Coupling selection

The ROTEX® coupling is selected in accordance with DIN 740 part 2. The coupling has to be dimensioned in a way that the permissible coupling load is not exceeded in any operating condition. For this purpose the actual loads have to be compared to the permissible parameters of the coupling.

1 **Drives without periodical torsional vibrations**
e. g. centrifugal pumps, fans, screw compressors, etc.
The coupling is selected taking into account the rated torques T_{KN} and maximum torque $T_{K\,max}$.

1.1 **Load produced by rated torque**

$$T_N\ [Nm] = 9550 \cdot \frac{P\ [kW]}{n\ [rpm]}$$

$$T_{KN} \geq T_N \cdot S_t$$

Taking into consideration the ambient temperature, the permissible rated torque T_{KN} of the coupling has to correspond at least to the rated torque T_N of the machine.

1.2 **Load produced by torque shocks**

$$T_{K\,max} \geq T_S \cdot S_z \cdot S_t + T_N \cdot S_t$$

Drive-sided shock
$$T_S = T_{AS} \cdot M_A \cdot S_A$$

Load-sided shock
$$T_S = T_{LS} \cdot M_L \cdot S_L$$

$$M_A = \frac{J_L}{J_A + J_L} \qquad M_L = \frac{J_A}{J_A + J_L}$$

The permissible maximum torque of the coupling has to correspond at least to the total of peak torque T_S and the rated torque T_N of the machine, taking into account the shock frequency Z and the ambient temperature.

This applies in case if the rated torque T_N of the machine is at the same time subject to shocks.

Knowing the mass distribution, shock direction and shock mode, the peak torque T_S can be calculated.

For drives with A. C.-motors with high masses on the load side we would recommend to calculate the peak driving torque with the help of our simulation programme.

2. **Drives with periodical torsional vibrations.** For drives subject to high torsional vibrations, e. g. diesel engines, piston compressors, piston pumps, generators, etc., it is necessary to perform a torsional vibration calculation to ensure a safe operation. If requested, we perform the torsional vibration calculation and the coupling selection in our company. For necessary details please see KTR standard 20004.

2.1 **Load produced by rated torque**

$$T_{KN} \geq T_N \cdot S_t$$

Taking into account the ambient temperature, the permissible rated torque T_{KN} of the coupling has to correspond at least to the rated torque T_N of the machine.

2.2 **Passing through the resonance range**

$$T_{K\,max} \geq T_S \cdot S_t$$

Taking into account the temperature, the peak torque T_S arising when the resonance range is run through must not exceed the maximum torque T_{Kmax} of the coupling.

2.3 **Load produced by vibratory torque shocks**

$$T_{KW} \geq T_W \cdot S_t$$

Taking into account the ambient temperature, the permissible vibratory torque T_{KW} of the coupling must not be exceeded by the highest periodical vibratory torque T_W with operating speed.

$$P_{KW} \geq P_W$$

For higher operating frequencies f > 10, the heat produced by damping in the elastomer part is considered as damping power P_W.

The permissible damping power P_{KW} of the coupling depends on the ambient temperature and must not be exceeded by the damping power produced.

Description	Symbol	Definition or explanation
Rated torque of coupling	T_{KN}	Torque that can continuously be transmitted over the entire permissible speed range
Maximum torque of coupling	$T_{K\,max}$	Torque that can be transmitted as dynamic load ≥ 10^5 times or 5 x 10^4 as vibratory load, respectively, during the entire operating life of the coupling
Vibratory torque of coupling	T_{KW}	Torque amplitude of the permissible periodical torque fluctuation with a frequency of 10 Hz and a basic load of T_{KN} or dynamic load up to T_{KN}, respectively
Damping power of coupling	P_{KW}	Permissible damping power with an ambient temperature of + 30 °C.
Rated torque of machine	T_N	Stationary rated torque on the coupling
Rated torque of driving side	T_{AN}	Rated torque of machine, calculated from rated power and rated speed
Rated torque of load side	T_{LN}	Maximum figure of the load torque calculated from power and speed
Peak torque of machine	T_S	Peak torque on the coupling
Peak torque on the driving side	T_{AS}	Peak torque with torque shock on the driving side, e. g. breakdown torque of the electric motor

