

High-performance Universal Joint Shafts

including ATEX certification

Series: S, R, CH, E

Instruction manual (Translation) G853 en 07/2013, Version 1

If you have questions regarding the product, please contact us specifying the serial number and parts list number:

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1 About this instruction manual



Before you use the universal joint shaft, you must read this instruction manual carefully and understand it.

This instruction manual is part of the product and familiarizes you with the basic work on the universal joint shaft – from installation to disposal.

It contains information about the safe and proper use of the universal joint shaft.

1.1 Target groups

Target group	Task
Operator	<p>⇒ Keep this instruction manual accessible to personnel at all times.</p> <p>⇒ Make sure that employees read and heed the instruction manual and the other applicable documents, especially the basic safety instructions and warnings.</p> <p>⇒ Heed additional system-related details and regulations.</p>
Specialized personnel, service engineer	<p>⇒ Read, heed, and follow this instruction manual and the other applicable documents, especially the basic safety instructions and warnings.</p>

Tab. 1.1: Target groups

1.2 Product observation

We are under legal obligation to observe our products, even after shipment.

- ⇒ Therefore, please inform us about anything that might be of interest, e.g.:
- Change in operating data
 - Experience gained with the universal joint shaft
 - Recurring problems
 - Damage to the universal joint shaft
 - Problems with the instruction manual

1.3 Other applicable documents

Document	Information	Source
Documents for all designs		
System documentation	<ul style="list-style-type: none"> System-specific information about the removal and installation of the universal joint shaft. 	Operator
Dimensional drawing of the universal joint shaft	<ul style="list-style-type: none"> Dimensions of the connection flange. Tightening torques of the bolted connections of the flange connections. Weight of the universal joint shaft. Shortest and maximum permissible length of the universal joint shaft. 	J.M. Voith SE & Co. KG/VTa
Delivery note	<ul style="list-style-type: none"> Weight of the universal joint shaft 	J.M. Voith SE & Co. KG/VTa
Repair instructions for the respective designs and sizes	For the manufacturer's authorized service personnel: <ul style="list-style-type: none"> Information about repair of the universal joint shaft 	J.M. Voith SE & Co. KG/VTa
Balancing instruction	For the manufacturer's authorized service personnel: <ul style="list-style-type: none"> Information about the balancing of the universal joint shaft 	J.M. Voith SE & Co. KG/VTa
Documents for special designs		
Mounting and dismounting instructions for split flange yokes	For designs with split flange yokes: <ul style="list-style-type: none"> Information about installing and removing the universal joint shaft 	J.M. Voith SE & Co. KG/VTa
Mounting and dismounting instructions for tripod center parts	For designs with tripod center parts: <ul style="list-style-type: none"> Information about installing and removing the universal joint shaft 	
Mounting and dismounting instructions for spring-mounted center parts	For designs with spring-mounted center part: <ul style="list-style-type: none"> Information about installing and removing the universal joint shaft 	J.M. Voith SE & Co. KG/VTa

Mounting and dismounting instructions for hydraulically-movable center parts	For designs with hydraulic center part: <ul style="list-style-type: none"> Information about installing and removing the universal joint shaft 	J.M. Voith SE & Co. KG/VTA
Mounting and dismounting instructions for deflection brakes	For designs with deflection brake: <ul style="list-style-type: none"> Information about installing and removing the universal joint shaft 	J.M. Voith SE & Co. KG/VTA
Mounting and dismounting instructions for shaft angle limiters	For designs with shaft angle limitation: <ul style="list-style-type: none"> Information about installing and removing the universal joint shaft 	J.M. Voith SE & Co. KG/VTA
Mounting and dismounting instructions for quick-release couplings	For designs with quick-release coupling: <ul style="list-style-type: none"> Information about installing and removing the universal joint shaft 	J.M. Voith SE & Co. KG/VTA

Tab. 1.2: Other applicable documents

1.4 Additional documents



For additional information about the universal joint shafts, please see the following documents:

- High-performance universal joint shafts catalogue
- General delivery conditions
- Hirth serrations

Order from: UJShafts@Voith.com

1.5 Symbols and markings

Symbols and markings are used in this instruction manual in order to allow you quick access to information.

Symbol	Meaning
	Note about the effective use of the universal joint shaft and this instruction manual
	Note for ATEX certified universal joint shafts
1. 2. 3.	Action with several steps, whose sequence is relevant
⇒	Action with one step –or– Action with several steps, whose sequence is not relevant
✓	Prerequisite
•	List (first level)
–	List (second level)
➔	Cross-reference to additional information




Tab. 1.3: Symbols and markings

1.6 Warning

For your safety, warnings are used in this instruction manual. The warnings are next to the appropriate action instruction.





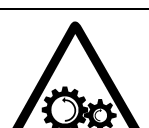






Depending on the likelihood of occurrence and consequences if the instructions are not heeded, various danger levels are used. The warnings are indicated with safety symbols, which depict the type of danger visually.

1.6.1 Levels of danger

Level of danger	Likelihood of occurrence	Consequences if not heeded
 DANGER	Imminent danger	Death, severe bodily harm
 WARNING	Possible imminent danger	Death, severe bodily harm
 CAUTION	Possible imminent danger	Slight bodily harm

Tab. 1.4: Meaning of the danger levels

1.6.2 Safety symbols

Safety symbols	Warning about
	General dangers The type of danger is described in more detail in the warning.
	Crushing
	Hand injuries
	Slipping
	Rotating parts
	Falling parts
	Suspended loads
	Flammable materials
	Acidic materials
	Poisonous materials
	Danger of explosion

Tab. 1.5: Meaning of the safety symbols

2 Basic Safety Information



⇒ Please heed the following safety information before engaging in any activities.

2.1 Product safety

The universal joint shaft has been developed and built according to the state of technology as well as the applicable safety regulations at the time it was put on the market.

Nevertheless, its use can result in danger to life and limb of the user or damage to the universal joint shaft itself and other property.

- ⇒ Only install the universal joint shaft if it is in proper condition and only for the designated use, in a safety-conscious manner that complies with the instruction manual.
- ⇒ Immediately correct (or have corrected) any defects that adversely affect safety.

2.2 Proper use

Universal joint shafts transmit torques between defined drive and machine components. Therefore, the universal joint shaft is intended for installation in the specific machine/system for which it was selected.

Any other use, especially installation in other machines, is not proper and forbidden.

Voith universal joint shafts are not approved for use in the food industry.

In liquid media, universal joint shafts may only be used with written permission of the manufacturer.

The universal joint shaft type we make and size can only be regarded as recommendations.

Any improper use or activities on the universal joint shafts not described in this instruction manual are impermissible misuse outside of the legal liability limits of the manufacturer.

Foreseeable misuse

Heed the following measures to avoid misuse:

- ⇒ Only operate the universal joint shaft within the specified speed and torque range.

- ⇒ Universal joint shafts are resiliently-flexible bodies that are designed for bending vibrations and bending-critical speeds. Therefore, for safety reasons, the maximum operating speed must be significantly below the critical-bending speed 1st and 2nd order (see universal joint catalog G830).
- ⇒ For sufficient balance and security for the universal joint shaft, it must be ensured that the operating speed does not exceed the maximum permissible value depending on the shaft angle (see universal joint catalog G830) and that the driving and driven system parts are aligned with one another (plan and concentric run-out see page 40)
- ⇒ Do not exceed permissible shaft angles of the universal joint shaft.
- ⇒ Adhere to the lengths and temperatures specified for the selection of the universal joint shaft.
- ⇒ For universal joint shafts with length compensation, make sure that the maximum permissible movement path is not exceeded.
- ⇒ A local heating of the universal joint shaft, e.g. due to the burning off of old color remnants is not permissible in order to change the run-out properties.
- ⇒ Protect components coated with Rilsan against too-high temperatures, chemical solvents, steam, and mechanical damage.
- ⇒ Attaching parts to the universal joint shaft by welding or other connection types is not permissible.
- ⇒ Adhere to the manufacturer's specifications with respect to operation, maintenance, and repairs.
- ⇒ Have work on universal joint shafts done by the manufacturer or by service technicians authorized by the manufacturer.
- ⇒ Do not make any unauthorized modifications or changes.



In areas subject to explosion (atmosphere), only use ATEX-certified universal joint shafts. Here, heed certification (→ Chapter 3.1, page 22).

2.3 Remaining risks

Before beginning construction and planning, the remaining risks of the universal joint shaft were analyzed and evaluated.

Remaining risks that could not be avoided during the entire life cycle of the universal joint shafts are:

- Risk of death and injury due to
 - Misuse
 - Improper handling
 - Improper transport
 - Missing protection systems
 - Defective or damaged mechanical parts
- Environmental hazard, e.g. due to
 - Improper handling of preserving agents and lubricants
- Property damage to the universal joint shaft due to
 - Improper handling
 - Hazardous environmental influences, application conditions
 - Operating specifications not adhered to
 - Unsuitable operating materials (e.g. bearing grease)
- Property damage to other assets due to improper handling
- Performance or functional limitations due to
 - Improper handling
 - Improper maintenance or repair
 - Subsequent damage due to overload

Avoid existing remaining risks with the practical implementation and heeding of the following specifications:

- Basic safety instructions and warnings in this instruction manual
- Work instructions from the operator
- Technical data for the system (→ system documentation)

2.4 Safety information for the operator



- ⇒ The operator must take appropriate safety precautions in order to prevent the endangering of people and materials due to rotating universal joint shafts and their parts.
- ⇒ For the operation of the universal joint shaft within a machine, the EU machine directive must be heeded.

Safety-conscious working

- ⇒ Ensure adherence and monitoring:
 - Of proper use
 - Of laws and regulations for accident prevention and environmental protection
 - Of safety regulations for the handling of hazardous materials
 - Of applicable standards and guidelines for the country of operation

- ⇒ Make protective equipment available (→ Chapter 2.6, page 21).
- ⇒ For telescopic lengths without profile guard: provide guard in the system.

Organizational measures

- ⇒ Keep this instruction manual and all applicable documents accessible to personnel at all times.
- ⇒ Specify responsibilities of the personnel clearly and monitor adherence.

Selection and qualification of staff

All activities on the universal joint shaft may only be performed by authorized personnel.

- ⇒ Ensure that the staff members
 - are at least 18 years old.
 - have read and understood the "Basic safety information" chapter.
 - can apply and implement the contents of the "Basic safety instructions" chapter.
 - have the bodily and mental abilities to perform their responsibilities, tasks, and activities on the universal joint shaft.
 - are trained according to their responsibilities, tasks, and activities on the universal joint shaft.
 - have understood and can practically implement the technical documentation with respect to their responsibilities, tasks, and activities on the universal joint shaft.
 - is familiar with and can apply the components of the system and their function.
 - is familiar according to his responsibilities with the instructions for cleaning, preserving, lubricating, and using hazardous materials and taking first aid measures in case of accidents.

- Warranty**
- ⇒ The warranty is voided in case of any change to the universal joint shaft without our written permission.
 - ⇒ During the warranty, obtain the manufacturer's permission before making repairs to the universal joint shaft.
 - ⇒ Only use original parts or parts approved by the manufacturer.

2.5 Safety information for the personnel

- Safety-conscious working**
- The consumption of alcohol, drugs, medications or other mind-altering substances is forbidden.
- ⇒ Protect universal joint shaft against unauthorized operation.
 - ⇒ Adhere to applicable accident prevention regulations.
 - ⇒ If necessary or required by regulations, wear personal protective equipment (→ Chapter 2.6, page 21).
 - ⇒ Keep unauthorized personnel out of the danger area of the universal joint shaft.
 - ⇒ Keep safety and notice signs on the universal joint shaft in easily-legible condition, e.g. lubrication points.
 - ⇒ Follow the supervisor or safety officer's safety and work instructions.
 - ⇒ Only linger in the workplaces provided in the danger area (→ system documentation).
 - ⇒ Do not make any constructional changes to the universal joint shaft.
 - ⇒ Handle hazardous materials according to the safety data sheets. Heed safety measures and wear personal protective equipment.

Lifting, transport, setting down

Depending on the design, universal joint shafts can weigh up to 80 tons.

- ⇒ Heed weight (→ Delivery note/Dimensional drawing of the universal joint shaft).
- ⇒ Only lift and transport universal joint shafts with sufficiently-dimensioned transport equipment (→ Fig. 4.1, page 32).
- ⇒ Heed common attachment regulations.
- ⇒ Do not load profile guard.
- ⇒ Heed the center of gravity (hoist axis).
- ⇒ Only store universal joint shafts
 - on floors with sufficient load capacity
 - on suitable bases
- ⇒ Secure universal joint shaft against rolling away.



Only transport universal joint shaft in areas not subject to explosion (atmosphere).

Unsecured universal joints can tip during lifting, transport, setting down.

- ⇒ Secure universal joints against tipping, e.g. with a suitable rope or wedge.
- ⇒ Never reach between the universal joint, even if there is a deflection guard present.

