

SIZING AND SELECTION

According to
DIN 740 part 2

GENERAL INFORMATION

SAFETY COUPLINGS

ST

SAFETY COUPLINGS

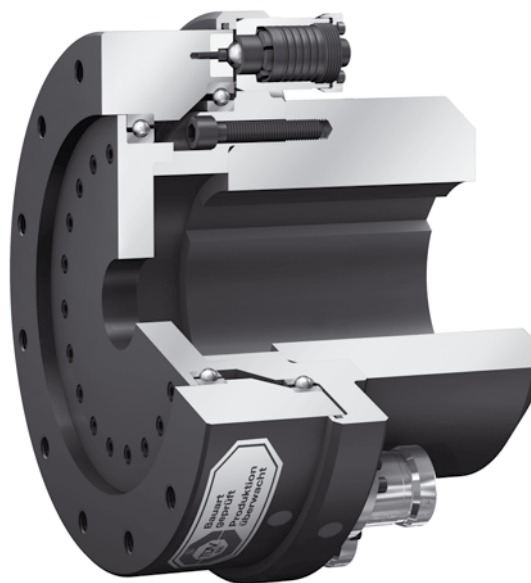
RELIABLE TORQUE OVERLOAD PROTECTION

ST series safety couplings are designed to decouple machine drives in the event of torque overload, preventing damage and downtime.

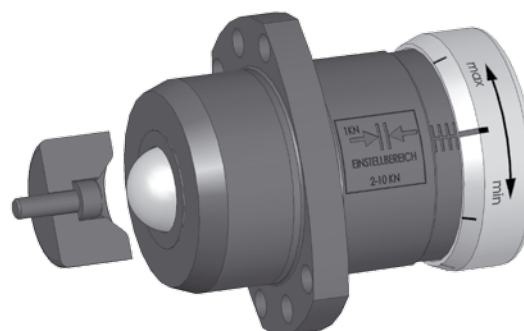
A series of ball bearings are spring loaded into detents on an otherwise freely spinning output plate. In the case of the ST series, these ball bearings are mounted onto plungers which are individually loaded in order to generate high clutching forces while maintaining a relatively small profile.

The transmittable torque is determined by the number and force setting of the safety elements and their distance from the center of the rotational axis. In the event of an overload, the force applied by the detents causes the plungers to overcome the spring loading and retract into the housings, resulting in a complete separation of the driving and driven hubs.

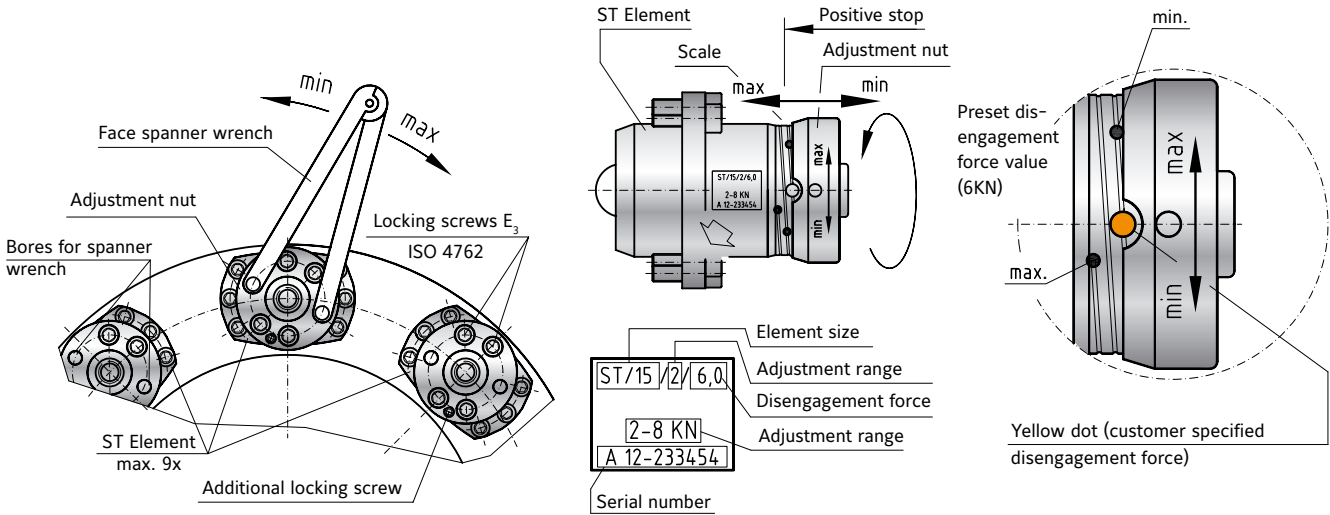
They will not re-engage automatically. After the overload condition has passed, an axial force must be applied in order to re-engage the safety elements into the detents of the output plate.



The safety elements consist of two components: the detent receptacle and the adjustable plunger mechanism.



TORQUE ADJUSTMENT



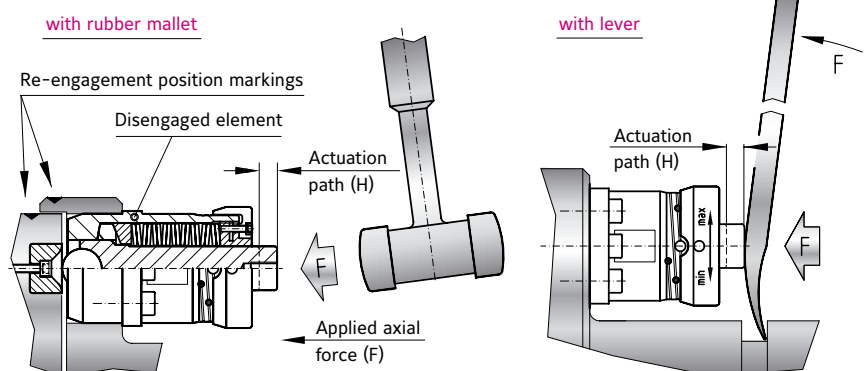
After loosening (approx. 1 rotation) the locking screws (E₃), the adjustment nut can be turned to adjust the disengagement setting. Minimum, maximum and preset values are marked on the adjustment scale. After adjustment, the torque setting is secured by tightening the locking screws (E₃).

