

## Installation and Operating Manual

(Translation of the original installation and operating manual)

TRI...

TR...

## Turbo Coupling with Constant Fill and Pulley

including design as per Directive 2014/34/EU (ATEX directive)

Version 6 , 2017-07-10

3626-011200 en, Protection Class 0: public

Serial No. <sup>1)</sup>		
Coupling type <sup>2)</sup>		
Year of manufacture		
Mass (weight)		kg
Power transmission		kW
Input speed		rpm
Operating fluid	<input type="checkbox"/> mineral oil <input type="checkbox"/> water <input type="checkbox"/>	
Filling volume		dm <sup>3</sup> (liters)
Number of screws z <sup>3)</sup>		
Nominal response temperature of fusible plugs		°C
Pulley	Diameter: Profile: Number of grooves:	mm
Sound pressure level L <sub>PA,1m</sub>		dB
Installation position	<input type="checkbox"/> horizontal <input type="checkbox"/> vertical	
Drive via	<input type="checkbox"/> outer wheel <input type="checkbox"/> inner wheel	

1) Please indicate the serial number in any correspondence (→ Chapter 18).

2) T...: oil / TW...: water.

3) Determine and record the number of screws z (→ Chapter 10.1).

Please consult Voith Turbo in case that the data on the cover sheet are incomplete.

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3626-011200 en

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# 1 Voith Turbo Coupling with Constant Fill

## 1.1 Function

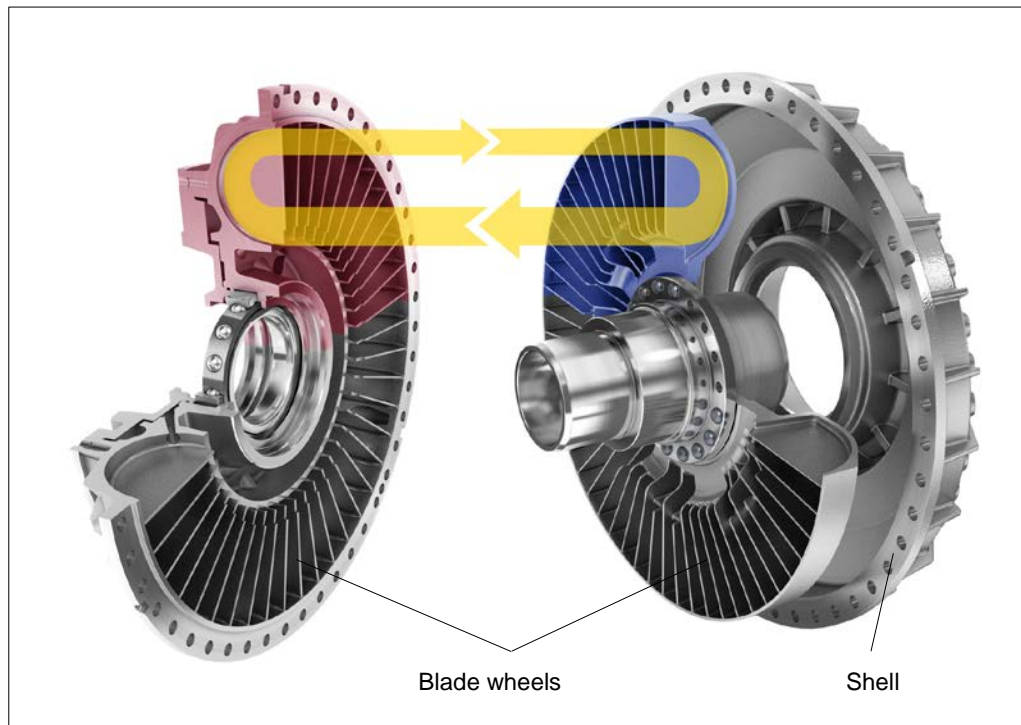


Fig. 1

The Voith turbo coupling is a hydrodynamic coupling working to the Föttinger principle. Its main elements consist of two blade wheels - the pump impeller and the turbine wheel - enclosed by a shell. Both wheels are provided with bearings relative to each other. The power is transmitted with hardly any wear, there is no mechanical contact between the power-transmitting parts. A constant amount of operating fluid is in the coupling.

The mechanical energy provided by the drive motor is converted into kinetic energy of the operating fluid in the connected pump impeller. In the turbine wheel, this kinetic energy is reconverted into mechanical energy.

Three conditions are to be considered with regard to the coupling function:

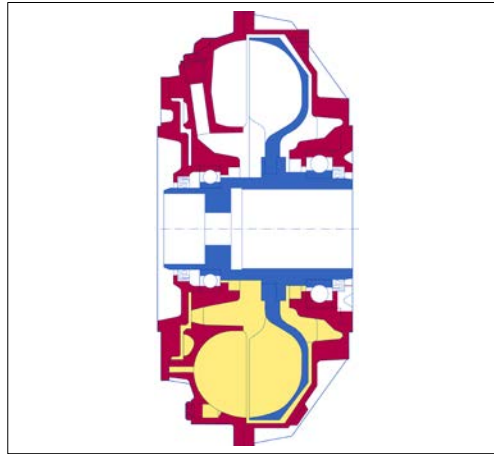


Fig. 2

### Standstill

The whole operating fluid rests in the coupling.

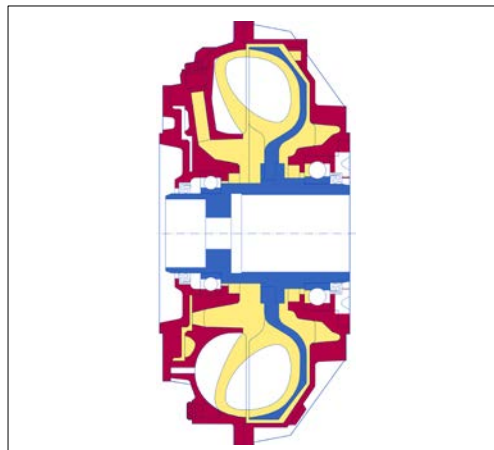


Fig. 3

### Starting condition

The pump impeller accelerates the operating fluid with increasing motor speed causing a circulating flow in the working chamber. The whole blade space of the turbine wheel is flooded, and the turbine wheel starts to move as a result of the kinetic energy of the fluid flow. The coupling characteristic curve determines the torque curve during start-up.

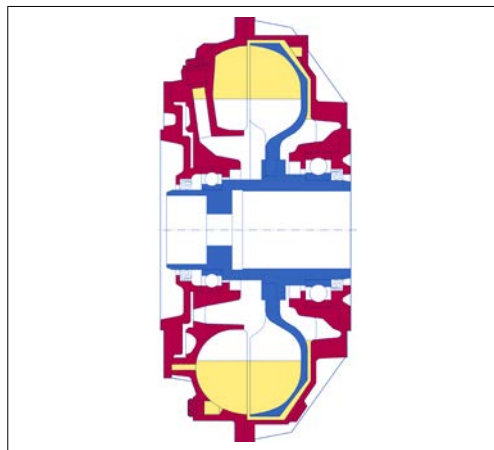


Fig. 4

### Nominal operation

During nominal operation, only the torque required by the driven machine is transmitted. The low speed difference between pump impeller and turbine wheel (the so-called rated slip) results in a stationary flow condition in the coupling.



## 2 Technical Data

### Information required for use in potentially explosive atmospheres:




CE  marking:		
Ambient temperature, if deviating from -25 °C T <sub>a</sub> 40 °C		°C
max. surface temperature (T <sub>3</sub> = 200 °C, T <sub>4</sub> = 135 °C, or deviating)		°C
Temperature Monitoring	<input type="checkbox"/> MTS <sup>1)</sup> for pre-warning	
	<input type="checkbox"/> BTS <sup>2)</sup> for pre-warning	
	<input type="checkbox"/> BTS-Ex <sup>2)</sup> for limitation of max. surface temperature for Voith turbo couplings acc. to ATEX directive.  Maximum permissible temperature of turbo coupling when switching on the motor:	°C
Nominal response temperature of temperature monitoring		°C
Max. permissible filling volume <sup>3)</sup>		dm <sup>3</sup> (liters)
Overload (à Chapter 5.8), causing the thermal fuse (fusible plug/s and/or BTS- Ex) to respond, requires the power supply to be switched off after		s (sec)
An additional monitoring of the output speed is required to switch off the power supply before the fusible plugs respond.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
After switching on the motor, monitoring of output speed has to begin after		s (sec)
Diameter of input (output) <sup>4)</sup>		mm
Diameter of pulley	(see cover sheet)	mm
For turbo couplings of type TRI only: Re-lubrication interval for the bearing underneath the pulley	→ Chapter 13	h
Replacement of ball and roller bearings after	→ Chapter 13	h

Table 1

- 1) MTS: Mechanical thermal switch unit (→ Chapter 19.1).
- 2) BTS: Non-contacting thermal switch unit (→ Chapter 19.2).
- 3) Applies if filling volume is not indicated on the cover sheet.
- 4) Diameter and fit of hub or shaft to be joined by means of shaft-hub connection.



**Additional information/data required for use in potentially explosive atmospheres:**

## 3 Declarations of Manufacturer

### 3.1 Declaration regarding assemblies and components

Since 29 December 2009, a new Machinery Directive 2006/42/EC has to be applied bindingly in the member states of the European Economic Area (EEA).

Voith turbo couplings of Product Group "Start-up Components", as defined by the new Machinery Directive 2006/42/EC and the explanations of the guidelines published in December 2009 to implement the Machinery Directive, are neither "machines" nor "incomplete machinery", but rather assemblies or components.

As our products are no incomplete machinery, we do not issue a declaration of incorporation as per Machinery Directive 2006/42/EC.

An EC Declaration of Conformity must not be issued for these products either, nor CE marking be provided, unless specified by other EC / EU directives or regulations.

Voith as certified company ensures that the basic safety and health requirements for their products are always be met by internal quality management systems and by applying harmonized standards.

The technical documentation for Voith products is so comprehensive that they may be installed reliably into machinery or incomplete machinery. Safe operation of the complete machinery with regard to Voith products is also ensured at a later date when observing this documentation.

## **3.2 Declaration of conformity**

→ Annex (see EU Declaration of Conformity)

## 4 User Information

This manual will support you in using the turbo coupling with pulley in a safe, proper and economical way.

If you observe the information contained in this manual, you will

- increase the reliability and lifetime of the turbo coupling and installation,
- avoid any risks
- reduce repairs and downtimes.

This manual must

- always to be available at the machine jobsite
- be read and used by every person who transports the turbo coupling, works on the turbo coupling or commissions the same.

The turbo coupling has been manufactured according to the latest design standard and approved safety regulations. Nevertheless, the user's or third party's life may be endangered or the machine or other property impaired in case of improper handling or unintended use.

### **Spare parts:**

Spare parts must comply with the technical requirements stipulated by Voith. This is guaranteed when original spare parts are used.

Installation and/or use of non-original spare parts may negatively change the mechanical properties of the **Voith Turbo coupling** and thus have an adverse impact on the safety.

Voith is not liable for any damages resulting from the use of non-original spare parts.

Use only appropriate workshop equipment for maintenance. Professional maintenance and/or repair can only be guaranteed by the manufacturer or an authorized specialist workshop.

This manual has been issued with the utmost care. However, should you need any further information, please contact:

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Voith Turbo reserves the right for modifications.

## 5 Safety

### 5.1 Safety information

Safety information indicating the descriptions and symbols as described in the following are used in the operating manual.

#### 5.1.1 Structure of safety information

	<b>DANGER WORD</b>
<b>Hazard consequences</b> Source of hazard <ul style="list-style-type: none"> <li>Warding off of danger</li> </ul>	

#### Danger word

The danger word divides the severity of the danger in several levels:




Danger word	Severity of danger
 DANGER	Death or serious injury (irreversible personal injury)
 WARNING	Death or serious injury possible
 CAUTION	Minor or moderate injury possible
NOTICE	Possibly damage to property of <ul style="list-style-type: none"> <li>the product</li> <li>its environment</li> </ul>
SAFETY INFORMATION	General applications details, useful information, safe job procedure and proper safety measures

Table 2

#### Hazard consequences

Hazard consequences indicate the kind of hazard.

#### Source of hazard

The source of hazard indicates the cause of hazard.

#### Warding off of danger

Warding off of danger describes the measures to be taken to ward off a danger

## 5.1.2 Definition of safety symbols


Symbol	Definition
	Danger of explosion Marking with the Ex-symbol indicates possible hazards which have to be observed for the use in potentially explosive atmospheres.

Table 3

## 5.2 Intended use

The turbo coupling with constant fill and pulley is provided to transmit the torque from the drive motor to the driven machine.

The **power** permitted during stationary operation at a specific **input speed** and a specific **coupling filling** (operating fluid and filling) is entered on the cover sheet of this manual. Any use beyond that is deemed unintended (→ Chapter 5.3 Unintended use).

Intended use also includes observing this installation and operating manual and complying with the inspection and maintenance conditions.

The manufacturer is not liable for any damages resulting from unintended use. The risk has to be borne solely by the user.



### SAFETY INFORMATION

- Observe the assembly plan belonging to the order.
- If not indicated accordingly in → Chapter 2, it is not allowed to use this turbo coupling in potentially explosive atmospheres!
- Please check with reference to the marking whether the turbo coupling is approved for potentially explosive atmospheres.
- If the zonal classification changes, the operator has to check whether it is still allowed to operate the turbo coupling in that zone.

A marking according to ATEX Directive has been provided on the periphery of the turbo couplings. The marking specifies in what potentially explosive atmospheres and under what conditions the use is permitted.

Example:   II 2D c 180 C X

Industrial area in which during normal operation an explosive atmosphere may form occasionally in form of a cloud of combustible dust in the air. Mechanical explosion protection by constructional safety. Maximum surface temperature: 180 °C.



### 5.3 Unintended use

The power transmission permitted during stationary operation at a specific input speed and a specific coupling filling (operating fluid and quantity) is entered on the cover sheet of this manual.

Any use beyond that described herein, e.g. for higher powers, higher speeds, other operating fluids or operating conditions that have not been agreed upon, is deemed unintended.

Moreover, it is not permitted to use BTS-Ex non-contacting thermal switch units from third parties.

### 5.4 Structural changes



#### WARNING

##### **Risk of personal injuries and damage to property**

Structural changes not done properly on the turbo coupling may cause personal injury and damage to property.

- Changes, attachments or conversions on the turbo coupling may only be performed upon approval by Voith Turbo GmbH & Co. KG, Crailsheim.

### 5.5 General information as to dangerous situations

**For all work performed on the turbo coupling, please observe the local regulations for the prevention of accidents!**

**Hazards while working on the turbo coupling:**



#### WARNING

##### **Risk of injury**

While working on the turbo coupling, there is the risk of injury through cutting, crushing, burns and cold burns in case of minus degrees.

- Never touch the turbo coupling without wearing protective gloves.
- Start to work on the turbo coupling only after it has cooled down.
- Ensure that there is sufficient light, a sufficiently large working space and good ventilation when working on the turbo coupling.
- Switch off the unit in which the turbo coupling is installed and secure the switch against inadvertent switch-on.
- For all work performed on the turbo coupling ensure that both the drive motor and the driven machine have stopped running and that a re-start is absolutely impossible!

**Hot surfaces:**



**WARNING**

**Risk of burning**

The turbo coupling gets warm during operation.

- Please provide a guard for protection against contact with the turbo coupling!  
However, ventilation of the turbo coupling must not be impaired.

**NOTICE**

**Damage to property**

Thermal distortion or tensions if the warm turbo coupling is cooled down by means of fluids.

- Never use fluids to cool down the turbo coupling!
- Let the turbo coupling cool down at ambient temperature.

**Rotating parts:**

Protective cover  
→ Chapter 11



**WARNING**

**Entanglement hazard**

Rotating parts, such as the turbo coupling itself and exposed shaft parts need to be protected by a protective cover against contact with and entry of loose parts.

- Never operate the turbo coupling without these protective covers.

**Noise:**

Sound pressure  
level  
→ Cover sheet



**WARNING**

**Hearing loss, permanent impairment of hearing**

The turbo coupling generates noise during operation. If the A-classified equivalent sound pressure level  $L_{PA, 1m}$  exceeds 80 dB(A), this may cause impairment of hearing!

