

Definition - servo couplings:

Servo couplings are compensating couplings with a backlash free and conformal torque transfer providing high torsional stiffness and a low moment of inertia. According to these requirements, JAKOB metal bellow couplings can be regarded as the ideal solution. For more than 25 years, they have proven themselves in thousands of servo drives as being excellent. Elastomer couplings with a flexible polyurethan-spider can also represent a perfect alternative for different applications because of their product-specific advantages. All JAKOB servo couplings have one thing in common, they are all backlash free (also shaft-hub-connection) and flexible to allow the compensation of shaft misalignments. Because of the unique characteristics of the different series, the designer will (almost) always find the best solution within the large-scale JAKOB coupling program. The area of application ranges from highly dynamic feed drives of the axis in machine tools to high performance drives in the general machine tool design.

Characteristics - JAKOB servo couplings:

- **absolutely backlash free, exact torque transfer**
- **low moment of inertia - high balancing quality**
- **excellent operational characteristics - high speed**
- **compensation of shaft misalignments - low restoring forces**
- **frictional, easy to fit shaft-hub-connection**
- **metal bellow: max. torsional rigidity, wear free, up to 300°C**
- **elastomer spider: plug-in, oscillation dampening, up to 120°C**
- **compact - flexible areas of applications**
- **large number of types and sizes available (modular system)**
- **precise production - best quality - long life**

The JAKOB modular system:

As flexible compensating parts, stainless steel bellows are used in different forms as well as polyurethane spiders with different shore hardnesses, oldham- type spacer as polyacetal and stainless steel membrane hubs. Another important aspect is the kind of connection between the driven shafts resp. primary shafts and the coupling hubs. Several versions of backlash free frictional clamping hubs or conical hubs are available. In the following, the most important and widely used series of compensating elements and kinds of hubs, derived from the numerous possibilities of combinations, are described in this catalogue. A well-contrived modular system, which provides multiple use of many parts, enables production in cost-effective batch sizes and very short delivery period.

The JAKOB coupling program is divided into the following four main groups:

- **Metal bellow couplings**
- **Elastomer couplings**
- **Miniature couplings**
- **Distance couplings with intermediate pipe**

For decades, the centre of the JAKOB coupling program has been a large variety of different metal bellow couplings.



Technical information - definitions / details:

- **Nominal torque of the coupling:** T_{KN} - [Nm]

The nominal torque of the coupling defines the max. load of the prolonged alternating-stress strength. If in normal operation T_{KN} is not exceeded, an infinite number of operation cycles can be carried out (see "useful life of the coupling").

- **Moment of inertia:** J_K - [10^{-3}kgm^2]

The values for the moment of inertia are defined for medium hub- bores in the given diameter range D_{min}/D_{max} . Conversion: [kgcm^2] = [10^{-4}kgm^2]

- **Torsional rigidity:** C_{TK} - [Nm / arc min]

The values for the specific torsional rigidity of all couplings and gear series are converted from the existing values [103 Nm/rad] to "Newtonmeter per angular minute". This enables the constructor to determine the twisting angle failure quite easily (see "b" below) under consideration of the operating torque. 60 angular minutes (resp. arc minutes) correspond to one angular degree.

This defines the conversion factor $1 \text{ rad} \hat{=} 57,3^\circ \hat{=} 3438 \text{ arcmin}$.

Conversion: [$10^3 \text{Nm/rad} \hat{=} 0,291 \text{ Nm/arcmin}$] resp. [$1 \text{Nm/arcmin} \hat{=} 3438 \text{ Nm/rad}$]

Example: Size KM 170: $17,5 \text{ Nm/arcmin} \hat{=} 60 \text{ kNm/rad}$

- **Max. alignment of shafts:** [mm]

The maximum alignment of shafts is the largest allowed misalignment between drive shaft and output shaft, which results from the calculation of the prolonged alternating-stress strength for compensating elements. If the allowed displacement values are not exceeded, an infinite number of load alternations can be carried out. In exceptional cases (e.g. during fixing) resp. at reduced numbers of load alternations, the displacement values may be considerably higher (please contact for further consultation).

- **axial displacement:** usually without problems (expansion due to temperature)
- **angular displacement:** usually without problems - allowed max. value: 1 to 2 degrees
- **lateral or parallel displacement:** If the admissible values are considerably exceeded, permanent distortion at the bellows resp. higher wear of the elastomer spider can occur. Special care during fitting must be taken!