► **Note**

All safety elements must be set to the same value.

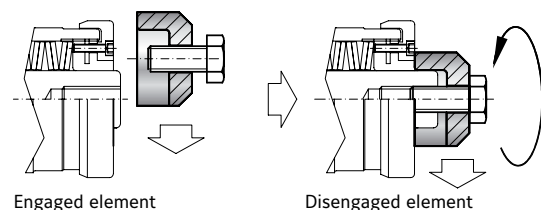
RE-ENGAGEMENT OF THE SAFETY ELEMENTS

After the overload has been cleared, the drive or driven side must be rotated until the re-engagement position markings are lined up. The elements can only be re-engaged in this position. The element is re-engaged through applying an axial force to the plunger. Re-engagement is audible. Once this is complete, the torque limiter is ready for operation.



MANUAL DISENGAGEMENT OF ELEMENTS

Prior to machine start-up, the individual elements can be manually disengaged. A manual disengagement tool is available from R+W (see page 61).



SAFETY COUPLINGS

SYMBOLS

| | |
|--------------|---|
| T_{AR} | = Disengagement torque of the coupling (Nm) |
| K | = Service factor |
| T_{max} | = Maximum torque of the drive system (Nm) |
| T_{AN} | = Rated torque of the motor (Nm) |
| P_{Drive} | = Drive power (kW) |
| n | = Drive speed (min^{-1}) |
| α | = Angular acceleration (rad/s^2) |
| t | = Acceleration time (s) |
| ω | = Angular velocity (rad/s) |
| J_L | = Moment of inertia of load (kgm^2) |
| J_A | = Moment of inertia of drive (kgm^2) |
| T_{AS} | = Peak motor torque (Nm) |
| S | = Number of safety elements |
| F | = Tangential force (kN) |
| r | = Radius to element (m) |
| s | = Spindle pitch (mm) |
| F_V | = Feed force (N) |
| η | = Spindle efficiency |
| d_0 | = Pitch diameter (mm) |
| F_V | = Feed force (N) |
| C_T | = Torsional stiffness of coupling (Nm/rad) |
| $J_{Masch.}$ | = Total load inertia (kgm^2) (e.g. shaft + sprocket + chain + roller + 1/2 of coupling) |
| $J_{Mot.}$ | = Total driving inertia (kgm^2) (e.g. motor shaft + 1/2 of coupling) |
| f_e | = Resonant frequency of the two mass system (Hz) |

| Shock or Load Factor S_A | | |
|--|------------------|------------------|
| uniform load | non-uniform load | heavy shock load |
| 1 | 2 | 3 |
| For many crushing and shredding applications load factors are commonly $S_A = 2-3$ | | |

ACCORDING TO DISENGAGEMENT TORQUE

Safety couplings are normally selected according to the required disengagement torque, which must be greater than the maximum torque required for start-up and operation.

Disengagement torque values are often determined from the drive data and are typically a multiple of the nominal torque at the operating drive speed (T_{AN}). In addition to a start-up torque (T_{max}), the following values are used as further safety factors, depending on the load conditions:

- $K = 1.3$ uniform harmonious load
- $K = 1.5$ non-uniform load
- $K = 1.8$ heavy shock load

$$T_{AR} \geq K \cdot T_{max} \text{ (Nm)}$$

or

$$T_{AN} \geq 9,550 \cdot \frac{P_{Drive}}{n} \text{ (Nm)}$$

ACCORDING TO ACCELERATION
(START-UP WITH NO LOAD)

$$T_{AR} \cong \frac{J_L}{J_A + J_L} \cdot T_{AS} \cdot S_A \cong \alpha \cdot J_L \text{ (Nm)}$$

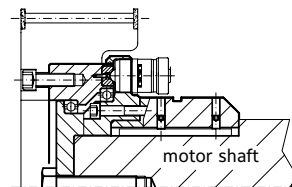
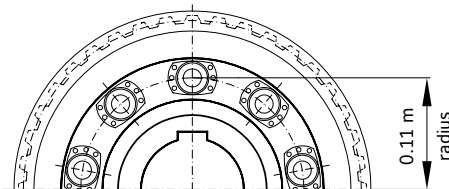
$$\alpha = \frac{\omega}{n} = \frac{\pi \cdot n}{t \cdot 30}$$

ACCORDING TO
ACCELERATION
(START-UP WITH LOAD)

$$T_{AR} \cong \left[\frac{J_L}{J_A + J_L} \cdot (T_{AS} - T_{AN}) + T_{AN} \right] \cdot S_A \cong \alpha \cdot J_L + T_{AN} \text{ (Nm)}$$

ACCORDING TO THE NUMBER
OF SAFETY ELEMENTS

$$T_{AR} = S \cdot F \cdot r$$



ACCORDING TO LINEAR FEED FORCE

Screw drive

$$T_{AN} = \frac{s \cdot F_v}{2,000 \cdot \pi \cdot \eta} \text{ (Nm)}$$

Rack and pinion drive

$$T_{AN} = \frac{d_0 \cdot F_v}{2,000} \text{ (Nm)}$$

ACCORDING TO RESONANT FREQUENCY

The torsional natural frequency of the coupling must be significantly higher or lower than that of the equipment. For the mechanical substitution model the two mass system applies.

