Metal bellows couplings

Product information / Design

Typical characteristics of metal bellows couplings

- Backlash-free transmission of torque
- High torsional stiffness, precision of transmission of rotational angle
- Different torsional stiffness
- Backlash-free shaft connection
- Small dimensions, low moment of inertia
- Compensation for radial, axial, and angular misalignment
- Free of wear, maintenance-free, no standstill period
- Not sensitive to temperatures between -30 °C and +100 °C, higher temperature ranges available on demand
- Simple and operationally safe assembly
- Economical and user-friendly due to modular system
- Nominal moments between 0.4 - 5000 Nm

Backlash-free, torsionally stiff metal bellows couplings are ready to install when delivered. The metal bellows are made of anti-corrosive steel, all other parts are manufactured from aluminum or steel and partly have an environmental friendly protective coating.

As a standard, the boreholes are equipped with a fitting in accordance with ISO-H7. For the shafts, we recommend an transition, e.g. H7/g6. When selecting other shaft fitting, the fitting should not exceed a maximum of 0.03 mm.

The power transmission between the coupling hub and the shaft occurs through compression and friction between the contact surfaces. Special attention must be paid to the tightening torque of the retaining screws as well as the perfect condition of the contact surfaces.

The contact surfaces must be free of oil and grease. Types with a keyway are available. The torques indicated in the lists of Technical Data can only be safely transferred if these points are complied with. Otherwise it would be necessary to make compromises.

The dimensioning in accordance with the torque

Metal bellows couplings are generally designed according to the nominal torque stated in the lists of the Technical Data below. The nominal torque must always be higher than the regularly transferred torque. This generally applies to the use of servo motors, whose acceleration moment in positive and negative directions is much higher than the nominal moment.

The use of metal bellows couplings which are put in controlled, high dynamic drives, the following dimensioning values have proven to be reliable in practice:

K = 1,5	for evenly shaped movements
K = 2	for unevenly shaped movements
K = 2,5 – 4	for jerky movements

For Servo drives within tool making machines, the values for K of 1.5-2 should be used.

In general, the following relationships apply:

$$T_{KN} \geq K \times T_{AS} \times \frac{J_{Mach}}{J_{Mot} + J_{Mach}} = [Nm]$$

Design

Design with consideration for dynamic torsional stiffness.

Although metal bellows couplings are backlash-free and torsion-rigid, it should not be overlocked that they link two rotating masses. In disadvantageous cases like torsion springs the couplings can effect a high stiffness. The hunting of the drives and the harmonic oscillation in the armature current of the motor, e.g. thyristor industrial drives with low pulse number must therefore never be within the range of the mechanical resonance frequency.

$$f_{res} = \frac{1}{2\pi} \sqrt{C_{T\,dyn} \times \frac{J_{Mot} + J_{Mach}}{J_{Mot} \times J_{Mach}}} = [Hz]$$

In practice the resonance frequency "f_{res}" must be twice as large as the excitation frequency of the drive.

For most normal drives, e.g. NC-machine tool, this will be between 150 and 350 Hz.

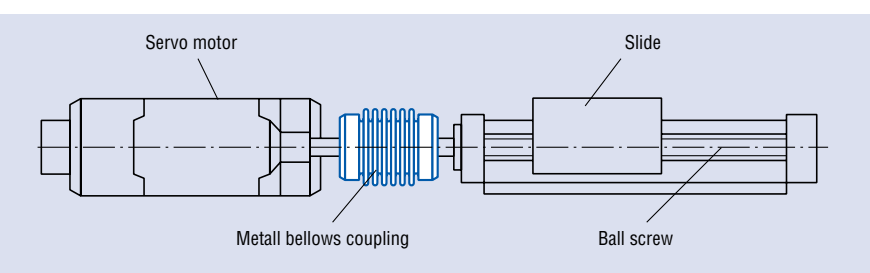
In the development of metal bellows couplings this factor was given special consideration. The dynamic torsional stiffness $C_{T\,dyn}$ was selected so that it would not be within the range of clearance diameter from most applications. Various levels of torsional stiffness are available as standard versions.

We would be pleased to design your metal bellows couplings for you. Feel free to use our experience and know-how for your success.

Speak to us.

Sample calculation

Application of a metal bellows coupling in a machine tool drive



Drive related data

Servo motor 1 FT 5104

Maximum torque T_{AS} = 160 Nm
Moment of inertia
J_{Mot} = 18.3 x 10^{-3} kgm²

Output-data

Machine tool

Moment of inertia of ball screw and slide J_{Mach} = 17 x 10^{-3} kgm²

The low moment of inertia of the metal bellows coupling is disregarded. K = Load factor, impulse factor selected for this drive K = 2

Design according to torque:

$$T_{KN} \geq K \times T_{AS} \times \frac{J_{Mach}}{J_{Mot} + J_{Mach}} = 2 \times 160\ Nm \times \frac{17 \times 10^{-3}\ Kgm^2}{(18{,}3 + 17) \times 10^{-3}\ Kgm^2} = 154\ Nm$$

Coupling selection: AKD 200, T_{KN} = 200 Nm, $C_{T\,dyn}$ = 116 x 10^3 Nm/rad.