Description	Symbol	Definition or explanation
Peak torque of load side	T_{LS}	Peak torque with torque shock on load side, e. g. braking
Vibratory torque of machine	T_W	Amplitude of the vibratory torque effective on the coupling
Damping power of the machine	P_W	Damping power which is effective on the coupling due to the load produced by the vibratory torque
Moment of inertia of driving side	J_A	Total of moments of inertia existing on the driving or load side referring to the coupling speed
Moment of inertia of load side	J_L	
Rotational inertia coefficient of driving side	M_A	Factor taking into account the mass distribution with shocks and vibrations produced on the driving or load side
Rotational inertia coefficient of load side	M_L	$M_A = \frac{J_L}{(J_A + J_L)}$ $M_L = \frac{J_A}{(J_A + J_L)}$

Coupling selection

Service factor S_t for temperature

	-30 °C +30 °C	+40 °C	+60 °C	+80 °C
S_t	1,0	1,2	1,4	1,8

Service factor S_Z for starting frequency

starting frequency/h	100	200	400	800
S_Z	1,0	1,2	1,4	1,6

Service factor S_A / S_L for shocks

	S_A/S_L
gentle shocks	1,5
average shocks	1,8
heavy shocks	2,5

Permissible load on feather key of the coupling hub

The shaft-hub-connection has to be verified by the customer. Permissible surface pressure according to DIN 6892 (method C).

Cast iron EN-GJL-250 (GG 25)	225 N/mm²
material nodular iron EN-GJS-400-15 (GGG 40)	225 N/mm²
material steel S355J2G3 (St 52.3)	250 N/mm²
for other steel materials p_{zul} =	$0{,}9 \cdot R_e$ ($R_{p0.2}$)

Example of calculation of standard IEC motors shown on page 22:

Given: Details of driving side

A. C. motor	type 315 L ⇛ S_A = 1,8
Motor output	P = 160 kW
Speed	n = 1485 rpm
Moment of inertia driven side	J_A = 2,9 kgm²
Start-up frequency	z = 6 1/h ⇛ S_Z = 1,0
Ambient temperature	= + 60 °C ⇛ S_t = 1,4

Given: Details of load side

Screw compressor	
Rated torque of load side	T_{LN} = 930 Nm
Moment of inertia of load side	J_L = 6,8 kgm²

Calculation

- Rated driving torque

$$T_{AN}\,[\text{Nm}] = 9550\,\frac{P_{AN}[\text{kW}]}{n_{AN}\,[\text{rpm}]}$$

$$T_{AN} = 9550 \cdot \frac{160\ \text{kW}}{1485\ \text{rpm}} = \underline{1029\ \text{Nm}}$$

Coupling selection:

- Load produced by rated torque

$$T_{KN} \geq T_{LN} \cdot S_t$$

$$T_{KN} \geq 930\text{Nm} \cdot 1{,}4 = \underline{1302\ \text{Nm}}$$

Selected: ROTEX® Size 90 - spider 92 Shore A with:

T_{KN} = 2400 Nm

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

- Load produced by torque shocks

$$T_{K\,max} \geq T_S \cdot S_z \cdot S_t$$

→ Drive-sided shock

$$T_S = T_{AS} \cdot M_A \cdot S_A$$

→ $$M_A = \frac{J_L}{(J_A + J_L)} = \frac{6{,}8\ \text{kgm}^2}{(2{,}9\text{kgm}^2 + 6{,}8\ \text{kgm}^2)} = \underline{0{,}7}$$

→ ● Driving torque

$$T_{AS} = 2{,}0 \cdot T_{AN} = 2{,}0 \cdot 1029\ \text{Nm} = \underline{2058\ \text{Nm}}$$

$$T_S = 2058\ \text{Nm} \cdot 0{,}7 \cdot 1{,}8 = \underline{2593{,}1\ \text{Nm}}$$

$$T_{K\,max} \geq 2593{,}1\ \text{Nm} \cdot 1 \cdot 1{,}4 = \underline{3630{,}3\ \text{Nm}}$$

$T_{K\,max}$ with 4800 Nm ≥ 3630,3 Nm ✓