$$f_e = \frac{1}{2 \cdot \pi} \sqrt{C_T \cdot \frac{J_{Masch} + J_{Mot}}{J_{Masch} \cdot J_{Mot}}} \text{ (Hz)}$$

SAFETY COUPLINGS

ELASTIC JAW COUPLING DESIGN ST2

| Size | | ST2 / 2 | ST2 / 5 | ST2 / 10 | ST2 / 25 | ST2 / 40 | ST2 / 60 | ST2 / 100 | ST2 / 160 |
|--------------------------------------|--|---------|---------|----------|----------|----------|----------|-----------|-----------|
| T_{KN} Rated Torque (Nm) | | 2,000 | 3,000 | 5,000 | 7,500 | 20,000 | 20,000 | 40,000 | 40,000 |
| T_{Kmax} Maximum Torque (Nm) | | 4,800 | 7,500 | 18,000 | 25,000 | 48,000 | 48,000 | 120,000 | 120,000 |
| Torsional Stiffness (10^3 Nm/rad) | | 58 | 92 | 145 | 230 | 500 | 580 | 850 | 1000 |
| Relative Damping | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

LOAD FACTORS BY MACHINE TYPE

EXCAVATORS

- S bucket chain excavators
- S traveling gear (caterpillar)
- M traveling gear (rails)
- M suction pumps
- S bucket wheels
- M slewing gears

CONSTRUCTION MACHINERY

- M concrete mixers
- M road construction machinery

CHEMICAL INDUSTRY

- M mixers
- G agitators (light fluids)
- M dryer drums
- G centrifuges

FEEDERS AND CONVEYORS

- S belt conveyors
- G belt conveyors (bulk materials)
- M belt bucket conveyors
- M screw conveyors
- M circular conveyors
- M hoists

BLOWERS AND FANS¹⁾

- G blowers (axial/radial) $P:n \leq 0.007$
- M blowers (axial/radial) $P:n \leq 0.07$
- S blowers (axial/radial) $P:n > 0.07$
- G cooling tower fans $P:n \leq 0.007$
- M cooling tower fans $P:n \leq 0.07$
- S cooling tower fans $P:n > 0.07$

GENERATORS AND TRANSFORMERS

- S generators

RUBBER MACHINERY

- S extruders
- S calendars
- M mixers
- S rolling millse

WOOD PROCESSING MACHINERY

- G woodworking machines

CRANES

- S traveling gears
- S hoisting gears
- M slewing gears

PLASTICS MACHINERY

- M mixers
- M shredders

METALWORKING MACHINERY

- M sheet metal bending machines
- S plate straightening machines

- S presses
- M shears
- S punch presses
- M machine tools, main drives

FOOD PROCESSING MACHINERY

- G filling machines
- M kneading machines
- M cane crushers
- M cane cutters
- S cane mills
- M sugar beet cutters
- M sugar beet washers

PAPER MACHINERY

- S wood cutters
- S calendars
- S wet presses
- S suction presses
- S suction rollers
- S drying cylinders

PUMPS

- S piston pumps
- G centrifugal pumps (light fluids)
- S reciprocating pumps

STONE AND CLAY MACHINES

- S breakers

- S rotary kilns
- S hammer mills
- S brick presses

TEXTILE MACHINERY

- M tanning vats
- M willows
- M looms

COMPRESSORS

- S reciprocating compressors
- M centrifugal compressors

METAL ROLLING MILLS

- M plate tilters
- S ingot handling machinery
- M winding machines (strip and wire)
- S descaling machines
- S cold rolling mills
- M chain transfers
- M cross transfers
- M roller straighteners
- S tube welding machines
- S continuous casting plants
- M roller adjustment drives

LAUNDRY MACHINES

- M tumblers
- M washing machines

WASTEWATER TREATMENT PLANTS

- M aerators
- G screw pumps

¹⁾ P = power of drive in kW
n = speed of drive in rpm

DESIGN FACTORS

Shock or Load Factor S_A

| Drive type | Load characteristics of driven machine | | |
|---|--|-----|-----|
| | G | M | S |
| electric motors, turbines, hydraulic motors | 1.25 | 1.6 | 2.0 |
| internal combustion engines ≥ 4 cylinder degree of uniformity $\geq 1:100$ | 1.5 | 2.0 | 2.5 |

G = smooth uniform load | M = moderate load | S = heavy shock load

Temperature Factor S_v

| Ambient Temperature | -40 C° +30 C° | +40 C° | +60 C° | +80 C° | > +80 C° |
|---------------------|------------------|--------|--------|--------|------------|
| S_v | 1.0 | 1.1 | 1.4 | 1.8 | on request |

Start Factor S_z

| Starts per Hour | 30 | 60 | 120 | 240 | >240 |
|-----------------|-----|-----|-----|-----|------------|
| S_z | 1.0 | 1.1 | 1.2 | 1.3 | on request |

ACCORDING TO TORQUE

1. Calculate the drive torque T_{AN} .

$$T_{AN} \geq 9,550 \cdot \frac{P_{Drive}}{n} \quad (\text{Nm})$$

2. Base the coupling rated torque T_{KN} on the drive torque T_{AN} multiplied by the application factors.

$$T_{KN} \geq T_{AN} \cdot S_A \cdot S_v \cdot S_z$$

Example:

Coupling between an electric motor (P = 450 kW and n = 980 rpm) and a gearbox driving a belt conveyor for bulk materials.

$$T_{AN} = 9,550 \cdot \frac{450 \text{ kW}}{980 \text{ min}^{-1}} = 4,385.2 \text{ Nm}$$

smooth uniform load
= G : $S_A = 1.25$
ambient temperature
40°C : $S_v = 1.1$
starts
30/h : $S_z = 1.0$

$$T_{KN} \geq T_{AN} \cdot S_A \cdot S_v \cdot S_z$$

$$T_{KN} \geq 4,385.2 \text{ Nm} \cdot 1.25 \cdot 1.1 \cdot 1.0 = 6,029.7 \text{ Nm}$$