- Wear ear protection.

**Electric shock:****DANGER****Electric shock**

On account of incorrectly mounted or incorrectly connected electrical components, and disconnected electric connections, persons could get an electric shock and be severely injured, possibly with fatal consequences.

Incorrectly mounted or incorrectly connected electrical components and disconnected electric connections may cause damages to the machine.

- A qualified electrician has to properly carry out the connection to the electric supply network considering the system voltage and the maximum power consumption!
- The system voltage has to be in conformity with the system voltage indicated on the nameplate!
- There has to be a corresponding electrical protection by a fuse on the network side!

**DANGER****Electrostatic processes**

Electrostatic charging may injure persons by an electric shock.

- Allow only a qualified electrician to install the equipment into which the turbo coupling is installed.
- Machine and electric installation are provided with grounding connections.

**Overspeed:****NOTICE****Damage to property**

Non-recognition of overspeed, wrong direction of rotation or parameters outside the tolerance due to incorrect programming, may destroy the turbo coupling.

- Check whether the entire system is equipped with a device which safely prevents overspeed (for example brake or backstop).
- For rated speed, → cover sheet.

This refers only to installations where overspeed (exceeding the rated speed) is possible.

**Extreme ambient temperatures:**

Ambient  
temperature  
→ Chapter 2



**WARNING**

**Risk of personal injuries and damage to property**

Extreme ambient temperatures may result in thermal overload of the turbo coupling, thus causing the fusible plugs to melt and seriously injure any persons in their immediate surroundings, and to cause damage to the turbo coupling.

- Observe the permissible ambient temperature.

Only when water is  
used as operating  
fluid

**NOTICE**

**Damage to property**

The turbo coupling may be damaged by frozen operating fluid.

- The ambient temperature must be above the freezing point of the operating fluid.
- Adhere to the temperature limits indicated (→ Chapter 5.8).

**Operating fluid which sprays off or leaks out:**



**WARNING**

**Risk of losing sight due to operating fluid spraying off, risk of burning**

In case of thermal overload of the turbo coupling, the fusible plugs respond. Operating fluid leaks out through these fusible plugs.

- Persons close to the turbo coupling must wear safety goggles.
- Please make sure that the spraying-off operating fluid cannot get in contact with persons.
- If the fusible plugs spray off, switch off the drive immediately.
- Electrical devices located near the coupling need to be splash-guarded.

**WARNING****Fire hazard**

After the fusible plugs responded, spraying off oil may ignite on hot surfaces causing fire, as well as releasing toxic gases and vapor.

- Make sure that spraying off operating fluid cannot get into contact with hot machine parts, heaters, sparks or open flames.
- Immediately switch off the driving machine when the fusible plugs respond.
- Please pay attention to the information contained in the safety data sheets.

**CAUTION****Danger of slipping**

Slipping hazard due to spraying off solder of fusible plugs and leaking out operating fluid.

- Please provide a catch pan of sufficient size.
- Immediately remove any leaking out solder and operating fluid.
- Please pay attention to the information contained in the safety data sheets.

**Checking the methane content before working on the turbo coupling:****WARNING****Explosion hazard**

For turbo couplings with housings made of aluminum alloys and when the protective cover was removed, if the permissible methane content is exceeded, there is the risk of explosion.

- Before and during all work performed on the turbo coupling, check the methane content around the turbo coupling.
- Should this permissible limit value be exceeded, the work has to be stopped until the value is again below the limit value.



**Permissible limit  
values according to  
local regulations**

## 5.6 Remaining risks



### WARNING

#### **Risk of personal injuries and damage to property**

Unintended use or incorrect operation may cause death, serious injuries or minor injuries as well as damage to property and the environment.

- Only persons who are sufficiently qualified, trained and authorized are allowed to work on or with the turbo coupling.
- Please observe the warnings and safety information.

## 5.7 What to do in case of accidents

### SAFETY INFORMATION

- In case of accidents, please observe the local regulations, the operating manuals and the operator's safety measures.

## 5.8 Information with regard to operation

### SAFETY INFORMATION

- If irregularities are found during operation, immediately switch off the drive unit.

### **Power transmission:**

The cover sheet of this manual indicates the possible power transmission at a specific input speed and a specific coupling filling (operating fluid and quantity).

These values describe a permissible working point for the stationary operation of the turbo coupling.

### NOTICE

#### **Damage to property**

Deviations from the permissible working point cause damage the turbo coupling.

- Voith Turbo's approval is required for a stationary operation of the turbo coupling at a different working point.

### **Operating fluid:**

**NOTICE****Damage to property**

Too little filling results in thermal overload of the turbo coupling, and in case of too much filling, the turbo coupling may be damaged by internal pressure.

- Operate the turbo coupling only with the filling quantity stated on the cover sheet of this manual.
- Use only the operating fluid indicated on the cover sheet of this manual.

**Heating up during start-up:****NOTICE****Damage to property**

During start-up, the turbo coupling heats up more than during stationary operation due to the increased slip.

- Please provide sufficient intervals between start-ups to avoid thermal overload.

**Starting characteristic of turbo couplings with delay chamber:**

On start-up, the operating fluid flows from the delay chamber into the turbo coupling working chamber. On standstill, the operating fluid returns into the delay chamber. Please provide sufficient intervals (a few minutes) between the starts to get a correct starting characteristic.

### Coupling temperature:



#### **WARNING**

##### **Explosion hazard**

Explosion hazard due to high temperature of turbo coupling.

- Make sure that the air surrounding the turbo coupling does not exceed the permissible value.

Technical data:  
→ Chapter 2 and  
ordering documents

#### **NOTICE**

##### **Damage to property**

The turbo coupling may be damaged due to falling below the permissible ambient temperature.

- Please consult Voith Turbo if the turbo coupling shall be used
  - in case of risk of frost when water is used as operating fluid
  - at ambient temperatures below -25 °C when oil is used as operating fluid.

#### **NOTICE**

##### **Damage to property**

Overheating (nominal temperature is exceeded) may damage the turbo coupling.

- Provide sufficient ventilation / aeration of the turbo coupling.

### Fusible plugs:

The fusible plugs protect the turbo coupling against damage due to thermal overload.

Technical Data  
→ Chapter 2

#### **NOTICE**

##### **Damage to property**

The turbo coupling will be damaged if operation is continued after a fusible plug responded.

- Switch off the drive motor immediately on response of one of the fusible plugs!
- Use original fusible plugs only with the response temperature indicated on the → cover sheet of this operating manual.



**Monitoring devices:****NOTICE****Damage to property**

Damage to turbo coupling due to monitoring devices not ready for service.

- Check whether existing monitoring devices are in a state ready for service.
- Repair any defective monitoring device immediately.
- Never bypass safety devices.

**Monitoring devices**  
→ Chapter 19

**Blocking:****NOTICE****Damage to property**

Blocking of the driven machine may cause overheating of the turbo coupling and response of the fusible plugs thus endangering persons as well as the turbo coupling and environment.

- Immediately switch off the driving machine.

**Overload of turbo coupling:**

After the thermal fuse responded, switch off the power supply after the time required in → Chapter 2 at the latest.

In case of multi-motor drive, switch off the whole system!

If an additional monitoring of the overload is required, monitor the output speed.

If the output speed falls below the input speed by more than 10%, immediately switch off the power supply.

It is necessary to switch off the power supply as otherwise the permissible surface temperature indicated cannot be met.

**Permissible surface temperature,**  
→ Chapter 2

**NOTICE****Overload of turbo coupling**

The turbo coupling will be overloaded in cases where

- the driven machine blocks
- the driven machine is loaded excessively during nominal operation and/or during start-up.

Please consult Voith Turbo in case of unforeseeable turbo coupling overload.

## 5.9 Qualification of staff

Only qualified and authorized professional staff are allowed to perform work, such as transportation, storage, installation, electrical connection, commissioning, operation, maintenance, servicing and repair.

Qualified professional staff in the sense of this installation and operating manual are persons who are familiar with transportation, storage, installation, electrical connection, commissioning, maintenance, service and repair, and who have the necessary qualifications for their job. Qualification has to be ensured by performing training and giving instructions on the turbo coupling.

This staff must be trained, instructed and authorized to:

- operate and service machines in a professional manner in accordance with the technical safety standards.
- use lifting appliances, slings (ropes, chains, etc.) and lifting points in a professional manner.
- properly dispose of media and their components, e.g. lubricating grease.
- service and use safety devices in a manner that ensures compliance with safety standards.
- prevent accidents and provide first aid.

Staff to be trained may only perform work on the turbo coupling under the supervision of a qualified and authorized person.

The staff in charge of any work to be done on the coupling must

- be reliable,
- have the legal age,
- be trained, instructed and authorized with regard to the intended work.

## 5.10 Product monitoring

We are under legal obligation to keep the performance of our products under observation, even after shipment.

Therefore, please inform us about anything that might be of interest to us. For example:

- Change in operating data,
- experience gained with the machine,
- recurring problems,
- problems experienced with this installation and operating manual.

Our address,  
→ Page 2

## 6 Transport and Storage

### 6.1 As delivered condition

- The turbo coupling is delivered completely, with mounted pulley (if included in the scope of supply).
- The turbo coupling is not filled. If the scope of supply includes the operating fluid, it will be delivered in a separate container.
- Other accessories will be supplied as loose parts.

**Packing**  
→ Chapter 6.5

### 6.2 Scope of supply

The turbo coupling will be supplied as indicated on the cover sheet.

Additional parts belonging to the scope of supply, such as connecting coupling, fusible plugs, temperature monitoring, mounting and removal device, etc. will be stated in the order confirmation.

### 6.3 Transport



#### WARNING

##### Explosion hazard

For turbo couplings with housings made of aluminum alloys, there can be the risk of explosion when being transported in / through explosive atmospheres.

- In potentially explosive atmospheres it is only allowed to transport the turbo coupling in suitable packing.
- This transport packing has to meet the same minimum requirements as the protective cover.



**Protective cover**  
→ Chapter 11



#### WARNING

##### Risk of injury

Falling parts may seriously injure or kill you.

- Secure the turbo coupling sufficiently.
- Pay attention to the center of gravity position.
- Use the provided lifting points.
- Use appropriate transportation means and slings (ropes, chains, etc.).



### WARNING

#### Risk of crushing

Incorrect handling of the turbo coupling may cause bruising of upper and lower limbs and seriously injure persons.

- Skilled staff only is allowed to carry out transportation!

## 6.4 Lifting

### Lifting appliances, load carrying attachments, lifting points

Weight of turbo coupling  
→ cover sheet.  
Weights of over 100 kg will be stamped on the turbo coupling.

Observe the turbo coupling weight!

Lifting appliances (e.g. crane, high-lift truck), slings (ropes, chains, etc.) and lifting points (swivels, thread size as for item 0960, → Chapter 7.3) need to be

- checked and approved,
- sufficiently dimensioned and in sound condition,
- and may only be operated by authorized and trained persons.

It is not allowed to use eyebolts!

Read the operating instructions for lifting appliances, slings (ropes, chains, etc.) and lifting points!



### WARNING

#### Risk of injury

Damaged load carrying attachments or those with insufficient carrying capacity may break under load, with the consequence of serious or even fatal injuries!

- Check the lifting appliances and load carrying attachments for
  - sufficient carrying capacity (for weight, → cover sheet).
  - sound condition.

### Fixing the turbo coupling



### WARNING

#### Risk of injury

Falling parts may seriously injure or kill you.

- Do not walk under suspended loads.

**NOTICE****Personal injury and damage to property**

Improper fixing and lifting of the turbo coupling may cause personal injury and damage to property

- It is only allowed to lift the turbo coupling at the lifting points provided for this purpose (see the following pictures).
  - When fastening and lifting the turbo coupling, do not damage the ribbing of the turbo coupling through lifting appliances or load carrying attachments.
  - Damaged ribs may result in unbalance of the turbo coupling, thus causing uneven running of the machine.
- 
- Screw suitable swivels (thread size as for item 0960, → Chapter 7.3) into the turbo coupling.  
Do not unscrew existing screws for this purpose; please use the threads provided.
  - Fix the slings (ropes, chains, etc.).



Fig. 5



## WARNING

### Risk of injury

Danger to life and risk of injury caused by falling load, tilting or sliding of the turbo coupling.

- Always use at least 2 slings (ropes, chains, etc.) for fixing.
- Do not walk under suspended loads.
- Observe the general guidelines for the prevention of accidents.
- Secure the turbo coupling against tilting and sliding as long as it is not mounted between the driving and driven machine.

### Turning the turbo coupling

- Screw suitable swivels (thread size as for item 0960, → Chapter 7.3) into the turbo coupling.  
Do not unscrew existing screws for this purpose; please use the threads provided.
- Fix the slings (ropes, chains, etc.).



Fig. 6



**WARNING****Risk of crushing**

Incorrect handling of the turbo coupling may cause bruising of upper and lower limbs and seriously injure persons.

- Always use at least 2 slings (ropes, chains, etc.) for fixing.
  - For turning, please use 2 slings (ropes, chains, etc.) on each side.
- 
- On the opposite side, screw suitable swivels (thread size as for item 0960, → Chapter 7.3) into the turbo coupling.  
Do not unscrew existing screws for this purpose; please use the threads provided.
  - Fix the turbo coupling to the second slings.

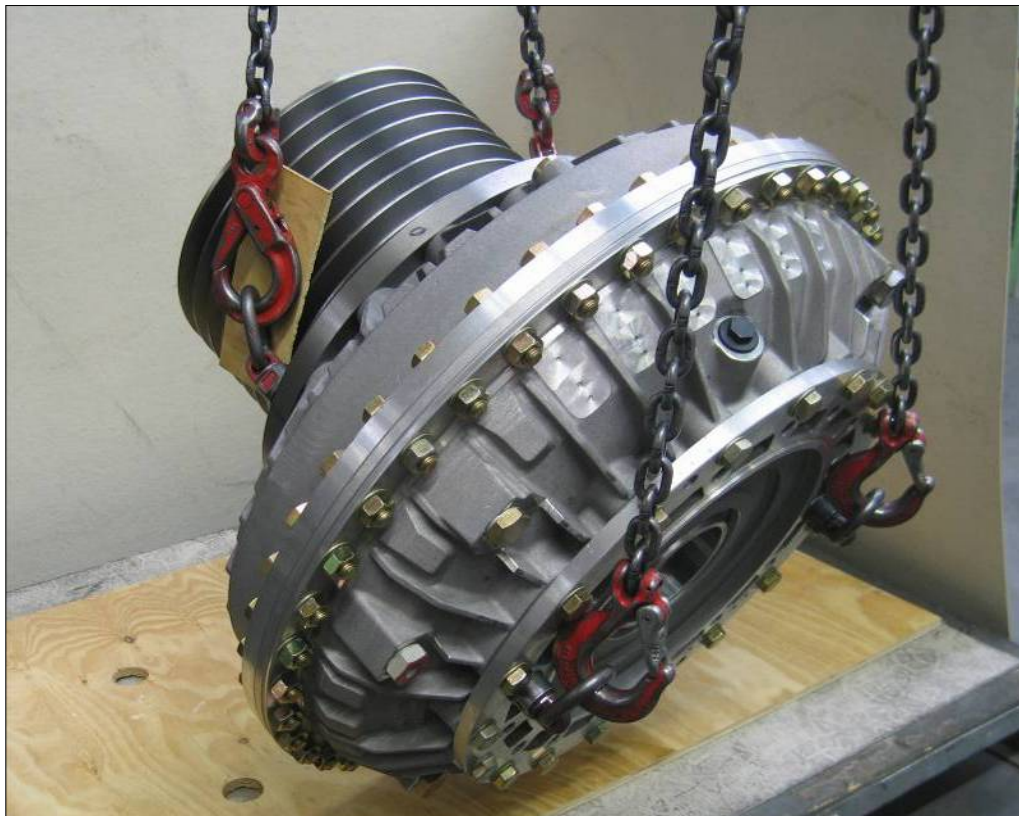


Fig. 7

- Align the turbo coupling horizontally using the two lifting appliances.



