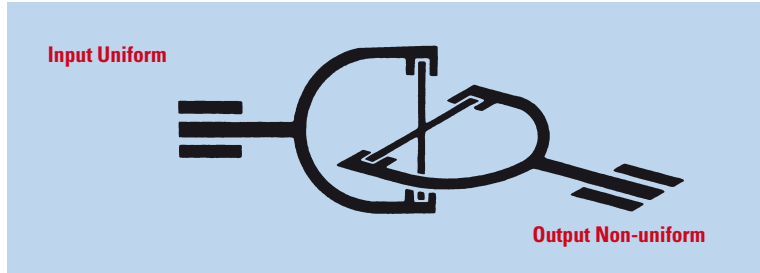


1. Installation and arrangement of universal drivelines

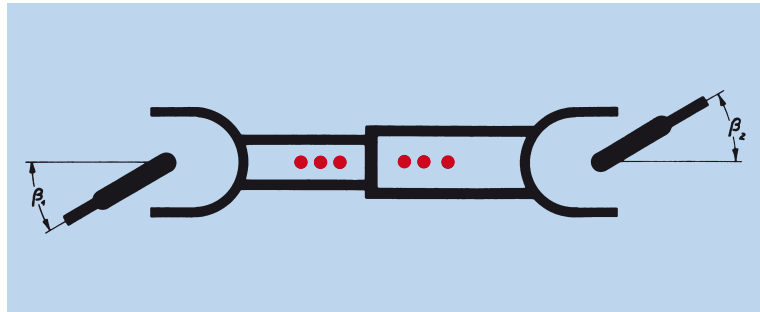
1.1 Basic installation rules

When a single universal-, cross- or ball joint is rotated uniformly in an angled position, a non-uniform motion occurs at the output side. (See motion characteristics and torques under 2).



This fluctuation is eliminated when two single joints are connected, forming a driveline. To obtain complete synchronous motion, the following conditions must be met:

- Equal deflection angles at both joints ($\beta_1 = \beta_2$)
- The two inner forks must be on one plane.
- In- and output shaft must also lie on one plane.



Exception:

If a driveline is angled three-dimensionally, in- and output shafts are not located in one plane. To obtain a uniform output motion, it is necessary in this case to offset the inner forks relative to each other so that they end up in the same plane of deflection created by their joints. Also, the three-dimensional deflection angles must be equal. (Our Engineering Department will gladly assist you in determining the correct angular offset).

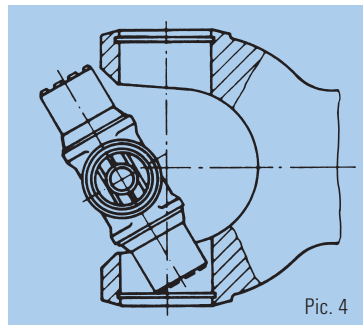
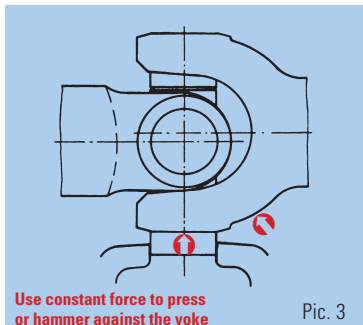
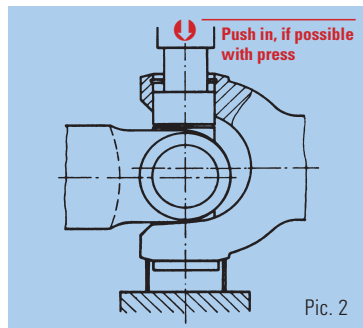
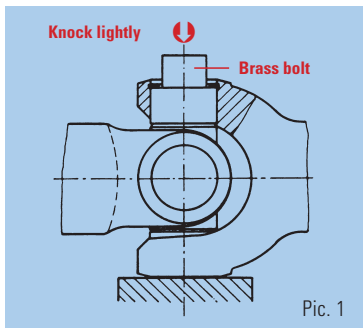
Note:

Incorrectly assembled universal joints do not equalize fluctuating output motion. They amplify it. This can lead to early joint bearing and spline failure. Therefore, when assembling the two driveline halves, the marker points on the spline shaft and spline sleeve must face each other.