Selected coupling: ST2 / 10 with elastomer coupling $T_{KN} = 6,030 \text{ Nm}$

SIZING AND SELECTION

SAFETY COUPLINGS

ST

GEAR COUPLING DESIGN ST4

| Size | ST4 / 2 | ST4 / 5 | ST4 / 10 | ST4 / 25 | ST4 / 40 | ST4 / 60 | ST4 / 100 | ST4 / 160 | ST4 / 250 |
|---|---------|---------|----------|----------|----------|----------|-----------|-----------|-----------|
| T _{KN} Rated Torque (Nm) | 5,700 | 9,000 | 14,500 | 22,000 | 45,000 | 70,000 | 150,000 | 200,000 | 402,000 |
| T _{Kmax} Maximum Torque (Nm) | 14,000 | 21,500 | 35,000 | 54,000 | 110,000 | 170,000 | 360,000 | 480,000 | 804,000 |
| n Ref (max speed) (min. ⁻¹) | 4,000 | 3,900 | 3,700 | 3,550 | 2,750 | 2,420 | 1,950 | 1,730 | 990 |

ACCORDING TO TORQUE

1. Calculate the drive torque. T_{AN} .

$$T_{AN} \cong 9,550 \cdot \frac{P_{Drive}}{n} \quad (\text{Nm})$$

2. Base the coupling rated torque T_{KN} on the drive torque T_{AN} multiplied by the application factor. (see page 20 for shock or load factors S_A).

$$T_{KN} \geq T_{AN} \cdot S_A$$

Example:

Coupling between an electric motor (P = 800 kW and n = 980 rpm) and a gearbox driving a bucket chain excavator ($S_A = 2$).

$$T_{AN} = 9,550 \cdot \frac{800 \text{ kW}}{980 \text{ min.}^{-1}} = 7,796 \text{ Nm}$$

$$\begin{aligned} T_{KN} &\geq T_{AN} \cdot S_A \\ T_{KN} &\geq 7,796 \text{ Nm} \cdot 2 = 15,592 \text{ Nm} \end{aligned}$$

Selected coupling: ST4 / 10 with gear coupling $T_{KN} = 16,000 \text{ Nm}$

SIZING AND SELECTION

LP

DISC PACK COUPLINGS

SYMBOLS

- T_{KN} = Rated torque of the coupling (Nm)
 T_{AS} = Peak torque of the drive system
e.g. max. acceleration torque of drive (Nm)
or max. braking torque of load (Nm)
 J_L = Total load inertia (e.g. shaft + sprocket + chain + roller + 1/2 of coupling) (kgm²)
 J_A = Total driving inertia (motor [including gear ratio] + 1/2 of coupling) (kgm²)

| Shock or Load Factor S_A | | |
|--|------------------|---------------------|
| uniform load | non-uniform load | highly dynamic load |
| 1 | 2 | 3-4 |
| Common factor for servo drives in machine tools: $S_A = 2-3$ | | |

ACCORDING TO TORQUE

Couplings are normally sized for the highest torque to be regularly transmitted. The peak torque of the application should not exceed the rated torque of the coupling. The following calculation provides an approximation of the minimum required coupling size, and allows for the maximum rated speed and misalignment to exist in the application.

$$T_{KN} \cong 1.5 \cdot T_{AS} \text{ (Nm)}$$

ACCORDING TO ACCELERATION TORQUE

A more detailed calculation takes acceleration and the driving and driven moments of inertia into account. A strong inertia ratio diminishes the effect of the load factor in the sizing calculation.

$$T_{KN} \cong T_{AS} \cdot S_A \cdot \frac{J_L}{J_A + J_L} \text{ (Nm)}$$

GENERAL INFORMATION

GEAR COUPLING

BZ

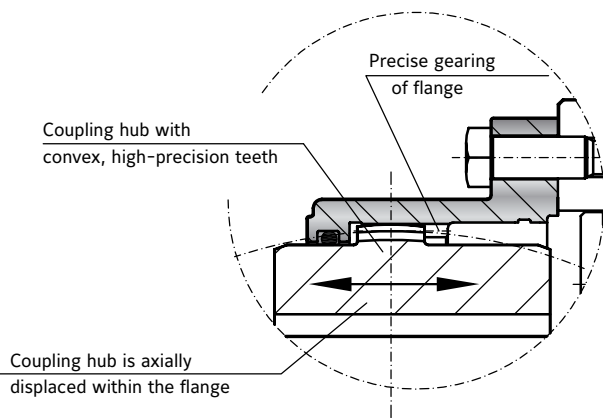
GEAR COUPLING

FUNCTION OF THE GEAR COUPLING

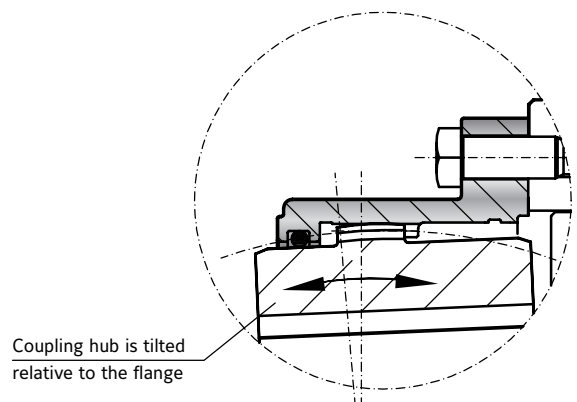
The high precision gearing of the coupling compensates for lateral, angular, and axial misalignment. The gearing transmits torque with minimal backlash and a high degree

of torsional rigidity. The precise geometry of the gearing ensures the performance of the coupling.

