	628	28	450	580	628	30	450	630	681
180	30	500	630	681	30	500	630	681	32	500	690	744
200	32	550	690	744	32	550	690	744	36	550	750	811
224	36	550	750	811	36	550	750	811	36	550	750	811
250	36	550	750	811	36	550	750	811	40	650	820	888
280	40	650	820	888	40	650	820	888	40	650	820	888
315	40	650	820	888	40	650	820	888				

2 layers, 1 rope
Reduction by 1 mechanism group

2 layers, 1 rope

	M1				M2				M3				M4			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_t [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_t [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_t [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_t [mm]	Max. winding diameter D_{W_max} [mm]
16													10	300	420	437
18	10	300	420	437	10	300	420	437	10	300	420	437	10	300	420	437
20	10	300	420	437	10	300	420	437	10	300	420	437	11	300	420	439
22.4	11	300	420	439	11	300	420	439	11	300	420	439	12	300	420	440
25	12	300	420	440	12	300	420	440	12	300	420	440	12	300	420	440
28	12	300	420	440	12	300	420	440	12	300	420	440	13	300	420	442
31.5	13	300	420	442	13	300	420	442	13	300	420	442	14	300	420	444
35.5	14	300	420	444	14	300	420	444	14	300	420	444	14	300	420	444
40	14	300	420	444	14	300	420	444	14	300	420	444	15	300	420	446
45	15	300	420	446	15	300	420	446	15	300	420	446	16	300	420	447
50	16	300	420	447	16	300	420	447	16	350	455	482	18	350	455	486
56	18	350	455	486	18	350	455	486	18	350	455	486	18	350	455	486
63	18	350	455	486	18	350	455	486	18	350	455	486	20	350	455	489
71	20	350	455	489	20	350	455	489	20	350	455	489	20	350	455	489
80	20	350	455	489	20	350	455	489	20	350	455	489	22	350	455	492
90	22	350	455	492	22	350	455	492	22	350	455	492	24	350	505	546
100	24	400	505	546	24	400	505	546	24	400	505	546	24	400	505	546
112	24	400	505	546	24	400	505	546	24	400	505	546	26	400	580	624
125	26	450	580	624	26	450	580	624	26	450	580	624	28	450	580	628
140	28	450	580	628	28	450	580	628	28	450	580	628	28	450	580	628
160	28	450	580	628	28	450	580	628	28	450	580	628	30	450	630	681
180	30	500	630	681	30	500	630	681	30	500	630	681	32	500	690	744
200	32	550	690	744	32	550	690	744	32	550	690	744	36	550	750	811
224	36	550	750	811	36	550	750	811	36	550	750	811	36	550	750	811
250	36	550	750	811	36	550	750	811	36	550	750	811	40	650	820	888
280	40	650	820	888	40	650	820	888	40	650	820	888	40	650	820	888
315	40	650	820	888	40	650	820	888	40	650	820	888				

2 layers, 1 rope
Increase by 1 mechanism group

2 layers, 1 rope

	M2				M3				M4				M5				M6			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
16																	10	300	420	437
18	10	300	420	437	10	300	420	437	10	300	420	437	10	300	420	437	10	300	420	437
20	10	300	420	437	10	300	420	437	10	300	420	437	10	300	420	437	11	300	420	439
22.4	11	300	420	439	11	300	420	439	11	300	420	439	11	300	420	439	12	300	420	440
25	12	300	420	440	12	300	420	440	12	300	420	440	12	300	420	440	12	300	420	440
28	12	300	420	440	12	300	420	440	12	300	420	440	12	300	420	440	13	300	420	442
31.5	13	300	420	442	13	300	420	442	13	300	420	442	13	300	420	442	14	300	420	444
35.5	14	300	420	444	14	300	420	444	14	300	420	444	14	300	420	444	14	300	420	444
40	14	300	420	444	14	300	420	444	14	300	420	444	14	300	420	444	15	350	455	481
45	15	300	420	446	15	300	420	446	15	300	420	446	15	350	455	481	16	350	455	482
50	16	300	420	447	16	350	455	482	16	350	455	482	16	350	455	482	18	350	455	486
56	18	350	455	486	18	350	455	486	18	350	455	486	18	350	455	486	18	350	455	486
63	18	350	455	486	18	350	455	486	18	350	455	486	18	350	455	486	20	350	455	489
71	20	350	455	489	20	350	455	489	20	350	455	489	20	350	455	489	20	350	455	489
80	20	350	455	489	20	350	455	489	20	350	455	489	20	350	455	489	22	350	455	492
90	22	350	455	492	22	350	455	492	22	350	455	492	22	350	455	492	24	400	505	546
100	24	400	505	546	24	400	505	546	24	400	505	546	24	400	505	546	24	400	505	546
112	24	400	505	546	24	400	505	546	24	400	505	546	24	400	505	546	26	450	580	624
125	26	450	580	624	26	450	580	624	26	450	580	624	26	450	580	624	28	450	580	628
140	28	450	580	628	28	450	580	628	28	450	580	628	28	450	580	628	28	450	580	628
160	28	450	580	628	28	450	580	628	28	450	580	628	28	500	630	678	30	500	630	681
180	30	500	630	681	30	500	630	681	30	500	630	681	30	500	630	681	32	550	690	744
200	32	550	690	744	32	550	690	744	32	550	690	744	32	550	690	744	36	550	750	811
224	36	550	750	811	36	550	750	811	36	550	750	811	36	550	750	811	36	550	750	811
250	36	550	750	811	36	550	750	811	36	550	750	811	36	550	750	811	40	650	820	888
280	40	650	820	888	40	650	820	888	40	650	820	888	40	650	820	888	40	650	820	888
315	40	650	820	888	40	650	820	888	40	650	820	888	40	650	820	888				

2 layers, 1 rope
Increase by 2 mechanism groups

2 layers, 1 rope

	M3				M4				M5				M6				M7			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
16																	10	300	420	437
18	10	300	420	437	10	300	420	437	10	300	420	437	10	300	420	437	10	300	420	437
20	10	300	420	437	10	300	420	437	10	300	420	437	10	300	420	437	11	300	420	439
22.4	11	300	420	439	11	300	420	439	11	300	420	439	11	300	420	439	12	300	420	440
25	12	300	420	440	12	300	420	440	12	300	420	440	12	300	420	440	12	300	420	440
28	12	300	420	440	12	300	420	440	12	300	420	440	12	300	420	440	13	300	420	442
31.5	13	300	420	442	13	300	420	442	13	300	420	442	13	300	420	442	14	300	420	444
35.5	14	300	420	444	14	300	420	444	14	300	420	444	14	300	420	444	14	350	455	479
40	14	300	420	444	14	300	420	444	14	300	420	444	14	350	455	479	15	350	455	481
45	15	300	420	446	15	300	420	446	15	350	455	481	15	350	455	481	16	350	455	482
50	16	350	455	482	16	350	455	482	16	350	455	482	16	350	455	482	18	350	455	486
56	18	350	455	486	18	350	455	486	18	350	455	486	18	350	455	486	18	350	455	486
63	18	350	455	486	18	350	455	486	18	350	455	486	18	350	455	486	20	350	455	489
71	20	350	455	489	20	350	455	489	20	350	455	489	20	350	455	489	20	350	455	489
80	20	350	455	489	20	350	455	489	20	350	455	489	20	350	455	489	22	400	505	542
90	22	350	455	492	22	350	455	492	22	350	455	492	22	400	505	542	24	400	505	546
100	24	400	505	546	24	400	505	546	24	400	505	546	24	400	505	546	24	450	580	621
112	24	400	505	546	24	400	505	546	24	400	505	546	24	450	580	621	26	450	580	624
125	26	450	580	624	26	450	580	624	26	450	580	624	26	450	580	624	28	450	580	628
140	28	450	580	628	28	450	580	628	28	450	580	628	28	450	580	628	28	500	630	678
160	28	450	580	628	28	450	580	628	28	500	630	678	28	500	630	678	30	500	630	681
180	30	500	630	681	30	500	630	681	30	500	630	681	30	500	630	681	32	550	690	744
200	32	550	690	744	32	550	690	744	32	550	690	744	32	550	690	744	36	650	750	811
224	36	550	750	811	36	550	750	811	36	550	750	811	36	550	750	811	36	650	750	811
250	36	550	750	811	36	550	750	811	36	550	750	811	36	650	750	811	40	650	820	888
280	40	650	820	888	40	650	820	888	40	650	820	888	40	650	820	888	40	700	820	888
315	40	650	820	888	40	650	820	888	40	650	820	888	40	700	820	888				