Fig. 8

- Carefully set the turbo coupling down on a wooden board / pallet, and secure it against tilting.  
The turbo coupling has been turned.



## 6.5 Storage / Packing / Preservation

→ Annex (see the preservation and packaging instructions)

### Disposal of the packaging

Dispose of packaging material according to the local regulations.

Notes on disposal  
→ Chapter 16

### NOTICE

#### Damage to property

Danger of frost

- In case of risk of frost, it is mandatory to drain the water of "TW" type turbo couplings.

## 7 Tightening Torques

### NOTICE

#### Damage to property

The turbo coupling may be damaged by incorrectly tightened screws.

- Tighten all screws using a torque-adjustable torque wrench!

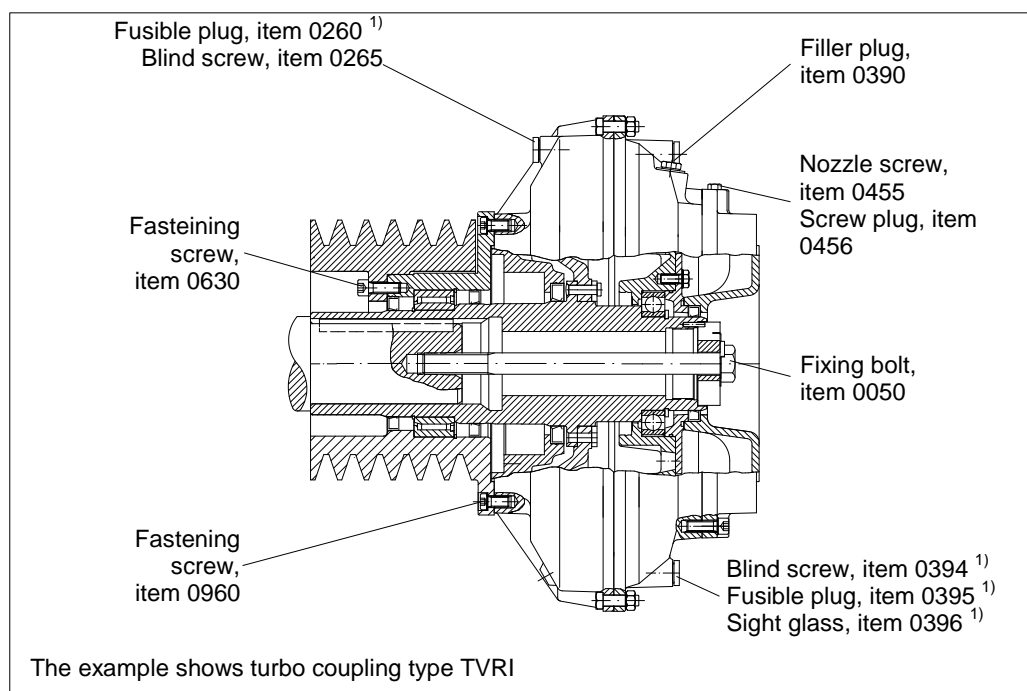


Fig. 9

- 1) For arrangement and quantity, → Chapter 22 and/or assembly plan

## 7.1 Fixing bolts

	Tightening torque in Nm						
Thread	M8	M10	M12	M16	M20	M24	M30
Fixing bolt, item 0050	23	46	80	195	380	660	1350

Table 4

The tightening torques for fixing bolts apply to screws with property class 8.8 or higher, oil-moistened and relevant shaft journal material.

## 7.2 Fusible plugs, filler plugs, sight glasses, blind- and nozzle screws

	Tightening torque in Nm (dimension of thread)				
Coupling size	Fusible plug, Item 0260 item 0395	Filler plug, Item 0390	Blind screw, item 0265, item 0394	Sight glass, item 0396	Nozzle screw, item 0455, Screw plug, item 0456
154	8 (M8)	13 (M10)	8 (M8)	-	-
206	13 (M10)	20 (M12x1.5)	13 (M10)	-	-
274	13 (M10)	30 (M14x1.5)	13 (M10)	-	-
366 to 562	50 (M18x1.5)	80 (M24x1.5)	50 (M18x1.5)	50 (M18x1.5)	48 (M16x1.5)
650	144 (M24x1.5)	80 (M24x1.5)	144 (M24x1.5)	144 (M24x1.5)	48 (M16x1.5)

Table 5

### 7.3 Fastening screws

Coupling size and type	Tightening torque in Nm (dimension of thread)	
	Hex. screw / socket head screw, Item 0630	Hex. screw / socket head screw, Item 0960
<b>154 T</b>	-	-
<b>206 T</b>	23 (M8)	18 (M8)
<b>274 T</b>	23 (M8)	62 (M12)
<b>274 DT</b>	46 (M10)	62 (M12)
<b>366 T</b>	46 (M10)	62 (M12)
<b>422 T</b>	46 (M10)	62 (M12)
<b>487 T</b>	80 (M12)	62 (M12)
<b>562 T</b>	80 (M12)	62 (M12)
<b>650 T</b>	195 (M16)	152 (M16)

Table 6

Screws with property class 8.8 or higher are used.

## 8 Installation and Alignment



### WARNING

#### Risk of injury

Please observe, in particular, → Chapter 5 (Safety) when working on the turbo coupling!

### 8.1 Tools



### WARNING

#### Explosion hazard

There is the risk of explosion when using unsuitable tools.

- When using or assembling an Ex-coupling, use only tools approved for application in potentially explosive atmospheres.
- Observe the locally applicable regulations.
- Avoid formation of sparks.



The following tools are required; check in detail with the assembly plan.

#### Tools:

Set of open-end wrenches  
Set of ring spanners  
Socket wrench box (containing hexagon spanners, ratchet, etc.)  
Set of Allan keys  
Screwdrivers  
Torque wrenches  
Hammer, rubber mallet  
Set of files  
Wire brush

Dimension of thread  
→ Chapter 7

#### Measuring equipment:

Caliper gauge  
External screw-type micrometer according to shaft diameter  
Inside micrometer according to hub diameter

#### Mounting auxiliaries:

Auxiliaries for alignment of motor and gearbox (fastening screws), e.g. shims for motor and gearbox feet (0.1 - 0.3 - 0.5 - 1.0 - 3.0 mm).  
Grinding cloth, graining 100, 240.

Swivel sizes  
→ Chapter 7.3,  
Item 0960

### Lifting appliances and load carrying attachments:

Crane.

Two shackles with appropriate slings (ropes, chains, etc.) for lifting the coupling.

Observe the pictures → 8.3.1!

Adjustable chains or ropes with sufficient tensile strength (see individual weights).

## 8.2 Preparation

Weight of turbo  
coupling  
→ Cover sheet  
Weights of more  
than 100 kg are  
stamped on the  
turbo coupling.

- Prepare suitable tools and lifting appliances.
- Observe the turbo coupling weight.
- Check the shaft journals of drive motor and driven machine for true radial running.
- Check the length of fixing bolt if the length of the shaft journal, on which the turbo coupling is mounted, was changed or not indicated to Voith Turbo.
- Clean fitting surfaces on shaft journals and hubs using emery cloth.
- Degrease flanges which will be bolted.
- Clean all preserved surfaces.
- Slightly oil the threads of bolts.
- Apply a thin film of lubricant to the shaft journals.

### SAFETY INFORMATION

Use a lubricant with the following characteristics:

- Operating temperature range: -20 °C...180 °C
- Water- and wash-out-resistant
- Protection against fretting corrosion and corrosion

### Proposed lubricants:

Producer	Designation	Note
Dow Corning	Molykote G-N Plus Paste Molykote G-Rapid Plus Paste Molykote TP 42	
Fuchs	Gleitmo 815	
Liqui Moly	LM 48 Montagepaste	
Dow Corning	Molykote D 321 R Anti-Friction Coating	<b>Hazardous substance!</b> Observe the data sheet for hazardous substances!
Castrol Optimol	Molub-Alloy Paste White T Molub-Alloy Paste MP 3	

Table 7

## 8.2.1 Keys

### Requirement

Keys must

- have sufficient back clearance,
- be axially fixed and
- move easily in the grooves.

### Marking

When using a shaft-hub connection with key, the hub is marked with the key convention at the face side

- H: Half-key convention,
- F: Full-key convention.

This mark should comply with the mark on the shaft.

### Inserting keys

#### SAFETY INFORMATION

Remove the key to avoid an unbalance in case of a shaft-hub connection with:

- one key
- balancing according to half-key convention
- and if the key is longer than the hub.

- For coupling hubs with a key or half-key convention, a compensation groove can be provided opposite for balancing of unbalance.
- For coupling hubs with a key and full-key convention, an identical compensation groove is provided opposite for balancing of unbalance.
- Clean the keyway.
- Insert the key straight into the keyway.
- Do not cant the key.
- If necessary, secure the inserted key against falling out.

## 8.3 Turbo coupling installation

### Inner wheel drive:

The turbo coupling is mounted on the drive motor shaft, and then the turbo coupling pulley is coupled through belts with the pulley of the driven machine.

### Outer wheel drive (special case):

The turbo coupling is mounted on the driven machine shaft, and then the turbo coupling pulley is coupled through belts with the pulley of the drive motor.

### 8.3.1 Mounting

Qualification  
→ Chapter 5.9



#### WARNING

##### Risk of crushing, injuries by cuts

During mounting and assembly, manual turning and positioning the turbo coupling, persons could bruise fingers or cut themselves on sharp edges thus getting seriously injured!

- Sufficiently qualified, instructed and authorized persons only are allowed to mount the turbo coupling!
- Proceed carefully.

#### NOTICE

##### Damage to property

The use of unsuitable working means or methods may cause damage to property.

- Only use tools suitable for mounting:
  - Mounting and removal device (from coupling size 274) available as accessory (→ Chapter 8.3.2)
- For mounting, **do not** use:
  - hammers
  - welding torches
  - pressure plates



**SAFETY INFORMATION****Record the mounting process**

For use in areas with potentially explosive atmosphere, it is mandatory to record the mounting process of the turbo coupling.

We recommend recording the process also for all other applications.

- For required records, → Chapter 14.

For turbo couplings using water as operating fluid, the hub bore is provided with a solid film lubricant. The lubricant must not be removed!

**For operating fluid  
'water' only**

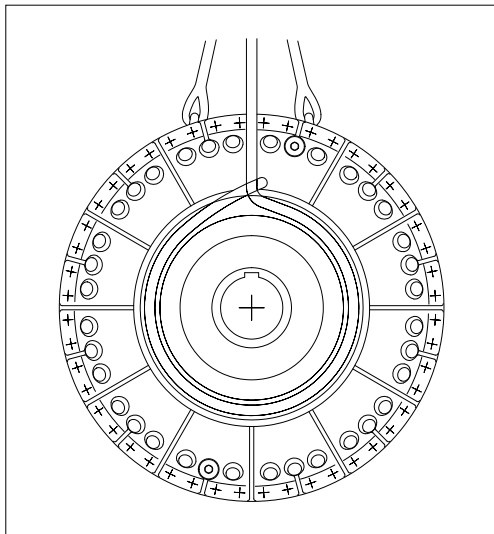


Fig. 10

- Fix the turbo coupling to a suitable lifting appliance.

**WARNING****Risk of burning**

The surface is hot due to getting warm.

- Do not touch the hub.

- Warm up carefully the hub to approx. 80 °C (facilitates mounting).
- Mount the turbo coupling on the relevant shaft journal.
- Insert the supplied holding disk:
  - For couplings **up to size 274** remove the circlip (item 0046) before inserting the holding disk, and then re-insert it.
  - For couplings **from size 366**, secure the holding disk against twisting by means of a roll pin (item 0070).
- Depending on the design of the shaft, ensure that the coupling hub is in contact with the shaft collar or the end face of shaft journal.

#### Coupling sizes 154 and 206:

- Insert a suitable and slightly oiled threaded rod in the shaft of the relevant machine.
- Mount the coupling on the shaft journal using a nut and a spacer tube.

Mounting device  
→ Chapter 8.3.2

#### Coupling size 274 to 650:

- Slightly oil the mounting spindle.
- Mount the coupling on the shaft journal using the mounting spindle, the spacer tube and the holding disk.

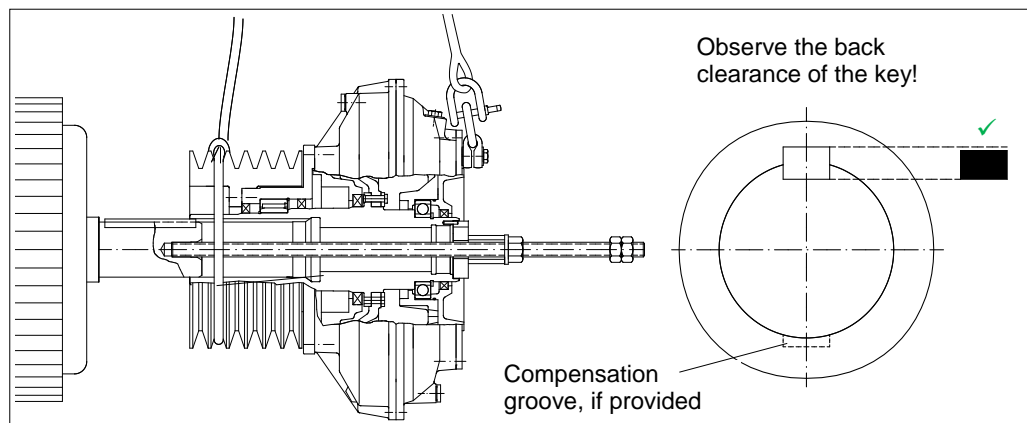


Fig. 11

Tightening torque  
→ Chapter 7.1

- Check the holding disk for proper seat.
- Put the locking plate and/or lock washer underneath the fixing bolt and tighten with the specified tightening torque.
- Secure the fixing bolt with the locking plate, if necessary.

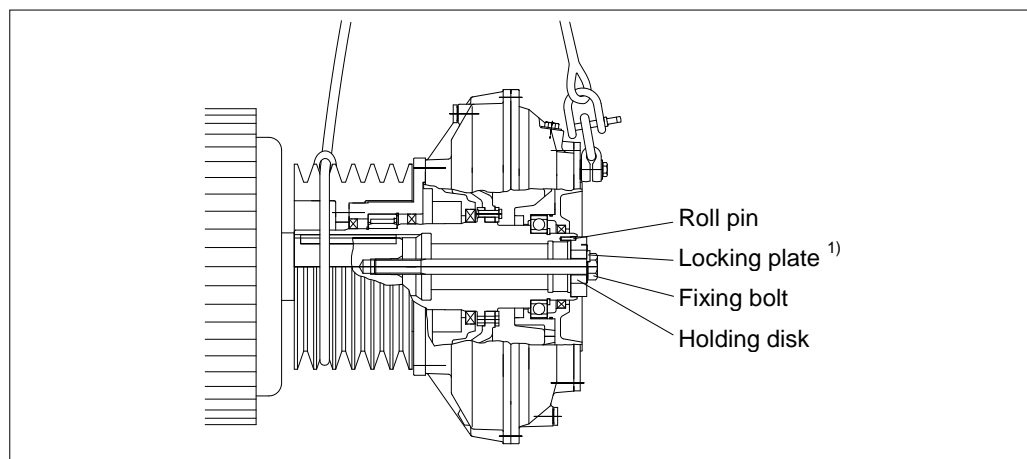


Fig. 12

- 1) Lock washer up to coupling size 274

### 8.3.2 Mounting device

Mounting device for basic type TR or TRI turbo couplings is available at Voith Turbo.