The cross Journals and the needle bearing cups wear simultaneously. It is therefore necessary to replace both the cross and the needle bearings, if they show signs of wear.

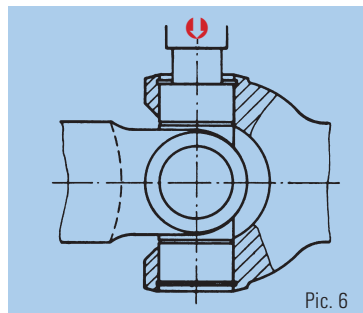
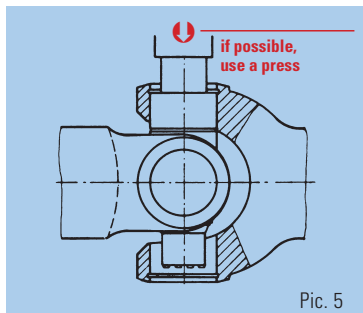
1.2 Disassembly

1. Eliminate the tension between circlips and cups (see picture 1).
2. Remove circlips (with special pliers).
3. Press out one cup at each yoke (see picture 2).
4. Grip cups extending out of the yokes and pull them out (see picture 3). Use aluminium or plastic hammer.
5. Press out and pull off the opposite cup.
6. Remove cross (see picture 4).



1.3 Assembly.

1. Insert the cross (see picture 4).
2. Press in the bearing cup on one side and secure it with a circlip (see picture 5).
3. Press in and secure the opposite cup (see picture 6).
4. Insert the cross in the second yoke. Then press in the bearing cup and secure it.
5. Tensions in the universal joint can be eliminated by lightly tapping against the yokes with a hammer. The joint will then move more freely.



Instructions for Exchanging the Cross Assemblies in Double Joints for Steering Axles:

The bearing cups of the centre piece are fitted with a detaching thread. These cups can therefore be removed with a puller after removing the screw plugs. All other steps for assembling and disassembling are the same as described above.

Attention:

Before pressing in the bearing cups, make sure that all needles are in contact with the inside diameter of the cup.

After replacing any worn parts, high-speed shafts must be rebalanced in accordance with rating G16 acc. to DIN ISO 21940. If the shaft is only subjected to low speeds, rebalancing is not necessary. The speed limit lies between 500 and 800 rpm depending on size and design of the shaft.

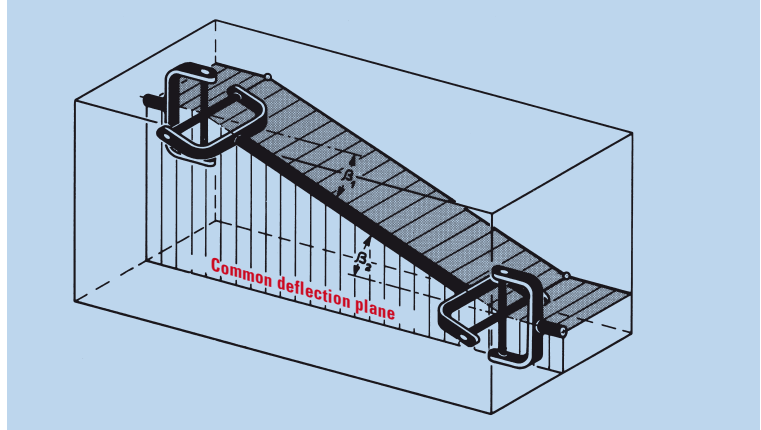
If, for any special reason, high-speed shafts cannot be rebalanced, the individual components of the yoke should be carefully marked before disassembling so that they can be realigned exactly afterwards. In this way the unbalance can be limited to a minimum.

1.4 Arrangement configuration

Z-Configuration:

Input and output shaft are parallel to each other on one plane.

