Dimensions of Double Jointed Shafts - Selection of Joint Sizes

The selection torque for determining the double joint size is calculated from the engine moment distribution and the maximum gear ratio, including the differential gear ratio.

The load from the wheel adhesion torque, determined by the axle load, tyre rolling radius, coefficient of friction and possibly final drive ratio, must be checked.

$$M_{shaft\ mot} = M_{mot\ max} \cdot i_{g\ max} \cdot i_{V\ max} \cdot \eta_g \cdot \eta_V \cdot \frac{1}{1+V} \cdot i_D \cdot \eta_D$$

$$M_{shaft\ Rad} = G_x\ R_{dyn} \cdot \mu_R \cdot \frac{1}{i_R} \cdot \eta_R$$

Formulae symbols in addition to 8.2:

i_D = differential gear ratio
i_R = final drive ratio
η_R = efficiency of final drive
η_D = efficiency of differential gears

The lower of the two torques must not exceed the nominal moment of the double jointed shaft.

The double jointed shaft determined in this way has an adequate life as the time proportion of maximum load is usually very low.

If the vehicle is driven mainly or exclusively via driven steering axles, the life must be checked.

In these cases, we recommend making the selection on the basis of the collective load in collaboration with us.

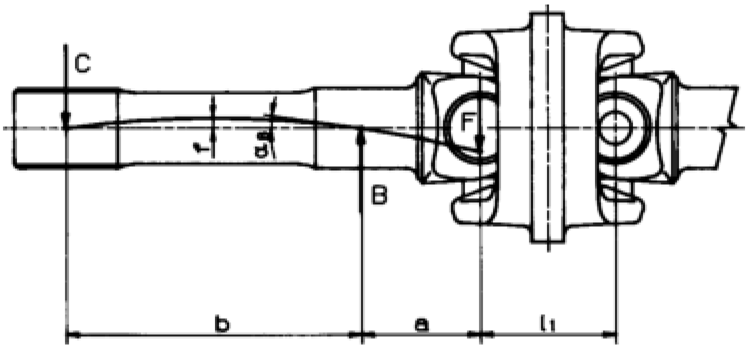
The transferability of double jointed shafts decreases as the deflection angle increases. This limitation is usually insignificant as in practice the maximum engine torque is not transmitted at full steering lock of the wheels for technical reasons.

10.1 Load on Shaft Bearings

Double jointed shafts must be supported on bearings on both shaft halves immediately next to the joint, where the driven shaft or wheel hub pin is axially fixed and the drive shaft must be axially mobile (see sections 9.1 and 9.2).

When the moment is transferred, additional forces are generated which must be taken into account in the dimensioning of the shaft bearings.

Fig. 31:



According to section 7.2 the bearing forces are calculated as follows (Fig. 31.)

Bearing load in B:

$$B = \frac{2 \cdot M \cdot \sin\frac{\beta}{2} \cdot (a + b)}{l_1 \cdot b}$$

Bearing load in C:

$$C = \frac{2 \cdot M \cdot \sin\frac{\beta}{2} \cdot a}{l_1 \cdot b}$$

The axle shaft which is normally longest in practice (drive shaft) should therefore not be dimensioned from the torque, but because of the bending must be stronger. Bearing B should be either an adjustable ball bearing or must have a small bearing width so that the oblique position α_B can be supported by the bearing without constraint.

The elastic flexion is determined as follows:

$$f_1 = \frac{2 \cdot M \cdot \sin\frac{\beta}{2} \cdot a \cdot b^2}{l_1 \cdot 9 \cdot \sqrt{3} \cdot E \cdot J}$$

The oblique position of the shaft bearing is:

$$\text{arc tan}\, \alpha_B = 0{,}1925 \cdot \frac{f_1}{b}$$

The loading conditions on the driven shaft (wheel hub pin) are similar. The flexion here is usually irrelevant because of the shorter lengths.