COUPLING SELECTION BASED ON OPERATING FACTORS

Coupling types

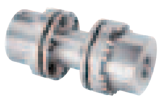
Lamina couplings

RADEX®-N

Steel lamina coupling (see page 164)

- Torsionally rigid
- Backlash-free
- Maintenance-free
- Compact dimensions
- Single-cardanic or double-cardanic
- All-steel

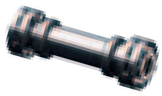
RIGIFLEX®-N



Steel lamina coupling (see page 164)

- Torsionally rigid
- Backlash-free
- Maintenance-free
- Double-cardanic
- All-steel
- Coupling in accordance with API 610, API 671 optionally

RIGIFLEX®-HP



High-performance steel lamina coupling (see page 164)

- Torsionally rigid
- Backlash-free
- Maintenance-free
- Double-cardanic
- All-steel
- Coupling design as per API 671

Pin & bush couplings

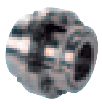
REVOLEX® KX-D

Flexible pin & bush coupling (see page 73)

- Flexible
- Maintenance-free
- Fail-safe
- Compact dimensions
- Axial plug-in

Gear couplings

GEARex®



All-steel gear coupling (see page 82)

- Torsionally rigid
- Fail-safe
- Compact dimensions
- Double-cardanic
- High power density
- All-steel

Terminology of coupling selection

Description	Symbol	Definition or explanation
Rated torque of coupling [Nm]	T_{KN}	Torque that can be continuously transmitted over the entire permissible speed range.
Maximum torque of coupling [Nm]	$T_{K\,max.}$	Torque that can be transmitted as dynamic load ≥ 10^5 times or 5 x 10^4 as vibratory load, respectively, over the entire operating life of the coupling
Vibratory torque of coupling [Nm]	T_{KW}	Torque amplitude of the permissible periodical torque fluctuation with a frequency of 10 Hz and a basic load of TKN or dynamic load up to TKN, respectively
Rated torque of machine [Nm]	T_N	Stationary rated torque on the coupling
Peak torque of machine [Nm]	T_S	Peak torque on the coupling

Description	Symbol	Definition or explanation
Engine power [kW]	P	Rated power of drive
Speed [rpm]	n	Rated speed of engine
Starting factor	S_Z	Factor taking into account load caused by starting frequency per hour
Direction factor	S_R	Considers the torsional direction
Temperature factor	S_t	Temperature factor – Factor considering the lower loading capacity particularly in case of increased temperatures.
Operating factor	S_B	Factor considering the different demands on the coupling dependent on the application.

COUPLING SELECTION BASED ON OPERATING FACTORS

Factors

Temperature factor S_t								
	−30 °C +30 °C	≤ +40 °C	≤ +60 °C	≤ +80 °C	≤ +150 °C	≤ +200 °C	≤ +230 °C	≤ +270 °C
REVOLEX® KX-D	1,0	1,2	1,4	1,8	–	–	–	–
GEARex®	1,0	1,0	1,0	1,0	–	–	–	–
RADEX®-N, RIGIFLEX®-N, RIGIFLEX®-HP	1,0	1,0	1,0	1,0	1,0	1,10	1,25	1,43

Starting factor S_Z			
Starting frequency per hour	<10	<25	<50
S_Z	1,0	1,2	1,4

Direction factor S_R	
Same torsional direction	1,0
Alternating torsional direction	1,7

