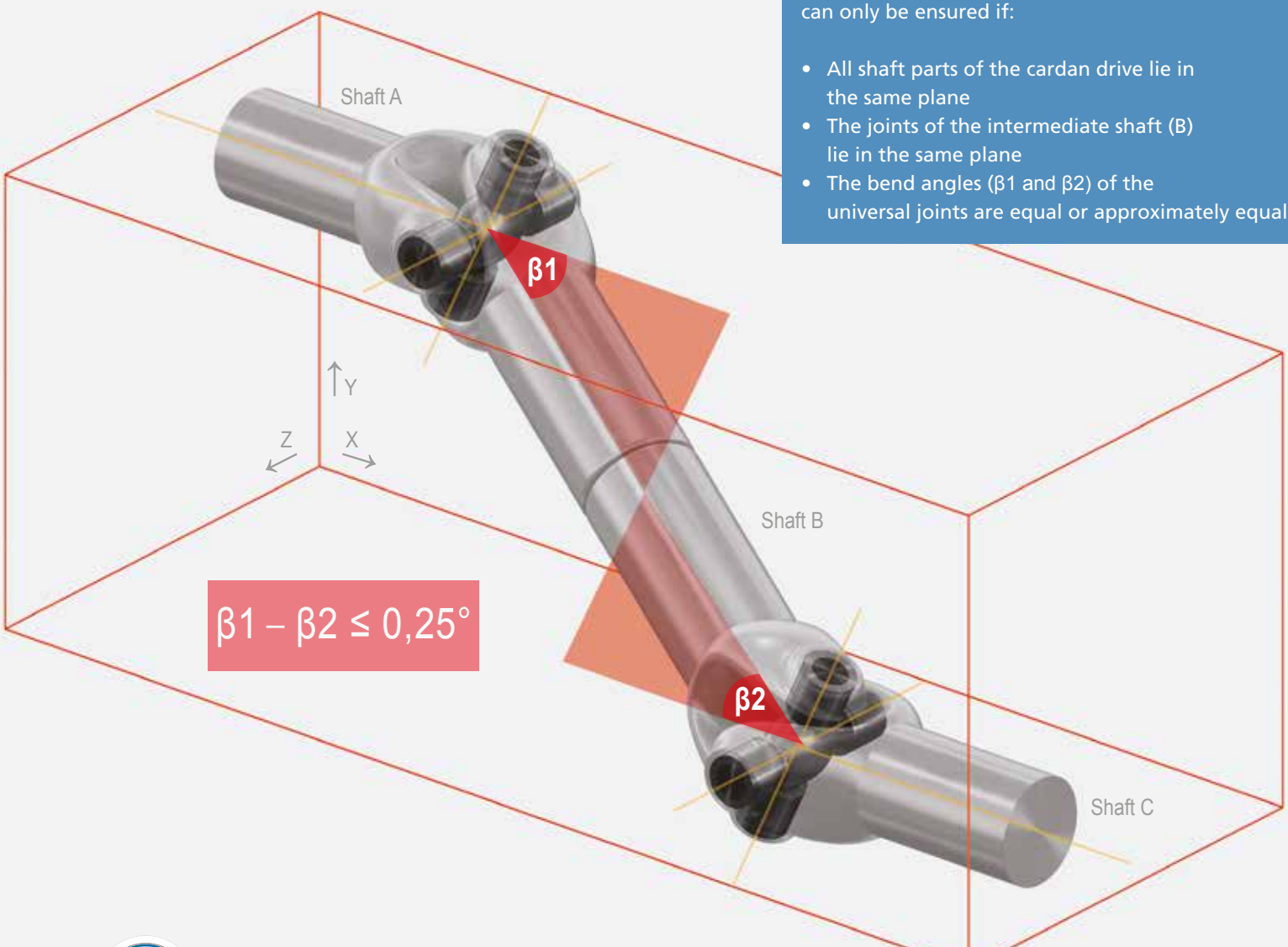


PRUFTECHNIK Service Center

Reducing Cardan Errors for Low-Vibration Operation of Coupled Machines

Synchronous run of both shaft parts (A and C) can only be ensured if:

- All shaft parts of the cardan drive lie in the same plane
- The joints of the intermediate shaft (B) lie in the same plane
- The bend angles (β_1 and β_2) of the universal joints are equal or approximately equal



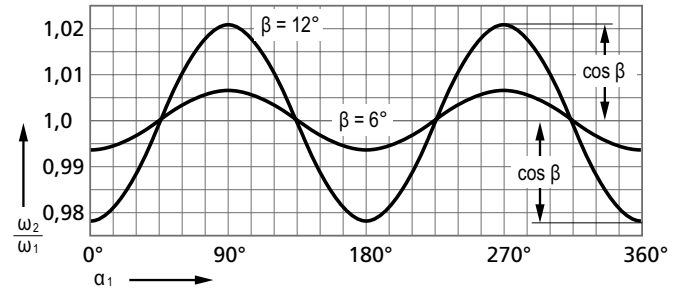
The theory

If two shafts A and B – bent at a certain angle β to one another – are connected using a universal joint, and if shaft A rotates at a constant angular speed, shaft B moves at a variable speed. This fluctuation must be considered during bearing diagnostics.

During one revolution of shaft A, the acceleration and deceleration maximum is passed twice in shaft B. This Cardan error means a sinusoidal variation in the angular speed that can be calculated using this function for every rotational position.

$$\omega_2 = \frac{\cos \beta}{1 - \sin^2 \alpha_1 \cdot \sin^2 \beta} \cdot \omega_1 \quad \left[\frac{1}{s} \right]$$

Here, α_1 is the angle of rotation of drive shaft 1.
 β is the bend angle of the joint.



The reality

A single universal joint may only be used, where the irregularity of the rotational motion of the output shaft is insignificant and only small forces are transferred at low speeds and small bend angles.

The irregular movement in shaft B can be compensated, if two universal joints with a phase shift of 90° are used in the cardan drive in Z- or W-arrangement.

In this case, shaft part C runs synchronously with shaft A.

However, achieving perfect compensation is difficult in reality and requires competent laser-optical alignment of cardan shafts in the removed as well as installed state.



Cardan shaft in Z-arrangement



Cardan shaft in W-arrangement

Competence required

Cardan shaft alignment requires competence.

The 3 shafts and the 2 joints of the cardan must lie in the same plane. The bend angles β_1 and β_2 of the universal joints 1 and 2 must be approximately equal.

If any one of these conditions is not met, the cardan shaft does not operate in a homokinetic way anymore; resulting in additional vibrations, additional forces, and additional loads up to shaft breakage.

PRUFTECHNIK engineers have many years of experience in aligning cardan shafts in installed and removed state, and are available to you for such alignment services as well as vibration analyses.



Laser-optical alignment of an installed cardan shaft

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