For telescopic lengths: an unsecured telescoping part can be pulled apart when lifting, transporting or setting down.

- ⇒ Secure telescoping part against being pulled apart, e.g. with a suitable rope.

Preservation

Cleansers and anti-corrosion agents are usually flammable in their liquid form.

- ⇒ Ensure sufficient ventilation.
- ⇒ Prevent direct bodily contact and inhalation.
- ⇒ Heed the manufacturer's safety data sheets.

installation

- ⇒ Heed additional regulations for flange bolted connections (→ Chapter 6.1, page 35).
- ⇒ Heed safety instructions for lifting, transport, setting down.
- ⇒ Secure drive against starting up.

- ⇒ Keep personnel who are not participating away, e.g. using supervisory personnel, enclosures, fences.



Only install universal joint shaft in areas not subject to explosion (atmosphere).

For specially-designed universal joint shafts, improper installation and removal can cause severe injuries or even death.

- ⇒ Heed and if necessary order additional documentation (→ Chapter 1.3, page 8).

Commissioning and operation

- ⇒ Only put a completely functional and safe universal joint shaft/system into operation.
- ⇒ Before commissioning, remove deflection and transport braces.
- ⇒ Before commissioning, check tightening torques and null markings.
- ⇒ Only operate universal joint shaft with appropriate guards (→ system documentation).
- ⇒ For telescopic lengths: protect gearing of the telescopic parts against dirt and foreign bodies.
- ⇒ In case of changed operating state and faults, take the universal joint shaft out of commission immediately. Report changed operating states and faults to the responsible office/person immediately.
- ⇒ Do not perform cleaning work when operation is ongoing.
- ⇒ If it is not possible to prevent people from lingering in the danger radius of the universal joint shaft while it is in operation, special safety measures must be taken in case of a universal joint shaft break.
- ⇒ If there can be blockages or collisions with resulting personal injury as a result of a universal joint break in the case of mobile drives, appropriate arresting devices must be provided for the universal joint shafts.



In case of ATEX-certified universal joint shafts, it must be ensured that

- ⇒ The surface temperature in the field of joint bearings not exceed 140°C.
- ⇒ Voith recommends at both joints, to attach a temperature monitoring in the field of the joint bearings.

Maintenance work and inspections

The operator's service personnel may only perform the maintenance work and inspections described in this instruction manual. Other maintenance work (especially overhauls) may only be performed by the manufacturer's service personnel or personnel authorized by the manufacturer.

- ⇒ Observe specified intervals (→ Chapter 9.2, page 57).
- ⇒ Do not perform any maintenance work or inspections during ongoing operation.
- ⇒ Before maintenance and inspection work, secure the drive against starting up.
- ⇒ Do not remove any safety equipment as long as the universal joint shaft/system is not standing still and secured against starting up again.
- ⇒ When the universal joint shaft is standing still, do not load it with high lifting or attachment forces and do not place any objects on the universal joint shaft or hang or attach anything to it.
- ⇒ Before reattaching the universal joint shaft/system, reattach all safety equipment.
- ⇒ The universal joint shaft must be checked regularly for changed running noises and vibrations.

Repair

Repairs may only be made by the manufacturer's service personnel or personnel authorized by the manufacturer.

- ⇒ Only make repairs after consultation with the manufacturer.
- ⇒ Do not make any repairs when operation is ongoing.



Only repair universal joint shaft in areas not subject to explosion (atmosphere).

Decommissioning

See system documentation

Removal

See repair instructions/system documentation



Only remove universal joint shaft in areas not subject to explosion (atmosphere).

Disposal

- ⇒ Dispose of packaging material according to the applicable regulations in the place of use.
- ⇒ Dispose of operating and hazardous materials separately according to the locally-applicable regulations. Heed the manufacturer's safety data sheets.

2.6 Personal protective equipment



- ⇒ Heed additional notices in the system documentation.
- ⇒ Heed additional operator-side regulations.
- ⇒ In order to prevent injuries, wear personal protective equipment according to the following table:

Activity	Protective equipment
Re-installation	<ul style="list-style-type: none"> • Safety helmet • Safety shoes with slip-proof, oil-resistant soles • Protective gloves • Fall protection • Safety glasses
Commissioning and operation	<ul style="list-style-type: none"> • Closely-fitting clothing • Ear protection • Safety shoes with slip-proof, oil-resistant soles • Safety glasses
Transport	<ul style="list-style-type: none"> • Safety helmet • Safety shoes with slip-proof, oil-resistant soles • Safety glasses
Preservation	<ul style="list-style-type: none"> • Safety glasses • Protective gloves
Maintenance	<ul style="list-style-type: none"> • Safety helmet • Protective gloves • Safety shoes with slip-proof, oil-resistant soles • Fall protection • Safety glasses

Tab. 2.1: Personal protective equipment

2.7 Spare parts

Spare parts must meet the technical specifications of the manufacturer. Same is guaranteed if original parts are used, as these are subject to a regular quality control. Spare parts from other suppliers may, in some cases, change the characteristics of the machine and result in substantial defects, for which Voith cannot assume any responsibility.

3 High-performance Universal Joint Shafts

3.1 Structure

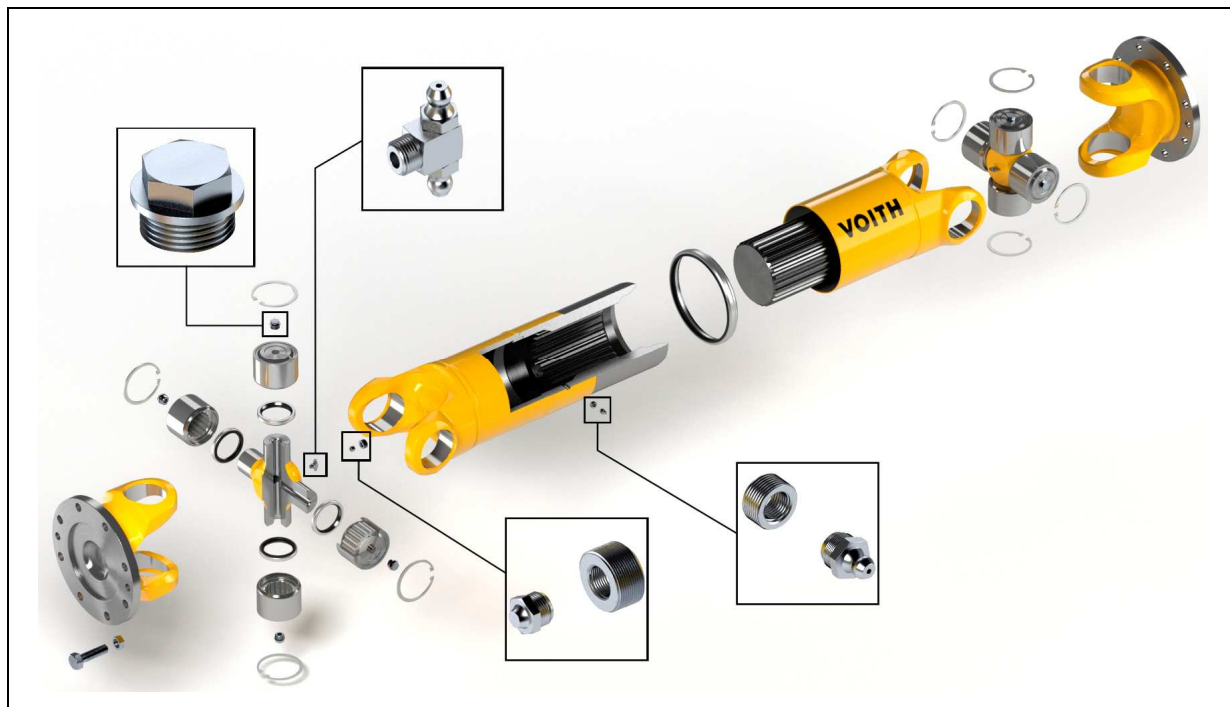


Fig. 3.1: Structure of the universal joint shaft (example of type RT)

Link head

The link head consists of:

- an integral flange yoke
- or–
- a semi-integral flange yoke

Journal cross set

A journal cross set consists of:

- a journal cross
- four bearing units

Flange yoke

The flange yokes depend on the universal joint shaft type (→ Chapter 3.3, page 26).

Telescopic length with standard center part

Depending on the size, the telescopic length is either equipped with an involute profile or a diameter-centered SAE profile with length compensation.

The involute profile can optionally be provided with a low-maintenance Rilsan® plastic coating.

Telescopic length with tripod center part

The tripod shaft consists of two standard joints and one special center part for length compensation.

At the free end of the guide shaft, three bolts offset by 120° with roller bearings are arranged radially.

Accordingly, the guide hub has three grooves for accommodating the roller bearings.

Fixed length universal joint shafts

The fixed center part has a fixed length.

ATEX-certified universal joint shaft

In contrast to standard universal joint shafts, ATEX-certified universal joint shafts have:



⇒ A nameplate that clearly identifies the ATEX-certified universal joint shaft.

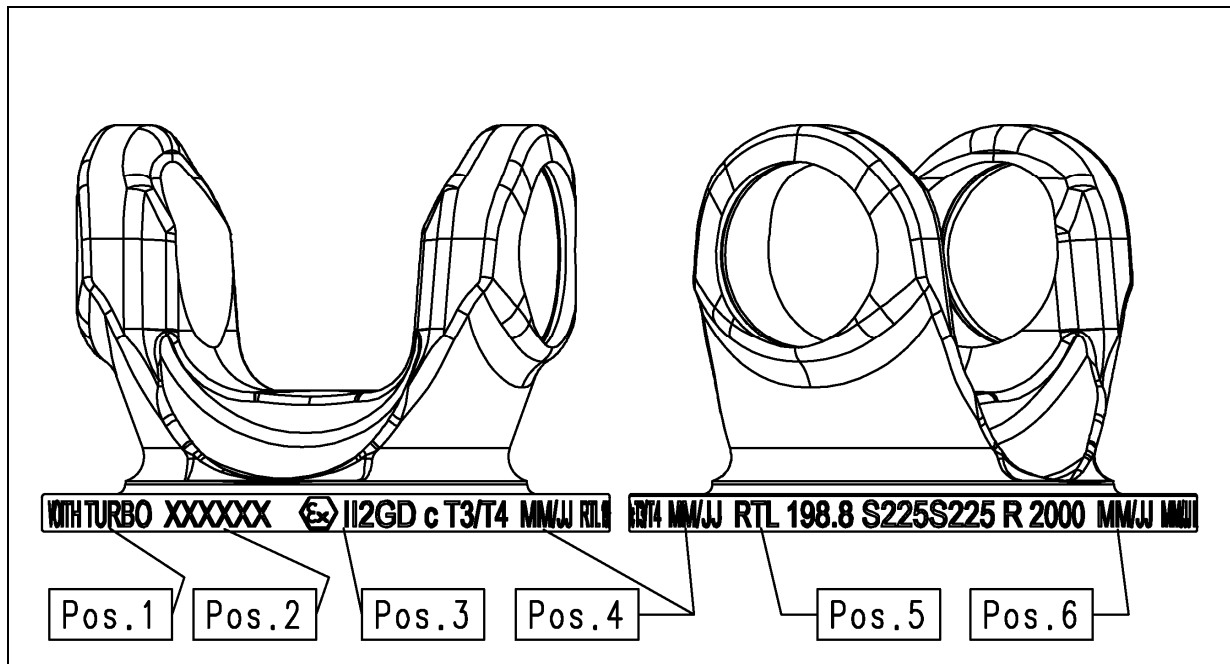



Fig. 3.2: Nameplate of an ATEX-certified universal joint shaft

- Pos. 1: Manufacturer's name
- Pos. 2: Serial number
- Pos. 3: ATEX identification
- Pos. 4: Year of manufacture
- Pos. 5: Designation according to the type designation
- Pos. 6: Date for next primary examination

The ATEX identifier shown in Pos. 3 of the nameplate is composed as follows, in accordance with DIN 13463-1:

	II	2GD	c	T3
EX identifier				
Equipment group				
Equipment category				
Type of ignition protection				
Temperature range				

For ATEX-certified universal joint shafts, the surface temperature in the field of joint bearings should not exceed 140°C.

⇒ Voith recommends at both joints to attach a temperature monitoring in the field of joint bearings (→ Fig. 3.3, page 24).