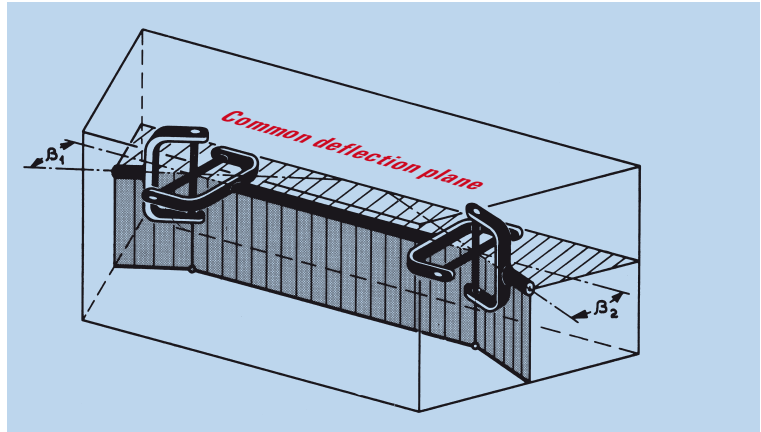
Requirement: $\beta_1 = \beta_2$



W-Configuration:

Input and output shaft intersect on one plane.

Requirement: $\beta_1 = \beta_2$



Three-dimensional configuration:

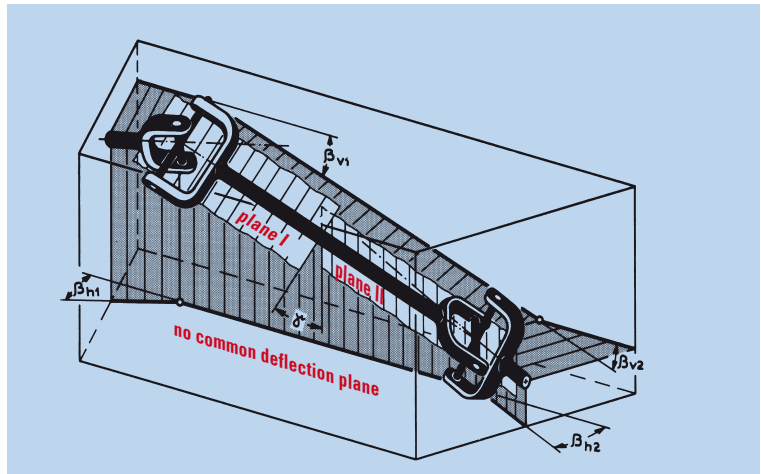
(Combined Z and W configuration)

Input and output shaft cross each other offset in space. No common plane exists. Therefore the inner forks must be offset by the angle γ (See 1.1 „Exception“).

Requirement: $\beta_{R1} = \beta_{R2}$

The resultant three-dimensional deflection angle β_R derived from the vertical and horizontal angular deviation, is calculated as:

$$\beta_R = \arctan \sqrt{\tan^2 \beta_v + \tan^2 \beta_h}$$



9. Transport and storage – installation information

Our universal drivelines are delivered ready for installation. If not otherwise specified by the customer, they are balanced dynamically at $n = 2000$ RPM according to classification Q 16 of the VDI recommendation 2060.

9.1 Transport and storage

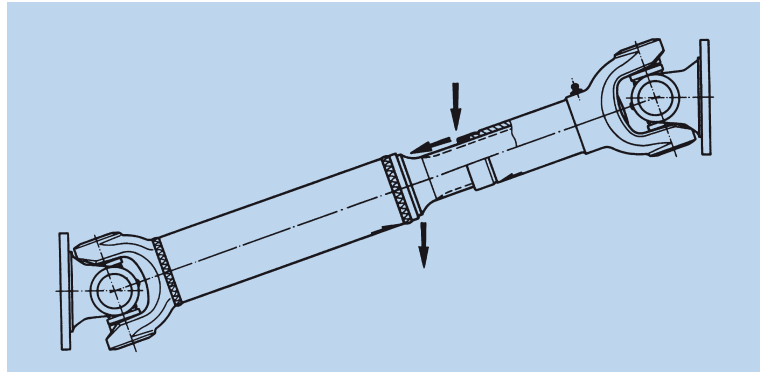
To retain the high degree of balance, the drivelines must be protected during transportation or storage from blows or jolts. It is recommended to transport them in horizontal position. When transporting them vertically, appropriate measures must be taken to avoid separation of the driveline halves. A horizontal position is also preferred for storage of the driveline, since doing so eliminates tipping over and possible damage. Never store drivelines on the floor, but if possible, on wooden shelves. In case of prolonged storage, blank metal parts must be checked for corrosion, and if necessary, treated again with a corrosion inhibiting oil.