Axial misalignment



Angular and lateral misalignment



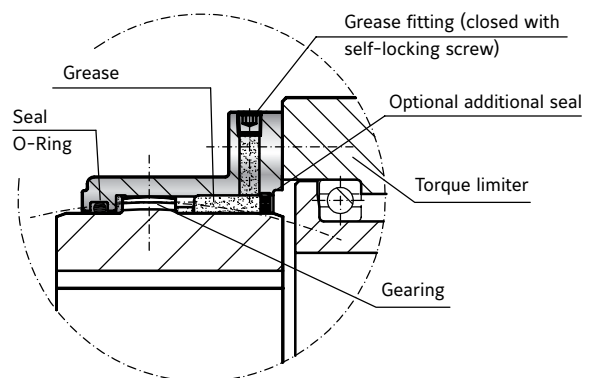
MAINTENANCE AND LUBRICATION

► **Note:** Lubrication of the gearing is very important to the service life of the coupling. An additional seal (optional) ensures the lubrication of the gearing over a long period of time.

Use only high performance grease

RECOMMENDED LUBRICANTS

| Normal speed | | High speed | |
|--------------|-------------------------------|------------|----------------------|
| Castrol | Impervia MDX | Caltex | Coupling Grease |
| Esso | Fibrax 370 | Klüber | Klüberplex GE 11-680 |
| Klüber | Klüberplex GE 11-680 | Mobil | Mobilgrease XTC |
| Mobil | Mobilux EPO | Shell | Albida GC1 |
| Shell | Alvania grease EP R-O or ER 1 | Texaco | Coupling Grease |
| Total | Specis EPG | | |



For easier handling, the coupling will be shipped unassembled.

GEAR COUPLINGS

SYMBOLS

- T_{KN} = Rated torque of the coupling (Nm)
 T_{AN} = Rated torque of the drive (Nm)
 S_A = Shock or load factor
 P = Drive power (kW)
 n = Rotational speed (rpm)

DESIGN FACTORS

Shock or Load Factor S_A

| Drive type | Load characteristics of driven machine | | |
|---|--|-----|-----|
| | G | M | S |
| electric motors, turbines, hydraulic motors | 1.25 | 1.6 | 2.0 |
| internal combustion engines ≥ 4 cylinder degree of uniformity $\geq 1:100$ | 1.5 | 2.2 | 2.5 |

G = smooth uniform load | M = moderate load | S = heavy shock load

LOAD FACTORS BY MACHINE TYPE

EXCAVATORS

- S bucket chain excavators
- S traveling gear (caterpillar)
- M traveling gear (rails)
- M suction pumps
- S bucket wheels
- M slewing gears

CONSTRUCTION MACHINERY

- M concrete mixers
- M road construction machinery

CHEMICAL INDUSTRY

- M mixers
- G agitators (light fluids)
- M dryer drums
- G centrifuges

FEEDERS AND CONVEYORS

- S belt conveyors
- G belt conveyors (bulk materials)
- M belt bucket conveyors
- M screw conveyors
- M circular conveyors
- M hoists

BLOWERS AND FANS¹⁾

- G blowers (axial/radial) $P:n \leq 0.007$
- M blowers (axial/radial) $P:n \leq 0.07$
- S blowers (axial/radial) $P:n > 0.07$
- G cooling tower fans $P:n \leq 0.007$
- M cooling tower fans $P:n \leq 0.07$
- S cooling tower fans $P:n > 0.07$

GENERATORS AND TRANSFORMERS

- S generators

RUBBER MACHINERY

- S extruders
- S calendars
- M mixers
- S rolling millse

WOOD PROCESSING MACHINERY

- G woodworking machines

CRANES

- S traveling gears
- S hoisting gears
- M slewing gears

PLASTICS MACHINERY

- M mixers
- M shredders

METALWORKING MACHINERY

- M sheet metal bending machines
- S plate straightening machines

- S presses

- M shears
- S punch presses
- M machine tools, main drives

FOOD PROCESSING MACHINERY

- G filling machines
- M kneading machines
- M cane crushers
- M cane cutters
- S cane mills
- M sugar beet cutters
- M sugar beet washers

PAPER MACHINERY

- S wood cutters
- S calendars
- S wet presses
- S suction presses
- S suction rollers
- S drying cylinders

PUMPS

- S piston pumps
- G centrifugal pumps (light fluids)
- S reciprocating pumps

STONE AND CLAY MACHINES

- S breakers

- S rotary kilns
- S hammer mills
- S brick presses

TEXTILE MACHINERY

- M tanning vats
- M willows
- M looms

COMPRESSORS

- S reciprocating compressors
- M centrifugal compressors

METAL ROLLING MILLS

- M plate tilters
- S ingot handling machinery
- M winding machines (strip and wire)
- S descaling machines
- S cold rolling mills
- M chain transfers
- M cross transfers
- M roller straighteners
- S tube welding machines
- S continuous casting plants
- M roller adjustment drives

LAUNDRY MACHINES

- M tumblers
- M washing machines

WASTEWATER TREATMENT PLANTS

- M aerators
- G screw pumps

¹⁾ P = power of drive in kW
n = speed of drive in rpm

ACCORDING TO TORQUE

1. Calculate the drive torque at speed T_{AN} .

$$T_{AN} \cong 9,550 \cdot \frac{P_{Drive}}{n} \text{ (Nm)}$$

2. Determine the required torque rating of the coupling T_{KN} based on the drive torque T_{AN} multiplied by the shock or load factor S_A (see page 20)

$$T_{KN} \geq T_{AN} \cdot S_A$$

Sample calculation:

Coupling between an electric motor (P = 800 kW at n = 980 rpm) and a transmission, driving a screw conveyor ($S_A = 1.6$).