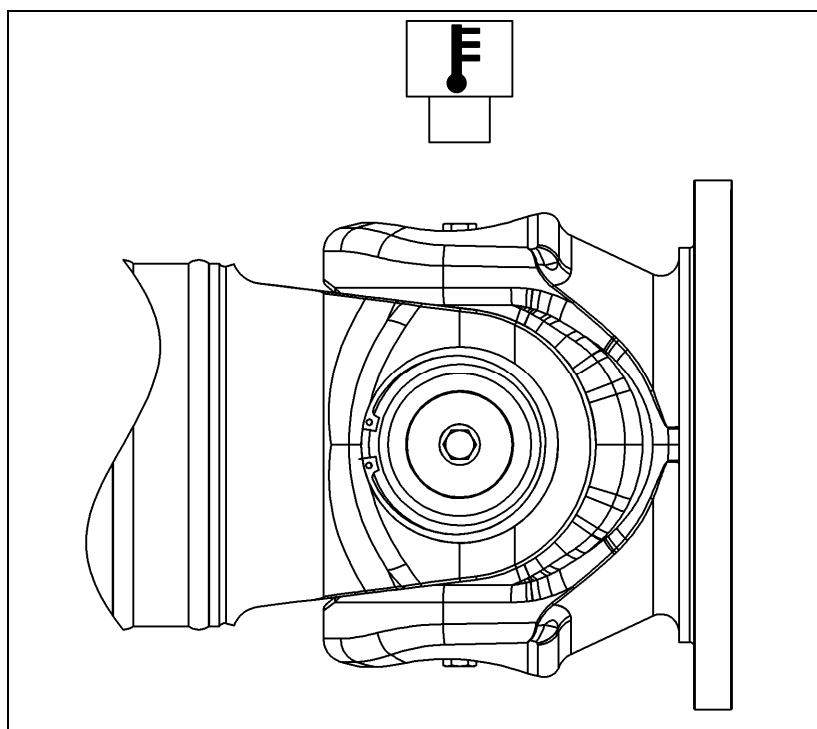


Fig. 3.3: Schematic structure of temperature monitoring

The temperature monitoring is not included in the Voith scope of delivery and must be provided by the operator.

3.2 Application

The universal joint transfers torque from axes tilted toward one another at a shaft angle β .

Universal joint shafts with two universal joints transfer torques between a drive motor and a machine. Here, only a Z or W arrangement is permitted, for which the angles β_1 and β_2 must be equal (\rightarrow Fig. 3.4, page 25 and Fig. 3.5, page 25).

Z arrangement

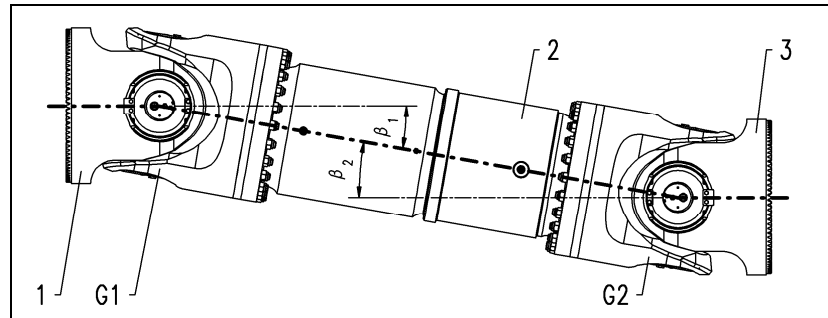


Fig. 3.4: Z arrangement

- | | | | |
|---|--------------------|-----------|-----------------------|
| 1 | Input side/flange | G_1 | Universal joint 1 |
| 2 | Center part | G_2 | Universal joint 2 |
| 3 | Output side/flange | β_1 | Shaft angle (G_1) |
| | | β_2 | Shaft angle (G_2) |

W arrangement

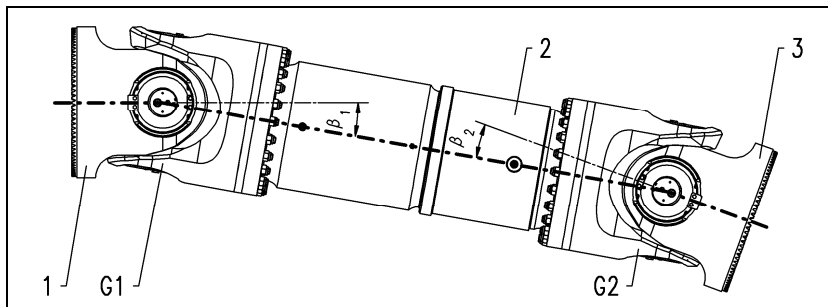


Fig. 3.5: W arrangement

- | | | | |
|---|--------------------|-----------|-----------------------|
| 1 | Input side/flange | G_1 | Universal joint 1 |
| 2 | Center part | G_2 | Universal joint 2 |
| 3 | Output side/flange | β_1 | Shaft angle (G_1) |
| | | β_2 | Shaft angle (G_2) |

3.3 Series



⇒ For detailed information about the respective series:
See catalogs for High-performance universal joints (G830)
from Voith Turbo GmbH & Co. KG.

3.3.1 Type designations

The design of standard universal joint shafts can be read off using the type designation. The design of special joint shafts must be taken from the dimensional drawing.

Example	R	T	250.8	S 285/ S 315	R	2560
Series S,R,CH,E						
Center-section design T,TL,TK,TR,F,GK,FZ,Z						
Size. Bearing type						
Flange design (S,K,Q,H) S: friction flange K: flange with split sleeve Q: flange with face key H: flange with Hirth connections						
Flange size input side/output side						
Profile coating S: Steel (Standard) R: Rilsan® P: PTFE						
Length l_{min} or $l_{z min}$ in mm						

3.3.2 S Series

Size: 58–225

Torque transmission: 0.25 - 35 kNm

Flange design: standard design with friction fit

Area of application: marine drives, pumps, locomotives, motor cars, paper machines, general mechanical engineering

Type	Description
ST	Telescopic length with standard center part
STK 1–4	Telescopic length with shortened center part
SF	Fixed length universal joint shaft
SGK	Joint coupling; short, separable fixed length universal joint shaft
SFZ	Intermediate shaft with a joint head and bearing
SZ	Intermediate shaft with dual bearings

3.3.3 R Series

Size: 198–550

Torque transmission: 32 - 1000 kNm

Flange design: standard design of the sizes 198 - 390 with friction fit, optionally with face-key or Hirth serration, standard design of the sizes 440 - 550 with face-key, optionally with Hirth serration.

Area of application: general mechanical engineering, railway drives, rolling mills, conveyor systems, paper machines, marine drives

Type	Description
RT	Telescopic length with standard center part
RTL	Telescopic length with extended center part
RTK 1–2	Telescopic length with shortened center part
RF	Fixed length universal joint shaft
RGK	Joint coupling; short, separable fixed length universal joint shaft
RFZ	Intermediate shaft with a joint head and bearing
RZ	Intermediate shaft with dual bearings

3.3.4 CH Series

Size: 350–1460

Torque transmission: 260 - 19440 kNm

Flange design: Hirth serration or face-key

Area of application: rolling mill main drives, heavy machinery, heavily-loaded drives in mechanical engineering

Type	Description
CHT	Telescopic length with standard center part
CHF	Fixed length universal joint shaft
CHGK	Joint coupling; short, separable fixed length universal joint shaft

3.3.5 E Series

Size: 590–1220

Torque transmission: 1600 - 14000 kNm

Flange design: 2-part flange yoke with coupling splines arranged on an axis of symmetry, Hirth serration on the flange

Area of application: rolling mill drives, heavy machinery

Type	Description
ET	Telescopic length with standard center part
EF	Fixed length universal joint shaft
EGK	Joint coupling; short, separable fixed length universal joint shaft

4 Packaging, transport



Universal joint shafts are ready to install on delivery.

4.1 Packaging

- Europe**
- Stable wood packaging/wood frame
 - Secured with appropriate shims

- Sea freight**
- Stable wood packaging
 - Secured with appropriate shims
 - Sealed with permanent plastic film
 - Addition of drying agents

4.2 Unpacking the universal joint shaft and checking the delivery



If the load capacity of the fork lift is at least 125% of the weight of the universal joint shaft:

- ⇒ Transport packaged universal joint shaft to the installation location with a fork lift. Heed weight (Delivery note/dimensional drawing of the universal joint shaft).

1. Check delivery immediately upon receipt:
 - Packaging for transport damage
 - Universal joint shaft for damage
 - Delivery for completeness, that is, compare delivery to order
2. Report transport damage to delivery service and document, e.g. with photos.
3. Report complaints to the manufacturer.
4. Dispose of packaging material according to the applicable regulations in the place of use.

4.3 Lifting, transporting, setting down the universal joint shaft

- ✓ Access to the installation location is possible freely and without hindrances



- ⇒ Heed the load capacity of the lifting devices, the load lifting and transport equipment: min. 125% of the weight of the universal joint shaft (→ Delivery note/ dimensional drawing of the universal joint shaft).



Only transport universal joint shaft in areas not subject to explosion (atmosphere).

Transport with a fork lift

If the load capacity of the fork lift is at least 125% of the weight of the universal joint shaft:

- ⇒ Transport universal joint shaft to the installation location with a fork lift. Heed weight (→ Delivery note/ dimensional drawing of the universal joint shaft).



⚠ DANGER

Severe to deadly injuries due to swinging or rolling universal joint shaft!

- ⇒ Place universal joint shaft securely on the forks of the fork lift.
- ⇒ Secure universal joint shaft against rolling off the forks.

Transport with truck/crane



⚠ DANGER

Severe to deadly injuries due to swinging or falling universal joint shaft!

- ⇒ Heed common attachment regulations.
- ⇒ Only lift universal joint shafts at the prescribed attachment points (→ Fig. 4.1, page 32).
- ⇒ Do not attach universal joint shaft in marked area (→ Fig. 4.1, page 32).
- ⇒ Only use sufficiently dimensioned and tested lifting appliance.
- ⇒ Secure danger zone under the universal joint shaft against entry.
- ⇒ Wear safety helmet, safety shoes, gloves, safety glasses, and fall protection.


⚠ DANGER

In case of telescopic lengths: Severe to deadly injuries due to falling parts!

- ⇒ Secure telescoping part against being pulled apart, e.g. with a suitable rope.


⚠ DANGER

Severe crushing or crushing of limbs due to tipping universal joint!

- ⇒ Secure universal joints against tipping, e.g. with a suitable rope or wedge.
- ⇒ Never reach between the universal joint, even if there is a deflection guard present


⚠ DANGER

Severe to deadly injuries due to rolling universal joint shaft!

- ⇒ Only set universal joint shaft down on suitable bases.
- ⇒ Secure universal joint shaft against rolling away.


⚠ DANGER

In case of ATEX-certified universal joint shafts: severe to deadly injuries due to spark formation in case of:

- Equipotential bonding
- Impact-like touching of adjacent metal parts
- ⇒ Only transport universal joint shaft in areas not subject to explosion (atmosphere).

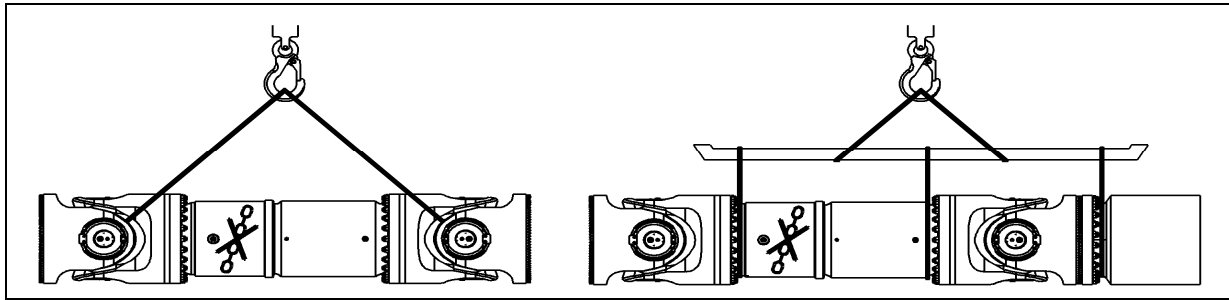


Fig. 4.1: Attaching the universal joint shaft



Universal joint shafts are, as much as possible, balanced at the factory.

- ⇒ Protect universal joint shaft against damage.
- ⇒ Transport universal joint shaft without impact.
- ⇒ Do not attach universal joint shaft in marked area (→ Fig. 4.1, page 32).
- ⇒ Heed the center of gravity (hoist axis).
- ⇒ Transport universal joint shaft as horizontally as possible.
- ⇒ In case of vertical transport of the universal joint shaft, secure the universal joint shaft from separating with suitable restraints.
- ⇒ For attaching, use plastic fiber ropes if possible in order not to damage the universal joint shaft. Heed sufficient edge protection.
- ⇒ Only set universal joint shaft down on a suitable base and secure it against rolling away.



- ⇒ Universal joint shafts are delivered balanced and lubricated so they are ready for installation and operation and.
- ⇒ To guarantee that the system documentation, the delivered universal joint shaft must not be changed.

5 Storage and preservation



You can store universal joint shafts for up to 3 months after delivery without re-coating the preservation.

