COUPLING SELECTION ACCORDING TO DIN 740 PART II

Coupling types

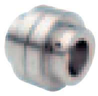
Flexible jaw couplings

ROTEX®

Flexible coupling **(see page 24)**

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

POLY-NORM®



Flexible coupling (see page 24)

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

POLY

Flexible, shear-type coupling (see page **24)**

- Flexible
- Maintenance-free
- Shear type
- Axial plug-in

Gear couplings

BoWex®

Torsionally rigid curved-tooth gear coupling®, **(see page 82)**

- Torsionally rigid
- Maintenance-free
- Shear type
- Compact dimensions
- Single-cardanic or double-cardanic
- Axial plug-in

BoWex® HEW Compact

Highly flexible shaft coupling **(see page 82)**

- Highly flexible
- Maintenance-free
- Shear type
- Compact dimensions
- Single-cardanic
- Axial plug-in

Flange couplings for I.C.- engines

BoWex-ELASTIC®

Highly flexible flange coupling (see page 184)

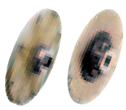
- Flexible to highly flexible
- Maintenance-free
- Shear type
- Compact dimensions
- Single-cardanic
- Axial plug-in

MONOLASTIC®

One-piece, flexible flange coupling (see page 184)

- Flexible
- Maintenance-free
- Shear type
- Compact dimensions
- Single-cardanic
- Axial plug-in

BoWex® FLE-PA (PAC)



Torsionally rigid flange coupling **(see page 184)**

- Torsionally rigid
- Maintenance-free
- Shear type
- Compact dimensions
- Single-cardanic
- Axial plug-in

COUPLING SELECTION ACCORDING TO DIN 740 PART II

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
Damping power of coupling [W]	P_{KW}	Permissible damping power with an ambient temperature of + 30 °C.
Rated torque of machine [Nm]	T_N	Stationary rated torque on the coupling
Rated torque of driving side [Nm]	T_{AN}	Rated torque of machine, calculated from rated power and rated speed
Rated torque of load side [Nm]	T_{LN}	Maximum figure of the load torque calculated from power and speed
Peak torque of machine [Nm]	T_S	Peak torque on the coupling
Peak torque of driving side [Nm]	T_{AS}	Peak torque with torque shock on driving side, e. g. tilting moment of the electric motor.
Peak torque of load side [Nm]	T_{LS}	Peak torque with torque shock on load side, e. g. braking
Vibratory torque of machine [Nm]	T_W	Amplitude of the vibratory torque effective on the coupling

Description	Symbol	Definition or explanation
Damping power of machine [W]	P_W	Damping power which is effective on the coupling due to the load generated by the vibratory torque
Engine power [kW]	P	Rated power of drive
Speed [rpm]	n	Rated speed of engine
Rotational inertia coefficient of driving side	M_A	Factor taking into account the mass distribution with shocks and vibrations generated on the driving or load side
Rotational inertia coefficient of load side	M_L	
Mass moment of inertia of driving side [kgm²]	J_A	Total of moments of inertia existing on the driving or load side referring to the coupling speed
Mass moment of inertia of load side [kgm²]	J_L	
Mass moment of inertia of coupling [kgm²]	J_{KA}	Mass mom. of inertia of the coupl. half on the drive side
	J_{KL}	Mass mom. of inertia of the coupl. half on the load side
Starting factor	S_Z	Factor taking into account load caused by starting frequency per hour
Shock factor on driving side	S_A	Factor taking into account the shocks arising depending on the application (e. g. starting shocks)
Shock factor on load side	S_L	
Temperature factor	S_t	Temperature factor – Factor considering the lower loading capacity or larger deformation of an elastomer part under load particularly in case of increased temperatures.
Operating factor	S_B	Factor considering the different demands on the coupling dependent on the application.
Screw tightening torque [Nm]	T_A	Screw tightening torque