3 layers, 1 rope
Reduction by 2 or more mechanism groups

3 layers, 1 rope

	M1				M2				M3			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
16									10	300	420	454
18	10	300	420	454	10	300	420	454	10	300	420	454
20	10	300	420	454	10	300	420	454	11	300	420	457
22.4	11	300	420	457	11	300	420	457	12	300	420	461
25	12	300	420	461	12	300	420	461	12	300	420	461
28	12	300	420	461	12	300	420	461	13	300	420	464
31.5	13	300	420	464	13	300	420	464	14	300	420	468
35.5	14	300	420	468	14	300	420	468	14	300	420	468
40	14	300	420	468	14	300	420	468	15	300	420	471
45	15	300	420	471	15	300	420	471	16	300	420	474
50	16	350	455	509	16	350	455	509	18	350	455	516
56	18	350	455	516	18	350	455	516	18	350	455	516
63	18	350	455	516	18	350	455	516	20	350	455	523
71	20	350	455	523	20	350	455	523	20	350	455	523
80	20	350	455	523	20	350	455	523	22	350	455	530
90	22	350	455	530	22	350	455	530	24	400	505	587
100	24	400	505	587	24	400	505	587	24	400	505	587
112	24	400	505	587	24	400	505	587	26	450	580	669
125	26	450	580	669	26	450	580	669	28	450	580	675
140	28	450	580	675	28	450	580	675	28	450	580	675
160	28	450	580	675	28	450	580	675	30	500	630	732
180	30	500	630	732	30	500	630	732	32	500	690	799
200	32	550	690	799	32	550	690	799	36	550	750	873
224	36	550	750	873	36	550	750	873	36	550	750	873
250	36	650	750	873	36	650	750	873	40	650	820	956
280	40	650	820	956	40	650	820	956	40	650	820	956
315	40	650	820	956	40	650	820	956				

3 layers, 1 rope
Reduction by 1 mechanism group

3 layers, 1 rope

	M1				M2				M3				M4			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_t [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_t [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_t [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_t [mm]	Max. winding diameter D_{W_max} [mm]
16													10	300	420	454
18	10	300	420	454	10	300	420	454	10	300	420	454	10	300	420	454
20	10	300	420	454	10	300	420	454	10	300	420	454	11	300	420	457
22.4	11	300	420	457	11	300	420	457	11	300	420	457	12	300	420	461
25	12	300	420	461	12	300	420	461	12	300	420	461	12	300	420	461
28	12	300	420	461	12	300	420	461	12	300	420	461	13	300	420	464
31.5	13	300	420	464	13	300	420	464	13	300	420	464	14	300	420	468
35.5	14	300	420	468	14	300	420	468	14	300	420	468	14	300	420	468
40	14	300	420	468	14	300	420	468	14	300	420	468	15	300	420	471
45	15	300	420	471	15	300	420	471	15	300	420	471	16	350	455	509
50	16	350	455	509	16	350	455	509	16	350	455	509	18	350	455	516
56	18	350	455	516	18	350	455	516	18	350	455	516	18	350	455	516
63	18	350	455	516	18	350	455	516	18	350	455	516	20	350	455	523
71	20	350	455	523	20	350	455	523	20	350	455	523	20	350	455	523
80	20	350	455	523	20	350	455	523	20	350	455	523	22	350	455	530
90	22	350	455	530	22	350	455	530	22	350	455	530	24	400	505	587
100	24	400	505	587	24	400	505	587	24	400	505	587	24	400	505	587
112	24	400	505	587	24	400	505	587	24	400	505	587	26	450	580	669
125	26	450	580	669	26	450	580	669	26	450	580	669	28	450	580	675
140	28	450	580	675	28	450	580	675	28	450	580	675	28	450	580	675
160	28	450	580	675	28	450	580	675	28	450	580	675	30	500	630	732
180	30	500	630	732	30	500	630	732	30	500	630	732	32	500	690	799
200	32	550	690	799	32	550	690	799	32	550	690	799	36	550	750	873
224	36	550	750	873	36	550	750	873	36	550	750	873	36	550	750	873
250	36	650	750	873	36	650	750	873	36	650	750	873	40	650	820	956
280	40	650	820	956	40	650	820	956	40	650	820	956	40	650	820	956
315	40	650	820	956	40	650	820	956	40	650	820	956				

3 layers, 1 rope
Increase by 1 mechanism group

3 layers, 1 rope

	M2				M3				M4				M5				M6			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
16																	10	300	420	454
18	10	300	420	454	10	300	420	454	10	300	420	454	10	300	420	454	10	300	420	454
20	10	300	420	454	10	300	420	454	10	300	420	454	10	300	420	454	11	300	420	457
22.4	11	300	420	457	11	300	420	457	11	300	420	457	11	300	420	457	12	300	420	461
25	12	300	420	461	12	300	420	461	12	300	420	461	12	300	420	461	12	300	420	461
28	12	300	420	461	12	300	420	461	12	300	420	461	12	300	420	461	13	300	420	464
31.5	13	300	420	464	13	300	420	464	13	300	420	464	13	300	420	464	14	300	420	468
35.5	14	300	420	468	14	300	420	468	14	300	420	468	14	300	420	468	14	350	455	503
40	14	300	420	468	14	300	420	468	14	300	420	468	14	350	455	503	15	350	455	506
45	15	300	420	471	15	300	420	471	15	350	455	506	15	350	455	506	16	350	455	509
50	16	350	455	509	16	350	455	509	16	350	455	509	16	350	455	509	18	350	455	516
56	18	350	455	516	18	350	455	516	18	350	455	516	18	350	455	516	18	350	455	516
63	18	350	455	516	18	350	455	516	18	350	455	516	18	350	455	516	20	350	455	523
71	20	350	455	523	20	350	455	523	20	350	455	523	20	350	455	523	20	350	455	523
80	20	350	455	523	20	350	455	523	20	350	455	523	20	350	455	523	22	400	505	580
90	22	350	455	530	22	350	455	530	22	350	455	530	22	400	505	580	24	400	505	587
100	24	400	505	587	24	400	505	587	24	400	505	587	24	400	505	587	24	450	580	662
112	24	400	505	587	24	400	505	587	24	400	505	587	24	400	505	587	26	450	580	669
125	26	450	580	669	26	450	580	669	26	450	580	669	26	450	580	669	28	450	580	675
140	28	450	580	675	28	450	580	675	28	450	580	675	28	450	580	675	28	500	630	725
160	28	450	580	675	28	450	580	675	28	450	580	675	28	500	630	725	30	500	630	732
180	30	500	630	732	30	500	630	732	30	500	630	732	30	500	630	732	32	550	690	799
200	32	550	690	799	32	550	690	799	32	550	690	799	32	550	690	799	36	550	750	873
224	36	550	750	873	36	550	750	873	36	550	750	873	36	550	750	873	36	650	750	873
250	36	650	750	873	36	650	750	873	36	650	750	873	36	650	750	873	40	650	820	956
280	40	650	820	956	40	650	820	956	40	650	820	956	40	650	820	956	40	700	820	956
315	40	650	820	956	40	650	820	956	40	650	820	956	40	650	820	956				