Operating factor S_B

Application	
Construction machines	
Manoeuvre winches	1,50 – 2,00
Swing gears	1,50 – 2,00
Miscellaneous winches	1,50 – 2,00
Filters, cable winches	1,75 – 2,25
Multi-bucket excavators	1,75 – 2,25
Running gears (caterpillars)	1,75 – 2,25
Impellers	1,75 – 2,25
Cutter drives	2,00 – 2,50
Elevators	1,50 – 2,00
Conveyors	
Bucket elevators	1,50 – 2,00
Elevators	1,75 – 2,25
Hauling winches	1,50 – 2,00
Apron conveyors	1,25 – 1,75
Rubber belt conveyors (bulk)	1,25 – 1,75
Boom plate bucket conveyors	1,25 – 1,75
Rotary conveyors	1,50 – 1,75
Steel plate conveyors	1,50 – 1,75
Worm conveyors	1,25 – 1,50
Steel belt conveyors	1,75 – 2,00
Conveyors	1,75 – 2,00
Rubber belt conveyor (bulk)	1,75 – 2,00
Inclined lifts	1,75 – 2,00
Shaking slides	2,00 – 2,25
Generators	
Frequency converters	1,75 – 2,00
Generators	1,50 – 2,00
Rubber & nylon industry	
Rubber calenders and rolling mills	1,25 – 2,00
Mixers	1,25 – 2,00
Extruders	1,25 – 2,00
Lifters/cranes	
Bridge cranes for steel industry	2,00 – 2,25
Cranes (heavy load operation)	2,00 – 2,25
Running gears	1,75 – 2,25
Lifting gears	1,75 – 2,25
Woodworking machinery	
Planing machines	1,50 – 1,75
Barking machines	1,75 – 2,00
Saw frames	1,75 – 2,00
Compressors	
Centrifugal compressors	1,50 – 2,00
Rotary compressors	1,50 – 2,00
Turbo compressors	2,00 – 2,50
Piston compressors	2,50 – 3,00
Metal industry	
Wire pulls	1,25 – 1,50
Winders	1,25 – 1,50
Winding drums	1,50 – 2,00
Wire drawing machines	2,00 – 2,50
Plate shears	2,00 – 2,50
Block pushers	2,00 – 2,50
Blooming and slabbing	2,00 – 2,50
De-scalers	2,00 – 2,50
Hot-rolling mill	2,00 – 2,50
Cold rolling mills	2,00 – 2,50
Billet shears	2,00 – 2,50
Plugging machines	2,00 – 2,50
Continuous casting machines	2,00 – 2,50
Shifting devices	2,00 – 2,50
Application	2,00 – 2,50
Roller tables (heavy-weight)	2,00 – 2,50
Mixers	
Constant density	1,75 – 2,25
Variable density	2,00 – 2,50

Application	
Mixers	
Constant density	1,75 – 2,25
Variable density	2,00 – 2,50
Grinders	
Centrifugal mills	1,75 – 2,00
Beater mills	1,75 – 2,00
Autogenous mills	1,75 – 2,00
Hammer and ball mills	2,00 – 2,50
Food industry	
Sugarcane harvesters	1,25 – 1,50
Sugar-beet harvesters	1,25 – 1,50
Sugar-beet washing	1,25 – 1,50
Kneading machines	1,75 – 2,00
Sugarcane breakers	1,75 – 2,00
Sugarcane mills	1,75 – 2,00
Oil industry	
Filter presses for paraffin	1,50 – 2,00
Rotary furnaces	1,75 – 2,00
Paper machines	
Couch rolls	1,75 – 2,25
Calanders	1,75 – 2,25
Wet presses	1,75 – 2,25
Pumps	
Radial pumps	1,25 – 1,75
Centrifugal pumps (light liquid)	1,50 – 2,00
Centrifugal pumps (viscous liquid)	2,25 – 1,50
Gear and vane pumps	1,50 – 1,75
Piston pumps, plunger pumps and press pumps	2,00 – 2,50
Agitators	
Light liquid	1,25 – 1,50
Viscous liquid	1,50 – 1,75
Liquid with constant density	1,25 – 1,50
Liquid with variable density	1,50 – 2,00
Textile industry	
Winders	1,25 – 1,75
Printing and dyeing machines	1,25 – 1,75
Shredders	1,50 – 2,00
Fans, ventilators and blowers	
Light-weight fans	1,25 – 1,75
Large blowers	1,75 – 2,50
Centrifugal fans	1,25 –1,50
Industrial fans	1,25 –1,50
Rotary blowers	1,25 –1,75
Fans (axial / radial)	1,25 –1,75
Fans for cooling towers	1,50 – 2,00
Wastewater treatment plants	
Rakes	1,25 – 1,50
Worm pumps	1,25 – 1,50
Concentrators	1,25 – 1,50
Mixers	1,25 – 1,75
Aerators	1,75 – 2,00
Machine tools	
Scissors	1,50 – 2,00
Dressing rollers	1,50 – 2,00
Bending machines	1,50 – 2,00
Hole punching machines	1,75 – 2,50
Levelling machines	1,75 – 2,50
Hammers	1,75 – 2,50
Presses	1,75 – 2,50
Forging presses	1,75 – 2,50
Other	
Equipment for transport of persons	2,00 – 2,50
Rock crushers	2,50 – 3,00
Rolling mill drives	2,00 – 2,50

COUPLING SELECTION BASED ON OPERATING FACTORS

Coupling selection

The coupling selection is based on operating factors. The coupling has to be dimensioned in a way that the permissible coupling load is not exceeded with any operating condition. For this purpose the actual loads have to be compared to the permissible parameters of the coupling. The shaft-hub-connection has to be investigated by the customer.