Temperature factor S_t

	-50 °C	-30 °C/+30 °C	≤ +40 °C	≤ +50 °C	≤ +60 °C	≤ +70 °C	≤ +80 °C	≤ +90 °C	≤ +100 °C	≤ +110 °C	≤ +120 °C
ROTEX®											
T-PUR®	1,0	1,0	1,1	1,2	1,3	1,45	1,6	1,8	2,1	2,5	3,0
PUR	–	1,0	1,2	1,3	1,4	1,55	1,8	2,2	–	–	–
POLY-NORM®											
NBR 78 Shore A	–	1,0	1,2	1,3	1,4	1,6	1,8	–	–	–	–
POLY											
NBR (building block)	–	1,0	1,2	1,3	1,4	1,6	1,8	–	–	–	–
BoWex®											
PA 6.6	1,0	1,0	1,0	1,0	1,0	1,2	1,4	1,6	1,8	–	–
PA-CF	1,0	1,0	1,0	1,0	1,0	1,1	1,2	1,4	1,6	1,9	2,2
BoWex® HEW Compact	–	1,0	1,0	1,0	1,0	1,1	1,4	1,7	–	–	–
BoWex® ELASTIC®											
Standard	–	1,0	1,0	1,0	1,0	1,2	1,6	–	–	–	–
Temperature stable M.*	–	1,0	1,0	1,0	1,0	1,1	1,4	1,7	–	–	–
MONOLASTIC®											
Standard	–	1,0	1,0	1,0	1,0	1,2	1,6	–	–	–	–
BoWex® FLE-PA (PAC)											
PA 6 GF	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,2	1,4	1,6	1,8
PA-CF	1,0	1,0	1,0	1,0	1,0	1,1	1,2	1,4	1,6	1,9	2,2

* Temperature stable compound is marked with „T“ in front of hardness (e. g. T 50 Sh)
For the selection with PEEK spider a temperature factor is not necessary.
For temperature factors for PA spiders see page 30.

Starting factor S_Z

ROTEX®, POLY-NORM®, POLY, BoWex®, BoWex® HEW Compact				
Starting frequency per hour	< 100	< 200	< 400	< 800
S_Z	1,0	1,2	1,4	1,6
BoWex-ELASTIC®				
Starting frequency per hour	< 10	< 60	< 120	> 120
S_Z	1,0	1,5	2,0	auf Anfrage

Shock factor S_A/S_L

ROTEX®, POLY-NORM®, POLY, BoWex®, BoWex® HEW Compact, BoWex-ELASTIC®	S_A/S_L
Moderate shocks	1,5
Average shocks	1,8
Heavy shocks	2,5

Operating factor S_B

Hydrostatic drives for BoWex® FLE-PA, MONOLASTIC®	
Applications	S_B
Wheel loaders	1,6
Compact loaders	1,6
Hydraulic excavators	1,4
Mobile cranes	1,6
Graders	1,5
Vibration rollers	1,4
Fork lift trucks	1,6
Concrete mixer trucks	1,3
Concrete pumps	1,4
Asphalt finishers	1,4
Concrete cutters	1,4
Road milling machines	1,4

Permissible load on feather key of the coupling hubs

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

Permissible surface pressure according to DIN 6892 (method C).

Cast iron GJL	225 N/mm²	Powder metal steel	180 N/mm²
Nodular iron GJS	225 N/mm²	Aluminium diecast Al-D	200 N/mm²
Steel	250 N/mm²	Aluminium semi-finished product Al-H	110 N/mm²
Polyamide	30 N/mm² (up to + 40 °C)	For other steel materials $p_{perm.}$	0,9 • R_e ($R_{p0.2}$)

COUPLING SELECTION ACCORDING TO DIN 740 PART II

Coupling selection

The coupling selection is based on DIN 740 part 2. The coupling has to be dimensioned such that the permissible coupling load is not exceeded during any operating condition. For this purpose the actual loads have to be compared to the permissible parameters of the coupling. The torques specified T_{KN} /$T_{K\ max.}$ refer to the couplings. The shaft-hub-connection has to be investigated by the customer.

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

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.