5.1 Storing the universal joint shaft



If not otherwise specified, the packaging is design for a storage time of max. 4 weeks.

In case of longer-term storage, heed the following:

- ⇒ Heed ambient conditions of the storage room:
 - dry
 - frost-free
 - relative humidity max. 70%
 - even temperature
- ⇒ In case of horizontal storage: place universal joint shaft on suitable underlay (e.g. of wood) to prevent rolling away.
- ⇒ In case of vertical storage: place universal joint shaft in a suitable frame (e.g. of wood) to prevent tipping over.
- ⇒ Check bare metal parts for corrosion every 6 weeks. If necessary, treat parts with anticorrosion agent, e.g. oil or wax.
- ⇒ Lubricate universal joints at least once a year. Move the universal joints back and forth on both directions in order to distribute the grease (→ Chapter 9.4, page 61).
- ⇒ Put telescopic section into shortest length at least once a year and move back and forth in order to distribute the grease (→ Chapter 9.4, page 61).
- ⇒ After a storage period of 18 months before installation, have the universal joint shafts examined by authorized service personnel since the seals are subject to aging.

5.2 Preserving the universal joint shaft



DANGER

Anticorrosion agents can contain acidic materials and additives!

- ⇒ Wear safety glasses and suitable protective gloves.
 - ⇒ Heed the manufacturer's safety data sheets.
-



DANGER

There is a danger of fire due to use/processing of flammable cleaning/anticorrosion agents!

- ⇒ Ensure sufficient ventilation.
 - ⇒ Prevent direct bodily contact and inhalation.
 - ⇒ Heed the manufacturer's safety data sheets.
-
- ⇒ For telescopic lengths: push telescopic part entirely together.
 - ⇒ Treat all bare metal parts with anticorrosion agent, e.g. oil or wax.

6 Installation

6.1 Additional regulations for flange bolted connections

6.1.1 Requirements of connecting flange and bolted connections

Design of connecting flange

For fixed length universal joint shaft or joint coupling:

- ⇒ A connecting flange can move lengthwise through a floating bearing in order to be able to push the universal joint shaft over the centering collar and compensate for possible length changes (e.g. due to heat elongation).
- ⇒ The use of universal joint shafts with length compensation assumes that the connecting flange sits firmly on the shaft of the connecting units.

Material

- ⇒ Select material that permits the use of bolts of the property class 10.9 (→ Fig. 6.1, page 36, Pos. m).



With the use of materials with lower property class values, the torques that can be transmitted by the flange connection and thus also the universal joint shaft are reduced.

- ⇒ With use of materials with lower property class values: reduce prescribed tightening torque of the bolts accordingly (→ Tab. 6.2, page 40, area A, column 5)

Dimensions of the connecting flanges and bolted connections

The dimensions of the connecting flange (→ Fig. 6.1, page 36 and Tab. 6.2, page 40) correspond to those of the universal joint shaft.

Exception:

- ⇒ Execute locating diameter c with clearance: fit H7/h6 (→ Tab. 6.2, page 40, area A, column 11).
- ⇒ For universal joint shafts with $\text{rota} > 550 \text{ mm}$: dimensions of the connecting flange and bolted connections as well as tightening torques see dimensional drawing of the universal joint shaft.



The relief diameter f_g on the universal joint shaft flange is not suitable for locking hexagon head bolts or nuts.

- ⇒ A relief diameter f_a on the connection flange is suitable for protection against twisting.

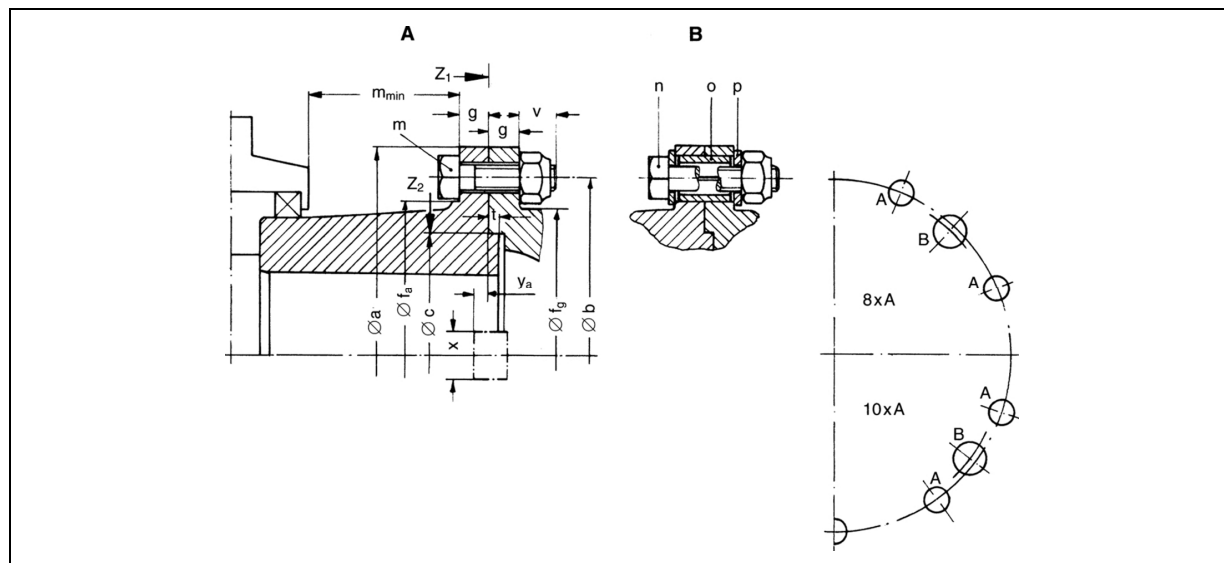


Fig. 6.1: Dimensions of the connecting flange and bolted connections

Pos.	Description	Additional information (→ Tab. 6.2, page 40)
Ø a	Flange diameter	Dimensions (→ "Dimensions of the connecting flange" area)
Ø b	Bolt circle diameter	
Ø c	Locating diameter	
Ø f _a	Flange diameter, bolt side	
Ø f _g	Flange diameter, nut side	
g	Flange thickness	
m _{min}	Minimum distance	<ul style="list-style-type: none"> Length of the hexagon head bolt m including the height of the bolt head Dimensions of the hexagon head bolt m (→ area A, column 4)
m	Hexagon head bolt in accordance with ISO 4014 - 10.9 Hex. nut in accordance with DIN 985	<ul style="list-style-type: none"> Number per connecting flange for universal joint shaft flange: <ul style="list-style-type: none"> Standard design (→ area A, column 1) with face-key (→ area A, column 2) with Hirth serrations (→ area A, column 3) Dimensions (→ area A, column 4) Tightening torque for a coefficient of friction $\mu = 0.12$ and 90 % utilization of the bolt yield point (→ area A, column 5)
n	Hexagon head bolt in accordance with ISO 4014 - 8.8 Hex. nut in accordance with DIN 985	<ul style="list-style-type: none"> Number per connecting flange (→ area B, column 6) Dimensions (→ area B, column 7) Tightening torque for a coefficient of friction $\mu = 0.12$ and 90 % utilization of the bolt yield point (→ area B, column 5)
o	Split sleeve	Dimensions (→ area B, column 8)
p	Washer	Dimensions (→ area B, column 9)
t	Deep centering	Dimensions (→ "Dimensions of the connecting flange" area)

Pos.	Description	Additional information (→ Tab. 6.2, page 40)
v	Length from the bearing surface of the nut to the end of the bolt	
x	face-key width	
y _a	face-key depth	
Z ₁	Axial run-out	Permissible values for deviation in axial runout Z ₁ and concentricity Z ₂ at operating speeds < 1,500 min ⁻¹ rpm (→ column 10) Halve values at higher speeds up to 3000 min ⁻¹ .
Z ₂	Radial run-out	

Tab. 6.1: Dimensions of the connecting flange and bolted connections (key)

		A (→ Fig. 6.1)					B (→ Fig. 6.1)					Dimensions of the connecting flanges								Z ₁ ,Z ₂	c
Column	-	1	2	3	4	5	6	7	8	9	5									10	11
Size	a	-	-	-	m	MA	z	n	o	p	MA	b±0.1	f _{a-0.3}	f _g	g	t	v	X P9	Y _a ^{+0.5}	Z ₁ ,Z ₂	c
	[mm]					[Nm]					[Nm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]

Types: ST/STK 1-4/ SF/ SGK/ SFZ/ SZ

058.1	58	4			M5 x 16	7						47	38.5		3.5	1.2 _{-0.15}	9			0.05	30
065.1	65	4			M6 x 20	13						52	41.5		4	1.5 _{-0.25}	12			0.05	35
075.1	75	6			M6 x 25	13						62	51.5		5.5	2.3 _{-0.2}	14			0.05	42
090.2	90	4			M8 x 25	31						74.5	61		6	2.3 _{-0.2}	13			0.05	47
100.2	100	6			M8 x 25	31						84	70.5		7	2.3 _{-0.2}	11			0.05	57
120.2	120	8			M10 x 30	63						101.5	84		8	2.3 _{-0.2}	14			0.05	75
120.5	120	8			M10 x 30	63						101.5	84		9	2.3 _{-0.2}	13			0.05	75
150.2	150	8			M12 x 40	109						130	110.3		10	2.3 _{-0.2}	20			0.05	90
150.3	150	8			M12 x 40	109						130	110.3		12	2.3 _{-0.2}	18			0.05	90
150.5	150	8			M12 x 40	109						130	110.3		12	2.3 _{-0.2}	18			0.05	90
180.5	180	8			M14 x 45	175						155.5	132.5		14	2.3 _{-0.2}	21			0.05	110
225.7	225	8			M16 x 55	265	4	M12 x 60	21 x 28	13	80	196	171	159	15	4 _{-0.2}	25			0.06	140

		A (→ Fig. 6.1)					B (→ Fig. 6.1)					Dimensions of the connecting flanges								Z ₁ ,Z ₂	c
Column	-	1	2	3	4	5	6	7	8	9	5									10	11
Size	a	-	-	-	m	MA	z	n	o	p	MA	b±0.1	f _{a-0.3}	f _g	g	t	v	X P9	Y _a ^{+0.5}	Z ₁ ,Z ₂	c
	[mm]					[Nm]					[Nm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]

Types: RT/ RTL/ RTK 1-2/ RF/ RGK/ RFZ/ RZ (design with friction flange)

225	225	8			M16 x 55	265						196	171	159	15	4 _{-0.2}	25			0.06	140
250	250	8			M18 x60	365						218	190	176	18	5 _{-0.2}	24			0.06	140
285	285	8			M20 x70	515						245	214	199	20	6 _{-0.5}	30			0.06	175
315	315	8			M22 x75	695						280	247	231	22	6 _{-0.5}	31			0.06	175
350	350	10			M22 x80	695						310	277	261	25	7 _{-0.5}	30			0.06	220
390	390	10			M24 x100	890						345	308	290	32	7 _{-0.5}	36			0.06	250
435	435	10			M27 x120	1310						385	342	320	40	8 _{-0.5}	40			0.06	280

Types: RT/ RTL/ RTK 1-2/ RF/ RGK/ RFZ/ RZ design with split sleeves)

225	225						4	M12 x 60	21 x 28	13	80	196	171	159	15	4 _{-0.2}	15			0.06	140
250	250						4	M14 x 70	25 x 32	15	128	218	190	176	18	5 _{-0.2}	24			0.06	140
285	285						4	M16 x 75	28 x 36	17	195	245	214	199	20	6 _{-0.5}	30			0.06	175
315	315						4	M16 x 80	30 x 40	17	195	280	247	231	22	6 _{-0.5}	31			0.06	175
350	350						4	M18 x 90	32 x 45	19	270	310	277	261	25	7 _{-0.5}	30			0.06	220
390	390						4	M18 x 110	32 x 60	19	270	345	308	290	32	7 _{-0.5}	36			0.06	250
435	435						4	M20 x 110	35 x 60	21	380	385	342	320	40	8 _{-0.5}	40			0.06	280

Column	-	A (→ Fig. 6.1)					B (→ Fig. 6.1)					Dimensions of the connecting flanges								Z ₁ ,Z ₂	c
		1	2	3	4	5	6	7	8	9	5									10	11
Size	a	-	-	-	m	MA	z	n	o	p	MA	b±0.1	f _{a-0.3}	f _g	g	t	v	X P9	Y _a ^{+0.5}	Z ₁ ,Z ₂	c
	[mm]					[Nm]					[Nm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]

Types: RT/ RTL/ RTK 1-2/ RF/ RGK/ RFZ/ RZ (design with cross-key)