1. Drives without periodical torsional vibrations

For example centrifugal pumps, fans, screw compressors, etc. The coupling selection requires that the rated torque T_{KN} and the maximum torque T_{Kmax} are reveiwed.

1.1 Loading by rated torque

Taking into account the operating factor S_B, the temperature factor St and the directional factor S_R, the permissible rated torque must be at least as big as the the rated torque T_N of the machine.

$$T_N\,[Nm] = 9550 \bullet \frac{P\,[kW]}{n\,[1/min]}$$

$$T_{KN} \geq T_N \bullet S_B \bullet S_t \bullet S_R$$

1.2 Loading by torque shocks

The permissible maximum torque of T_{Kmax} of the coupling must be at least as big as the sum of the peak torque T_S and the rated torque TN of the machine, taking into account all relevant service factors. This applies in case that the rated trque of the machine is superimposed by a shock. For drives with A. C. motors and big masses on the load side we would recommend to do a joint calculation of the peak starting torque by our simulation programm.

$$T_{K\,max.} \geq (T_N + T_{S)} \bullet S_Z \bullet S_t \bullet S_R$$

2. Drives with periodical torsional vibrations

For drives subject to dangerous torsional vibrations e. g. diesel engines, piston compressors, piston pumps, generators, etc. it is necessary to perform a torsional vibration calculation to ensure a correct coupling selection. KTR is able to perform such a torsional vibration calculation and coupling selection in house. For necessary details please see KTR standard 20004.

COUPLING SELECTION BASED ON OPERATING FACTORS

Example of calculation

Requested:	Double-cardanic steel lamina coupling for bridging a shaft distance dimension → RADEX®-N
Application:	Connection of IEC standard motor and radial pump

- Coupling selection following page 16, item 1: Drives without periodical torsional vibrations

Given: Details of driving side

Rotary current motor:	Size 315 L	
Motor output:	P = 200 kW	
Speed:	n = 1500 1/min	
Starting frequency:	6 times per hour	→ S_Z =1.0 (see page 15)
Ambient temperature:	+ 65 °C	→ S_t =1.0 (see page 15)
Peak torque (starting torque) T_{AS}	= 2 • T_{AN}	
Diameter of motor shaft	80 mm	

Given: Details of load side

Radial pump		→ S_B =1.5 (see page 15)
Rated torque of load side:	T_{LN} = 930 Nm	
Diameter of pump shaft	75 mm	
Distance dimension of motor shaft - pump shaft (DBSE)	= 250 mm	
Direction of torque	same	→ S_R =1.0 (see page 15)

Calculation

1.1 Loading by rated torque

- Rated torque of drive T_{AN}

$$T_{AN} = 9550 \cdot \frac{P\,[kW]}{n\,[1/min]} \quad \rightarrow 9550 \cdot \frac{200\ kW}{1500\ 1/min} = \underline{1273\ Nm}$$

- Load produced by rated torque

$$T_{KN} \geq T_{AN} \cdot S_B \cdot S_t \cdot S_R \quad \rightarrow 1273\ Nm \cdot 1{,}5 \cdot 1 \cdot 1 = 1348{,}5\ Nm \quad \rightarrow T_{KN} \geq \underline{1909{,}5\ Nm}$$

1.2 Loading by torque shocks

- Shock on driving side without load torque being overlapping

$$T_{K\,max.} \geq (T_N + T_S) \cdot S_Z \cdot S_t \cdot S_R \quad \rightarrow T_N = 0$$

Starting torque $T_{AS} = 2 \cdot T_{AN}$ → 2 • 930 Nm= $\underline{1860\ Nm}$

$$\rightarrow T_{K\,max.} \geq 1860\ Nm \cdot 1 \cdot 1 \cdot 1 = \underline{1860\ Nm}$$

- Coupling selection

T_{KN} = 2400 Nm

$T_{K\,max.}$ = 4800 Nm

Result

The coupling is sufficiently dimensioned.

Please note:

The shaft-hub-connection has to be verified by the customer separately.