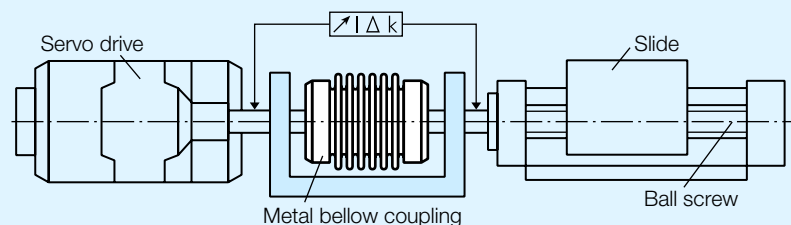


Design Sample Calculation



Design / Product information

Backlash-free, torsionally stiff metal bellow couplings are ready to install when delivered. The metal bellows are made of stainless steel, all other parts are made of aluminium or steel and partly have environmental friendly protective coating.

As a standard, the boreholes are equipped with a fitting in accordance with ISO-H7. For the shafts, we recommend a transition, e.g. H7/g6. When selecting other shaft fitting, the fitting should not exceed a maximum of 0,01 – 0,05 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 when having a depth of roughness of R_{tmax} . 16µ for the shaft. Versions with keyway are available.

The torques indicated can only be safely transferred if these points are complied with. Otherwise compromises must be accepted.

Dimensioning in accordance with the torque

Metal bellow couplings are generally designed according to the nominal torque stated in the list of technical data below as TKN.

The nominal torque must always be higher than the regular 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.

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

Calculation for the application of a metal bellow coupling in a machine tool drive

Drive related data for servo motor I FT 5104:

Maximum torque TAS = 160 Nm
Moment of inertia J_{Mot} = 18,3 x 10⁻³ kgm²
Moment of inertia of ball screw and slide J_{Mach} = 17 x 10⁻³ kgm²

Output data for machine tool:

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

Design according to torque:

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

Coupling selection: AKD 200, T_{KN} = 200 Nm, C_{Tdyn} = 116 x 10³ Nm/rad

The metal bellow coupling is sufficient dimensioned, since 200 Nm ≥ 154 Nm

Design according the resonance frequency:

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

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

K = 1,5 for evenly shaped movements

K = 2 for unevenly shaped movements

K = 2,5 for jerky movements

armature current of the motor must therefore never be within the range of the mechanical resonance frequency.

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

For servo drives within tool making machines, the values for K = 1,5 – 2 should be used.

Design with consideration for dynamic torsional stiffness

Although metal bellow couplings are backlash-free and torsion-rigid, it should not be overlooked that they link two rotating masses. In disadvantageous cases the couplings can effect like torsion springs with high stiffness. The hunting of the drives and the harmonic oscillation in the

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

In practice the resonance frequency "f_{res}" must be twice as large as the excitation frequency of the drive. The dynamic torsional stiffness C_{Tdyn} 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 bellow couplings for you. Feel free to use our experience and know-how for your success.

Speak to us!

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