3 layers, 1 rope
Increase by 2 mechanism groups

3 layers, 1 rope

	M3				M4				M5				M6				M7			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
16																	10	300	420	454
18	10	300	420	454	10	300	420	454	10	300	420	454	10	300	420	454	10	300	420	454
20	10	300	420	454	10	300	420	454	10	300	420	454	10	300	420	454	11	300	420	457
22.4	11	300	420	457	11	300	420	457	11	300	420	457	11	300	420	457	12	300	420	461
25	12	300	420	461	12	300	420	461	12	300	420	461	12	300	420	461	12	300	420	461
28	12	300	420	461	12	300	420	461	12	300	420	461	12	300	420	461	13	300	420	464
31.5	13	300	420	464	13	300	420	464	13	300	420	464	13	300	420	464	14	350	455	503
35.5	14	300	420	468	14	300	420	468	14	300	420	468	14	350	455	503	14	350	455	503
40	14	300	420	468	14	300	420	468	14	350	455	503	14	350	455	503	15	350	455	506
45	15	300	420	471	15	350	455	506	15	350	455	506	15	350	455	506	16	350	455	509
50	16	350	455	509	16	350	455	509	16	350	455	509	16	350	455	509	18	350	455	516
56	18	350	455	516	18	350	455	516	18	350	455	516	18	350	455	516	18	350	455	516
63	18	350	455	516	18	350	455	516	18	350	455	516	18	350	455	516	20	350	455	523
71	20	350	455	523	20	350	455	523	20	350	455	523	20	350	455	523	20	400	505	573
80	20	350	455	523	20	350	455	523	20	350	455	523	20	400	505	573	22	400	505	580
90	22	350	455	530	22	350	455	530	22	400	505	580	22	400	505	580	24	450	580	662
100	24	400	505	587	24	400	505	587	24	400	505	587	24	450	580	662	24	450	580	662
112	24	400	505	587	24	400	505	587	24	400	505	587	24	450	580	662	26	450	580	669
125	26	450	580	669	26	450	580	669	26	450	580	669	26	450	580	669	28	500	630	725
140	28	450	580	675	28	450	580	675	28	450	580	675	28	500	630	725	28	500	630	725
160	28	450	580	675	28	450	580	675	28	500	630	725	28	500	630	725	30	550	690	792
180	30	500	630	732	30	500	630	732	30	500	630	732	30	550	690	792	32	550	690	799
200	32	550	690	799	32	550	690	799	32	550	690	799	32	550	690	799	36	650	750	873
224	36	550	750	873	36	550	750	873	36	550	750	873	36	650	750	873	36	650	750	873
250	36	650	750	873	36	650	750	873	36	650	750	873	36	650	750	873	40	700	820	956
280	40	650	820	956	40	650	820	956	40	650	820	956	40	700	820	956	40	700	820	956
315	40	650	820	956	40	650	820	956	40	650	820	956	40	700	820	956				

4 layers, 1 rope
Reduction by 2 or more mechanism groups

4 layers, 1 rope

	M1				M2				M3			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
16									10	300	420	471
18	10	300	420	471	10	300	420	471	10	300	420	471
20	10	300	420	471	10	300	420	471	11	300	420	476
22.4	11	300	420	476	11	300	420	476	12	300	420	481
25	12	300	420	481	12	300	420	481	12	300	420	481
28	12	300	420	481	12	300	420	481	13	300	420	486
31.5	13	300	420	486	13	300	420	486	14	300	420	491
35.5	14	300	420	491	14	300	420	491	14	300	420	491
40	14	300	420	491	14	300	420	491	15	300	420	497
45	15	300	420	497	15	300	420	497	16	350	455	537
50	16	350	455	537	16	350	455	537	18	350	455	547
56	18	350	455	547	18	350	455	547	18	350	455	547
63	18	350	455	547	18	350	455	547	20	350	455	557
71	20	350	455	557	20	350	455	557	20	350	455	557
80	20	350	455	557	20	350	455	557	22	350	455	567
90	22	350	455	567	22	350	455	567	24	400	505	628
100	24	400	505	628	24	400	505	628	24	400	505	628
112	24	400	505	628	24	400	505	628	26	450	580	713
125	26	450	580	713	26	450	580	713	28	450	580	723
140	28	450	580	723	28	450	580	723	28	450	580	723
160	28	500	630	773	28	500	630	773	30	500	630	783
180	30	500	630	783	30	500	630	783	32	550	690	853
200	32	550	690	853	32	550	690	853	36	550	750	934
224	36	650	750	934	36	650	750	934	36	650	750	934
250	36	650	750	934	36	650	750	934	40	650	820	1,024
280	40	650	820	1,024	40	650	820	1,024	40	650	820	1,024
315	40	700	820	1,024	40	700	820	1,024				

4 layers, 1 rope
Reduction by 1 mechanism group

4 layers, 1 rope

	M1				M2				M3				M4			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
16													10	300	420	471
18	10	300	420	471	10	300	420	471	10	300	420	471	10	300	420	471
20	10	300	420	471	10	300	420	471	10	300	420	471	11	300	420	476
22.4	11	300	420	476	11	300	420	476	11	300	420	476	12	300	420	481
25	12	300	420	481	12	300	420	481	12	300	420	481	12	300	420	481
28	12	300	420	481	12	300	420	481	12	300	420	481	13	300	420	486
31.5	13	300	420	486	13	300	420	486	13	300	420	486	14	300	420	491
35.5	14	300	420	491	14	300	420	491	14	300	420	491	14	300	420	491
40	14	300	420	491	14	300	420	491	14	300	420	491	15	300	420	497
45	15	300	420	497	15	300	420	497	15	350	455	532	16	350	455	537
50	16	350	455	537	16	350	455	537	16	350	455	537	18	350	455	547
56	18	350	455	547	18	350	455	547	18	350	455	547	18	350	455	547
63	18	350	455	547	18	350	455	547	18	350	455	547	20	350	455	557
71	20	350	455	557	20	350	455	557	20	350	455	557	20	350	455	557
80	20	350	455	557	20	350	455	557	20	350	455	557	22	350	455	567
90	22	350	455	567	22	350	455	567	22	350	455	567	24	400	505	628
100	24	400	505	628	24	400	505	628	24	400	505	628	24	400	505	628
112	24	400	505	628	24	400	505	628	24	400	505	628	26	450	580	713
125	26	450	580	713	26	450	580	713	26	450	580	713	28	450	580	723
140	28	450	580	723	28	450	580	723	28	450	580	723	28	450	580	723
160	28	500	630	773	28	500	630	773	28	500	630	773	30	500	630	783
180	30	500	630	783	30	500	630	783	30	500	630	783	32	550	690	853
200	32	550	690	853	32	550	690	853	32	550	690	853	36	550	750	934
224	36	650	750	934	36	650	750	934	36	650	750	934	36	650	750	934
250	36	650	750	934	36	650	750	934	36	650	750	934	40	650	820	1,024
280	40	650	820	1,024	40	650	820	1,024	40	650	820	1,024	40	650	820	1,024
315	40	700	820	1,024	40	700	820	1,024	40	700	820	1,024				