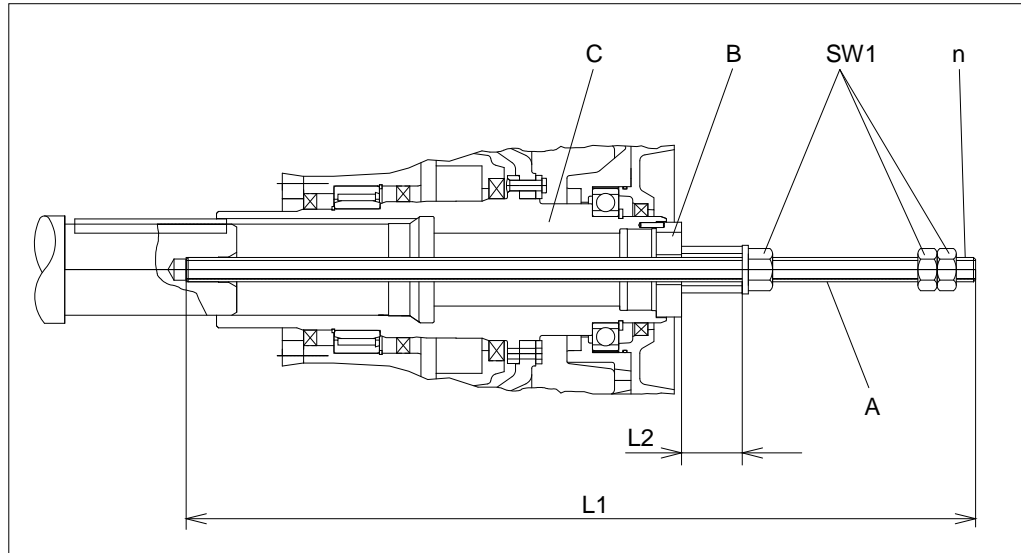


Fig. 13

- |    |                       |      |                                      |
|----|-----------------------|------|--------------------------------------|
| A: | Mounting spindle      | L1:  | Total length                         |
| B: | Original holding disk | L2:  | Length of spacer tube                |
| C: | Coupling hub          | n:   | Dimension of mounting spindle thread |
|    |                       | SW1: | Width across flats                   |

Coupling size	L1 in mm	L2 in mm	n	SW1 in mm	Article No. of mounting spindle	Article No. of spacer tube
274	520	135	M10	17	TCR.10659840	TCR.10659880
			M12	19	TCR.10659850	TCR.10659890
			M16	24	TCR.10659860	TCR.10659900
			M20	30	TCR.10659870	TCR.10659910
366, 422, 487	780	190	M16	24	TCR.11110620	TCR.11054200
			M20	30	TCR.10457720	TCR.11054210
			M24	36	TCR.10457730	TCR.10457920
			M30	46	TCR.10457740	TCR.11110770
562, 650	1150	245	M20	30	TCR.11110630	TCR.10457860
			M24	36	TCR.11110640	TCR.10457870
			M30	46	TCR.11071880	TCR.10457880

Table 8

## 8.4 Mounting of belts and belt tension

- Correct dimensioning of the belt drive depends on a number of factors and environmental conditions. Please observe the system and belt manufacturer's instructions!
- Please observe the system and belt manufacturer's instructions regarding mounting of belts and adjustment of belt tension.
- Belts must neither slip on startup nor during continuous operation.
- The pulleys must be in alignment during operation. Pulleys which are not in alignment may reduce the lifetime of the belts.
- Replace belts in sets.

### NOTICE

#### Damage to property

For turbo couplings with pulleys that have no bearings (type "TR"), please observe the radial load acting on the coupling caused by the belt tension.

- It is vital to consult Voith Turbo to determine the effective diameter of the pulley as it depends on the power and speed.

- Clean the pulley grooves. The grooves must be free from burrs, grease and other impurities.
- Check the alignment of the pulleys.
- Adjust the center distance of the pulleys so that the belts can be mounted without exerting any excessive force.
- Put the belts individually on the pulleys.
- Pretension the belts properly (→ Chapter 8.4.1).
- Check the alignment of the pulleys (→ Chapter 8.5).
- Operate the system for some time, and pay attention to irregularities (noise, vibrations, excessive heating of belts, etc.).
- Then check the pretension of the belts.

Commissioning  
→ Chapter 11

### 8.4.1 Permissible radial force

Permissible radial force  $F_r$  caused by the belt drive as a function of the lever arm  $h$ .

Basis: nominal lifetime  $L_{10h} = 25000$  h.

When the radial force indicated in the following diagrams is reduced by approx. 20%, the bearing lifetime increases to  $L_{10h} = 50000$  h.

**SAFETY INFORMATION**

The permissible radial force only applies to the turbo coupling. Reaction forces on adjacent components have to be regarded separately.

The lever arm  $h$  is defined as distance between the connection of bearing cover / pulley and the load application point in the (V-belt) pulley center; see the following illustration.

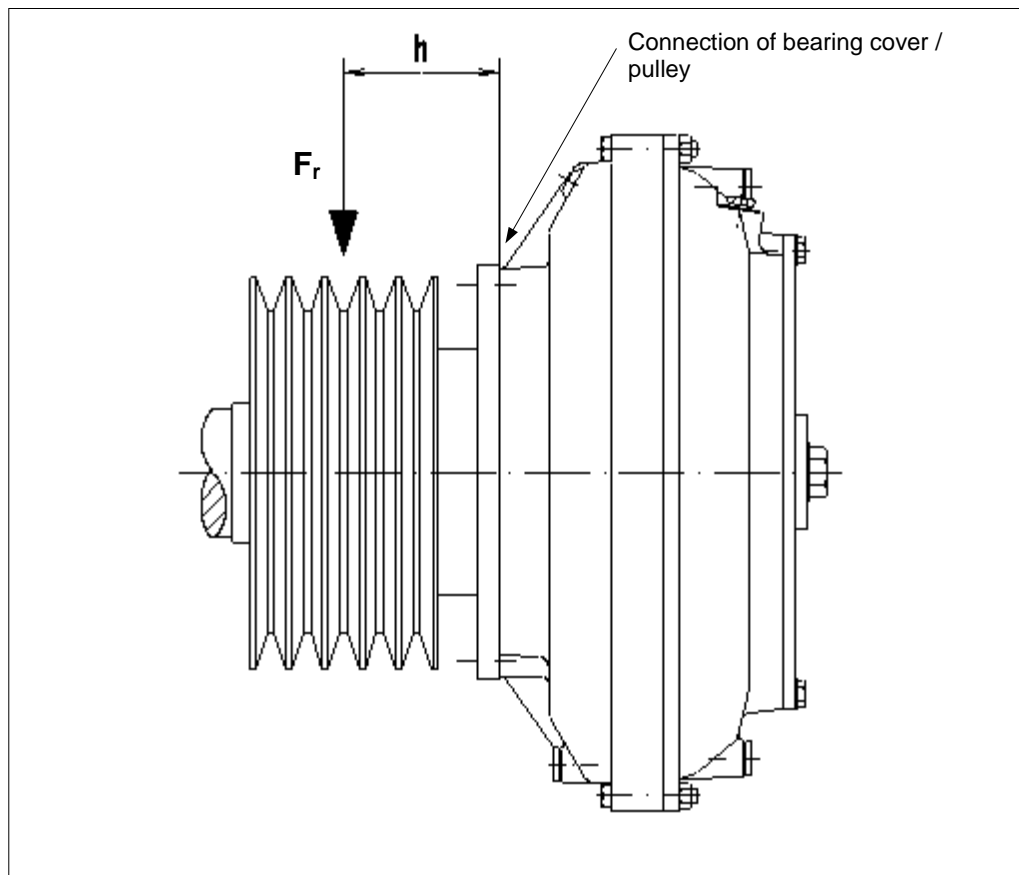


Fig. 14

**NOTICE****Damage to property**

If the belt pull of the system is higher than the permissible radial forces (→ diagrams):

- Please consult Voith Turbo.

### Diagram for TR..., DTR... couplings

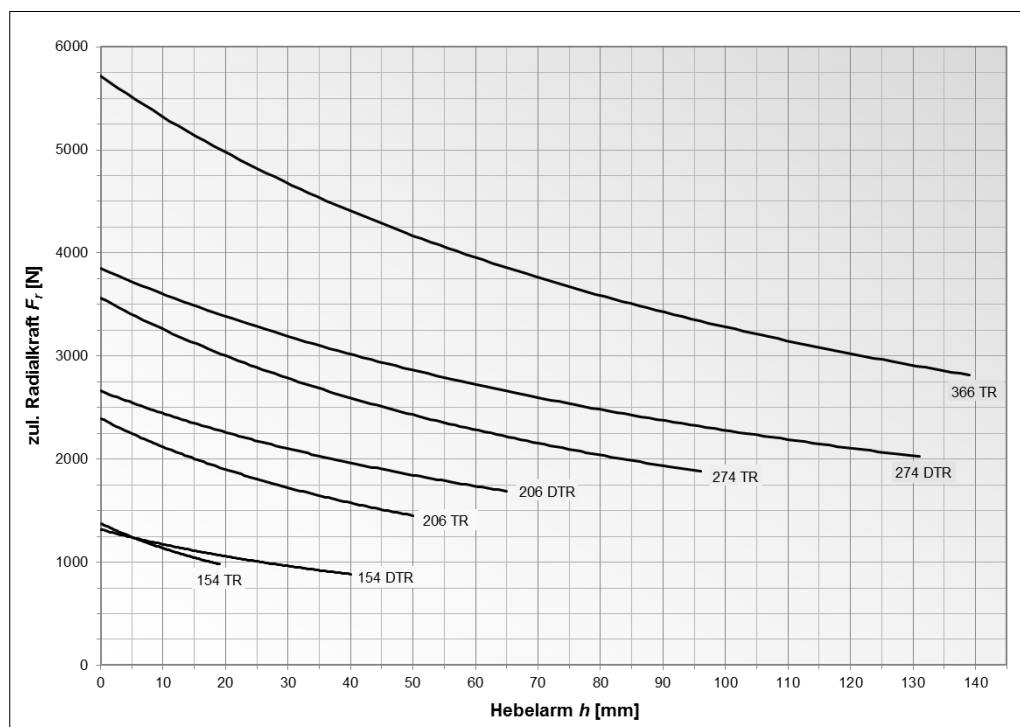


Fig. 15

### Diagram for TRI..., DTRI... couplings

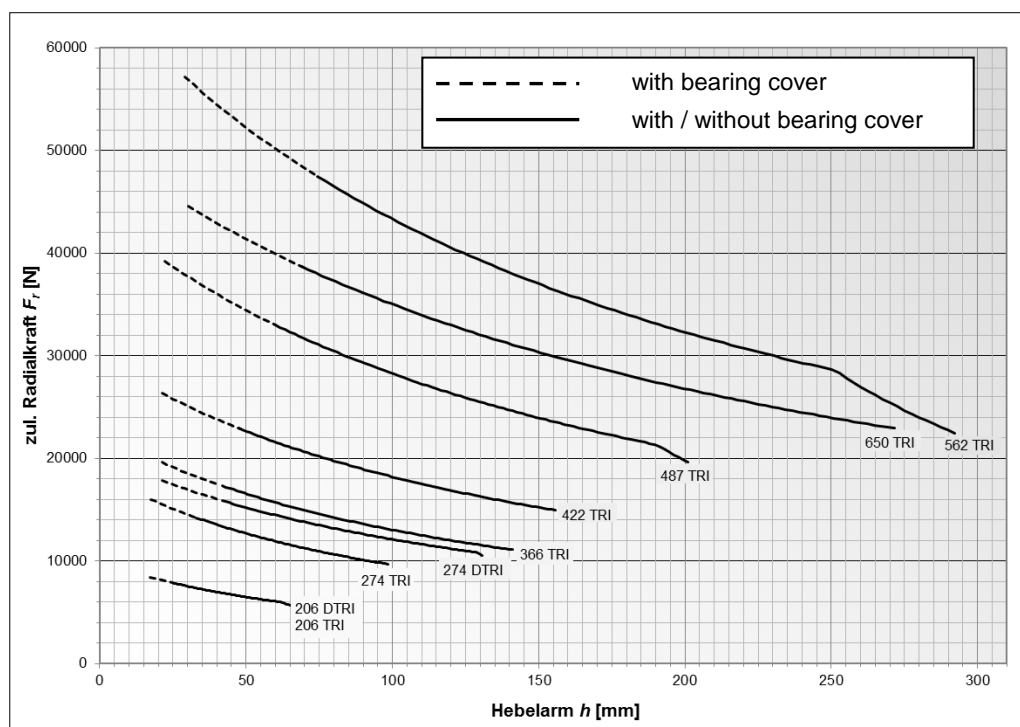


Fig. 16

## 8.5 Alignment

### 8.5.1 Alignment tolerances



#### WARNING

##### Explosion hazard

Explosion hazard due to damage to the material caused by excessive misalignments.

- Please observe the system and belt manufacturer's instructions!
- Pulleys which are not in alignment may reduce the lifetime of the system and the belts.
- In particular, observe any displacements due to changes in temperature.



#### NOTICE

##### Misalignments

The smaller the radial and angular displacement between turbo coupling and shaft journal

- the higher the lifetime and reliability of the machine.
- the smoother the operation.

### 8.5.2 Alignment

For alignment, support the motor feet using shims or foil sheets.

It is advantageous to use claws for the adjusting screws on the foundation for lateral movement of the drive unit.

- Mount the turbo coupling.
- Align the input and output shafts with each other. The pulleys must be in alignment.
- Securely fix the motor and gearbox (input and output unit) to the foundation.  
**Stability depends on the whole unit and has to be guaranteed!**
- Tighten all screws.
- Check the alignment, and correct, if necessary.
- Fill in the assembly check report.

Protocols/reports  
→ Chapter 14

## 9 Operating Fluids

→ Annex (see operating fluids for Voith turbo couplings)



### WARNING

#### Risk of injury

Hot operating fluid could spray off from defective components or fusible plugs, seriously injuring persons!

- Maintain the turbo coupling regularly!
- Experts only are allowed to work on the turbo coupling!

### NOTICE

#### Damage to property

Use only the operating fluid for the turbo coupling which is indicated on the cover sheet!

- Unsuitable operating fluids may damage the turbo coupling permanently!
- Consult Voith Turbo if you want to use an operating fluid not mentioned.

### NOTICE

#### Environmental pollution

Operating fluids are detrimental to health and may pollute the environment.

- Dispose of used operating fluid via an authorized collecting station in accordance with the national statutory provisions.
- Make sure that no operating fluid gets into the ground or water!



## SAFETY INFORMATION

The values mentioned for the pour point, flash and fire point are approximate values and data originating from the oil suppliers. These may vary and Voith Turbo does not assume any warranty!

Country-specific production of the basic oil may result in different values.

- We recommend comparing the data with our specifications at any rate.
- In case of deviations, we urgently recommend consulting the respective oil producer.

## 9.1 Requirements to be fulfilled by the operating fluid 'water'

Requirement to	
Sealing compatibility	NBR (Nitril-Butadien caoutchouc)
ph value	5...8

The water used should

- to the greatest possible extent, be free from solid matters,
- contain only a low amount of salt,
- contain only a low concentration of other additives.

### 9.1.1 Usable operating fluids

Normally, drinking water satisfies these requirements.

## 10 Filling, Filling Check and Draining

The quantity and type of operating fluid used substantially determines the performance of the turbo coupling.

- A too high quantity stresses the drive motor more on start-up and results in a higher stall torque.
- A too low quantity thermally loads the turbo coupling more and results in a lower stall torque.



### WARNING

#### Risk of burning

The turbo coupling gets warm during operation.

- Please observe, in particular, → Chapter 5 (Safety) when working on the turbo coupling!
- Start to work on the turbo coupling only after it has cooled down.



### CAUTION

#### Danger to health

Operating fluids may cause irritations or inflammation if coming into contact with skin and mucous membranes.

- Please pay attention to the information contained in the safety data sheets.
- Please always wear safety goggles when working with the operating fluid!
- Should you get any operating fluid in your eyes, rinse them immediately using plenty of water and consult a physician without delay!
- After finishing work, carefully clean your hands with soap.

Impurities in the operating fluid cause higher wear on the coupling as well as damages to bearings so that explosion protection can no longer be guaranteed.



- Make sure that any containers, funnels, filling tubes, etc. used for filling the coupling, are clean.

### NOTICE

#### Damage to property

Non-compliance with specifications.

- Observe the quantity to be filled in that is indicated on the cover sheet of this operating manual.
- An overfilling is not permitted! This would lead to an undue high internal pressure in the coupling, which may destroy the coupling.
- An underfilling is not permitted! This will result in an improper operation of the coupling.
- Do not mix different types of operating fluids.
- Use only the operating fluid indicated on the cover sheet of this manual.
- Ensure that the original sealing rings used are in sound condition.