The metal bellows coupling is sufficiently dimensioned, since 200 Nm ≥ 154 Nm.

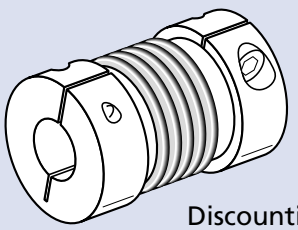
Design according to resonance frequency:

$$f_{res} = \frac{1}{2\pi} \times \sqrt{C_{T\,dyn} \times \frac{J_{Mot} + J_{Mach}}{J_{Mot} \times J_{Mach}}} = \frac{1}{2\pi} \times \sqrt{116000\ Nm/rad \times \frac{0{,}0183 + 0{,}017\ Kgm^2}{0{,}0183 \times 0{,}017\ Kgm^2}} = 578\ Hz$$

The arithmetic calculation is clearly much higher than the expected resonance frequency.

Summary of type series

Series DK – miniature



Discountinued model

To connect two shafts, backlash-free shaft-hub connection using collet clamps. For torques between 0.10 – 10 Nm.

Technical data and dimensions

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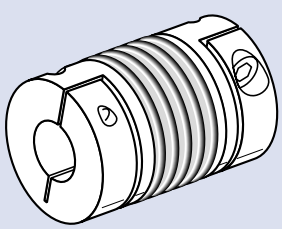
Series DKN – miniature



To connect two shafts, backlash-free shaft-hub connection using collet clamps. For torques between 0.40 – 10 Nm.

Technical data and dimensions

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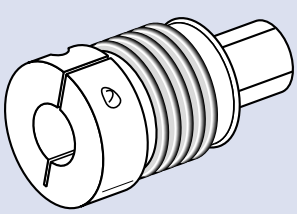
Series DK/S – miniature



To connect two shafts, backlash-free shaft-hub connection using a collet clamp and an expanding clamp.
For torques between 0.40 – 10 Nm.

Technical data and dimensions

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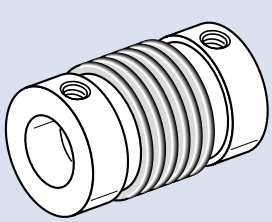
Series EK – miniature



To connect two shafts, backlash-free shaft-hub connection using set screws.
For torques between 0.10 – 10 Nm.

Technical data and dimensions

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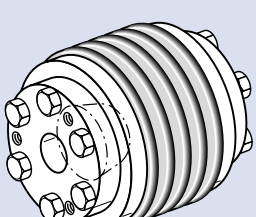
Series AK



Inner conical hub

To connect two shafts, backlash-free shaft-hub connection using conical hubs. For torques between 30 – 5000 Nm.

Technical data and dimensions

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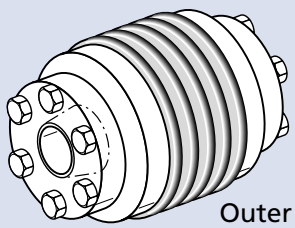
Summary of type series

Series AK/SB



Outer conical hub

To connect two shafts, backlash free shaft-hub connection using outer conical hubs, contracting disc, no releasing screw required, release during dismantling. For torques between 18 – 5000 Nm.

Technical data and dimensions

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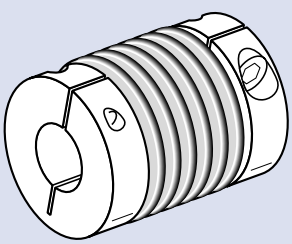
Series AKD



To connect two shafts, backlash free shaft-hub connection using collet clamps. For torques between 18 – 500 Nm.

Technical data and dimensions

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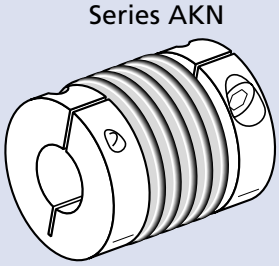
Series AKN



Same as Series AKD but with shorter length and higher torsional stiffness. For torques between 18 – 500 Nm.

Technical data and dimensions

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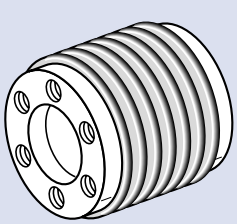
Series CK



Variable installation element for mounting of hubs, flanged shafts, flanges, etc. For torques between 18 – 5000 Nm.

Technical data and dimensions

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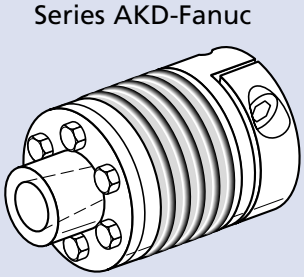
Series AKD-Fanuc



Appropriate coupling for Fanuc AC motors. Shorter installation models available. For torques between 18 – 60 Nm.

Technical data and dimensions

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User-friendly solutions

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