4 layers, 1 rope
Increase by 1 mechanism group

4 layers, 1 rope

	M2				M3				M4				M5				M6			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
16																	10	300	420	471
18	10	300	420	471	10	300	420	471	10	300	420	471	10	300	420	471	10	300	420	471
20	10	300	420	471	10	300	420	471	10	300	420	471	10	300	420	471	11	300	420	476
22.4	11	300	420	476	11	300	420	476	11	300	420	476	11	300	420	476	12	300	420	481
25	12	300	420	481	12	300	420	481	12	300	420	481	12	300	420	481	12	300	420	481
28	12	300	420	481	12	300	420	481	12	300	420	481	12	300	420	481	13	300	420	486
31.5	13	300	420	486	13	300	420	486	13	300	420	486	13	300	420	486	14	300	420	491
35.5	14	300	420	491	14	300	420	491	14	300	420	491	14	300	420	491	14	350	455	526
40	14	300	420	491	14	300	420	491	14	300	420	491	14	350	455	526	15	350	455	532
45	15	300	420	497	15	350	455	532	15	350	455	532	15	350	455	532	16	350	455	537
50	16	350	455	537	16	350	455	537	16	350	455	537	16	350	455	537	18	350	455	547
56	18	350	455	547	18	350	455	547	18	350	455	547	18	350	455	547	18	350	455	547
63	18	350	455	547	18	350	455	547	18	350	455	547	18	350	455	547	20	350	455	557
71	20	350	455	557	20	350	455	557	20	350	455	557	20	350	455	557	20	350	455	557
80	20	350	455	557	20	350	455	557	20	350	455	557	20	350	455	557	22	400	505	617
90	22	350	455	567	22	350	455	567	22	350	455	567	22	400	505	617	24	400	505	628
100	24	400	505	628	24	400	505	628	24	400	505	628	24	400	505	628	24	450	580	703
112	24	400	505	628	24	400	505	628	24	400	505	628	24	450	580	703	26	450	580	713
125	26	450	580	713	26	450	580	713	26	450	580	713	26	450	580	713	28	500	630	773
140	28	450	580	723	28	450	580	723	28	450	580	723	28	500	630	773	28	500	630	773
160	28	500	630	773	28	500	630	773	28	500	630	773	28	500	630	773	30	500	630	783
180	30	500	630	783	30	500	630	783	30	500	630	783	30	500	630	783	32	550	690	853
200	32	550	690	853	32	550	690	853	32	550	690	853	32	550	690	853	36	650	750	934
224	36	650	750	934	36	650	750	934	36	650	750	934	36	650	750	934	36	650	750	934
250	36	650	750	934	36	650	750	934	36	650	750	934	36	650	750	934	40	650	820	1,024
280	40	650	820	1,024	40	650	820	1,024	40	650	820	1,024	40	650	820	1,024	40	700	820	1,024
315	40	700	820	1,024	40	700	820	1,024	40	700	820	1,024	40	700	820	1,024				

4 layers, 1 rope
Increase by 2 mechanism groups

4 layers, 1 rope

	M3				M4				M5				M6				M7			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
16																	10	300	420	471
18	10	300	420	471	10	300	420	471	10	300	420	471	10	300	420	471	10	300	420	471
20	10	300	420	471	10	300	420	471	10	300	420	471	10	300	420	471	11	300	420	476
22.4	11	300	420	476	11	300	420	476	11	300	420	476	11	300	420	476	12	300	420	481
25	12	300	420	481	12	300	420	481	12	300	420	481	12	300	420	481	12	300	420	481
28	12	300	420	481	12	300	420	481	12	300	420	481	12	300	420	481	13	300	420	486
31.5	13	300	420	486	13	300	420	486	13	300	420	486	13	300	420	486	14	350	455	526
35.5	14	300	420	491	14	300	420	491	14	300	420	491	14	350	455	526	14	350	455	526
40	14	300	420	491	14	300	420	491	14	350	455	526	14	350	455	526	15	350	455	532
45	15	350	455	532	15	350	455	532	15	350	455	532	15	350	455	532	16	350	455	537
50	16	350	455	537	16	350	455	537	16	350	455	537	16	350	455	537	18	350	455	547
56	18	350	455	547	18	350	455	547	18	350	455	547	18	350	455	547	18	350	455	547
63	18	350	455	547	18	350	455	547	18	350	455	547	18	350	455	547	20	350	455	557
71	20	350	455	557	20	350	455	557	20	350	455	557	20	350	455	557	20	400	505	607
80	20	350	455	557	20	350	455	557	20	350	455	557	20	400	505	607	22	400	505	617
90	22	350	455	567	22	350	455	567	22	400	505	617	22	400	505	617	24	450	580	703
100	24	400	505	628	24	400	505	628	24	400	505	628	24	450	580	703	24	450	580	703
112	24	400	505	628	24	400	505	628	24	450	580	703	24	450	580	703	26	500	630	763
125	26	450	580	713	26	450	580	713	26	450	580	713	26	500	630	763	28	500	630	773
140	28	450	580	723	28	450	580	723	28	500	630	773	28	500	630	773	28	500	630	773
160	28	500	630	773	28	500	630	773	28	500	630	773	28	500	630	773	30	550	690	843
180	30	500	630	783	30	500	630	783	30	500	630	783	30	550	690	843	32	550	690	853
200	32	550	690	853	32	550	690	853	32	550	690	853	32	550	690	853	36	650	750	934
224	36	650	750	934	36	650	750	934	36	650	750	934	36	650	750	934	36	650	750	934
250	36	650	750	934	36	650	750	934	36	650	750	934	36	650	750	934	40	700	820	1,024
280	40	650	820	1,024	40	650	820	1,024	40	650	820	1,024	40	700	820	1,024	40	700	820	1,024
315	40	700	820	1,024	40	700	820	1,024	40	700	820	1,024	40	700	820	1,024				

5 layers, 1 rope
Reduction by 2 or more mechanism groups

5 layers, 1 rope

	M1				M2				M3			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
16									10	300	420	488
18	10	300	420	488	10	300	420	488	10	300	420	488
20	10	300	420	488	10	300	420	488	11	300	420	495
22.4	11	300	420	495	11	300	420	495	12	300	420	502
25	12	300	420	502	12	300	420	502	12	300	420	502
28	12	300	420	502	12	300	420	502	13	300	420	509
31.5	13	300	420	509	13	300	420	509	14	300	420	515
35.5	14	300	420	515	14	300	420	515	14	300	420	515
40	14	300	420	515	14	300	420	515	15	300	420	522
45	15	350	455	557	15	350	455	557	16	350	455	564
50	16	350	455	564	16	350	455	564	18	350	455	578
56	18	350	455	578	18	350	455	578	18	350	455	578
63	18	350	455	578	18	350	455	578	20	350	455	591
71	20	350	455	591	20	350	455	591	20	350	455	591
80	20	350	455	591	20	350	455	591	22	350	455	605
90	22	400	505	655	22	400	505	655	24	400	505	668
100	24	400	505	668	24	400	505	668	24	400	505	668
112	24	450	580	743	24	450	580	743	26	450	580	757
125	26	450	580	757	26	450	580	757	28	450	580	771
140	28	450	580	771	28	450	580	771	28	450	580	771
160	28	500	630	821	28	500	630	821	30	500	630	834
180	30	550	690	894	30	550	690	894	32	550	690	908
200	32	550	690	908	32	550	690	908	36	550	750	995
224	36	650	750	995	36	650	750	995	36	650	750	995
250	36	650	750	995	36	650	750	995	40	650	820	1,092
280	40	700	820	1,092	40	700	820	1,092	40	700	820	1,092
315	40	700	820	1,092	40	700	820	1,092				