## 10.1 Filling the turbo coupling

TurboGuide  
→ <https://turbo-guide.voith.com>

### SAFETY INFORMATION

Turbo couplings are shipped unfilled.

- If operating fluid is included in the scope of supply, it is shipped in a separate container.

### 10.1.1 How to fill turbo couplings installed in horizontal position, inclination $\leq 30^\circ$

- Turbo couplings of sizes 154 – 274:  
Turn the turbo coupling until the filler plug (item 0390) is on top.
- Turbo couplings of sizes 366 – 650:  
Turn the turbo coupling until the filler plug (item 0390) that is closest to the sight glass (item 0396) is on top.
- Remove the filler plug (item 0390).
- Remove the top fusible plug for pressure compensation.

**Operating fluid and filling volume**  
→ Cover sheet

- Fill in the specified quantity of operating fluid (→ Chapter 9) through a fine strainer
  - mesh size  $\leq 25 \mu\text{m}$  for turbo couplings using oil and operating medium (type T...)
  - mesh size  $\leq 50 \mu\text{m}$  for turbo couplings using water as operating medium (type TW...)
- via the opening in the filler plug (item 0390).

**Tightening torques**  
→ Chapter 7.2

- Tighten the filler plug (item 0390).
- If the coupling is provided with a sight glass (item 0396), tighten the fusible plug.

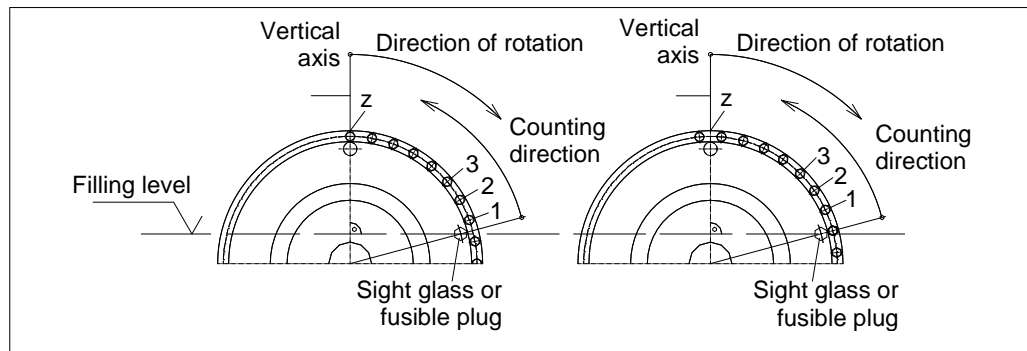


Fig. 17

z = \_\_\_\_\_

**Assembly check report**  
→ Chapter 14.1 or cover sheet

**Tightening torques**  
→ Chapter 7.2

- Turn the turbo coupling until the operating fluid is just visible on the sight glass (if existing) or until the operating fluid can be seen on the (still) removed fusible plug, but is not yet leaking out.
- Determine the **number z** of the flange screws from the sight glass or fusible plug to the vertical axis. The first screw is the one which center line is in counting direction, **after** the intersection line through the sight glass or the fusible plug.
- For later filling level checks, record the **number z** of screws determined. In addition, mark the turbo coupling or the protective cover.
- Tighten the fusible plug.
- Check the coupling for leaks during a test run (with protective cover!).

### 10.1.2 How to fill turbo couplings installed in vertical position, inclination > 30°

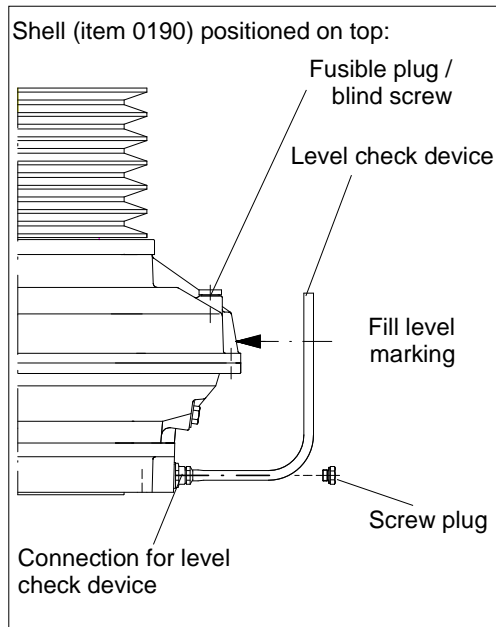


Fig. 18

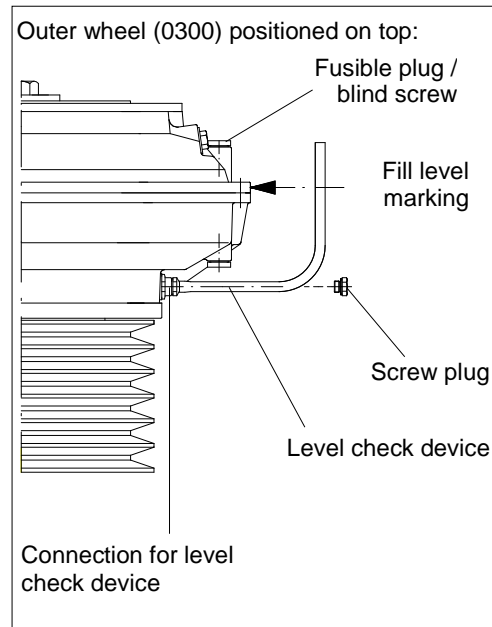


Fig. 19

- Remove two screws being on top.
  - For an **upper pulley**, up to coupling size 274 these are one blind screw and one filler plug, and from coupling size 366 these are two blind screws.
  - For a **lower pulley**, up to coupling size 274, these are one fusible plug and one filler plug, from coupling sizes 366, these are two screws (fusible plug and/or blind screw).
- Fill in the specified quantity of operating fluid (→ Chapter 9) through a fine strainer
  - mesh size ≤ 25 µm for turbo couplings using oil as operating medium (type T...)
  - Mesh size ≤ 50 µm for turbo couplings using water as operating medium (type TW...)
 via a screw hole. The second screw hole serves for pressure compensation.
- Re-close the screw holes on top using the screws. Rotate the turbo coupling with nominal speed for a short time to let the operating fluid **spread evenly**.
- Remove the screws being on top once again.
- Fit the level check device to the connection provided for this purpose. (→ schematic sketch above).
- Provide the level mark on the turbo coupling or protective cover for later level checks.
- Remove the level check device.
- Tighten slackened screws.  
Tightening torque for the screw plug: **30 Nm** (M14x1.5).
- Check the coupling for leaks during a test run (with protective cover!).

The level check device is available at Voith Turbo as accessory for couplings from size 366.

Tightening torques  
→ Chapter 7.2

## 10.2 Level check

You will find the **filling volume** on the **cover sheet** of this operating manual.

### 10.2.1 Level check for turbo couplings installed in horizontal position

#### SAFETY INFORMATION

**From size 366**, turbo couplings are equipped with a sight glass in the outer wheel.

- The sight glass position is marked by an arrow.

- If no sight glass is provided, turn the turbo coupling until a fusible plug is on top. Then unscrew and remove this fusible plug.
- Turn the turbo coupling until the operating fluid is just visible on the sight glass or until the operating fluid can be seen on the removed fusible plug, but is not yet leaking out.
- Determine the **number z** of the flange screws from the sight glass or fusible plug to the vertical axis. The first screw is the one which center line is in counting direction, **after** the intersection line through the sight glass or the fusible plug.
- Compare the number of screws determined with the number of screws determined during filling. Please observe the marking provided additionally on the coupling or guard.
- Correct the quantity filled in, if necessary.
- Re-insert and tighten any removed fusible plug.
- Check the coupling for leaks during a test run (with protective cover!).

Number z  
→ Chapter 10.1

Tightening torques  
→ Chapter 7.2

## 10.2.2 Level check for turbo couplings installed in vertical position

### SAFETY INFORMATION

The level of turbo couplings **from size 366** is checked using a level check device. This level check device is available as accessory at Voith Turbo (→ schematic sketch, Chapter 10.1.2).

Turbo couplings **up to size 274** need to be drained to check the filling, and then be re-filled.

- Remove one screw being on top (fusible plug or blind screw) for ventilation purposes.
- Remove the screw plug.
- Fit the level check device to the connection provided for this purpose.
- Compare the level with the marking that was provided when filling in.
- Correct the quantity filled in, if necessary.
- Remove the level check device.
- Tighten slackened screws.  
Tightening torque for the screw plug: **30 Nm** (M14x1.5).
- Check the coupling for leaks during a test run (with protective cover!).

**Tightening torques**  
→ Chapter 7.2

## 10.3 Draining the turbo coupling

### NOTICE

#### Environmental pollution

Improper disposal of operating fluid may cause damages to the environment!

- On disposal, please observe the applicable laws and the producer's or supplier's instructions.
- Provide suitable containers to collect the operating fluid.

**Notes on disposal**  
→ Chapter 16

### 10.3.1 Draining of turbo couplings without delay chamber installed in horizontal position

- Put a catch pan underneath.
- Turn the turbo coupling until one fusible plug is at the bottom.
- Remove this fusible plug.
- For aeration, remove one opposite filler or fusible plug.
- The operating fluids flows out from the turbo coupling.
- Wait until no more operating fluid comes out.
- Only use original seals.
- Re-tighten all screws.

Tightening torques  
→ Chapter 7.2

### 10.3.2 Draining of turbo couplings with delay chamber installed in horizontal position

- Put a catch pan underneath.
- Turn the turbo coupling until one fusible plug is at the bottom.
- Remove this fusible plug.
- For aeration, remove one opposite filler or fusible plug.
- The operating fluid flows out from the working chamber of the turbo coupling.
- Wait until no more operating fluid comes out.

#### Coupling size 274:

- Re-tighten the fusible and filler plugs.
- Switch on the drive motor for about half a minute to maximal one minute. The operating fluid in the delay chamber drains into the working chamber.
- Remove the fusible plug again.

#### Coupling sizes 366 to 650:

- Remove the nozzle screw / screw plug (items 0455 / 0456).
- Turn the turbo coupling until the opening of the nozzle screw is at the bottom.
- The operating fluid flows out from the delay chamber of the turbo coupling.
- Wait until no more operating fluid comes out.
- Only use original seals.
- Tighten the nozzle screw.



- Turn the turbo coupling until the opening of the fusible plug is at the bottom.
- The remaining operating fluid flows out from the working chamber of the turbo coupling.
- Wait until no more operating fluid comes out.
- Only use original seals.
- Re-tighten all screws.

**Tightening torques**  
→ Chapter 7.2

### 10.3.3 How to drain turbo couplings installed in vertical position

#### SAFETY INFORMATION

On account of its design, the turbo coupling cannot completely drain when installed!

- Put a catch pan underneath.
- For aeration, remove one blind screw or fusible plug at the top of the coupling.

#### Up to coupling size 274:

- Remove one blind screw or fusible plug being at the bottom.

#### From coupling size 366:

- Remove the connection for the level check device.
- The operating fluids flows out from the turbo coupling.
- Wait until no more operating fluid comes out.
- Only use original seals.
- Tighten slackened screws.  
Tightening torque for the screw plug: **30 Nm** (M14x1.5).  
Tightening torque for the connection: **80 Nm** (M24x1.5).

**Tightening torques**  
→ Chapter 7.2

# 11 Commissioning



## WARNING

### Risk of injury

Please observe, in particular, → Chapter 5 (Safety) when working on the turbo coupling!

- A commissioning not performed properly could cause injury to persons, or harm to property and the environment!
- Experts only are allowed to perform commissioning, in particular, first starting of the turbo coupling!
- Secure the machine against unintentional switching on!



Marking  
→ Chapter 5.2

### Explosion hazard

- Please check with reference to the marking whether the turbo coupling is approved for use in potentially explosive atmospheres.
  - Provide the turbo coupling with a protective cover (e.g. perforated sheet, size of holes approx. 10 – 12 mm). This protective cover has to
    - prevent intrusion of damaging foreign particles (stones, corrosive steels, etc.).
    - withstand expected impacts without any major damages, thus preventing contact of the turbo coupling with the protective cover. Especially turbo couplings with outer parts made of aluminum must not get in contact with corrosive steel or iron.
    - collect spraying solder of fusible plugs.
    - collect any operating fluid leaking out to prevent contact with parts (motor, belt) that might ignite or catch fire.
    - provide sufficient ventilation to maintain the maximum surface temperature specified.  
A perforated sheet with 65% hole cross section enclosing the coupling on all sides does not reduce the ventilation (consult Voith Turbo, if necessary).
    - guarantee safety distances to prevent hazard zones from being reached (DIN EN ISO 13857).
- For constructional proposals for protective covers, please contact Voith Turbo.
- The turbo coupling is not equipped with insulated ball and roller bearings! The passage of current and stray currents may come from connected machines (e.g. VFD motor).
  - In order to avoid electrostatic charging, it is not allowed to install the turbo coupling with an insulation on both sides.
  - Provide an equipotential bonding between the input and output end.
  - Provide machines on which overspeed is possible, with a device preventing reliably overspeed (e.g. brake or backstop).

**WARNING****Hazard by being pulled in**

Slack clothing, long hair, necklaces, rings or loose parts may get caught and be drawn in or wound up causing serious injuries or damage to the turbo coupling and the environment.

- Only wear close-fitting clothes when working!
- Cover long hair with a hair net!
- Do not wear any jewelry (e.g. necklaces, rings, etc.)!
- Never operate the turbo coupling without protective cover!
- Fix a protective cover (e.g. plate with a hole size of about 10-12 mm) around the belt drive and exposed shaft parts.

**WARNING****Explosion hazard**

Explosion hazard due to frictional heat or overheating.

- Check the belt tension and readjust, if necessary.
- If you use a BTS-Ex to limit the maximum surface temperature, make sure not to exceed the maximum permissible temperature of the turbo coupling when switching on the motor.



Technical Data  
→ Chapter 2

**NOTICE****Damage to property**

Never operate the turbo coupling without operating fluid.

- On account of the type of bearings used for standard turbo couplings of sizes 366, 422, 487, 562, 650, at least one standstill within three months is required.
- On account of the type of bearings used for the standard turbo couplings of sizes 154, 206 and 274, at least one standstill is required once a week.

### Information with regard to commissioning

Operating fluid and  
filling volume  
→ Cover sheet

- The turbo coupling may be used for any direction of rotation.
- The direction of rotation of the driven machine may be specified! The direction of rotation of the motor must be in accordance with the specified direction of rotation of the driven machine!
- If the motor is started with star/delta connection, switch over from star to delta after 2...5 seconds at the latest.
- In case of a multi-motor drive, you should determine the load of the individual motors. Great differences regarding motor load may be balanced by an appropriate adjustment of the respective coupling filling volumes. **However, do not exceed the maximum permissible coupling filling level!**

### Commissioning

Commissioning  
report  
→ Chapter 14.2

- Perform all commissioning work according to the commissioning report.  
Pay special attention to:
  - a normal machine operation
  - normal noise
- Record the commissioning process.

## 12 Operation



### WARNING

#### Risk of injury

Please observe, in particular, → Chapter 5 (Safety) when working on the turbo coupling!

- An operation presupposes the successful commissioning according to → Chapter 11.

### Information with regard to operation

### NOTICE

#### Damage to property

Never operate the turbo coupling without operating fluid.

- On account of the type of bearings used for standard turbo couplings of sizes 366, 422, 487, 562, 650, at least one standstill within three months is required.
- On account of the type of bearings used for the standard turbo couplings of sizes 154, 206 and 274, at least one standstill is required once a week.

During normal operation, no operator actions on the turbo coupling are required.

Perform the necessary maintenance work time-/operating time-based according to → Chapter 13.

If malfunctions occur, eliminate such according to → Chapter 17.

## 13 Maintenance, Servicing

**Definition of the maintenance work described in the following (as per IEC 60079):**

**Maintenance and Servicing:** A combination of all activities conducted in order to maintain an object in a condition or to re-store it to such a condition which meets the requirements of the respective specification and ensures performance of the required functions.

**Inspection:** An activity involving the thorough examination of an object in order to provide a reliable statement as to the condition of said object, performed without disassembly or, if necessary, with only partial disassembly, supplemented by measures such as the taking of measurements.