225	225		8		M16 x 65	265						196	171	159	20	4 _{-0.2}	25	32	9.5	0.06	105
250	250		8		M18 x 75	365						218	190	176	25	5 _{-0.2}	25	40	13	0.06	105
285	285		8		M20 x 80	515						245	214	199	27	6 _{-0.5}	26	40	15.5	0.06	125
315	315		10		M22 x 95	695						280	247	231	32	7 _{-0.5}	31	40	15.5	0.06	130
350	350		10		M22 x 100	695						310	277	261	35	7 _{-0.5}	30	50	16.5	0.06	155
390	390		10		M24 x 120	890						345	308	290	40	7 _{-0.5}	40	70	18.5	0.06	170
440	435		10		M27 x 120	1310						385	342	320	42	9 _{-0.5}	38	80	20.5	0.1	190
480	480		10		M30 x 140	1780						425	377	350	47	11 _{-0.5}	46	90	23	0.1	205
550	550		10		M30 x 140	1780						492	444	420	50	11 _{-0.5}	40	100	23	0.1	250

Types: RT/ RTL/ RTK 1-2/ RF/ RGK/ RFZ/ RZ (design with Hirth serration)

208	225			4	M16 x 65	270						196	171	159	20		25			18	180
250	250			4	M18 x 75	372						218	190	175	25		25			20	200
285	285			4	M20 x 80	526						245	214	199	27		26			21	225
315	315			4	M22 x 95	710						280	247	230	32		31			23	250
350	350			6	M22 x 100	710						310	277	261	35		30			24	280
390	390			6	M24 x 120	906						345	308	290	40		40			25	315
440	435			6	M27 x 120	1340						385	342	322	42		36			28	345
480	480			8	M30 x 140	1820						425	377	350	47		36			31	370
550	550			8	M30 x 140	1820						492	444	420	50		40			32	440

Tab. 6.2: Dimensions of the connecting flange and bolted connections

6.1.2 Checking bolted connections and tightened parts

Checking bolts

- ⇒ Ensure that bearing surfaces and threads of the bolts are in perfect condition, that is,
 - edges are burr-free
 - no impact points (plastically deformed) present
 - surface black annealed, oiled, yet free from scale

Checking threads

- ⇒ For completely-rolled threads: do not re-cut thread for reasons of endurance strength.
- ⇒ Check threads of the bolts and nuts for accumulations or soiling, e.g. rust, paint or hardened oil.
- ⇒ In case of accumulations or soiling: clean bolts and nuts and lightly oiled with thin machine oil (12–38 mm²/s at 50 °C, ISO VG 15 to ISO VG 46).

Checking washers

If you are using washers:

- ⇒ Make sure that the hardness of the washers is appropriate for the property class of the bolts, e.g. washers HV 300 according to ISO 7089.
- ⇒ Ensure that the bearing surfaces are in good condition, that is,
 - edges burr-free
 - no impact points present

Checking tightened parts

- ⇒ Ensure that part joints and bearing surfaces of the bolts and nuts are even, at right angles, parallel, burr-free and that nuts are mounted so that the designation is visible and in case of self-locking nuts, not visible.

Checking stud screws

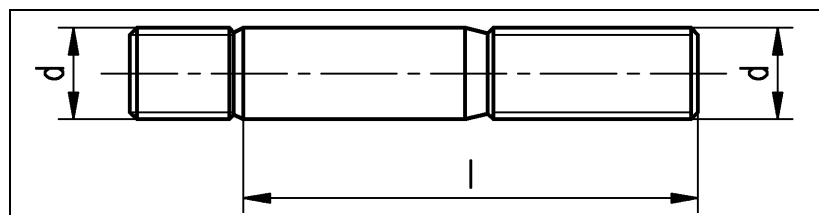


Fig. 6.2: Dimensions of a stud screw

- ⇒ To order stud screws, the measurement d and the measurement l must be measured and specified with the order.

6.2 Installing the universal joint shaft



The following instructions describe the installation of a universal joint shaft with standard flange.

- ⇒ Heed additional regulations:
 - for Hirth serration (→ Chapter 6.3, page 49)
 - for use in paper machines (→ Chapter 6.4, page 50)



Only install universal joint shaft in areas not subject to explosion (atmosphere).



DANGER

For specially-designed universal joint shafts, improper installation and removal can cause severe injuries or even death.

- ⇒ Heed and if necessary request additional documentation (→ Chapter 1.3, page 8).



DANGER

Severe to deadly injuries due to rotating parts!

- ⇒ Secure drive against starting up.
- ⇒ Keep personnel who are not participating away, e.g. using supervisory personnel, enclosures, fences.



DANGER

Severe to deadly injuries due to swinging or falling universal joint shaft!

- ⇒ Heed common attachment regulations.
- ⇒ Only lift universal joint shaft at the prescribed attachment points (→ Fig. 4.1, page 32).
- ⇒ Do not attach universal joint shaft in marked area (→ Fig. 4.1, page 32).
- ⇒ Only use sufficiently dimensioned and tested lifting appliance.
- ⇒ Secure danger zone under the universal joint shaft against entry.
- ⇒ Wear safety helmet, safety shoes, gloves, safety glasses, and fall protection.


⚠ DANGER

In case of telescopic lengths: Severe to deadly injuries due to falling parts!

- ⇒ Secure telescoping part against being pulled apart, e.g. with a suitable rope.


⚠ DANGER

In case of ATEX-certified universal joint shafts: severe to deadly injuries due to spark formation in case of:

- Equipotential bonding
 - Impact-like touching of adjacent metal parts
 - Slipping screw drivers
 - Hammer blows
- ⇒ Only install universal joint shaft in areas not subject to explosion (atmosphere).


⚠ DANGER

Severe crushing or crushing of limbs due to tipping universal joint!

- ⇒ Secure universal joints against tipping, e.g. with a suitable rope or wedge.
- ⇒ Never reach between the universal joint, even if there is a deflection guard present.


⚠ DANGER

Severe to deadly injuries due to rolling universal joint shaft!

- ⇒ Only set universal joint shaft down on suitable bases.
- ⇒ Secure universal joint shaft against rolling away.

6.2.1 Removing preservation



⚠ DANGER

Cleaning agents can contain acidic materials and additives!

- ⇒ Wear safety glasses and suitable protective gloves.
- ⇒ Heed the manufacturer's safety data sheets.



⚠ DANGER

There is a danger of fire due to use/processing of flammable cleaning/anticorrosion agents!

- ⇒ Ensure sufficient ventilation.
- ⇒ Prevent direct bodily contact and inhalation.
- ⇒ Heed the manufacturer's safety data sheets.

Remove the anticorrosion agent with cleaning agents.

6.2.2 Transport universal joint shaft to the installation location

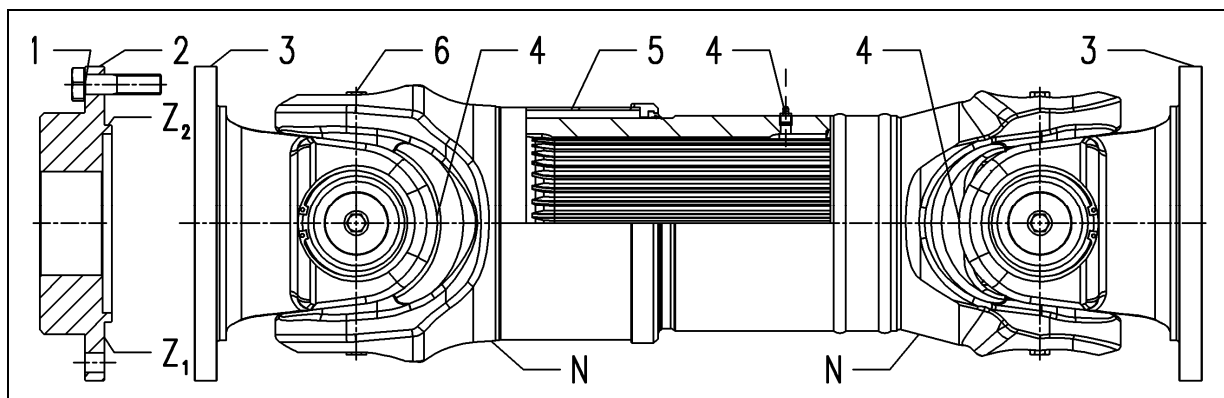


Fig. 6.3: Universal joint shaft

- | | | |
|---|--|-------------------------------|
| 1 Screw | 4 Grease/lubricating nipple | N Zero marking, e.g. arrow |
| 2 Connecting flange
(output, input side) | 5 For telescopic lengths:
profile guard | Z ₁ Axial run-out |
| 3 Flange yoke | 6 Screw plug | Z ₂ Radial run-out |



For universal joint shafts with sliding part

⇒ Do not load profile guard (5).

1. Transport universal joint shaft to the installation location (→ Chapter 4.3, page 30).
2. Remove transport braces.
3. Seal threaded holes of the transport braces with plugs.

6.2.3 Cleaning the universal joint shaft and connecting flange



⇒ For the cleaning of the universal joint shaft:

- Do not use any aggressive cleaning agents
 - Do not clean seal elements and grease/lubricating nipple with a high-pressure or steam cleaner.
1. Clean universal joint shafts and connecting flanges, that is, centering and plane surfaces must be free of dirt, grease, preserving agent, paint, and burrs.
 2. Clean grease/lubricating nipples (4).

6.2.4 Checking, aligning, and fastening connecting flange



⇒ Do not use pry bars to turn the universal joint shaft in the joint since otherwise bearing seals and the grease/lubricating nipple could be damaged.

⇒ The universal joint shaft must be arranged so that the key profile is protected against dirt and humidity. If possible, installation should be so that the opening of the profile guard (seal) points downward.

⇒ If two or more universal joint shafts are arranged next to one another, it is recommended that you install them turned by 90° to one another. Thus the mass acceleration torques caused by the cardan error of the universal joint shaft center part toward the outside are negated at least somewhat.

1. Check the connecting flange for roundness and true axial run out (→ Tab. 6.1, page 37).
2. Align and fasten the connecting flange to the universal joint shaft according to the installation situation (→ system documentation).

6.2.5 Checking the differential angle of the front faces of the connecting flange (with Z arrangement)

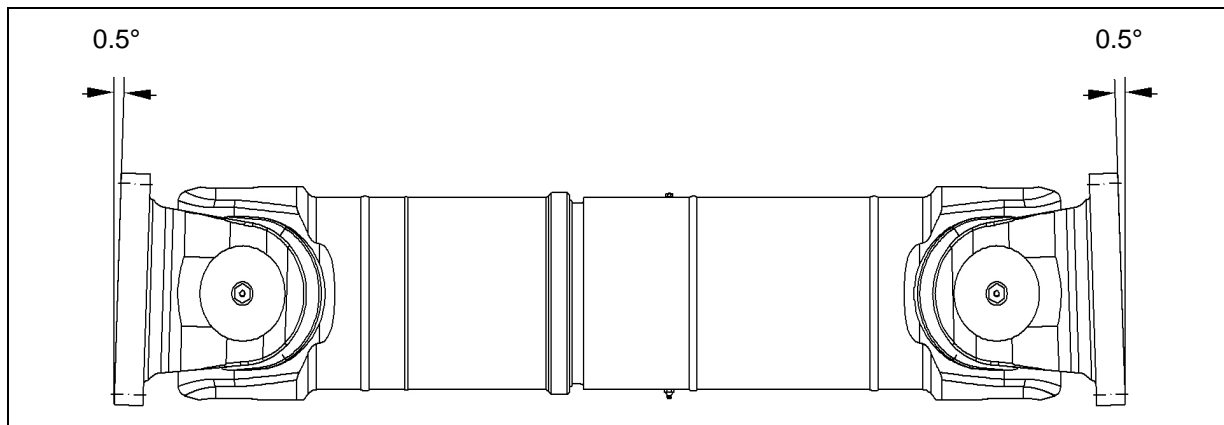


Fig. 6.4: Checking the difference in joint angle between the faces of the connecting flanges

1. Checking the difference in joint angle between the faces of the connecting flanges:

Speed [min^{-1}]	Max. differential angle [°]
< 1500	0.5
> 1500	→ Fig. 6.5, page 46

Tab. 6.3: Permissible differential angle (with Z arrangement)

2. In case of deviation: Realign connecting flange

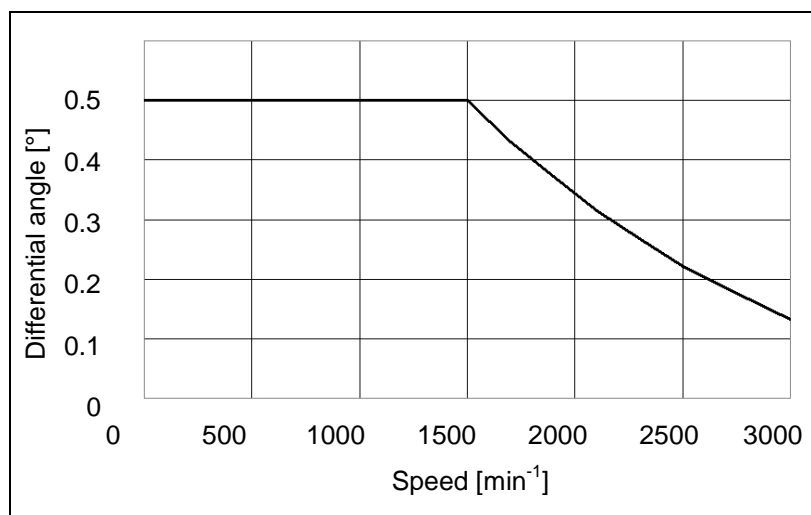


Fig. 6.5: Permissible differential angle (with Z arrangement)

6.2.6 Checking the differential angle of the front faces of the connecting flange (with W arrangement)

1. Checking the difference in joint angle between the faces of the connecting flanges:

Speed [min ⁻¹]	Max. differential angle [°]
< 1500	0.5
> 1500	on request

Tab. 6.4: Permissible differential angle (with W arrangement)

2. In case of deviation: Align connecting flange with alignment tips.

6.2.7 Bolting together the universal joint shaft and the connecting flange



- ⇒ Check that the contact surface of the bolts and nuts are bare metal, clean, flat, burr-free, and at a right angle to the hole.
- ⇒ During assembly of the universal joint shaft, make sure that the zero markings (N) are on a single plane (→ Fig. 6.5, page 44).
- ⇒ With several moving parts, make sure that the components are marked, so they cannot be confused.
- ⇒ Balancing weights may not be removed or shifted.