5 layers, 1 rope
Reduction by 1 mechanism group

5 layers, 1 rope

	M1				M2				M3				M4			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
16	9	300	420	481	9	300	420	481	9	300	420	481	10	300	420	488
18	10	300	420	488	10	300	420	488	10	300	420	488	10	300	420	488
20	10	300	420	488	10	300	420	488	10	300	420	488	11	300	420	495
22.4	11	300	420	495	11	300	420	495	11	300	420	495	12	300	420	502
25	12	300	420	502	12	300	420	502	12	300	420	502	12	300	420	502
28	12	300	420	502	12	300	420	502	12	300	420	502	13	300	420	509
31.5	13	300	420	509	13	300	420	509	13	300	420	509	14	300	420	515
35.5	14	300	420	515	14	300	420	515	14	300	420	515	14	300	420	515
40	14	300	420	515	14	300	420	515	14	300	420	515	15	350	455	557
45	15	350	455	557	15	350	455	557	15	350	455	557	16	350	455	564
50	16	350	455	564	16	350	455	564	16	350	455	564	18	350	455	578
56	18	350	455	578	18	350	455	578	18	350	455	578	18	350	455	578
63	18	350	455	578	18	350	455	578	18	350	455	578	20	350	455	591
71	20	350	455	591	20	350	455	591	20	350	455	591	20	350	455	591
80	20	350	455	591	20	350	455	591	20	350	455	591	22	350	455	605
90	22	400	505	655	22	400	505	655	22	400	505	655	24	400	505	668
100	24	400	505	668	24	400	505	668	24	400	505	668	24	400	505	668
112	24	450	580	743	24	450	580	743	24	450	580	743	26	450	580	757
125	26	450	580	757	26	450	580	757	26	450	580	757	28	450	580	771
140	28	450	580	771	28	450	580	771	28	450	580	771	28	450	580	771
160	28	500	630	821	28	500	630	821	28	500	630	821	30	500	630	834
180	30	550	690	894	30	550	690	894	30	550	690	894	32	550	690	908
200	32	550	690	908	32	550	690	908	32	550	690	908	36	550	750	995
224	36	650	750	995	36	650	750	995	36	650	750	995	36	650	750	995
250	36	650	750	995	36	650	750	995	36	650	750	995	40	650	820	1,092
280	40	700	820	1,092	40	700	820	1,092	40	700	820	1,092	40	700	820	1,092
315	40	700	820	1,092	40	700	820	1,092	40	700	820	1,092				

5 layers, 1 rope
Increase by 1 mechanism group

5 layers, 1 rope

	M2				M3				M4				M5				M6			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
16																	10	300	420	488
18	10	300	420	488	10	300	420	488	10	300	420	488	10	300	420	488	10	300	420	488
20	10	300	420	488	10	300	420	488	10	300	420	488	10	300	420	488	11	300	420	495
22.4	11	300	420	495	11	300	420	495	11	300	420	495	11	300	420	495	12	300	420	502
25	12	300	420	502	12	300	420	502	12	300	420	502	12	300	420	502	12	300	420	502
28	12	300	420	502	12	300	420	502	12	300	420	502	12	300	420	502	13	300	420	509
31.5	13	300	420	509	13	300	420	509	13	300	420	509	13	300	420	509	14	350	455	550
35.5	14	300	420	515	14	300	420	515	14	300	420	515	14	350	455	550	14	350	455	550
40	14	300	420	515	14	300	420	515	14	350	455	550	14	350	455	550	15	350	455	557
45	15	350	455	557	15	350	455	557	15	350	455	557	15	350	455	557	16	350	455	564
50	16	350	455	564	16	350	455	564	16	350	455	564	16	350	455	564	18	350	455	578
56	18	350	455	578	18	350	455	578	18	350	455	578	18	350	455	578	18	350	455	578
63	18	350	455	578	18	350	455	578	18	350	455	578	18	350	455	578	20	350	455	591
71	20	350	455	591	20	350	455	591	20	350	455	591	20	350	455	591	20	400	505	641
80	20	350	455	591	20	350	455	591	20	350	455	591	20	400	505	641	22	400	505	655
90	22	400	505	655	22	400	505	655	22	400	505	655	22	400	505	655	24	450	580	743
100	24	400	505	668	24	400	505	668	24	400	505	668	24	450	580	743	24	450	580	743
112	24	450	580	743	24	450	580	743	24	450	580	743	24	450	580	743	26	450	580	757
125	26	450	580	757	26	450	580	757	26	450	580	757	26	450	580	757	28	500	630	821
140	28	450	580	771	28	450	580	771	28	450	580	771	28	500	630	821	28	500	630	821
160	28	500	630	821	28	500	630	821	28	500	630	821	28	500	630	821	30	550	690	894
180	30	550	690	894	30	550	690	894	30	550	690	894	30	550	690	894	32	550	690	908
200	32	550	690	908	32	550	690	908	32	550	690	908	32	550	690	908	36	650	750	995
224	36	650	750	995	36	650	750	995	36	650	750	995	36	650	750	995	36	650	750	995
250	36	650	750	995	36	650	750	995	36	650	750	995	36	650	750	995	40	700	820	1,092
280	40	700	820	1,092	40	700	820	1,092	40	700	820	1,092	40	700	820	1,092	40	700	820	1,092
315	40	700	820	1,092	40	700	820	1,092	40	700	820	1,092	40	700	820	1,092				

5 layers, 1 rope
Increase by 2 mechanism groups

5 layers, 1 rope

	M3				M4				M5				M6				M7			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
16																	10	300	420	488
18	10	300	420	488	10	300	420	488	10	300	420	488	10	300	420	488	10	300	420	488
20	10	300	420	488	10	300	420	488	10	300	420	488	10	300	420	488	11	300	420	495
22.4	11	300	420	495	11	300	420	495	11	300	420	495	11	300	420	495	12	300	420	502
25	12	300	420	502	12	300	420	502	12	300	420	502	12	300	420	502	12	300	420	502
28	12	300	420	502	12	300	420	502	12	300	420	502	12	300	420	502	13	350	455	544
31.5	13	300	420	509	13	300	420	509	13	300	420	509	13	350	455	544	14	350	455	550
35.5	14	300	420	515	14	300	420	515	14	350	455	550	14	350	455	550	14	350	455	550
40	14	300	420	515	14	350	455	550	14	350	455	550	14	350	455	550	15	350	455	557
45	15	350	455	557	15	350	455	557	15	350	455	557	15	350	455	557	16	350	455	564
50	16	350	455	564	16	350	455	564	16	350	455	564	16	350	455	564	18	350	455	578
56	18	350	455	578	18	350	455	578	18	350	455	578	18	350	455	578	18	350	455	578
63	18	350	455	578	18	350	455	578	18	350	455	578	18	350	455	578	20	400	505	641
71	20	350	455	591	20	350	455	591	20	350	455	591	20	400	505	641	20	400	505	641
80	20	350	455	591	20	350	455	591	20	400	505	641	20	400	505	641	22	450	580	730
90	22	400	505	655	22	400	505	655	22	400	505	655	22	450	580	730	24	450	580	743
100	24	400	505	668	24	400	505	668	24	450	580	743	24	450	580	743	24	450	580	743
112	24	450	580	743	24	450	580	743	24	450	580	743	24	450	580	743	26	500	630	807
125	26	450	580	757	26	450	580	757	26	450	580	757	26	500	630	807	28	500	630	821
140	28	450	580	771	28	450	580	771	28	500	630	821	28	500	630	821	28	500	630	821
160	28	500	630	821	28	500	630	821	28	500	630	821	28	550	690	881	30	550	690	894
180	30	550	690	894	30	550	690	894	30	550	690	894	30	550	690	894	32	650	750	968
200	32	550	690	908	32	550	690	908	32	550	690	908	32	550	690	908	36	650	750	995
224	36	650	750	995	36	650	750	995	36	650	750	995	36	650	750	995	36	650	750	995
250	36	650	750	995	36	650	750	995	36	650	750	995	36	650	750	995	40	700	820	1,092
280	40	700	820	1,092	40	700	820	1,092	40	700	820	1,092	40	700	820	1,092	40	700	820	1,092
315	40	700	820	1,092	40	700	820	1,092	40	700	820	1,092	40	700	820	1,092				