**Visual inspection:** A visual inspection is an inspection in which visible defects, such as missing screws or bolts, are identified without the use of access equipment or tools.

**Close-up inspection:** An inspection in which, in addition to the areas covered by the visual inspection, defects such as loose bolts, that can only be detected by using access equipment, e.g. mobile stair steps (if required) and tools are identified. For close-up inspections, usually a housing does not need to be opened or the power to the equipment be cut off.

**Detailed inspection:** An inspection in which, in addition to the areas covered by the close-up inspection, defects such as loose connections, that can only be detected by opening housings and/or using tools and test equipment (if required) are identified.

**WARNING****Risk of injury**

Please observe, in particular, → Chapter 5 (Safety) when working on the turbo coupling!

- Please always keep access paths free to the turbo coupling!

- Skilled and authorized persons only are allowed to carry out maintenance and repair work! Qualification is ensured by performing training and giving instructions on the turbo coupling.
- Possible consequences of improper servicing and maintenance could be death, serious or minor injuries, damage to property and harm to the environment.
- Switch off the unit in which the turbo coupling is installed and secure the switch against inadvertent switch-on.
- For all work performed on the turbo coupling ensure that both the drive motor and the driven machine have stopped running and that a re-start is absolutely impossible!
- Components may only be replaced by original spare parts.

**Qualification**  
→ Chapter 5.9

Re-mount all protective covers and safety devices in their original position immediately after completion of the servicing and maintenance work. Check them for proper functioning.

**Maintenance schedule:**

Time	Maintenance work
Routine inspection after 500 operating hours, every 3 months at the latest.	Inspect the machine for irregularities visual inspection: for leaks, noise, vibrations).  Check the foundation bolts of the machine, and if necessary, re-tighten them with the specified torque.
3 months after commissioning, at the latest, then every year	Check the electrical system for sound condition if temperature monitoring is required in Chapter 2 (detailed inspection).
When mineral oil is used as operating fluid: After every 15000 operating hours	Change the operating fluid or check it for aging and - determine the remaining service life (see records → Chapter 14)! Consult the operating fluid supplier with regard to the permissible values (see Chapters 9 and 10).

Time	Maintenance work
On response of a fusible plug	Replace all fusible plugs and change the operating fluid (→ Chapter 13.4). Check the operating conditions (→ Chapter 2). Check the devices provided for temperature monitoring (see Chapter 19: MTS, BTS(ex), BTM).
In case of leaks	On the occasion of an overhaul of the turbo coupling, have shaft sealing rings, sealing rings and flat seals replaced by skilled persons authorized by Voith.
In case of noise, vibrations	Have the cause determined and eliminated by skilled persons authorized by Voith.
In case of impurities	Cleaning (→ Chapter 13.1).
Upon the system and belt manufacturer's request	Check the belt drive (→ Chapter 13.3).

Table 9

**Report samples**  
→ Chapter 14.3

- Carry out any maintenance work and routine inspections according to the report.
- Record the maintenance work carried out.



**For explosion-proof turbo couplings, the following maintenance work needs to be carried out in addition:**

Maintenance intervals	Maintenance work
<b>In case of impurities or dusting:</b> Clean the turbo coupling when used in potentially explosive atmospheres in regular intervals. The intervals are specified by the operator according to the environmental impact to which the equipment is exposed on the jobsite, e.g. in case of a dust accumulation of approx. 0.2 ... 0.5 mm or more.	Cleaning (→ Chapter 13.1).
Maintenance interval → Chapter 2	<ul style="list-style-type: none"> <li>- Replacement of ball and roller bearings (→ Chapter 13.2.3).</li> <li>- Re-lubricate the bearings underneath the pulleys (please call for a Voith field service representative).</li> </ul>

Table 10



**WARNING****Explosion hazard**

Explosion hazard due to maintenance work not performed according to schedule. It is vital to carry out all maintenance work according to the schedule in order to guarantee proper operation within the meaning of explosion-protection.

- Immediately remove any combustible layers of dust on the turbo couplings.
- To ensure a good aeration of the turbo coupling, it is vital to check and clean the protective cover in regular intervals.
- If a fusible plug has responded, immediately cover or close the opening that occurred in order to prevent the ingress of combustible dust into the turbo coupling.

## 13.1 Outside cleaning

**NOTICE****Damage to property**

Damage to the turbo coupling due to an improper, unsuitable outside cleaning.

- Please ensure that the cleaning agent is compatible with the sealing materials used, NBR and FPM/FKM!
  - Do not use high-pressure cleaning equipment!
  - Be careful with gaskets. Do not apply a water and compressed-air jet.
- Clean the turbo coupling with a grease solvent, as and when required.

## 13.2 Bearings

### 13.2.1 Bearing lubrication when mineral oil is used as operating fluid

Please observe the following in order to guarantee lubrication of the bearings:

#### NOTICE

##### Damage to property

Never operate the turbo coupling without operating fluid.

- On account of the type of bearings used for standard turbo couplings of sizes 366, 422, 487, 562, 650, at least one standstill within three months is required.
- On account of the type of bearings used for the standard turbo couplings of sizes 154, 206 and 274, at least one standstill is required once a week.

#### SAFETY INFORMATION

##### Lifetime grease filling

- Turbo couplings can be provided with special bearings that allow continuous operation and contain a lifetime grease filling.

### 13.2.2 Bearing lubrication when water is used as operating fluid

The turbo coupling bearings are filled with lifetime grease when water is used as operating fluid. Re-lubrication is not necessary.



Replacement  
interval of ball and  
roller bearings  
→ Chapter 2

### 13.2.3 Replacement of bearings / re-lubrication

#### SAFETY INFORMATION

On the occasion of an overhaul of the turbo couplings, have the bearings replaced / re-lubricated by skilled persons authorized by Voith.

### 13.3 Belts

- Check the pretension of the belts in regular intervals.
- Replace any worn belts in sets.

#### SAFETY INFORMATION

Unusually quickly worn belts may be a sign of improper alignment!

### 13.4 Fusible plugs

- The fusible plugs protect the turbo coupling against damage due to thermal overload.
- When the nominal response temperature is reached, the solder core of the fusible plugs melts and the operating fluid leaks out.

**Nominal response  
temperature of fu-  
sible plugs**  
→ Cover sheet

Fusible plugs are identified by

- the engraved nominal response temperature in °C,
- a color coding:

Nominal response temperature	Color coding	Operating fluid oil	Operating fluid water
95 °C	without (tinned)	X	X
110 °C	yellow	X	X
125 °C	brown	X	-
140 °C	red	X	-
160 °C	green	X	-
180 °C	blue	X	-

Table 11

Design  
→ Chapter 2

### SAFETY INFORMATION

- Observe the assembly plan belonging to the order.
- Use only original fusible plugs with the required nominal response temperature!
- Do not replace any fusible plugs by blind screws!
- Do not alter the arrangement of the fusible plugs.
- When water is used as operating fluid, only fusible plugs with a max. nominal response temperature of 110 °C are permitted!
- Never operate the turbo coupling without fusible plugs!

### SAFETY INFORMATION

#### Switching elements, unbalance

- There is a MTS and/or BTS switching element or a blind screw opposite the sight glass (position is marked by an arrow).
- Insert a weight-tolerated BTM blind screw opposite the BTM switching element. Do not insert the BTM switching element opposite a sight glass, blind screw or fusible plug having a lighter weight.

Tightening torques  
→ Chapter 7.2

#### On response of a fusible plug:

- Replace all fusible plugs.
- Change the operating fluid.



### WARNING

#### Fire hazard

When pulleys are used, select the position of the fusible plugs so that they do not spray onto the pulleys.

- This needs to be checked. In case of any deviation, please consult Voith Turbo.

## SAFETY INFORMATION

### Thermal monitoring devices

- A thermal monitoring system can prevent that operating fluid is sprayed off (→ Chapter 19).
- Thermal monitoring systems are available at Voith Turbo as accessories.

**Arrangement and number of fusible plugs (FP), blind screws, sight glasses and switching elements for outer wheel drive and/or inner wheel drive for the standard design.**

→ Annex (see arrangement of fusible plugs (FP))

## 14 Assembly Check, Commissioning and Maintenance Report



### WARNING

#### Risk of injury

Please observe, in particular, → Chapter 5 (Safety) when working on the turbo coupling!

Document all assembly work performed in the assembly check report (→ Chapter 14.1).  
Document the commissioning process in the commissioning report (→ Chapter 14.2).



### SAFETY INFORMATION

Document all **maintenance work** performed on the

- turbo coupling
- in the maintenance report for the general maintenance (→ Chapter 14.3).

Use copies of the samples, if necessary.

## 14.1 Assembly check report

Confirm the check or performance of the work by an "X" and/or enter the respective values.

### Voith turbo coupling

Size / type (→ Chapter 18):	
Serial No. (→ Chapter 18):	

Turbo coupling  
 approved for potentially  
 explosive atmospheres      yes ☐ / no ☐

### Operating fluid of turbo coupling

Filling:		I
Manufacturer:		
Designation:		

### Motor

Serial No.		
Input speed		rpm
Rated power		kW

### Assembly work was performed by:

Name:	
Date:	
Signature:	

### Driven machine / gearbox

Serial No.	
------------	--

The following applies to the table below:

The shaft is the input shaft, if the coupling is driven by the shaft.

The shaft is the output shaft, if the coupling is driven by belts.

Mounting - check step	Explanations	Completion notice / dimensions
Check of fixing bolt length (item 0050)	→ order documents	<input type="checkbox"/>
Measurement of radial runout of the shaft.	Manufacturer's specification	Desired: [mm] ACTUAL: [mm]
Measurement of diameter of the pulley.	Chapter 2	Desired: [mm] ACTUAL: [mm]
Measurement of diameter <sup>1)</sup> of shaft	Chapter 2	Desired: [mm] ACTUAL: [mm]
Check of back clearance of key (input side).	Chapter 8.2	<input type="checkbox"/>
Check of back clearance of key (output side).	Chapter 8.2	<input type="checkbox"/>
Key moves easily in the keyway of the input hub.	Chapter 8.2	<input type="checkbox"/>
Key moves easily in the keyway of the output hub	Chapter 8.2	<input type="checkbox"/>
Check of shaft-hub connection.	Chapter 8.2	Key convention of shaft and hub are identical H (half), F (full) <input type="checkbox"/> yes <input type="checkbox"/> no  Method applied: <input type="checkbox"/> half-key convention <input type="checkbox"/> full-key convention
Check of connection: bearing cover (item 0950) - pulley (item 0620).	Chapter 8.2	<input type="checkbox"/>
Check of alignment of pulley. Alignment tolerances comply with the specifications of the belt manufacturer.	Manufacturer's specifications	<input type="checkbox"/>
Cleaning of shaft and hub, and application of lubricant.	Chapter 8.2	<input type="checkbox"/>

1) Dimensions of shaft and/or hub to be connected by means of the shaft-hub connection.

Mounting - check step	Explanations	Completion notice / dimensions
Fixing bolt (item 0050) was tightened with torque.	Chapter 7.1	<input type="checkbox"/>
Tightening of foundation bolts.	Chapter 8.5.2	<input type="checkbox"/>
Mounting of coupling Screws (item 0960) were tightened.	Chapter 7.3	<input type="checkbox"/>
MTS / BTS / BTM (if required) Check of installation position according to operating manual.	Chapter 2 Chapter 19	<input type="checkbox"/>
MTS / BTS / BTM (if required) Check of electrical functioning.	Chapter 2 Chapter 19	<input type="checkbox"/>
A guard was mounted as recommended.	Chapter 11	<input type="checkbox"/>
Equipotential bonding between input and output was realized.	Chapter 11	<input type="checkbox"/>
Operating fluid was filled into the coupling.	Chapter 10	<input type="checkbox"/>
For <b>horizontally</b> installed turbo couplings only: Check of filling level / determination of number of screws "z" for filling	Chapter 10.1 and 10.2	<b>z =</b> screws
For <b>vertically</b> installed turbo couplings only: Level check device was used. Fill level was marked on the coupling.	Chapter 10.1.2	<input type="checkbox"/>
Alignment of turbo coupling was checked.	Chapter 8.5.1	<input type="checkbox"/>
Radial running of motor shaft is OK		<input type="checkbox"/>
Displacements during operation (to be indicated by the machine manufacturer): Observe displacements resulting from an increase in temperature or from mechanical movements. Enter only those values that change the above-ascertained alignment values.		



## 14.2 Commissioning report

Confirm the check or performance of the work by an "X" and/or enter the respective values.

### Voith turbo coupling

Size / type (→ Chapter 18):

Serial No. (→ Chapter 18):

Turbo coupling  
 approved for potentially  
 explosive atmospheres      yes ☐ / no ☐

### Commissioning was carried out

after  Oper. hrs.

Name:

Date:

Signature:

Commissioning - check step	Explanations	Completion notice
<b>Checks prior to switching on the drive motor:</b>		
Assembly/mounting check steps were carried out. Fill in the assembly check report.	Chapter 14.1	<input type="checkbox"/>
Applies only to turbo couplings that are used in potentially explosive atmospheres: Check according to the marking whether the turbo coupling is approved for the use in potentially explosive atmospheres.	Chapter 5.2	<input type="checkbox"/>
For <b>horizontally</b> installed turbo couplings only: Check the filling level / determine the number of screws "Z" for filling.	Chapter 10.1 and 10.2	<input type="checkbox"/> / z =      screws
For <b>vertically</b> installed turbo couplings only: Use the fill level check device. Fill level was compared with the previously made fill level marking.	Chapter 10.2.2	<input type="checkbox"/> / Difference =      mm
Fix a guard over the turbo coupling (for design, → Chapter 11).	Chapter 11	<input type="checkbox"/>
Check whether the machine was earthed with a grounding cable (16mm²).		<input type="checkbox"/>
Applies only to installations where overspeed is possible: Provide the unit with a device that reliably prevents overspeeds (e.g. brake or backstop).		<input type="checkbox"/>
Determine the next standstill of coupling for maintenance services.	Chapter 13	<input type="checkbox"/>
Check the belt tension, and readjust, if necessary. Observance of the system and pulley manufacturer's instructions.	Chapter 8.4 Chapter 8.4.1	
Applies only when a BTS-Ex is used as temperature monitoring system: Make sure that the maximum permissible turbo coupling temperature is not exceeded when switching on the motor!	Chapter 2	<input type="checkbox"/>
Check of foundation bolts.		<input type="checkbox"/>

Commissioning - check step	Explanations	Completion notice
<b>Checks during the test run:</b>		
Motor run-up is normal.		<input type="checkbox"/>
Turbo coupling is tight. Check of floor and environment for oil moistening, oil did not leak out.		<input type="checkbox"/>
Machine operation is normal.		<input type="checkbox"/>
Noises are normal.		<input type="checkbox"/>
<b>Checks after switching off the drive motor:</b>		
Turbo coupling is tight. Check of floor and environment for oil moistening, oil did not leak out.		<input type="checkbox"/>
<b>Check of switch units for temperature monitoring <sup>1)</sup>, if applicable:</b>		
Performance of a visual inspection.	<sup>1)</sup>	<input type="checkbox"/>
Removal of dust deposits.	<sup>1)</sup>	<input type="checkbox"/>
Check of electrical system.	<sup>1)</sup>	<input type="checkbox"/>

1) See separate operating manual / → Chapter 19

## 14.3 Maintenance report for general maintenance

Confirm the check or performance of the work by an "X" and/or enter the respective values.

**Voith turbo coupling**

Size / type (→ Chapter 18):

Serial No. (→ Chapter 18):

Turbo coupling  
 approved for potentially  
 explosive atmospheres      yes ☐ / no ☐

**The maintenance work was performed**

after  Oper. hrs.