⚠ DANGER

While working on the universal joint shaft of vehicles, severe injuries can result if the vehicle starts to move!

- ⇒ Secure vehicle against starting up/moving.



Standard designs of the universal joint shaft flange are self-centering thanks to advance and rebound.

- ⇒ Begin installation with the input side connecting flange.



If as a result of inexact position of the holes there are difficulties during installation:

- ⇒ Do **not** re-bore holes or enlarge them in order to prevent an impermissibly high area pressure and thus a possible failure of the connection.
- ⇒ Replace flawed part.



⇒ If you are using liquid locking agents such as "Loctite" or "Omnifit": heed deviating tightening torques (→ Manufacturer's instructions).

⇒ Do not use any lubricants that contain MoS₂, e. g. Molykote



⇒ Tighten bolts in a diagonally opposite sequence.



⇒ The use of used nuts or bolts is not permitted.



To avoid cold welding and guarantee the testability of the bolted connection, heed the following:

⇒ When using the nut make sure that the surface with the property class and company mark is visible. For self-locking nuts, by contrast, the company mark may not be visible.

Threaded connection

For a threaded connection:

1. Align the universal joint shaft with respect to the connecting flange and slide onto the spigot.
2. If the bolt head has a stop or is flush with the fastening: if necessary, tighten the bolt with screwdriver up to a snug torque (approx. 0.3 M_A) (→ Tab. 6.1, page 37).
3. Tighten the bolts using a calibrated torque wrench, quickly and without interruptions, to a tightening torque of M_A.

Blind hole connection

For a blind hole connection:

1. Screw stud bolts into blind hole (if using self-locking nuts secure the male thread of the studs e.g. with Loctite 242. Follow the special instructions of the manufacturer for blind holes).
2. Align the universal joint shaft with respect to the connecting flange and slide onto the spigot.
3. Thread on the nuts and using a calibrated torque wrench, quickly and without interruptions to a tightening torque of M_A.

6.2.8 Final work

⇒ Lubricate universal joint shaft (→ Chapter 9.4, page 61).

6.3 Additional regulations for Hirth serration



For divided flange yokes:

- ⇒ Heed additional documentation (→ Mounting and dismounting instructions for divided flange yokes).

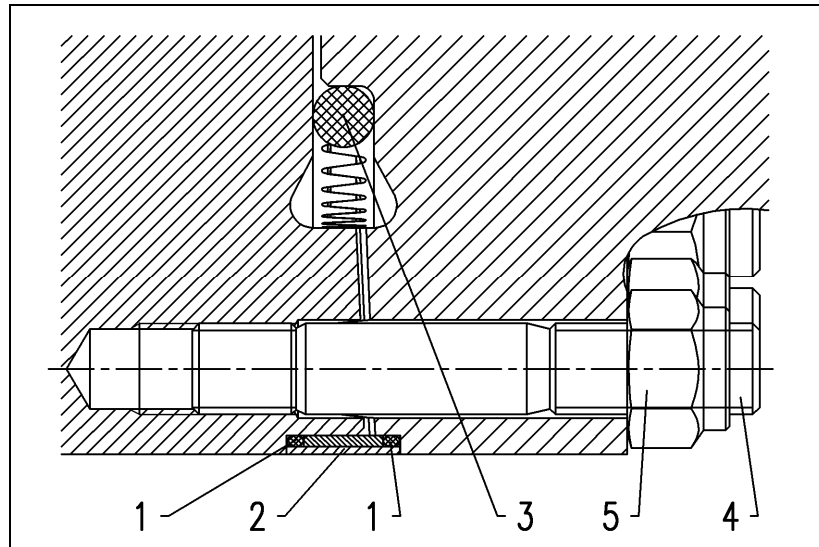


Fig. 6.6: Seals for Hirth serration

- | | | | |
|---|-----------------|---|-------------------|
| 1 | O-seal (2x) | 3 | O-seal (optional) |
| 2 | Protective ring | 4 | Screw |
| | | 5 | Nut |

1. If present: attach O-seal (3).
2. Attach O-seals (1).
3. Paint Hirth serration thinly with anti-seize (heed here that the threaded and blind holes are free of anti-seize, otherwise the friction value in the threads can be reduced by the anti-seize).
4. Heat up protective ring (2) to max. 80 °C and push onto universal joint over Hirth serration.



- ⇒ If necessary: use hydraulic wrench.

5. Tighten bolted connection with calibrated torque wrench cross-wise in stages of 40%, 70%, and 100% of the prescribed tightening torque:
 - for Rota < 550 mm (→ Tab. 6.1, page 37)
 - for Rota > 550 mm (→ Dimensional drawing of the universal joint shaft)

6.4 Additional regulations for use in paper machines

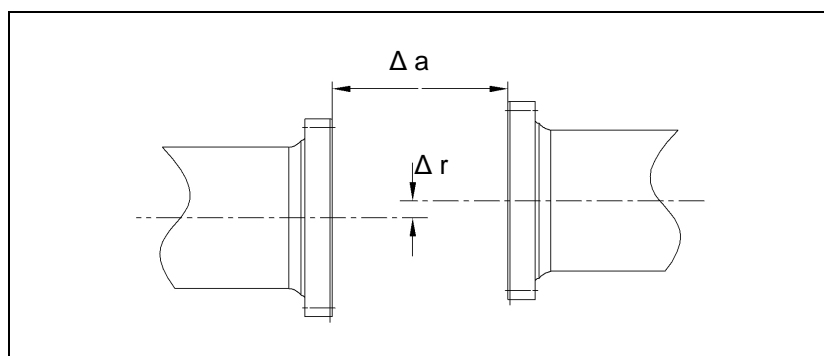


Fig. 6.7: Checking radial offset and flange distance (with use in paper machines)

Δr Radial offset

Δa Flange distance

⇒ Adhere to permissible radial offset and flange distance for alignment of the input and output shafts when installing the universal joint shafts:

Type	Universal joint shaft length l [mm]	Δr [mm]	Δa [mm]
Standard	< 800	± 2	± 2
Standard	800–1500	± 3	± 3
Standard	1500–2500	± 4	± 4
Standard	> 2500	± 5	± 5

Tab. 6.5: Permissible radial offset and flange distance (for use in paper machines)

⇒ Only use the bolts that are screwed into the associated flange yoke.

7 Commissioning and operation

7.1 Commissioning the universal joint shaft

- ⇒ Check position of the individual parts to one another: the zero marking (N) must be in a single plane.
- ⇒ Tighten the bolts (1) with tightening torque M_A (→ Tab. 6.1, page 37).



In areas subject to explosion (atmosphere), only use ATEX-certified universal joint shafts. Here, heed certification (→ Chapter 3.1, page 22).



In case of ATEX-certified universal joint shafts, it must be ensured that

- ⇒ The surface temperature in the field of joint bearings not exceed 140°C.
- ⇒ Voith recommends at both joints, to attach a temperature monitoring in the field of the joint bearings. (→ Chapter 3.1, page 22).



⚠ DANGER

Severe to deadly injuries due to rotating parts!

- ⇒ Attach guards (→ system documentation).

- ⇒ Lubricate telescopic center section of universal joint shafts that were stored for a longer time before commissioning in the shortest operating position (→ Chapter 9.4, page 61).
- ⇒ Before commissioning, check whether all attached transport braces have been removed.

7.2 Operating the universal joint shaft

- ✓ Universal joint shaft checked (→ Chapter 7.1, page 51)
- ✓ Guards attached (→ system documentation)



DANGER

Severe to deadly injuries due to rotating parts!

- ⇒ Keep personnel who are not participating away, e.g. using supervisory personnel, enclosures, fences.
- ⇒ Do not remove any safety equipment as long as the universal joint shaft/system is not standing still and secured against starting up again.
- ⇒ Before restarting the universal joint shaft/system, reattach all safety equipment.

- ⇒ Perform regular visual inspections, e.g. for damage, conspicuity.
- ⇒ Monitor operating noises for change. Report changes to the responsible office/person.



DANGER

In case of ATEX-certified universal joint shafts: severe to deadly injuries due to overheating universal joint shaft in case of:

- Vibrating or oscillating universal joint shaft
- Exceeding of the life span
- Overload of the universal joint shaft
- ⇒ Avoid vibrations and oscillations during operation
- ⇒ Heed life span of the universal joint shaft (→ Chapter 9.6, page 64)
- ⇒ Only operate the universal joint shaft within the specified speed and torque range. (→ Dimensional drawing of the system documentation)
- ⇒ Adhere to specific shaft angle. (→ Dimensional drawing of the system documentation)

8 Eliminating errors



The operator's service personnel may only perform the work for eliminating errors described in this instruction manual.

Additional measures to eliminate errors may only be performed by the manufacturer's service personnel or by service personnel authorized by the manufacturer.



DANGER

Severe to deadly injuries due to rotating parts!

- ⇒ Secure drive against starting up.
- ⇒ Keep personnel who are not participating away, e.g. using supervisory personnel, enclosures, fences.
- ⇒ Do not remove any safety equipment as long as the universal joint shaft/system is not standing still and secured against starting up again.
- ⇒ Before restarting the universal joint shaft/system, reattach all safety equipment.



DANGER

While working on the universal joint shaft of vehicles, severe injuries can result if the vehicle starts to move!

- ⇒ Secure vehicle against starting up/moving.



The errors refer to increased values as compared to normal operation.

Error	Cause	Action
Strong vibrations	Insufficient roundness and true axial run out of the connecting flange	<ul style="list-style-type: none"> ⇒ Remove universal joint shaft (Repair instructions/system documentation). ⇒ Check the connecting flange for roundness and axial run out (→ Tab. 6.1, page 37). ⇒ If necessary, realign connecting flange.
	Worn telescopic part	<ul style="list-style-type: none"> ⇒ Checking deflection play of the center part (→ Chapter 9.3.2, page 59).
	Loose bolted connections or connecting flange	<ul style="list-style-type: none"> ⇒ Remove universal joint shaft (→ Repair instructions/system documentation). ⇒ Check connection, universal joint shaft flange, and centering for damage (→ Chapter 6.2.7, page 47). ⇒ Replace bolts.
	Imbalance	<ul style="list-style-type: none"> ⇒ Remove universal joint shaft (→ Repair instructions/system documentation). ⇒ Check connection, universal joint shaft flange, and centering for damage and run-out (→ Chapter 6.2.7, page 47). ⇒ Only have universal joint shafts balanced by the manufacturer's service personnel or by service personnel authorized by the manufacturer.
High temperature in the area around the universal joints	Damaged journal cross set	<ul style="list-style-type: none"> ⇒ Remove universal joint shaft (→ Repair instructions/system documentation). ⇒ Replace journal cross set (→ Repair instructions). ⇒ Insofar as provided: Only have universal joint shaft balanced by the manufacturer's service personnel or by service personnel authorized by the manufacturer.
	Insufficient lubrication	<ul style="list-style-type: none"> ⇒ Lubricate universal joint shaft (→ Chapter 9.4, page 61).

Tab. 8.1: Eliminating errors

9 Maintenance



The operator's service personnel may only perform the maintenance work and inspections described in this instruction manual. Other maintenance work (especially overhauls) may only be performed by the manufacturer's service personnel or personnel authorized by the manufacturer.



DANGER

Severe to deadly injuries due to rotating parts!