9.2 Installation

Before installing drivelines, all traces of rust inhibitor, dirt and grease must be removed from the flange surfaces to preserve the coefficient of friction vital for torque transmission.

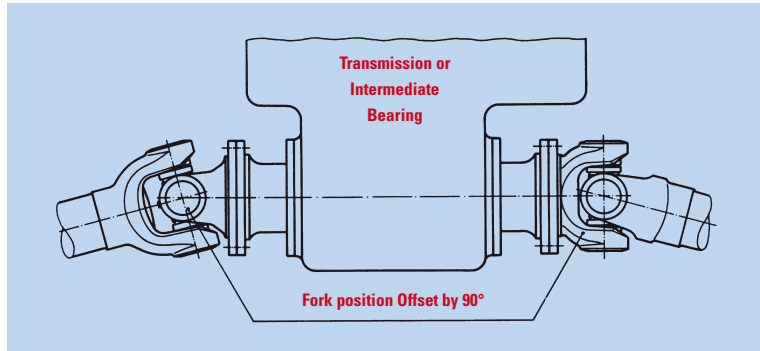
Drivelines should not be separated at the splines and the halves interchanged, otherwise the quality of balance is greatly impaired. For the same reason, balance plates should not be removed.

Prior to installing drivelines, it must be checked that they are assembled correctly, which means that the marker points on the splined shaft and splined hub must face each other (See also notation on Page 164).



These drivelines should be arranged such that the spline, whenever possible, is protected from dirt and moisture. As a rule, this means installing the driveline according to the sketch

above, where the spline seal points downwards so that spray water hitting it runs away from the spline.



If two or more drivelines are arranged in series behind each other, it is recommended that they be mounted offset to each other by 90° . Doing so will at least partially cancel to the outside the effect of the mass acceleration forces caused by the fluctuation motion of the driveline center parts.

quest. For bolt grades and necessary bolt torques, see page 74. When torquing down the bolts, if possible, a torque wrench should be used and the torque should be applied evenly in a crosswise pattern.

The necessary bolting hardware for flange mounting can also be supplied by us on re-

Our drivelines are delivered grease-packed, ready for installation. However, after prolonged storage, it is advisable to reapply grease before putting them into service.

10. Safety instructions and Maintenance

10.1 Safety instructions

The operator has to take corresponding safety precautions that will exclude dangers to persons and material by rotating drive shafts or their components.

- On working on the drive-shafts the **drive has to be in quiescent condition** – set down engine and secure, so that the drive can't be activated unauthorised by a third person.
- Installation, assembly and maintenance work may be performed only by **competent personnel**.
- When installing and disassembling and when transporting of the drive shafts don't reach into the joints to avoid contusions caused by **tilting flanges or components**. Take suitable measures to avoid that drive-shafts-shares **slide apart unintentionally** and cause injuries or damage.
- Fast mode or/and long shafts should be lined with protection devices like safety shackle and guard and protected against touching or point potential dangers explicitly out.
- Don't place weights onto shafts in standstill, don't place, hang or fasten tools or other objects on the shafts.

The user or operator has to observe the legal safety regulations and has to make arrangements before beginning the maintenance-work.

To avoid damages or dangers observe the following **basic information**:

- The permitted **operating speed** may not be exceeded.
- Don't exceed the permitted **angle of deflection**.
- In case of shafts with **length extension** the maximum permitted X-value may not be exceeded. It is recommended to use 1/3 of the complete length extension.
- The drive shaft has to be checked regularly for modified **running noises** and **vibrations** and if necessary to check the changing of the **joint slackness** and of the length extension in standstill.
- The **balance status** of drive shafts may not be changed.
- Don't make modifications or unauthorized repairs without the **written approval** of the manufacturer, as dangers for humans and material result and any claim of warranty becomes void.
- Drive shafts may not be cleaned with **pressure water** or **steam jet** to avoid damage of the seals and to prevent the penetration of water and dirt.
- When cleaning don't use **aggressive cleanser**.
- **Protect plastics-coated profiles** and sliding surfaces against mechanical, thermal and chemical damages. Sliding surfaces for seals have to be covered before colouring.
- The drive shafts may only be installed in fluid or solid media with written approval of the manufacturer.
- **Local heating** of the drive shafts (e. g. flame cleaning of colour residues) must not be carried out to avoid significant changes of the true running characteristics.