- **Spring rigidity - axial / lateral:** [N/mm]

Restoring forces of the metal bellow resp. of the elastomer spider, resulting of the misalignments.

Dimensioning of the coupling

a) according to torque:

Usually the size of the coupling is chosen according to the torque. For exact determination of the necessary driving torque, difficult calculations are necessary (see formularies). If the size of the motor is fixed, the necessary nominal torque of the coupling can be calculated as follows:

$$TKN \geq 1,25 \times TA_{max} \times i$$

TA_{max} = peak torque of the motor
i = transmission resp. reduction of the toothed belt drive resp. the spur- toothed wheel

b) according to the torsional rigidity:

For applications with very precise requirements (position control, transmitter), transfer errors due to high elastic deformation can be an important criteria of selection of the coupling. The torsional angle " α_T " is calculated as follows:

$$\alpha_T = \frac{TA}{C_{TK}} \text{ [arc minutes] with } TA = \text{driving torque [Nm]} / C_{TK} = \text{torsional rigidity of the coupling [Nm/arcmin]}$$

In very few cases, metal bellow couplings can have resonance sounds (e.g. a whistling or a humming). Then coupling types with a higher torsional rigidity or vibration reducing elastomer couplings are recommended.

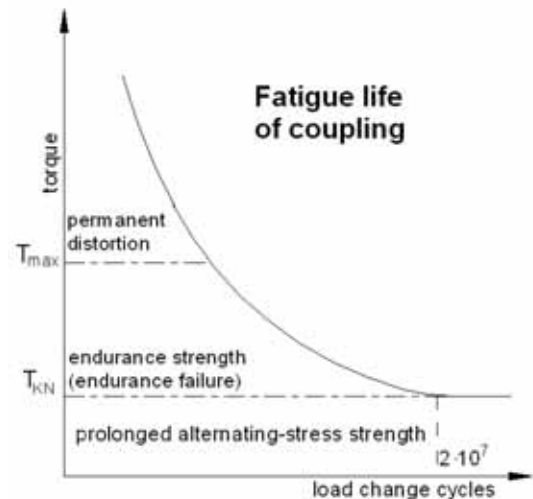
c) according to the shaft diameter:

After selecting the coupling type, it must be checked whether the requested shaft diameter corresponds with the allowed diameter (D_{min} / D_{max}) of the hub bores. Another coupling type or size must be chosen, if the shaft diameter is overdimensioned in relation to the torque, which means it is larger than D_{max} of the hub.

Note: Hub bores which are smaller than " D_{min} ". are possible; but an optimal transfer of the nominal torque can not be guaranteed in this case, so a reduction of TKM is necessary.

d) Useful life of the coupling - durability:

The durability of JAKOB compensating couplings is basically determined by the peak torque and the existing shaft displacement or misalignment. If the admissible maximum values for the axial, lateral and angular displacement are not exceeded, and if the operating torque at the same time is below the coupling nominal torque T_{KN} , then the coupling is within the range of prolonged alternating-stress strength limit. An infinite number of start - stop - cycles or acceleration and deceleration can be carried out without having to expect a break - down of the coupling during operation.

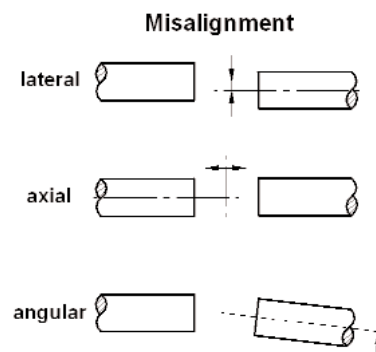


e) Max. load:

In special cases, the couplings (metal bellow, membrane, elastomer spider) can be overloaded for a short time with **twice the nominal torque ($2 \times T_{KN}$)**. The hub-bore-connection, however, must be calculated separately then.

f) Bearing loads:

Due to the flexibility of the compensating couplings in all directions, considerable bearing loads are prevented, in spite of possible axial, lateral or angular displacement from the drive shaft to the output shaft. Therefore, an early breakdown or higher wear of the rolling bearing can be prevented. This means less difficult and expensive repairing.



g) Operating temperatures:

Metal bellow and membrane couplings are, as whole metal couplings, extremely insensitive to temperature and can be used at temperatures up to $300^{\circ}C$ without limitation. The temperature limit of the elastomer spider is at $90^{\circ}C$ (98 Sh-A) resp. $120^{\circ}C$ (72 Sh-D). At high operating temperatures, an appropriate correction factor needs to be applied.

h) Speeds:

Due to precision machining and the rotation symmetrical design resp. the additional balance pin, the compensating couplings are generally suitable for high speeds up to $20,000 \text{ min}^{-1}$ even without additional balancing. The standard balancing quality are approx. Q 6.3 to Q 16. Couplings with conical hubs or hubs with tapered ring can be operated with speeds over $25,000 \text{ min}^{-1}$ (please contact us for further consultation). The low moment of inertia also has a positive effect.