- ⇒ Secure drive against starting up.
- ⇒ Keep personnel who are not participating away, e.g. using supervisory personnel, enclosures, fences.
- ⇒ Do not remove any safety equipment as long as the universal joint shaft/system is not standing still and secured against starting up again.
- ⇒ Before restarting the universal joint shaft/system, reattach all safety equipment.



DANGER

While working on the universal joint shaft of vehicles, severe injuries can result if the vehicle starts to move!

- ⇒ Secure vehicle against starting up/moving.



WARNING

Injuries due to sharp-edged, falling, swinging, rolling parts!

- ⇒ Wear safety helmet, safety shoes, safety glasses, gloves, and fall protection.

9.1 General notes about the maintenance and inspection of universal joint shafts



⇒ The user or operator must heed the legal safety regulations and take suitable preventative measures before starting maintenance work.



⇒ The universal joint shafts may not be separated at the key profile and exchanged for one another since the balancing quality will be impermissibly compromised.



⇒ Flange bolted connections must be checked for tightness and if necessary re-tightened to the prescribed torque.



⇒ To prevent impairment the balancing quality as well as a source of ignition, dirt accumulations must be removed periodically.



⇒ If universal joint shafts are cleaned with a high-pressure device, seal elements may not be cleaned with the direct stream. A re-lubrication after cleaning is recommended.



⇒ Universal joint shafts will be delivered painted on request. For re-working of the painting, we recommend our standards. Please contact us about this.

⇒ During color spraying of the universal joint shaft, attention must be paid that the area where the profile or the seal slides, is protected against color application. The same applies for the grease/lubrication nipple, the ventilation valves, the contact surfaces of the bolted connections, the flange and the centering surfaces.

9.2 Intervals for maintenance and inspections



The following intervals are guide values.

- ⇒ Adapt intervals to the respective operating conditions.
- ⇒ Agree on longer intervals with the manufacturer.

Lubrication intervals

- ⇒ Before longer downtimes, lubricate all lubrication points.
- ⇒ For 3-shift operation or in case of heavy loading of the seals, lubricate monthly. This may be necessary in roller mills due to the special operating conditions (e.g. water, steam, cinders, dust).
- ⇒ In case of use in paper machines with permanent operation, lubricate the universal joint shafts every two months.

Interval	Maintenance work or inspection	
One-time after installation	1	⇒ Lubricate universal joints (→ Chapter 9.4.2, page 61).
After every 200 operating hours	1	⇒ Lubricate universal joints (→ Chapter 9.4.2, page 61).
	2	⇒ Perform visual inspection, e.g. for damage, noteworthy changes, and especially the sealing seat of the lubrication nipple. Replace in case of leaks.
	3	⇒ Check bolted connections and connecting flange for tightness. ⇒ Re-tighten bolted connections if necessary (→ Tab. 6.1, page 37).
	4	⇒ For universal joint shafts with center part: lubricate telescopic part (→ Chapter 9.4.2, page 61).
	5	⇒ Check maximum service life of ATEX-certified universal joint shafts (→ Chapter 9.6, page 64).
Every 6 months	1	⇒ Check bolted connections and connecting flange for tightness. ⇒ Re-tighten bolted connections if necessary (→ Tab. 6.1, page 37).
	2	⇒ Perform visual inspection, e.g. for damage, noteworthy changes, and especially the sealing seat of the lubrication nipple. Replace in case of leaks. ⇒ Checking axial clearance of the journal cross set (→ Chapter 9.3.1, page 58). ⇒ Checking deflection play of the center part (→ Chapter 9.3.2, page 59).
	3	⇒ For universal joint shafts with center part: lubricate telescopic part (→ Chapter 9.4.2, page 61).
Annually	1	⇒ Check date for the next main overhaul of ATEX-certified universal joint shafts (→ Chapter 3.1, page 22)
	2	⇒ Recommendation: lubricate length compensation with Rilsan coating once a year for safety (→ Chapter 9.4.2, page 61).

After several years, depending on load	1	<ul style="list-style-type: none"> ⇒ Have main overhaul done by the manufacturer. ⇒ If necessary, order new universal joint shaft.
In case of unusual running noises:	1	<ul style="list-style-type: none"> ⇒ Perform visual inspection, e.g. for damage, noteworthy changes ⇒ Checking axial clearance of the journal cross set (→ Chapter 9.3.1, page 58). ⇒ Checking deflection play of the center part (→ Chapter 9.3.2, page 59). Determine cause, e.g. insufficient connection or other system parts are touching the universal joint shaft, e.g. hoses or cables. ⇒ If possible, eliminate the cause or consult the manufacturer.

Tab. 9.1: Intervals for maintenance work and inspections

9.3 Inspections

9.3.1 Checking axial clearance of the journal cross set



The measured values specified in this section are examples.

- ⇒ Binding measured values for each universal joint shaft type: see repair instructions.
- ⇒ Heed force for lifting the universal joint shaft: max. 1.5 x weight of the universal joint shaft.

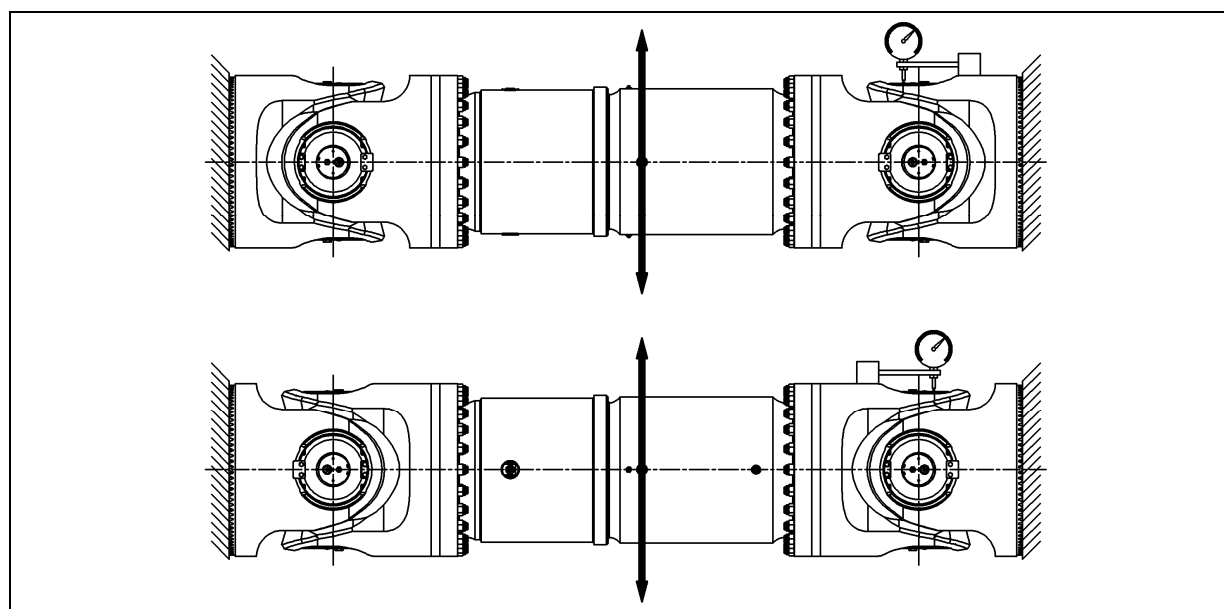


Fig. 9.1: Checking axial clearance of the journal cross set on two levels

1. On the first universal joint:
 - Set holder on the flange of the flange yoke.

- If possible, remove bearing cover and apply the dial gauge to the front face of the journal cross. Otherwise apply the dial gauge to the bottom of the bearing.
- Lift the universal joint shaft with a crane and read the measured value from the dial gauge.

2. Check measurement values:

Speed [min^{-1}]	Max. axial clearance [mm]
< 500	0.20
500–1500	0.06
> 1500	0.03

Tab. 9.2: Checking axial clearance of the journal cross set

3. If exceeded:

- ⇒ Use thicker locking rings to reduce the axial clearance (order repair instructions).
- ⇒ Send universal joint shaft to manufacturer.
- ⇒ Insofar as provided: Only have universal joint shaft balanced by the manufacturer's service personnel or by service personnel authorized by the manufacturer.

9.3.2 Checking deflection play of the center part

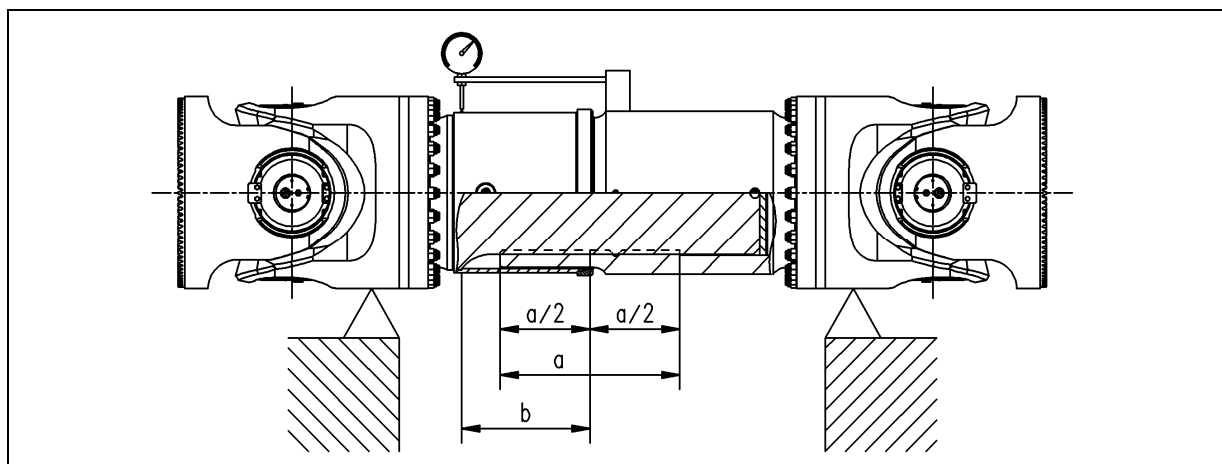


Fig. 9.2: Checking deflection play of the center part

1. Measure the length "a" of the spline profile on the top and mark the middle.
2. Position the universal joint shaft precisely at the installation length and put under neath.

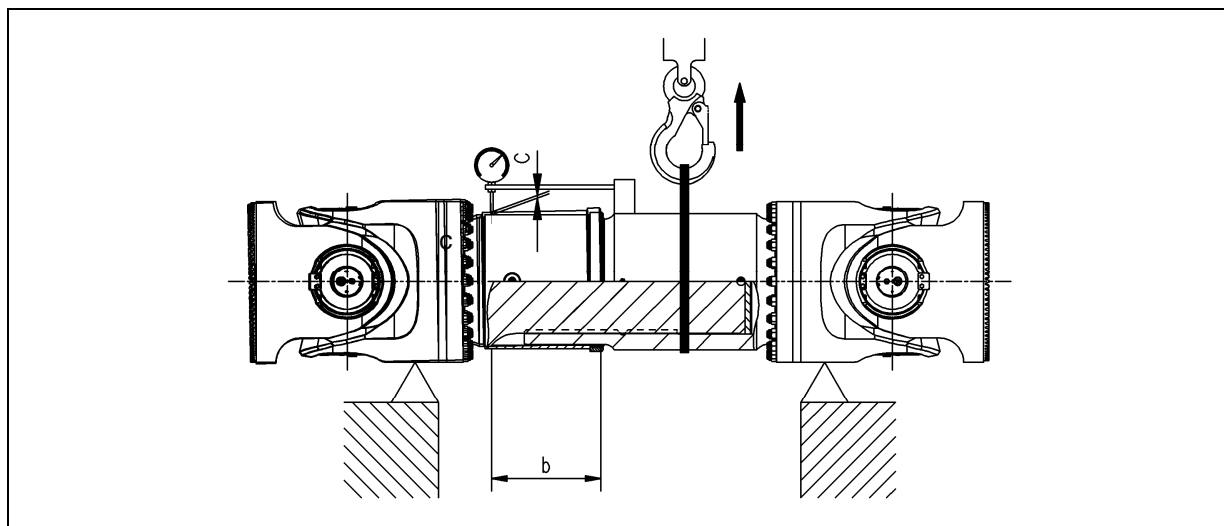


Fig. 9.3: Reading off deflection dimension

3. Apply dial gauge and set scale to "0."
4. Measure distance b from the measurement point to the middle of the key profile.



⇒ Heed force for lifting the universal joint shaft: max. 1.5 x weight of the universal joint shaft.

5. Lift the universal joint shaft and read the measured value from the dial gauge.
6. Calculate deflection ratio K: $K = \frac{c}{b}$

Example:

Dimension b = 300 mm Dimension c = 0.36 mm

$$\text{deflection ratio } K = \frac{0,36 \text{ mm}}{300 \text{ mm}} = 0,0012$$

Speed [min ⁻¹]	Max. deflection ratio
< 500	0.004
> 500	0.003

Tab. 9.3: Permissible deflection ratio

If exceeded:

⇒ Send universal joint shaft to manufacturer.