$$T_{AN} = 9,550 \cdot \frac{800 \text{ kW}}{980 \text{ min.}^{-1}} = 7,796 \text{ Nm}$$

$$\begin{aligned} T_{KN} &\geq T_{AN} \cdot S_A \\ T_{KN} &\geq 7,796 \text{ Nm} \cdot 1.6 = 15,592 \text{ Nm} \end{aligned}$$

SIZING AND SELECTION

BX

BELLOWS COUPLINGS

SYMBOLS

- T_{KN} = Rated torque of coupling (Nm)
 T_{AS} = Peak torque (Nm)
e.g. maximum acceleration peak torque or maximum braking torque from the load
 J_L = Moment of inertia of the load (load + drive line components + half of coupling) (kgm^2)
 J_A = Drive inertia (rotor of motor + drive line components + half of coupling) (kgm^2)
 C_T = Torsional stiffness of coupling (Nm/rad)
 f_e = Resonant frequency of the two mass system (Hz)
 f_{er} = Excitation frequency of the drive (Hz)
 φ = Angle of twist (degree)

| Shock or Load Factor S_A | | |
|--|------------------|------------------|
| uniform load | non-uniform load | heavy shock load |
| 1 | 2 | 3-4 |
| For many crushing and shredding applications load factors are commonly $S_A = 2-3$ | | |

ACCORDING TO TORQUE

Couplings are normally sized for the highest torque to be regularly transmitted. The peak torque of the application should not exceed the rated torque of the coupling. The following calculation provides an approximation of the minimum required coupling size, and allows for the maximum rated speed and misalignment to exist in the application.

$$T_{KN} \cong 1.5 \cdot T_{AS} \text{ (Nm)}$$

ACCORDING TO ACCELERATION TORQUE

A more detailed calculation takes acceleration and the driving and driven moments of inertia into account. A strong inertia ratio diminishes the effect of the load factor in the sizing calculation.

$$T_{KN} \cong T_{AS} \cdot S_A \cdot \frac{J_L}{J_A + J_L} \text{ (Nm)}$$

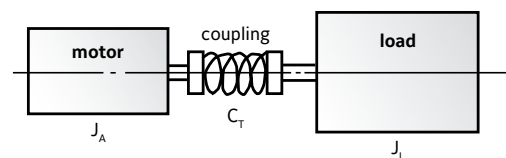
ACCORDING TO RESONANT FREQUENCY

The torsional natural frequency of the coupling must be significantly higher or lower than that of the equipment. For the mechanical substitution model the two mass system applies.

In practice the following applies: $f_e \geq 2 \cdot f_{er}$

$$f_e = \frac{1}{2 \cdot \pi} \sqrt{C_T \cdot \frac{J_A + J_L}{J_A \cdot J_L}} \text{ (Hz)}$$

Two Mass System



ACCORDING TO TORSIONAL DEFLECTION

To calculate transmission error as a result of torsional stress:

$$\varphi = \frac{180}{\pi} \cdot \frac{T_{AS}}{C_T} \text{ (degree)}$$

SIZING AND SELECTION

EK

ELASTIC JAW COUPLINGS

SYMBOLS

| | |
|---------------|---|
| T_{KN} | = Rated torque of the coupling (Nm) |
| T_{Kmax} | = Maximum torque rating of coupling (Nm) |
| T_S | = Peak torque applied to the coupling (Nm) |
| T_{AS} | = Peak torque of the drive system (Nm) |
| T_{AN} | = Nominal torque of the drive system (Nm) |
| T_{LN} | = Nominal torque of the load (Nm) |
| P | = Drive power (kW) |
| n | = Rotational speed (min. ⁻¹) |
| J_A | = Total driving inertia (kgm ²) (motor [including gear ratio] + 1/2 of coupling) |
| J_L | = Total load inertia (kgm ²) (load + drive line components + half of coupling) |
| J_1 | = Moment of inertia of driving coupling half (kgm ²) |
| J_2 | = Moment of inertia of driving coupling half (kgm ²) |
| m | = Ratio of the moment of inertia of the drive to the load |
| \mathcal{U} | = Temperature at the coupling (also consider radiant heat) |
| S_v | = Temperature factor |
| S_A | = Load factor |
| S_z | = Start factor (factor for the number of starts per hour) |
| Z_h | = Number of starts per hour (1/h) |

| Temperature factor S_v | A | B | E |
|--------------------------|---------|---------|---------|
| Temperature (v) | Sh 98 A | Sh 65 D | Sh 64 D |
| > -30°C to -10°C | 1.5 | 1.3 | 1.2 |
| > -10°C to +30°C | 1.0 | 1.0 | 1.0 |
| > +30°C to +40°C | 1.2 | 1.1 | 1.0 |
| > +40°C to +60°C | 1.4 | 1.3 | 1.2 |
| > +60°C to +80°C | 1.7 | 1.5 | 1.3 |
| > +80°C to +100°C | 2.0 | 1.8 | 1.6 |
| > +100°C to +120°C | - | 2.4 | 2.0 |
| > +120°C to +150°C | - | - | 2.8 |

| Start factor S_z | A | B | E |
|--------------------|-----------|------------|------------|
| Z_h | up to 120 | 120 to 240 | over 240 |
| S_z | 1.0 | 1.3 | on request |

| Shock / load factor S_A | A | B | E |
|---------------------------|---|------------------|------------------|
| uniform load | | non-uniform load | heavy shock load |
| 1 | | 1.8 | 2.5 |

COUPLING SELECTION FOR OPERATION WITHOUT SHOCK OR REVERSAL

The rated torque of the coupling (T_{KN}) must be greater than the rated torque of the load (T_{LN}), taking into account the temperature at the coupling (Temperature factor S_v). Should T_{LN} be unknown, T_{AN} can be used as a substitute in the formula.