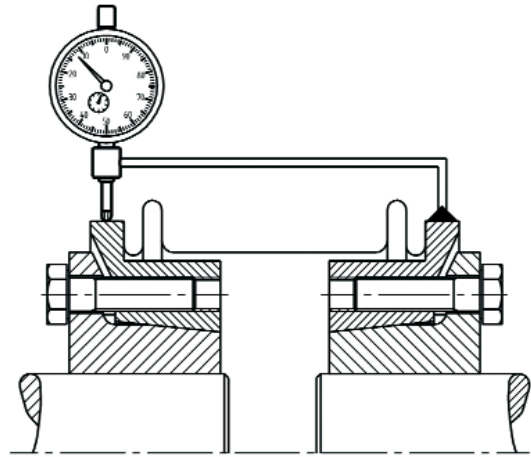
i) Maintenance and wear:

Compensation couplings are maintenance and wear free under normal conditions. The polyurethan spiders of the elastomer couplings should be changed in suitable periods, if critical operation parameters are given.

Servo couplings Installation instructions

Alignment of shafts:

Axial and angle displacement are usually without problems and also simple to measure. To obtain the lateral displacement it is recommended to proceed as follows: Fit a dial gauge with an appropriate holding device on one shaft end or on one hub of the coupling and bring it with the stylus onto the second shaft end or onto the second coupling half (sketch). Now the shafts are turned with the dial gauge and the deflection is read. One half of the total deflection is the lateral misalignment. The admissible value for the shaft displacements must be taken from the technical data sheets of the appropriate series.



Shaft - hub connection

The couplings are supplied with finished bores as a rule, and in exceptional cases they are also supplied prebored. The seat shaft/hub is to be selected as a transitional seat (example: hub bore diameter 28 G6 - shaft diameter 28 k6).

Prior to mounting the finished bore shaft end conical sleeve should be lightly oiled to prevent fretting corrosion. The coupling is then ready for assembly between the two shafts. An existing keyway in the shaft will not affect the frictional connection. (see EASY-clamp-system page 8)

a) Radial clamping hub

Admissible seat clearance shaft hub: **min. 0,01 mm**
max. 0,04 mm

Very simple fitting by tightening only one radially arranged clamping screw (DIN 912).

The value for the relevant tightening torques can be found in the data sheets. One hole in the housing is sufficient, as a rule, to tightening the clamping screw. (see EASY-clamp-system page 8)

b) Splithub

Admissible seat clearance shaft - hub: **min. 0,01mm**
max. 0,04mm

Two radial clamping screws (DIN 912) are arranged mirrored. The hubs or couplings are split and consist of 2 loose halves.

One of the splitting hubs can be put onto the aligned shaft. Tighten clamping screws evenly, alternating between both sides (note specified tightening torques). A larger opening must be provided in the housing for easy installations.

c) Conical hub/conical ring hub

Admissible seat clearance shaft - hub: **max. 0,02mm**
Assembly of the conical bush or of the conical clamping ring with several, concentrically arranged mounting screws (as a rule 6x DIN 933).

One side of the coupling is fitted onto the shaft end by evenly tightening the screws, crosswise (to prevent

uneven draw-on).

The drive or output is now turned by a few revolutions, so that the shaft pinion turns in the second hub and the hub can move on the shaft for axial release. Now the 6 screws of the second hub are also evenly tightened.

Disassembly

After releasing the 12 (6) retaining screws, the hubs are released with 3 push-off threads each. With axially tight space conditions, it is advisable to screw in and

secure the push-off-screws before fitting. For disassembly an opening in the housing should be provided.

Special notes

Metal bellows coupling:

As the metal bellows consist of thin stainless steel sheeting, special care during fitting and disassembly is necessary. Damages to the bellows can render the coupling useless.

Elastomer couplings:

Due to the plugability a blind fitting is also possible. Oil the elastomer spiders lightly before fitting.