6 layers, 1 rope
Reduction by 2 or more mechanism groups

6 layers, 1 rope

	M1				M2				M3			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
16									10	300	420	505
18	10	300	420	505	10	300	420	505	10	300	420	505
20	10	300	420	505	10	300	420	505	11	300	420	514
22.4	11	300	420	514	11	300	420	514	12	300	420	522
25	12	300	420	522	12	300	420	522	12	300	420	522
28	12	300	420	522	12	300	420	522	13	300	420	531
31.5	13	300	420	531	13	300	420	531	14	300	420	539
35.5	14	300	420	539	14	300	420	539	14	300	420	539
40	14	300	420	539	14	300	420	539	15	300	420	548
45	15	350	455	583	15	350	455	583	16	350	455	591
50	16	350	455	591	16	350	455	591	18	350	455	608
56	18	350	455	608	18	350	455	608	18	350	455	608
63	18	350	455	608	18	350	455	608	20	350	455	625
71	20	350	455	625	20	350	455	625	20	350	455	625
80	20	350	455	625	20	350	455	625	22	350	455	642
90	22	400	505	692	22	400	505	692	24	400	505	709
100	24	400	505	709	24	400	505	709	24	400	505	709
112	24	450	580	784	24	450	580	784	26	450	580	801
125	26	450	580	801	26	450	580	801	28	450	580	818
140	28	500	630	868	28	500	630	868	28	500	630	868
160	28	500	630	868	28	500	630	868	30	500	630	885
180	30	550	690	945	30	550	690	945	32	550	690	962
200	32	550	690	962	32	550	690	962	36	650	750	1,056
224	36	650	750	1,056	36	650	750	1,056	36	650	750	1,056
250	36	650	750	1,056	36	650	750	1,056	40	650	820	1,160
280	40	700	820	1,160	40	700	820	1,160	40	700	820	1,160
315	40	700	820	1,160	40	700	820	1,160				

6 layers, 1 rope
Reduction by 1 mechanism group

6 layers, 1 rope

	M1				M2				M3				M4			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_t [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_t [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_t [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_t [mm]	Max. winding diameter D_{W_max} [mm]
16													10	300	420	505
18	10	300	420	505	10	300	420	505	10	300	420	505	10	300	420	505
20	10	300	420	505	10	300	420	505	10	300	420	505	11	300	420	514
22.4	11	300	420	514	11	300	420	514	11	300	420	514	12	300	420	522
25	12	300	420	522	12	300	420	522	12	300	420	522	12	300	420	522
28	12	300	420	522	12	300	420	522	12	300	420	522	13	300	420	531
31.5	13	300	420	531	13	300	420	531	13	300	420	531	14	300	420	539
35.5	14	300	420	539	14	300	420	539	14	300	420	539	14	300	420	539
40	14	300	420	539	14	300	420	539	14	300	420	539	15	350	455	583
45	15	350	455	583	15	350	455	583	15	350	455	583	16	350	455	591
50	16	350	455	591	16	350	455	591	16	350	455	591	18	350	455	608
56	18	350	455	608	18	350	455	608	18	350	455	608	18	350	455	608
63	18	350	455	608	18	350	455	608	18	350	455	608	20	350	455	625
71	20	350	455	625	20	350	455	625	20	350	455	625	20	350	455	625
80	20	350	455	625	20	350	455	625	20	350	455	625	22	350	455	642
90	22	400	505	692	22	400	505	692	22	400	505	692	24	400	505	709
100	24	400	505	709	24	400	505	709	24	400	505	709	24	400	505	709
112	24	450	580	784	24	450	580	784	24	450	580	784	26	450	580	801
125	26	450	580	801	26	450	580	801	26	450	580	801	28	450	580	818
140	28	500	630	868	28	500	630	868	28	500	630	868	28	500	630	868
160	28	500	630	868	28	500	630	868	28	500	630	868	30	500	630	885
180	30	550	690	945	30	550	690	945	30	550	690	945	32	550	690	962
200	32	550	690	962	32	550	690	962	32	550	690	962	36	650	750	1,056
224	36	650	750	1,056	36	650	750	1,056	36	650	750	1,056	36	650	750	1,056
250	36	650	750	1,056	36	650	750	1,056	36	650	750	1,056	40	650	820	1,160
280	40	700	820	1,160	40	700	820	1,160	40	700	820	1,160	40	700	820	1,160
315	40	700	820	1,160	40	700	820	1,160	40	700	820	1,160				

6 layers, 1 rope
Increase by 1 mechanism group

6 layers, 1 rope

	M2				M3				M4				M5				M6			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
16																	10	300	420	505
18	10	300	420	505	10	300	420	505	10	300	420	505	10	300	420	505	10	300	420	505
20	10	300	420	505	10	300	420	505	10	300	420	505	10	300	420	505	11	300	420	514
22.4	11	300	420	514	11	300	420	514	11	300	420	514	11	300	420	514	12	300	420	522
25	12	300	420	522	12	300	420	522	12	300	420	522	12	300	420	522	12	300	420	522
28	12	300	420	522	12	300	420	522	12	300	420	522	12	300	420	522	13	300	420	531
31.5	13	300	420	531	13	300	420	531	13	300	420	531	13	300	420	531	14	350	455	574
35.5	14	300	420	539	14	300	420	539	14	300	420	539	14	350	455	574	14	350	455	574
40	14	300	420	539	14	300	420	539	14	350	455	574	14	350	455	574	15	350	455	583
45	15	350	455	583	15	350	455	583	15	350	455	583	15	350	455	583	16	350	455	591
50	16	350	455	591	16	350	455	591	16	350	455	591	16	350	455	591	18	350	455	608
56	18	350	455	608	18	350	455	608	18	350	455	608	18	350	455	608	18	350	455	608
63	18	350	455	608	18	350	455	608	18	350	455	608	18	350	455	608	20	350	455	625
71	20	350	455	625	20	350	455	625	20	350	455	625	20	350	455	625	20	400	505	675
80	20	350	455	625	20	350	455	625	20	350	455	625	20	400	505	675	22	400	505	692
90	22	400	505	692	22	400	505	692	22	400	505	692	22	400	505	692	24	450	580	784
100	24	400	505	709	24	400	505	709	24	400	505	709	24	450	580	784	24	450	580	784
112	24	450	580	784	24	450	580	784	24	450	580	784	24	450	580	784	26	500	630	851
125	26	450	580	801	26	450	580	801	26	450	580	801	26	500	630	851	28	500	630	868
140	28	500	630	868	28	500	630	868	28	500	630	868	28	500	630	868	28	500	630	868
160	28	500	630	868	28	500	630	868	28	500	630	868	28	500	630	868	30	550	690	945
180	30	550	690	945	30	550	690	945	30	550	690	945	30	550	690	945	32	550	690	962
200	32	550	690	962	32	550	690	962	32	550	690	962	32	550	690	962	36	650	750	1,056
224	36	650	750	1,056	36	650	750	1,056	36	650	750	1,056	36	650	750	1,056	36	650	750	1,056
250	36	650	750	1,056	36	650	750	1,056	36	650	750	1,056	36	650	750	1,056	40	700	820	1,160
280	40	700	820	1,160	40	700	820	1,160	40	700	820	1,160	40	700	820	1,160	40	700	820	1,160
315	40	700	820	1,160	40	700	820	1,160	40	700	820	1,160	40	700	820	1,160				