Name:

Date:

Signature:

Maintenance - check step	Explanations	Completion notice
Check for irregularities (every <b>500 h</b> , every <b>3 months</b> at the latest)		
Turbo coupling is tight. Check of floor and environment for oil moistening, oil did not leak out.		<input type="checkbox"/>
Machine operation is normal.		<input type="checkbox"/>
Noises are normal.		<input type="checkbox"/>
Check of protective cover.	Chapter 11	<input type="checkbox"/>
Check of foundation bolts.		<input type="checkbox"/>
Check of switch units for temperature monitoring <sup>1)</sup> , if applicable (every <b>3 months</b> )		
Performance of a visual inspection.	<sup>1)</sup>	<input type="checkbox"/>
Removal of dust deposits.	<sup>1)</sup>	<input type="checkbox"/>
Check of electrical system (after <b>3 months</b> , then <b>every year</b> ).	<sup>1)</sup>	<input type="checkbox"/>
Operating fluid (every <b>15000 h</b> )		
Analysis of operating fluid.		<input type="checkbox"/>
Determination of remaining operating time.		<input type="checkbox"/> / hours
Change of operating fluid.	Chapter 10	<input type="checkbox"/>
Ball and roller bearings (for the intervals, → Chapter 2)		
Replacement of ball and roller bearings.	Chapter 13.2.3	<input type="checkbox"/>
Re-lubrication of bearings underneath the pulley.	Ask for a Voith field service representative.	<input type="checkbox"/>
Cleaning of turbo coupling (after every contamination)		
Cleaning was performed.	Chapter 13.1	<input type="checkbox"/>

1) See separate operating manual / → Chapter 19

## 15 Disassembly of Turbo Coupling



### WARNING

#### Risk of injury

Please observe, in particular, → Chapter 5 (Safety) when working on the turbo coupling!

- Before beginning to work on the turbo coupling, switch off the main switch of the drive motor and secure it against being switched on!
- For all work performed on the turbo coupling ensure that both the drive motor and the driven machine have stopped running and that a re-start is absolutely impossible!

### 15.1 Preparation

Weight of turbo coupling  
→ Cover sheet  
Weights of more than 100 kg are stamped on the turbo coupling.

- Prepare suitable tools and lifting appliances.  
Observe the turbo coupling weight!
- Remove the belts.



### WARNING

#### Risk of injury

Damaged load carrying attachments or those with insufficient carrying capacity may break under load, with the consequence of serious or even fatal injuries!

- Check the lifting appliances and load carrying attachments for
  - sufficient carrying capacity (for weight, → cover sheet),
  - sound condition.



### WARNING

#### Risk of injury

Falling parts may seriously injure or kill you.

- Do not walk under suspended loads.

Lifting appliances  
→ Chapter 6.4

- Fix the turbo coupling to a suitable lifting appliance.

## 15.2 Disassembly of basic type TR(I) turbo coupling

### NOTICE

#### Damage to property

Turbo coupling may be damaged due to improper use of the removal device.

- It is not allowed to use an impact screwdriver to apply the torque.

### SAFETY INFORMATION

From **size 274**,

- the use of a mounting and removal device is recommended and can be procured as accessory from Voith Turbo.
- For holding the motor shaft, we recommend using the **spanner wrench** (→ schematic sketch below) which is available as special accessory from Voith Turbo.

Removal device  
→ Chapter 15.2.1

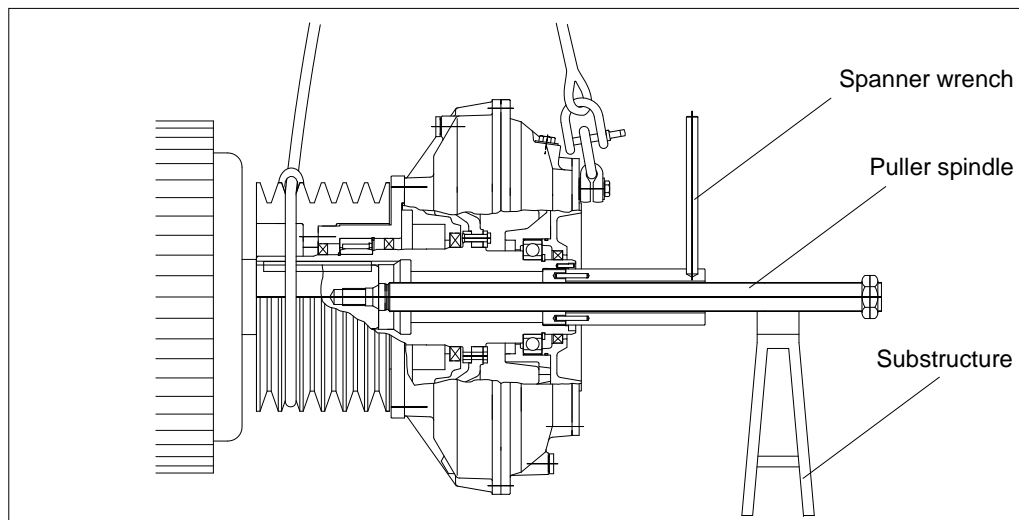


Fig. 20

Lubricant  
→ Chapter 8.2

- **Coupling sizes 154 and 206:**
  - Remove the fixing bolt.
  - Screw a suitable and slightly oiled screw into the internal thread of the holding disk and remove the turbo coupling.
- **Coupling size 274:**
  - Remove the circlip, fixing bolt and holding disk.
  - Put the threaded ring, supplied together with the removal device, into the coupling hub.
  - Secure the threaded ring using the circlip.
  - Apply lubricant to the thread of the puller spindle.
  - Screw the puller spindle into the internal thread of the threaded ring.
  - Support the puller spindle by a substructure.
  - Remove the turbo coupling using the puller spindle.

Lubricant  
→ Chapter 8.2

- **Coupling sizes 366 to 650:**
  - Remove the fixing bolt and holding disk.
  - Screw the threaded ring, supplied with the removal device, into the coupling hub.
  - Apply lubricant to the thread of the puller spindle.
  - Screw the puller spindle into the thread of coupling hub and/or into the threaded ring.
  - Support the puller spindle by a substructure.
  - Remove the turbo coupling using the puller spindle.

## 15.2.1 Removal device

Removal device available at Voith Turbo for turbo couplings of basic type TR(I):

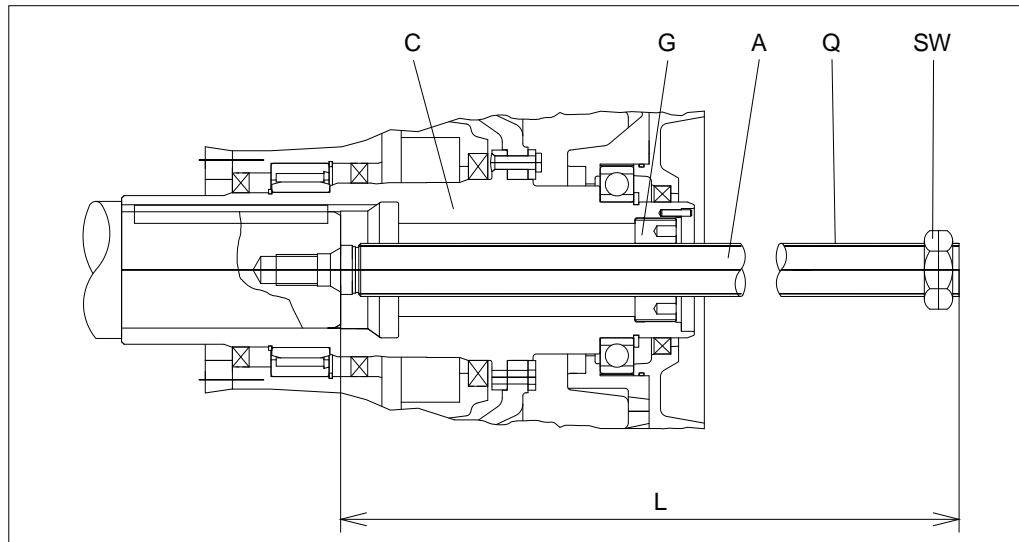


Fig. 21

A:	Puller spindle	L:	Total length
C:	Coupling hub	Q:	Dimension of thread of puller spindle
G:	Threaded ring	SW:	Width across flats

Coupling sizes	L in mm	Q in inches	SW in mm	Article No. of puller spindle	Hub bore in mm
274	360	G ½	34	TCR.11947150	For hub bore Ø 22-26
274	360	G ¾	36	TCR.10657260	For hub bore > Ø 26
366	520	G 1	46	TCR.11071730	-
422	700	G 1 ¼	55	TCR.11071760	-
487	700	G 1 ¼	55	TCR.11071790	-
562	910	G 1 ½	60	TCR.11071800	-
650	910	G 1 ½	60	TCR.11071830	-

Table 12

## 15.3 Reassembly of turbo coupling

Procedure for reassembly of the turbo coupling is described in → Chapter 8.3.

## 16 Disposal

### Disposal of the packaging

Dispose of packaging material according to the local regulations.

### How to dispose of operating fluids

On disposal, please observe the applicable laws and the producer's or supplier's instructions.

### How to dispose of the turbo coupling

Clean the turbo coupling carefully to ensure a purity of material.

Dismantle the turbo coupling, if necessary.

Dispose of the turbo coupling according to the local regulations.

For special information on the disposal of the substances and materials used, please see the following table:

Material / substance	Kind of disposal		
	Reuse	Residual waste	Special waste
Metals	x	-	-
Cables	x	-	-
Seals	-	x	-
Plastics	x <sup>1)</sup>	(x)	-
Operating media	-	-	x <sup>1), 2)</sup>
Packing	x	-	-

Table 13

1) If possible

2) Disposal according to the safety data sheet or the manufacturer's instructions



# 17 Malfunctions - Remedial Actions



## WARNING

### Risk of injury

Please observe, in particular, → Chapter 5 (Safety) when working on the turbo coupling!

The following table is intended to help finding the cause of malfunctions or problems quickly and to take remedial action, if necessary.

Malfunction	Possible cause(s)	Remedial action	See
Starting behavior of driven machine is not as expected.	Turbo coupling is not filled with the correct quantity of operating fluid.	Check and correct the quantity filled in.	Chapter 10.1
	The operating conditions have changed.	Please consult Voith Turbo.	Chapter 18
Driven machine does not reach the specified speed.	Driven machine is blocked or overloaded.	Eliminate blocking or the cause of overload.	
	Turbo coupling is not filled with the correct quantity of operating fluid.	Check and correct the quantity filled in.	Chapter 10.1
	The belts are damaged and/or the belt tension is incorrect.	Replace the belts in sets and/or apply the correct tension to the belts.	Observe the belt manufacturer's instructions.
Drive motor does not reach normal operation within the expected time.	Changeover from star to delta too late.	Changeover from star to delta should be made after 2...5s at the latest.	
	Drive motor is electrically or mechanically not in order.	Have the drive motor checked by authorized personnel.	

Malfunction	Possible cause(s)	Remedial action	See
Operating fluid leaks out of the turbo coupling.	A fusible plug responded due to overload (excess temperature).	Clarify the cause for the overload. Replace <b>all</b> fusible plugs and change the operating fluid.	Chapter 13.4
	The turbo coupling is leaky.	Eliminate the leak, check, in particular, tightening torques and seal rings of fusible and filler plugs as well as sight glasses and, if necessary, check the switching element of the thermal switch unit. If the leak cannot be eliminated, please consult Voith Turbo.	Chapter 7  Chapter 18
An existing thermal monitoring unit (MTS, BTS or BTM) has responded.	The turbo coupling was overloaded.	Clarify the cause for the overload, and avoid another overload.  Check and correct the quantity filled in.	Chapter 19  Chapter 10.2
	Thermal monitoring unit (MTS, BTS or BTM) is defective.	Check the monitoring unit.	Chapter 19
Uneven running of the machine (increased vibration).	Foundation fixing is loose.	Retighten the foundation fixing. Align the machine.	
	The machine is not aligned.	Align the machine.	Chapter 8.5
	Machine is not balanced.	Clarify the cause and eliminate the unbalance.	
	The belts are damaged and/or the belt tension is incorrect.	Replace the belts in sets and/or apply the correct tension to the belts.	Observe the belt manufacturer's instructions.
	Bearings are damaged.	Eliminate the bearing damage; consult Voith Turbo in case of a bearing damage on the turbo coupling.	Chapter 18
	Loose bolted joints.	Check the coupling components for damages, and replace the same, if necessary. Check the alignment of the machine. Tighten the screws and bolts with the specified tightening torque.	Chapter 7

Malfunction	Possible cause(s)	Remedial action	See
Premature wear of the belt drive.	Alignment error.	Eliminate the cause for alignment error. Re-align the machine. Check the belts for wear.	
	Impermissible temperatures.	Eliminate the cause for excessive temperature. Replace all belts. Re-align the machine, if necessary.	
	Contact with aggressive media.	Check the coupling components for damages, and replace the same, if necessary. Replace all belts. Re-align the machine, if necessary. Eliminate the cause for contact with aggressive media.	Chapter 8.5
	Excessive torque	Eliminate the cause for excessive torque. Check the filling level.	Chapter 10.2
Wear / fracture of pulleys / screws (item 0630 / bearing cover (item 0950) / bearing (item 0140).	Belt drive is worn / coupling parts are worn.	Replace damaged coupling components. Re-align the machine. Shorten maintenance intervals.	Chapter 8.5
	Excessive torque	Check the coupling design. Please consult Voith Turbo. Install the new coupling. Re-align the machine.	Chapter 18

Please consult Voith Turbo (→ Chapter 18), in case of a malfunction which is not included in this table.

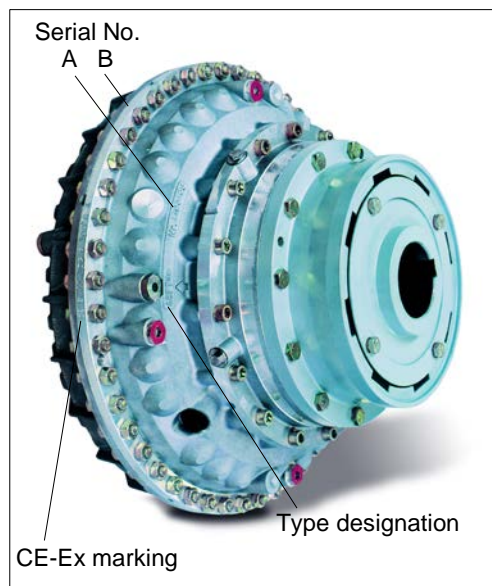
Table 14

## 18 Queries, Orders Placed for Field Service Representatives and Spare Parts

For

- Queries
- Ordering a field service representative
- Spare parts orders
- Commissionings

we need:



the **serial number** and **type designation** of the turbo coupling.

- You will find the serial number and type designation either on the outer wheel / coupling shell (A) or on the turbo coupling periphery (B).
- The serial number is stamped in with figure stamps.
- For turbo couplings, intended for the use in potentially explosive atmospheres, you will find the CE-Ex marking on the turbo coupling periphery.

Fig. 22

When placing an order for a **field service representative**, **commissioning** or a **service**, we need, in addition

- the turbo coupling installation site,
- the name and address of a contact person,
- details of the malfunction/problem occurred.

When placing a **spare parts order**, we need, in addition,

- the destination for the spare parts shipment.

Representatives  
→ Chapter 22

Please contact the local Voith representative  
(outside business hours: the emergency hotline).

# 19 Temperature Monitoring

## SAFETY INFORMATION



The thermal switch units MTS and BTS can be used in potentially explosive atmospheres to monitor the temperature. The signals serve for pre-warning. The MTS or BTS do not limit the maximum surface temperature.

The BTS-Ex is available as safety device to limit the maximum surface temperature, and it can be used as thermal switch-off device.

Also in this case, it is not allowed to replace the existing fusible plugs by fusible plugs with different nominal response temperatures or by blind screws.

Never bypass safety devices!



## DANGER

### Electric shock

Electric voltage may kill or severely injure you

- A qualified electrician has to properly carry out the connection to the electric supply network considering the system voltage and the maximum power consumption!
- The system voltage has to be in conformity with the system voltage indicated on the nameplate!
- There has to be a corresponding electrical protection by a fuse on the network side.

The temperature in the turbo coupling can be monitored by means of a limit switch or a temperature instrument.

The following systems are available as limit switch:

- a mechanical MTS system
- an electronic BTS system

These limit switches serve to monitor the temporarily permissible peak temperature, and to prevent a response of the fusible plugs provided the overload is eliminated promptly (e.g. by switching off the drive).