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

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

1.2 Load produced by torque shocks

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 S_Z and the ambient temperature S_t. 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.

$$T_{K\ max.} \geq T_S \bullet S_z \bullet S_t + T_N \bullet S_t$$

Antriebsseitiger Stoß

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

Lastseitiger Stoß

$$T_S = T_{LS} \bullet M_L \bullet S_L$$

$$M_A = \frac{J_L}{(J_A + J_L)}$$

$$M_L = \frac{J_A}{(J_A + J_L)}$$

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

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

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

2.2 Passing through the resonance

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.

$$T_{K\ max.} \geq T_S \bullet S_t$$

2.3 Load produced by vibratory torque shocks

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. For higher operating frequencies f > 10 Hz, the heat produced by damping in the elastomer part is considered as damping power P_W. The maxium allowed damping power P_{KW} of the coupling depends on the ambient tempreture and may not be exceeded by the existingdamping power P_W of the drive. The damping power of torsionally rigid couplings is of miner importance.

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

$$P_{KW} \geq P_W$$

Coupling selection for BoWex® FLE-PA and MONOLASTIC®

1. Loading by rated torque

For drives with small mass moments on the load side (hydrostatic drives) the selection can be simplified using operating factors.

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

Please note:

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. This applies in particular with large mass moments of inertia on the load side. If requested, we perform the torsional vibration calculation and the coupling selection in our company.

COUPLING SELECTION ACCORDING TO DIN 740 PART II

Example of calculation

Requested: Axial-plug in coupling damping vibrations → ROTEX®

Application: Connection of IEC standard motor and screw compressor

→ **Coupling selection following page 12, item 1: Drives without periodical torsional vibrations**

Given: Details of driving side

Rotary current motor:	Size 315 L	→ S_A =1.8 (see page 11)
Motor output:	P = 160 kW	
Speed:	n = 1485 1/min	
Moment of inertia of driving side:	J_{Motor} = 2.9 kgm²	
Starting frequency:	6 times per hour	→ S_Z =1.0 (see page 11)
Ambient temperature:	+ 70 °C	→ S_t =1.45 using T-PUR® (see page 11)
Peak torque (starting torque) T_{AS}	= 2 • T_{AN}	

Given: Details of load side

Screw compressor	
Rated torque of load side:	T_{LN} = 930 Nm
Moment of inertia of load side:	$J_{compressor}$ = 6.8 kgm²

Calculation

1.1 Loading by rated torque

- Rated torque of drive T_{AN}

$$T_{AN} = 9550 \bullet \frac{P\,[kW]}{n\,[1/min]} \quad \rightarrow 9550 \bullet \frac{160\ kW}{1485\ 1/min} = \underline{1029\ Nm}$$

- Rated torque of load side T_{LN}

$$T_{KN} \geq T_{LN} \bullet S_t \quad \rightarrow 930\ Nm \bullet 1.45 = 1348.5\ Nm \quad \rightarrow T_{KN} \geq \underline{1348{,}5\ Nm}$$

- Coupling selection

ROTEX® Size 90 - spider 92 Shore A with:

T_{KN} = 2400 Nm

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

Mass moments of inertia of page 59

J_{KA} = 0,0673 kgm²

J_{KL} = 0,0673 kgm²

1.2 Loading by torque shocks

- Shock on driving side without load torque being overlapping

$T_{K\ max.} \geq T_S \bullet S_Z \bullet S_t + T_N \bullet S_t$ → $T_N = 0$

Shock on driving side $T_S = T_{AS} \bullet M_A \bullet S_A$

$$M_A = \frac{J_L}{(J_A + J_L)} \quad \rightarrow \frac{6{,}8673\ kgm^2}{2{,}9673\ kgm^2 + 6{,}8673\ kgm^2} \rightarrow M_A = = \underline{0{,}7}$$

$J_A = J_{Motor} + J_{KA}$ → 2,9 kgm² + 0,0673 kgm² → J_A = <u>2,9673 kgm²</u>

$J_L = J_{compressor} + J_{KL}$ → 6,8 kgm² + 0,0673 kgm² → J_L = <u>6,8673 kgm²</u>

Starting torque $T_{AS} = 2 \bullet T_{AN}$ → 2 • 1029 Nm= <u>2058 Nm</u>

→ Shock on driving side T_S = 2058 • 0,7 • 1,8 = <u>2593,1 Nm</u>

→ $T_{K\ max.}$ ≥ 2593,1 Nm • 1 • 1,45 = <u>3760 Nm</u>

$T_{K\ max.}$ mit 4800 Nm ≥ 3760 Nm ✓

Result

The coupling is sufficiently dimensioned.

Please note:

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