6 layers, 1 rope
Increase by 2 mechanism groups

6 layers, 1 rope

	M3				M4				M5				M6				M7			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
16																	10	300	420	505
18	10	300	420	505	10	300	420	505	10	300	420	505	10	300	420	505	10	300	420	505
20	10	300	420	505	10	300	420	505	10	300	420	505	10	300	420	505	11	300	420	514
22.4	11	300	420	514	11	300	420	514	11	300	420	514	11	300	420	514	12	300	420	522
25	12	300	420	522	12	300	420	522	12	300	420	522	12	300	420	522	12	300	420	522
28	12	300	420	522	12	300	420	522	12	300	420	522	12	300	420	522	13	350	455	566
31.5	13	300	420	531	13	300	420	531	13	300	420	531	13	350	455	566	14	350	455	574
35.5	14	300	420	539	14	300	420	539	14	350	455	574	14	350	455	574	14	350	455	574
40	14	300	420	539	14	350	455	574	14	350	455	574	14	350	455	574	15	350	455	583
45	15	350	455	583	15	350	455	583	15	350	455	583	15	350	455	583	16	350	455	591
50	16	350	455	591	16	350	455	591	16	350	455	591	16	350	455	591	18	350	455	608
56	18	350	455	608	18	350	455	608	18	350	455	608	18	350	455	608	18	350	455	608
63	18	350	455	608	18	350	455	608	18	350	455	608	18	350	455	608	20	400	505	675
71	20	350	455	625	20	350	455	625	20	350	455	625	20	400	505	675	20	400	505	675
80	20	350	455	625	20	350	455	625	20	400	505	675	20	400	505	675	22	450	580	767
90	22	400	505	692	22	400	505	692	22	400	505	692	22	450	580	767	24	450	580	784
100	24	400	505	709	24	400	505	709	24	450	580	784	24	450	580	784	24	450	580	784
112	24	450	580	784	24	450	580	784	24	450	580	784	24	450	580	784	26	500	630	851
125	26	450	580	801	26	450	580	801	26	500	630	851	26	500	630	851	28	500	630	868
140	28	500	630	868	28	500	630	868	28	500	630	868	28	500	630	868	28	550	690	928
160	28	500	630	868	28	500	630	868	28	500	630	868	28	550	690	928	30	550	690	945
180	30	550	690	945	30	550	690	945	30	550	690	945	30	550	690	945	32	650	750	1,022
200	32	550	690	962	32	550	690	962	32	550	690	962	32	650	750	1,022	36	650	750	1,056
224	36	650	750	1,056	36	650	750	1,056	36	650	750	1,056	36	650	750	1,056	36	650	750	1,056
250	36	650	750	1,056	36	650	750	1,056	36	650	750	1,056	36	650	750	1,056	40	700	820	1,160
280	40	700	820	1,160	40	700	820	1,160	40	700	820	1,160	40	700	820	1,160	40	700	820	1,160
315	40	700	820	1,160	40	700	820	1,160	40	700	820	1,160	40	700	820	1,160				

7 layers, 1 rope
Reduction by 2 or more mechanism groups

7 layers, 1 rope

	M1				M2				M3			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
16									10	300	420	522
18	10	300	420	522	10	300	420	522	10	300	420	522
20	10	300	420	522	10	300	420	522	11	300	420	532
22.4	11	300	420	532	11	300	420	532	12	300	420	543
25	12	300	420	543	12	300	420	543	12	300	420	543
28	12	300	420	543	12	300	420	543	13	300	420	553
31.5	13	300	420	553	13	300	420	553	14	300	420	563
35.5	14	300	420	563	14	300	420	563	14	300	420	563
40	14	300	420	563	14	300	420	563	15	350	455	608
45	15	350	455	608	15	350	455	608	16	350	455	618
50	16	350	455	618	16	350	455	618	18	350	455	639
56	18	350	455	639	18	350	455	639	18	350	455	639
63	18	350	455	639	18	350	455	639	20	350	455	659
71	20	350	455	659	20	350	455	659	20	350	455	659
80	20	400	505	709	20	400	505	709	22	400	505	730
90	22	400	505	730	22	400	505	730	24	400	505	750
100	24	450	580	825	24	450	580	825	24	450	580	825
112	24	450	580	825	24	450	580	825	26	450	580	846
125	26	450	580	846	26	450	580	846	28	450	580	866
140	28	500	630	916	28	500	630	916	28	500	630	916
160	28	550	690	976	28	550	690	976	30	550	690	996
180	30	550	690	996	30	550	690	996	32	550	690	1,017
200	32	550	690	1,017	32	550	690	1,017	36	650	750	1,118
224	36	650	750	1,118	36	650	750	1,118	36	650	750	1,118
250	36	650	750	1,118	36	650	750	1,118	40	700	820	1,229
280	40	700	820	1,229	40	700	820	1,229	40	700	820	1,229
315	40	700	820	1,229	40	700	820	1,229				

7 layers, 1 rope
Reduction by 1 mechanism group

7 layers, 1 rope

	M1				M2				M3				M4			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
16													10	300	420	522
18	10	300	420	522	10	300	420	522	10	300	420	522	10	300	420	522
20	10	300	420	522	10	300	420	522	10	300	420	522	11	300	420	532
22.4	11	300	420	532	11	300	420	532	11	300	420	532	12	300	420	543
25	12	300	420	543	12	300	420	543	12	300	420	543	12	300	420	543
28	12	300	420	543	12	300	420	543	12	300	420	543	13	300	420	553
31.5	13	300	420	553	13	300	420	553	13	300	420	553	14	300	420	563
35.5	14	300	420	563	14	300	420	563	14	300	420	563	14	300	420	563
40	14	300	420	563	14	300	420	563	14	350	455	598	15	350	455	608
45	15	350	455	608	15	350	455	608	15	350	455	608	16	350	455	618
50	16	350	455	618	16	350	455	618	16	350	455	618	18	350	455	639
56	18	350	455	639	18	350	455	639	18	350	455	639	18	350	455	639
63	18	350	455	639	18	350	455	639	18	350	455	639	20	350	455	659
71	20	350	455	659	20	350	455	659	20	350	455	659	20	350	455	659
80	20	400	505	709	20	400	505	709	20	400	505	709	22	400	505	730
90	22	400	505	730	22	400	505	730	22	400	505	730	24	400	505	750
100	24	450	580	825	24	450	580	825	24	450	580	825	24	450	580	825
112	24	450	580	825	24	450	580	825	24	450	580	825	26	450	580	846
125	26	450	580	846	26	450	580	846	26	450	580	846	28	450	580	866
140	28	500	630	916	28	500	630	916	28	500	630	916	28	500	630	916
160	28	550	690	976	28	550	690	976	28	550	690	976	30	550	690	996
180	30	550	690	996	30	550	690	996	30	550	690	996	32	550	690	1,017
200	32	550	690	1,017	32	550	690	1,017	32	550	690	1,017	36	650	750	1,118
224	36	650	750	1,118	36	650	750	1,118	36	650	750	1,118	36	650	750	1,118
250	36	650	750	1,118	36	650	750	1,118	36	650	750	1,118	40	700	820	1,229
280	40	700	820	1,229	40	700	820	1,229	40	700	820	1,229	40	700	820	1,229
315	40	700	820	1,229	40	700	820	1,229	40	700	820	1,229				