Calculation

$$T_{KN} > T_{AN} \cdot S_v$$

Supplemental Calculation

$$T_{AN} = \frac{9,550 \cdot P}{n}$$

Sample calculation: (without shock loads)

Coupling conditions

$$v = 70^\circ \text{C}$$

$$S_v = 1.7 \text{ (for } 70^\circ \text{ Elastomer Type A)}$$

Drive for centrifugal pump

$$T_{AN} = 850 \text{ Nm}$$

$$\text{Calculation: } T_{KN} > T_{AN} \cdot S_v$$

$$T_{KN} > 850 \text{ Nm} \cdot 1.7$$

$$T_{KN} > \underline{1445 \text{ Nm}} \longrightarrow \text{Result: Coupling model EKH/2500/A (} T_{KN} = 1950 \text{ Nm) is selected.}$$

COUPLING SELECTION FOR OPERATION WITH SHOCK LOADS

Same basic conditions as above. In addition, the maximum torque rating of the coupling (T_{Kmax}) is dictated by peak torque (T_s) due to shock loads.

Calculation

$$T_{KN} > T_{AN} \cdot S_v$$

Calculation

$$T_{Kmax} > T_s \cdot S_z \cdot S_v$$

Supplemental Calculation

$$T_{AN} = \frac{9,550 \cdot P}{n}$$

Supplemental Calculation

$$T_s = \frac{T_{AS} \cdot S_A}{m + 1}$$

$$m = \frac{J_A \cdot J_1}{J_L \cdot J_2}$$

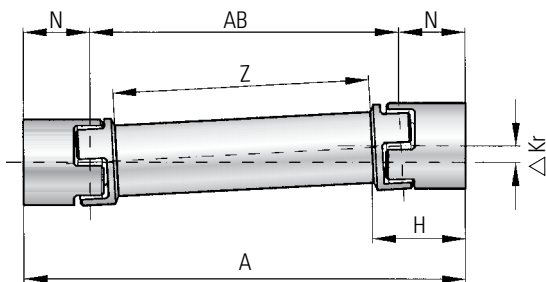
SIZING AND SELECTION

EZ

ELASTOMER-DRIVE SHAFT COUPLINGS

SYMBOLS

- A = Overall length (mm)
AB = Distance between flextures (mm)
 $AB = (A - 2xN)$
Z = Tube length (mm)
 $Z = (A - 2xH)$
H = Length of coupling ends (mm)
N = Length to flexure (mm)
 T_{AS} = Peak torque of the drive (Nm)
 φ = Torsional deflection (degree)
 C_T^B = Torsional stiffness of both flexible elements (Nm/rad)
 C_T^{ZWR} = Torsional stiffness per 1m of tubing (Nm/rad)
 C_T^{ZA} = Total torsional stiffness (Nm/rad)
 n_k = Critical speed (1/min.)
 C_{Tdyn}^E = Dynamic torsional stiffness of both elastomer inserts (Nm/rad)
 C_{Tdyn}^{EZ} = Total torsional stiffness (Nm/rad)



MODEL EZ

| Size | Torsional stiffness of both flexible elements | | Torsional stiffness per 1m of tubing | Length of coupling ends EZ | Length to flexure | Max. axial misalignment |
|------|---|--|--------------------------------------|----------------------------|-------------------|-------------------------|
| | Elastomer insert A C_T^B (Nm/rad) | Elastomer insert B C_T^B (Nm/rad) | C_T^{ZWR} (Nm/rad) | H (mm) | N (mm) | ΔK_a (mm) |
| 2500 | 87,500 | 108,000 | 1,000,000 | 142 | 108 | 5 |
| 4500 | 168,500 | 371,500 | 2,500,000 | 181 | 137 | 5 |
| 9500 | 590,000 | 670,000 | 5,000,000 | 229 | 171 | 6 |

Table 2

MAXIMUM TRANSMITTABLE TORQUE BY BORE DIAMETER (Nm)

| Size | Ø 35 | Ø 45 | Ø 50 | Ø 55 | Ø 60 | Ø 65 | Ø 70 | Ø 75 | Ø 80 | Ø 90 | Ø 120 | Ø 140 |
|------|------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 2500 | 1900 | 2600 | 2900 | 3200 | 3500 | 3800 | 4000 | 4300 | 4600 | 5200 | | |
| 4500 | | 5300 | 5800 | 6300 | 7000 | 7600 | 8200 | 8800 | 9400 | 10600 | 14100 | |
| 9500 | | | 9200 | 10100 | 11100 | 11900 | 12800 | 13800 | 14800 | 16700 | 22000 | 25600 |

TEMPERATURE FACTOR S

| Temperature (°C) | A | B |
|------------------|---------|---------|
| | Sh 98 A | Sh 64 D |
| > -30° to -10° | 1.5 | 1.7 |
| > -10° to +30° | 1.0 | 1.0 |
| > +30° to +40° | 1.2 | 1.1 |
| > +40° to +60° | 1.4 | 1.3 |
| > +60° to +80° | 1.7 | 1.5 |
| > +80° to +100° | 2.0 | 1.8 |
| > +100° to +120° | - | 2.4 |

ACCORDING TO TORSIONAL STIFFNESS

Condition: Line shaft EZ2, Size 4500 $T_{AS} = 5,000\text{Nm}$
Wanted: Total torsional stiffness C_T^{ZA}

$$(C_T^{ZA}) = \frac{168,500 \text{ Nm/rad} \times (2,500,000 \text{ Nm/rad} / 1.344 \text{ m})}{168,500 \text{ Nm/rad} + (2,500,000 \text{ Nm/rad} / 1.344 \text{ m})} = 154504 \text{ [Nm/rad]}$$

$$(C_T^{ZA}) = \frac{C_T^B \cdot (C_T^{ZWR}/Z)}{C_T^B + (C_T^{ZWR}/Z)} \text{ (Nm/rad)}$$