10.2 General maintenance information

ELBE drive shafts will be delivered as fully finished power units, are ready for use greased and balanced. To guarantee the characteristics specified in the documentation, the condition upon delivery may not be changed.

Above-average load, variations in temperature and the effect of dirt and water render it necessary to observe shorter maintenance intervals to guarantee the safe and efficient application.

The maintenance-cycle of the drive shafts depends particularly on the application conditions.

We recommend coordinating the inspection intervals of the drive shafts with the ones of other machine parts or with the service inter-

vals of the machine or of the vehicle.

Inspection and maintenance are required at least once a year.

Application field Joint	control and maintenance intervals	length extension
Commercial vehicles in street application	50.000 km or 1 year	maintenance-free
Commercial vehicles in street- and territory application	25.000 km or 6 months	maintenance-free
Commercial vehicles in pure construction-site and territory application	10.000 km or 1 month	maintenance-free or 100 hours
Earth-moving and construction machines	250 operating hours or 1 month	maintenance-free or 100 hours
Stationary plant and machines construction	500 operating hours or 3 months	maintenance-free or 3 months

10.3 Lubrication guidelines

ELBE cardan-drive-shafts are normally equipped with 3 cone-grease-nipples DIN 71412. Thereby every joint will be greased over per grease nipple, the third nipple serves for relubrication of the spline profile.

This nipple is omitted for plastic-coated length extensions.

10.3.1 Lubricants

- Temperature range -30°C up to max. +70°C: For relubrication of the drive shafts use only **lithium-saponified greases** of consistency class 2 with penetration 265/295 and drop point approx. 180°C. The lubrications may not contain **MoS2**-additives.
- Temperature range up to approx. +250°C, (**High-temperature-version**): use HT-greases of the consistency 2. Special versions up to +250°C are partly available.
- Temperature range from approx. -60°C up to +110°C (**low-temperature-version**): use TT-greases of the consistency 1 or 2.

10.3.2 Maintenance-free Cardan Shafts

- **Maintenance-free** versions of our shafts are possible in certain applications.
- However, the following **factors** in application and operating conditions are important to **consider**:
 - High ambient temperatures
 - Unfavorable angle/speed ratios
- **Furthermore, deterioration of the lubrication** needs to be considered. Since no relubrication is possible, we **recommend periodic replacement of the spider units**.

10.4 Technical information

- Before lubricating **clean grease nipples!**
- The relubrication of the spline-length-extension should be carried out **at compressed length** S_{min} or in the shortest operation status (vehicle loaded). Non-observance may result in excess axial forces.
- Air vent may not be taken off or be replaced by standard grease nipples.
- The lubricant may not be pressed in with excessive pressure or with hard lubrication impact.
- Max. permitted **lubrication pressure: 20 bar**.
- The cross units have to be relubricated over the grease nipples in the centre of the cross or on the bottom of a bearing housing of the cross. It must be ensured that grease is pressed in until it **leaks from all four seals of each bearing**.
- This is the only way to ensure that all four bearings have received fresh grease.
- Some versions of double drive-shafts are equipped with a grease nipple on the centre piece of the joint, over which both cross joints can be relubricated at the same time through lubrication ducts (**central lubrication**).
- Drive shafts that are stored more than 6 months have to be lubricated before starting.

10.5 Control information

- Fittings and connection flanges have to be checked for firm connection.
- Drive shafts should be checked in operation for abnormal noises or vibrations, to determine the cause and initiate repair work.
- Before lubrication, check the driveshaft for looseness in the joints or splines.
- The connection side of the drive shaft flanges and companion flanges must be cleaned before installation. They must not be greased or oiled.
- Corrosion inhibitors and paint residues must be thoroughly removed. Possible light transportation damage should be corrected (nicks and scratches).
- Companion flanges have to be checked for face and OD runout.