7 layers, 1 rope
Increase by 1 mechanism group

7 layers, 1 rope

	M2				M3				M4				M5				M6			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
16																	10	300	420	522
18	10	300	420	522	10	300	420	522	10	300	420	522	10	300	420	522	10	300	420	522
20	10	300	420	522	10	300	420	522	10	300	420	522	10	300	420	522	11	300	420	532
22.4	11	300	420	532	11	300	420	532	11	300	420	532	11	300	420	532	12	300	420	543
25	12	300	420	543	12	300	420	543	12	300	420	543	12	300	420	543	12	300	420	543
28	12	300	420	543	12	300	420	543	12	300	420	543	12	300	420	543	13	300	420	553
31.5	13	300	420	553	13	300	420	553	13	300	420	553	13	300	420	553	14	350	455	598
35.5	14	300	420	563	14	300	420	563	14	300	420	563	14	350	455	598	14	350	455	598
40	14	300	420	563	14	350	455	598	14	350	455	598	14	350	455	598	15	350	455	608
45	15	350	455	608	15	350	455	608	15	350	455	608	15	350	455	608	16	350	455	618
50	16	350	455	618	16	350	455	618	16	350	455	618	16	350	455	618	18	350	455	639
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71	20	350	455	659	20	350	455	659	20	350	455	659	20	400	505	709	20	400	505	709
80	20	400	505	709	20	400	505	709	20	400	505	709	20	400	505	709	22	400	505	730
90	22	400	505	730	22	400	505	730	22	400	505	730	22	400	505	730	24	450	580	825
100	24	450	580	825	24	450	580	825	24	450	580	825	24	450	580	825	24	450	580	825
112	24	450	580	825	24	450	580	825	24	450	580	825	24	450	580	825	26	500	630	896
125	26	450	580	846	26	450	580	846	26	450	580	846	26	500	630	896	28	500	630	916
140	28	500	630	916	28	500	630	916	28	500	630	916	28	500	630	916	28	500	630	916
160	28	550	690	976	28	550	690	976	28	550	690	976	28	550	690	976	30	550	690	996
180	30	550	690	996	30	550	690	996	30	550	690	996	30	550	690	996	32	650	750	1,077
200	32	550	690	1,017	32	550	690	1,017	32	550	690	1,017	32	550	690	1,017	36	650	750	1,118
224	36	650	750	1,118	36	650	750	1,118	36	650	750	1,118	36	650	750	1,118	36	650	750	1,118
250	36	650	750	1,118	36	650	750	1,118	36	650	750	1,118	36	650	750	1,118	40	700	820	1,229
280	40	700	820	1,229	40	700	820	1,229	40	700	820	1,229	40	700	820	1,229	40	700	820	1,229
315	40	700	820	1,229	40	700	820	1,229	40	700	820	1,229	40	700	820	1,229				

7 layers, 1 rope
Increase by 2 mechanism groups

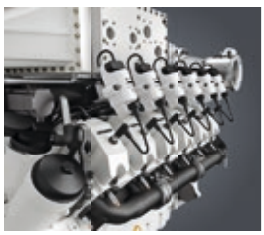
7 layers, 1 rope

	M3				M4				M5				M6				M7			
Rope tensile force F_S [kN]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]	Rope diameter d [mm]	Gearbox size PEG [mm]	Drum diameter D_T [mm]	Max. winding diameter D_{W_max} [mm]
16																	10	300	420	522
18	10	300	420	522	10	300	420	522	10	300	420	522	10	300	420	522	10	300	420	522
20	10	300	420	522	10	300	420	522	10	300	420	522	10	300	420	522	11	300	420	532
22.4	11	300	420	532	11	300	420	532	11	300	420	532	11	300	420	532	12	300	420	543
25	12	300	420	543	12	300	420	543	12	300	420	543	12	300	420	543	12	300	420	543
28	12	300	420	543	12	300	420	543	12	300	420	543	12	300	420	543	13	350	455	588
31.5	13	300	420	553	13	300	420	553	13	300	420	553	13	350	455	588	14	350	455	598
35.5	14	300	420	563	14	300	420	563	14	350	455	598	14	350	455	598	14	350	455	598
40	14	350	455	598	14	350	455	598	14	350	455	598	14	350	455	598	15	350	455	608
45	15	350	455	608	15	350	455	608	15	350	455	608	15	350	455	608	16	350	455	618
50	16	350	455	618	16	350	455	618	16	350	455	618	16	350	455	618	18	350	455	639
56	18	350	455	639	18	350	455	639	18	350	455	639	18	350	455	639	18	350	455	639
63	18	350	455	639	18	350	455	639	18	350	455	639	18	350	455	639	20	400	505	709
71	20	350	455	659	20	350	455	659	20	400	505	709	20	400	505	709	20	400	505	709
80	20	400	505	709	20	400	505	709	20	400	505	709	20	400	505	709	22	450	580	805
90	22	400	505	730	22	400	505	730	22	400	505	730	22	450	580	805	24	450	580	825
100	24	450	580	825	24	450	580	825	24	450	580	825	24	450	580	825	24	500	630	875
112	24	450	580	825	24	450	580	825	24	450	580	825	24	500	630	875	26	500	630	896
125	26	450	580	846	26	450	580	846	26	500	630	896	26	500	630	896	28	500	630	916
140	28	500	630	916	28	500	630	916	28	500	630	916	28	500	630	916	28	550	690	976
160	28	550	690	976	28	550	690	976	28	550	690	976	28	550	690	976	30	550	690	996
180	30	550	690	996	30	550	690	996	30	550	690	996	30	550	690	996	32	650	750	1,077
200	32	550	690	1,017	32	550	690	1,017	32	550	690	1,017	32	650	750	1,077	36	650	750	1,118
224	36	650	750	1,118	36	650	750	1,118	36	650	750	1,118	36	650	750	1,118	36	700	820	1,188
250	36	650	750	1,118	36	650	750	1,118	36	650	750	1,118	36	700	820	1,188	40	700	820	1,229
280	40	700	820	1,229	40	700	820	1,229	40	700	820	1,229	40	700	820	1,229				
315	40	700	820	1,229	40	700	820	1,229	40	700	820	1,229								

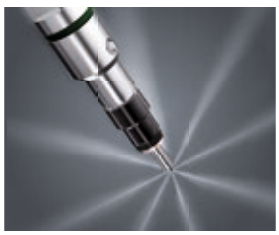
Notes

Notes

Liebherr Components


Gas engines


Diesel engines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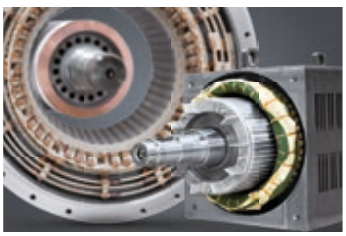
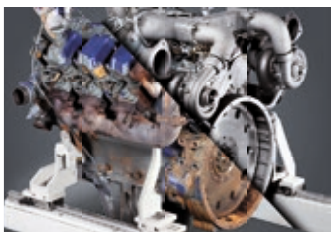
Hydraulic cylinders

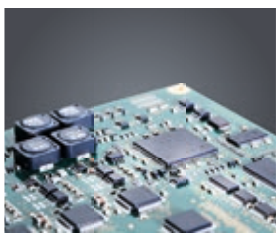

Slewing bearings


Gearboxes and winches


Electric machines


Remanufacturing


Human-machine interfaces and gateways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Control cabinets


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Printed in Germany by Eberl BK COB-AS-WISKAT-2.19-250-en
Subject to technical modifications.

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