9.4 Lubrication

9.4.1 Lubricants



Suitable for the lubrication of the universal joint shaft are greases that meet the requirements for the identification KP 2 K according to DIN 51825, e.g. "Renolit PEP 1/2" from Fuchs. For our CH and E series, we recommend Wear Care 500, which can also be mixed with other greases.

- ⇒ For other greases: consult the manufacturer.
- ⇒ No lubricants with MOS_2 additives may be used.

9.4.2 Lubricating the universal joint shaft



⚠ DANGER

Danger of slipping on escaped lubricants!

- ⇒ Wear safety shoes with slip-proof, oil-resistant soles, safety glasses, safety helmet, and fall protection.
- ⇒ Remove escaped lubricants as soon as possible.



- ⇒ For center parts with (plastic-coated) Rilsan spline profile, application related re-lubrication is required. Please contact the manufacturer.



- ⇒ The ventilation valves may not be removed or replaced by grease/lubricating nipples or other plugs.



- ⇒ Do not press in lubricant with hard knocks or too much pressure (max. 15 bar) on the grease/lubricating nipple.

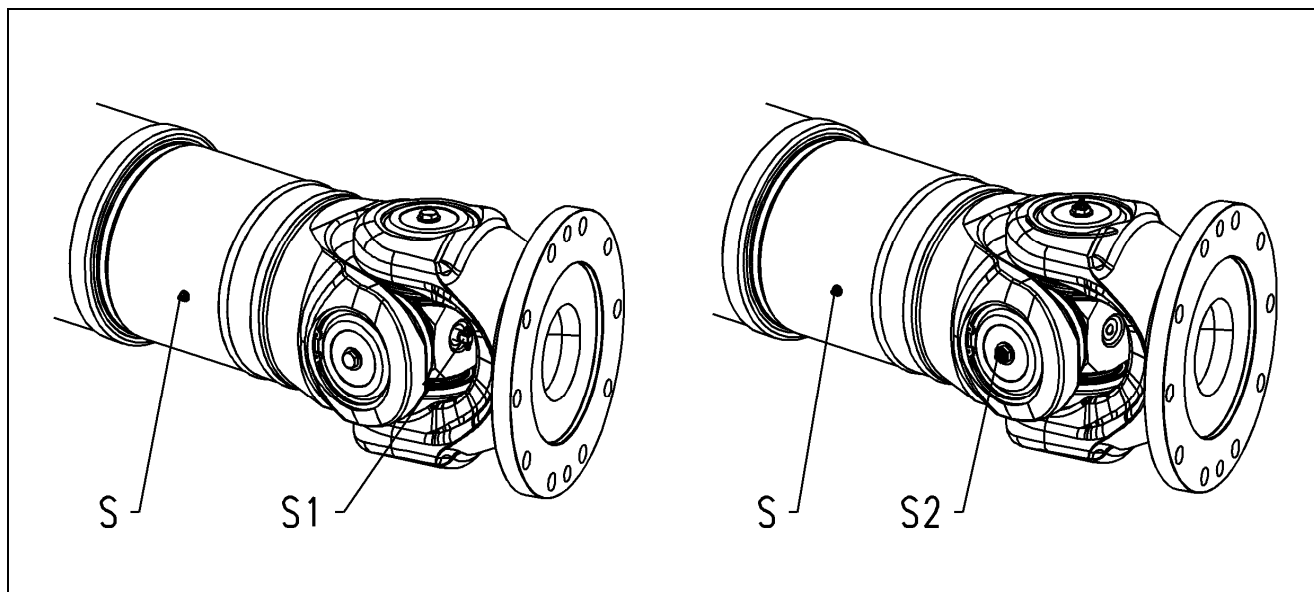


Fig. 9.4: Lubrication points of the universal joint shaft

S₁ Lubrication point (central on the journal cross)

S Lubrication point (for telescopic shafts)

S₂ Lubrication point (for individual lubrication)



⇒ Re-lubricating the length compensation should, if possible, always be done at the shortest operating position. If this is not possible, the lubricant quantities specified in the following table (→Tab. 9.4, page 64) must be used. At least once a year the universal joint shaft should be pushed slowly together to the shortest operating length so that excess grease can escape via the profile guard.

1. Put the universal joint shaft in the shortest operating position.
2. Clean all lubrication points.
3. Lubricate bearings until the lubricant escapes from all seal lips in order to ensure that
 - the quantity of grease is sufficient
 - any penetrated dirt is removed
 - the seal lips are re-greased.
4. For telescopic lengths:
 - If possible lubricate center part in the shortest operating position until lubricant escapes via the seal of the profile guard.
 - If the center part cannot be put into the shortest operating position, the lubricant quantity specified (→Tab. 9.4, page 64), must be used for re-lubrication if nothing else is specified on the dimensional drawing.

Rota [mm]	Standard designs	Amount of grease [cm ³]
198	RT	170
208	RT	40
	RTL	40
	RTK1	80
	RTK2	50
250	RT	60
	RTL	70
	RTK1	160
	RTK2	110
285	RT	80
	RTL	80
	RTK1	250
	RTK2	150
315	RT	90
	RTL	100
	RTK1	210
	RTK2	150
350	RT	140
	RTL	180
	RTK1	690
	RTK2	480
390	RT	150
	RTL	190
	RTK1	950
	RTK2	580
440	RT	220
	RTL	280
	RTK1	740
	RTK2	680
490	RT	340
	RTL	430
	RTK1	840
	RTK2	770
550	RT	420

	RTL	550
	RTK1	1500
	RTK2	1500
590 – 620	CHT / ET	590
650 – 680	CHT / ET	700
710	CHT / ET	960
740 – 800	CHT / ET	1100
830 – 860	CHT / ET	1500
890 – 920	CHT / ET	2000
950 – 1010	CHT / ET	2400
1040 – 1200	CHT / ET	3700
1220 – 1340	CHT / ET	4900

Tab. 9.4: Permissible lubricant quantity for the re-lubrication of standard center parts.



The lubricant quantities, which is specified in Tab. 9.4, page 64 relate to the center part and have to be divided by the number of lubricant nipples.

9.5 Main overhaul



Performing of the main overhaul requires specialized knowledge. We recommend having the manufacturer's specialized personnel perform the main overhaul.

⇒ Please contact the manufacturer.



The screw plugs (6) are necessary for the overhaul of the universal joint shaft.

⇒ Do not loosen the screw plugs (6) (→ Fig. 6.3, page 44).

9.6 Life span of ATEX universal joint shafts



ATEX-certified universal joint shafts must be sent back for main overhaul after expiration of the calculated life span (→ see drawing in the system documentation), at the longest after 5 years. The date for the next main overhaul is on the nameplate (→ Chapter 3.1, page 22).

10 Removal



During removal of the universal joint shaft:

- ⇒ Heed additional documentation: (→ Chapter 1.3, page 8).
- ⇒ Prevent sliding apart of the telescopic length part.
- ⇒ Prevent a tipping over of the flange yoke when loosening the flange connection.



Only remove universal joint shaft in areas not subject to explosion (atmosphere).



⚠ DANGER

For specially-designed universal joint shafts, improper installation and removal can cause severe injuries or even death.

- ⇒ Heed and if necessary request additional documentation (→ Chapter 1.3, page 8).



⚠ DANGER

Severe to deadly injuries due to rotating parts!

- ⇒ Secure drive against starting up.
- ⇒ Keep personnel who are not participating away, e.g. using supervisory personnel, enclosures, fences.



⚠ DANGER

Severe to deadly injuries due to swinging or falling universal joint shaft!

- ⇒ Heed common attachment regulations.
- ⇒ Only lift universal joint shaft at the prescribed attachment points (→ Fig. 4.1, page 32).
- ⇒ Do not attach universal joint shaft in marked area (→ Fig. 4.1, page 32).
- ⇒ Only use sufficiently dimensioned and tested lifting appliance.
- ⇒ Secure danger zone under the universal joint shaft against entry.
- ⇒ Wear safety helmet, safety shoes, gloves, safety glasses, and fall protection.

**⚠ DANGER**

In case of telescopic lengths: Severe to deadly injuries due to falling parts!

- ⇒ Secure telescoping part against being pulled apart, e.g. with a suitable rope.

**⚠ DANGER**

In case of ATEX-certified universal joint shafts: severe to deadly injuries due to spark formation in case of:

- Equipotential bonding
 - Impact-like touching of adjacent metal parts
 - Slipping screw drivers
 - Hammer blows
- ⇒ Only remove universal joint shaft in areas not subject to explosion (atmosphere).

**⚠ DANGER**

Severe crushing or crushing of limbs due to tipping universal joint!

- ⇒ Secure universal joints against tipping, e.g. with a suitable rope or wedge.
- ⇒ Never reach between the universal joint, even if there is a deflection guard present.

**⚠ DANGER**

Severe to deadly injuries due to rolling universal joint shaft!

- ⇒ Only set universal joint shaft down on suitable bases.
- ⇒ Secure universal joint shaft against rolling away.

11 Repair



Repairs may only be made by the manufacturer's service personnel or personnel authorized by the manufacturer

Only repair universal joint shaft in areas not subject to explosion (atmosphere).

⚠ DANGER

In case of ATEX-certified universal joint shafts: severe to deadly injuries due to spark formation in case of:

- Equipotential bonding
 - Impact-like touching of adjacent metal parts
 - Slipping screw drivers
 - Hammer blows
- ⇒ Only repair universal joint shaft in areas not subject to explosion (atmosphere).

Damage

- ⇒ If there is damage, first determine the cause of the damage and eliminate it.
- ⇒ To determine the cause of damage, consult service personnel authorized by the manufacturer.

Damage diagnosis

Exact damage diagnosis requires great experience. We recommend that you send the universal joint shaft to the manufacturer unassembled.

You will receive a damage report and a cost suggestion for a repair. You decide whether the repair is worthwhile or whether the universal joint shaft will be replaced. If desired, the manufacturer will handle the disposal of the old universal joint shaft.

Returning

Prepare defective universal joint shafts for returning as follows:

- ⇒ Secure in a wooden crate with suitable blocking.
- ⇒ Include a report with details about cause of damage, if known.

12 Disposal

- ⇒ Dispose of universal joint shaft in accordance with the locally-applicable regulations or send the defective universal joint shaft to the manufacturer.
- ⇒ Dispose of operating and hazardous materials separately according to the locally-applicable regulations. Heed the manufacturer's safety data sheets.

13 Declaration of incorporation

We,

J.M. Voith SE & Co. KG/ VTA
Alexanderstraße 2
89510 Heidenheim

hereby declare that the

machine called: High-performance universal joint shaft

in the series S,R,CH,E

corresponds insofar as possible given the scope of delivery to the essential health and safety requirements as per Annex I of Directive 2006/42/EC (Machinery Directive).

Other directives and harmonized standards applied, particularly DIN EN ISO 14121, DIN EN ISO 12100-1, DIN EN ISO 12100-2.

Moreover, we declare that relevant technical information for this partly completed machinery has been issued as per Annex VII Part B. We undertake to transmit in response to a reasoned request by the national authorities, relevant technical information on the partly completed machinery.

The method of transmission will be agreed with the national authorities.

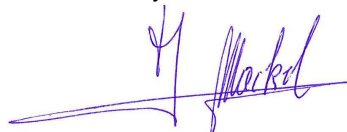
You may request the relevant technical information from the person authorized for technical information at

J.M. Voith SE & Co. KG/ VTA
Mrs. Gudrun Mißbeck
Alexanderstraße 2
89510 Heidenheim

The partly completed machinery must not be put into service until the final machinery into which it is to be incorporated has been declared in conformity with the provisions of Machinery Directive 2006/42/EC, where appropriate.

Making changes to the machinery, unless J.M. Voith SE & Co. KG/ VTA gave their express written approval, is not permitted.

Heidenheim, July 15, 2013



Dr. Jerry Mackel
Manager of the product group

14 Declaration of conformity

For ATEX certified universal joint shafts

We

J.M. Voith SE & Co. KG/VTa
Alexanderstraße 2
89510 Heidenheim

hereby declare that the device,

called: High-performance universal joint shaft

in the series S,R,CH,E in ATEX design

corresponds to the essential health and safety requirements as per
Annex II of

Directive 94/9/EG

of the Council of the European Community.

Other directives and harmonized standards applied, particularly

EN 13463-1: 2009

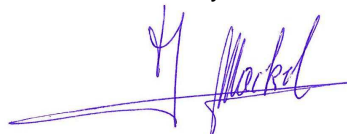
EN 13463-5: 2011

The labeling of the device includes the following information:

 II 2GD c T3/T4

By Changes to the device, except with express written approval
from Voith Turbo this declaration loses its validity.

Heidenheim, July 15, 2013



Dr. Jerry Mackel

Manager of the product group

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