ACCORDING TO TORSIONAL DEFLECTION

Condition: Line shaft EZ2, size 4500 $T_{AS} = 5,000 \text{ Nm}$
Wanted: Torsional deflection at maximum acceleration torque T_{AS}

Measurement (A) of line shaft = 1.706 m
 Length (Z) of tubing = $A - (2 \times H) = 1.344 \text{ m}$

$$\varphi = \frac{180 \times 5,000 \text{ Nm}}{\pi \times 154504 \text{ Nm/rad}} = 1,85^\circ$$

$$\varphi = \frac{180 \cdot T_{AS}}{\pi \cdot C_T^{ZA}} \text{ (degree)}$$

With a maximum torque of 5,000 Nm the torsional deflection is 1.85°

SIZING AND SELECTION

EZ

DRIVE SHAFT COUPLINGS

ACCORDING TO MAXIMUM MISALIGNMENT

Lateral misalignment ΔKr



$$\Delta Kr_{\max} = \tan \Delta \frac{Kw}{2} \cdot AB$$

$$AB = A - 2N$$

Angular misalignment ΔKw



$$\Delta Kw_{\max} = 2^\circ$$

Axial misalignment ΔKa



ΔKa See table
(Page 27)

R+W CALCULATION PROGRAM

Using proprietary software, R+W will calculate the specific mechanical details of exactly the model you plan to use. Overall length, tube materials (e.g. steel, aluminum, CFK), and other factors are used to determine a number of performance values unique to your line shaft coupling.

| | |
|-------------------------------|-----------------------------------|
| Critical speed | $n_k = 1/\text{min.}$ |
| Torsional stiffness of tubing | $C_T^{ZWR} = \text{Nm/rad}$ |
| Overall stiffness | $C_T^{ZA} = \text{Nm/rad}$ |
| Torsional deflection | $\varphi = \text{degree-min-sec}$ |
| Total Weight | $m = \text{kg}$ |
| Moment of inertia | $J = \text{kgm}^2$ |
| Maximum misalignment | $\Delta Kr = \text{mm}$ |

GENERAL INFORMATION ELASTOMER SEGMENT ST2

ST2

ELASTIC SAFETY COUPLING

THE ELASTOMER SEGMENT

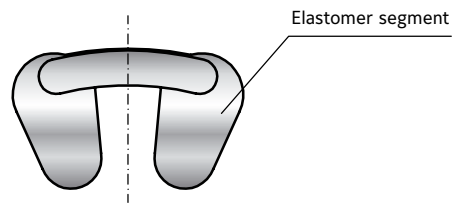
The compensating elements of the ST2 safety couplings are the elastomer segments. They transmit torque while damping vibration and compensating for lateral, axial

and angular misalignment. Three different versions are available with version A being supplied unless otherwise specified.

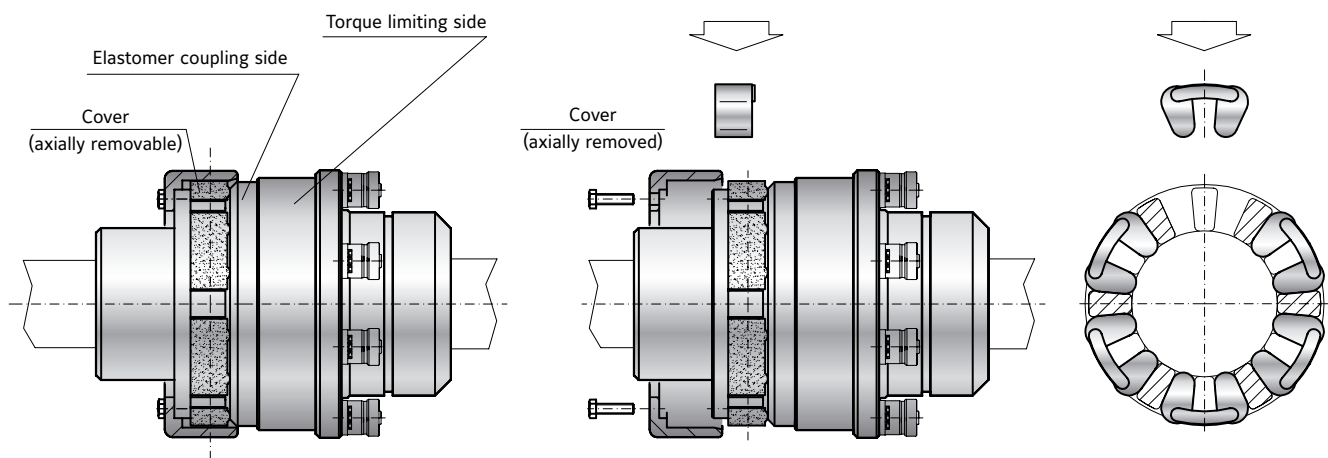
| Type | Relative damping (ψ) | Temperature range constant | Temperature range peak | Material | Shore hardness | Features |
|--------------|-----------------------------|----------------------------|------------------------|------------------------------|----------------|----------------------------------|
| A (Standard) | 1.0 | -40°C to +80°C | +90°C | Natural and synthetic rubber | 75-80 Shore A | Very high wear resistance |
| B | 1.0 | -40°C to +100°C | +120°C | Synthetic rubber | 73-78 Shore A | Resistant to many oils and fuels |
| C | 1.0 | -70°C to +120°C | +140°C | Silicone rubber | 70-75 Shore A | High temperature range |

► **Note**

Elastomer segments can be easily changed after installation. Every coupling utilizes 6x elastomer segments. The elastomer segments do not need to be installed prior to coupling mounting.



CHANGING THE ELASTOMER SEGMENTS



For easier handling, the coupling will be shipped unassembled.