The BTM can be used as temperature measuring device. This way, not only the temporarily permissible peak temperature can be monitored, but also the nominal operation.

For the MTS,  
Operating Manual  
3626-011800 is  
available at Voith  
Turbo.  
Or download it at  
[www.voith.com/  
fluid-couplings](http://www.voith.com/fluid-couplings).

## 19.1 MTS mechanical thermal switch unit for pre-warning

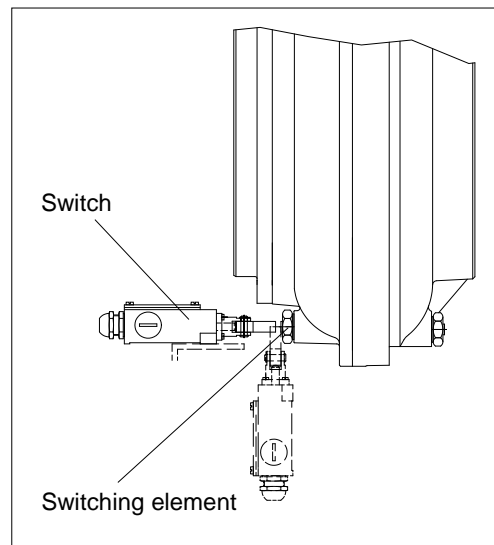


Fig. 23

### Functioning:

On excess temperature, the switching element releases a pin. The pin activates a switch on coupling rotation. This signal, for example, may trip an alarm or switch off the drive motor. The switching element needs to be replaced.

**In case of inner wheel drive and blocking of driven machine, the function is no longer guaranteed!**

The MTS is available for turbo couplings of all sizes.

For arrangement, see the table in → Chapter 22.

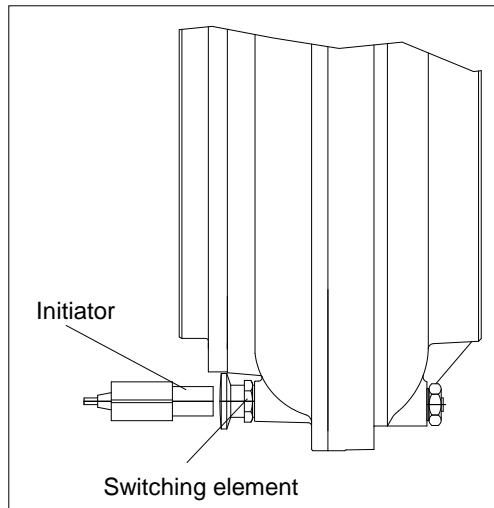
The switch is available in two designs:

- enclosed [protection IP 65],
- suitable for use in potentially explosive atmospheres  
type of protection:  $\text{Ex}$  II 2G EEx d IIC T6 (PTB 03 ATEX 1067 X).  
 $\text{Ex}$  II 2D IP65 T 80 C (PTB 03 ATEX 1067 X).

## 19.2 BTS non-contacting thermal switch unit

### 19.2.1 BTS non-contacting thermal switch unit for pre-warning

For the BTS, Operating Manual 3626-011500 is available at Voith Turbo. Or download it at [www.voith.com/fluid-couplings](http://www.voith.com/fluid-couplings).



#### Functioning:

On excess temperature, the switching element gives a specific signal to the initiator. This signal is transferred to an evaluator and may, for example,

- trigger an alarm
- or switch off the drive motor.

After the turbo coupling has cooled down, the switching element is again ready for service; it does not have to be replaced.

Fig. 24

The BTS is provided for turbo couplings from **size 206**.

For arrangement, see the table in → Chapter 22.

Switching element and initiator are

- cast in plastic,
  - insensitive to dirt,
  - suitable for use in potentially explosive atmospheres
- type of protection:  $\text{Ex}$  II 2G EEx ia IIC T6 (PTB 00 ATEX 2048 X).  
 $\text{Ex}$  II 1D Ex iaD 20 T... C (ZELM 03 ATEX 0128 X).

#### SAFETY INFORMATION

As the control circuit of the evaluator is **not** intrinsically safe, provide an appropriate isolating switch amplifier between evaluator and initiator!



- Isolating switch amplifier type KFD2-SOT2-Ex2 (24 V DC)  
type of protection:  $\text{Ex}$  II (1) GD [EEx ia] IIC (PTB 00 ATEX 2035).
- Isolating switch amplifier type KFA6-SOT2-Ex2 (230 V AC)  
type of protection:  $\text{Ex}$  II (1) G [EEx ia] IIC (PTB 98 ATEX 2164).



For the BTS-Ex,  
Operating Manual  
3626-019600 is  
available at Voith  
Turbo.  
Or download it at  
[www.voith.com/  
fluid-couplings](http://www.voith.com/fluid-couplings).

## 19.2.2 BTS-Ex non-contacting thermal switch unit for limiting the maximum surface temperature

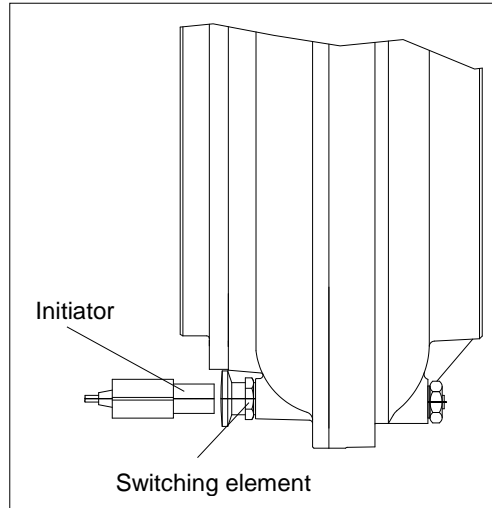


Fig. 25

### Functioning:

On excess temperature, the switching element gives a specific signal to the initiator. This signal is sent to an isolating switch amplifier and has to enforce the switch-off of the drive motor.

Use a BTS-Ex approved by Voith for this application.

After the turbo coupling has cooled down, the switching element is again ready for service; it does not have to be replaced.

The BTS-Ex is provided for turbo couplings from **size 366**.

For arrangement, see the table in → Chapter 22.

The BTS-Ex is provided for use in potentially explosive atmospheres as per ATEX directive in Equipment Group II, Equipment Category 2G and 2D ( II 2GD).



Technical data  
→ Chapter 2

## SAFETY INFORMATION

The BTS-Ex for limiting the maximum surface temperature is approved only in connection with the components supplied by Voith according to BTS-Ex operating manual.

Use of original Voith spare parts is imperative in case of a replacement demand. The evaluator serves to transmit control commands from potentially explosive atmospheres into non-explosive areas and to safely isolate intrinsically safe and non-intrinsically safe circuits.

- Make sure not to exceed the maximum permissible temperature of the turbo coupling when switching on the motor.



### 19.3 BTM non-contacting thermal measuring device for prewarning

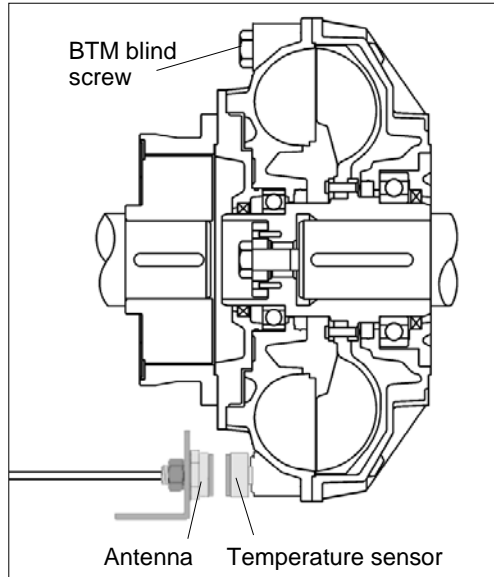


Fig. 26

#### Functioning:

The temperature sensor permanently transmits a measuring signal to the antenna. This signal is sent to an evaluator with 4 channels.

The measured temperatures of every channel are indicated on the evaluator. In addition, the measured temperatures are output as 4-20 mA signals.

Furthermore, two relay outputs are available per measuring channel with switching thresholds (e.g. pre-warning, switch-off) adjustable via the keyboard on the evaluator.

For the BTM, Operating Manual 3626-019800 is available at Voith Turbo. Or download it at [www.voith.com/fluid-couplings](http://www.voith.com/fluid-couplings).

The BTM is provided for turbo couplings from **size 366**.

For arrangement, see the table in → Chapter 22.

#### SAFETY INFORMATION

The BTM is not provided for use in potentially explosive areas as per ATEX directive.



## 20 Spare Parts Information

### SAFETY INFORMATION

#### Variety of variants

Considering the great variety, please find in the following only the basic designs of turbo couplings with constant fill and pulley.

- Spare parts must comply with the technical requirements stipulated by Voith. This is guaranteed when original spare parts are used.  
Installation and/or use of non-original spare parts may negatively change the mechanical properties of the **Voith Turbo couplings** and thus have an adverse impact on the safety.  
Voith is not liable for any damages resulting from the use of non-original spare parts.
- You will find the type of your turbo coupling and the pulley design on the cover sheet of this operating manual.
- Please observe → Chapter 18 (Queries, Orders placed for Field Service Representatives and Spare Parts).
- The customer is only allowed to perform the following work:
  - Replacement of fusible plugs (→ Chapter 13.4).
  - Work according to maintenance report (→ Chapter 14.3).
  - Change of operating fluid (→ Chapter 10).
  - Mounting of parts for which tightening torques are indicated (→ Chapter 7).**All remaining work may be performed by Voith staff only.**

### NOTICE

**Unauthorized changes or retrofits are not allowed to be performed on the coupling!**

**Do not retrofit accessories or equipment originating from other manufacturers!**

Any changes or conversions performed without the prior written consent of Voith Turbo will result in the loss of any warranty! Any claims will forfeit.

- Professional maintenance or repair can only be guaranteed by the manufacturer!



### SAFETY INFORMATION

If the turbo coupling is used in potentially explosive atmospheres (as per ATEX directive), the use of original parts that have been released for use in hazardous areas is allowed only.

## 20.1 Components overview - Voith turbo coupling 154 – 650

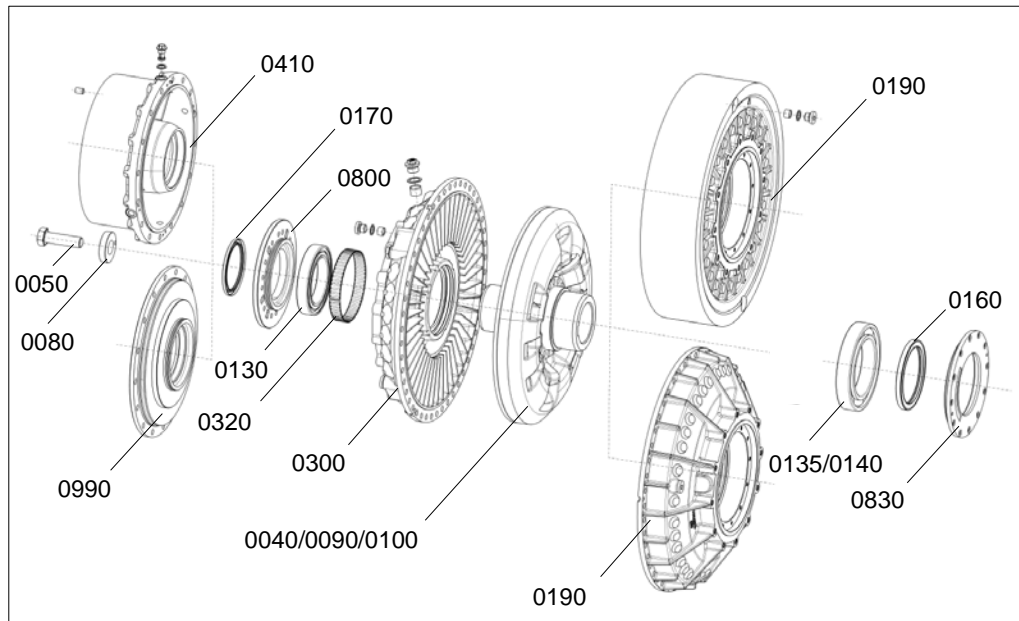


Fig. 27

Item No.	Description	Item No.	Description
0040	Coupling hub	0190	Coupling shell
0050	Fixing bolt	0300	Outer wheel
0080	Holding disk	0320	Tolerance ring
0090	Inner wheel	0410	Delay chamber cover
0100	Riveting ring/threaded ring/clamping ring	0800	Bearing support cover
0130	Grooved ball bearing	0830	Sealing ring cover
0135	Needle bearing (TRI)	0990	Connecting cover
0140	Grooved ball bearing (TR)		
0160	Radial shaft sealing ring		
0170	Radial shaft sealing ring		

Table 15

Spare parts for Voith turbo coupling, → Chapter 20.2.

## 20.2 Spare parts for Voith turbo coupling 154 – 650

Upper part of  
illustration:

With bearing cover

Lower part of  
illustration:

Without  
bearing cover

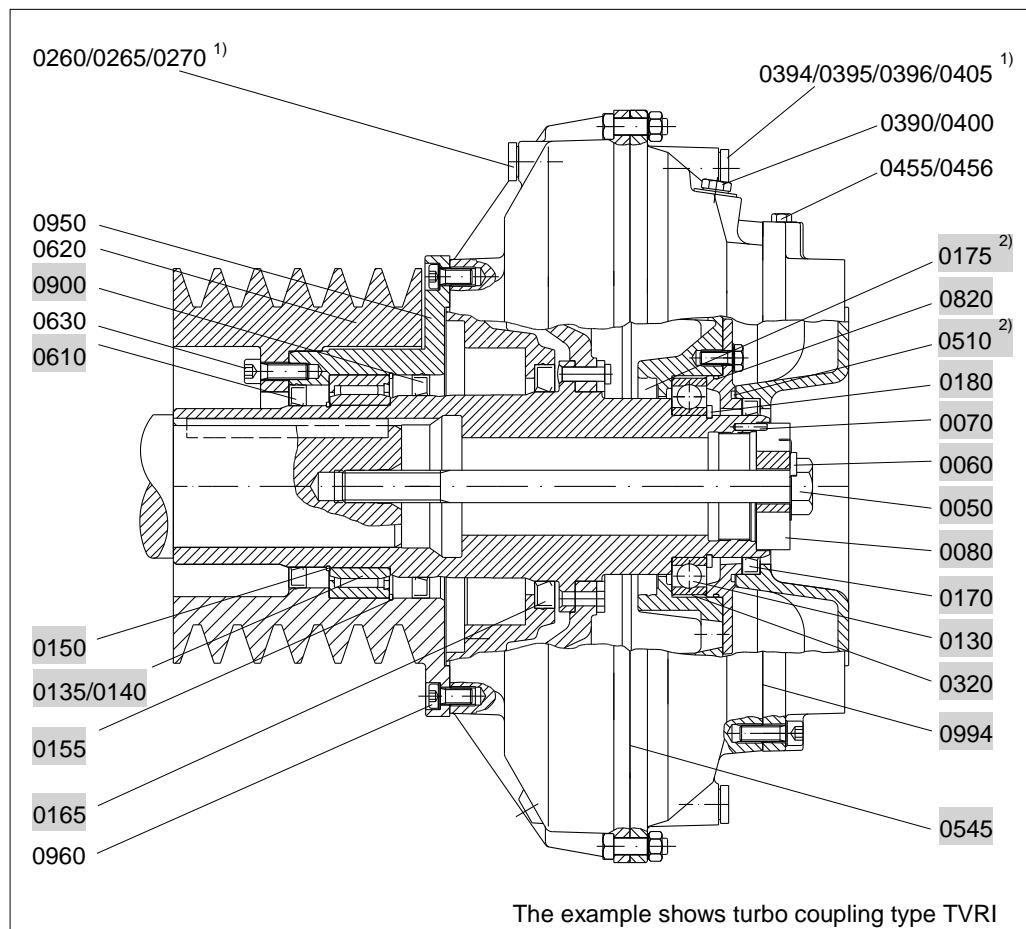


Fig. 28

- 1) For arrangement and quantity, see the table → Chapter 22.
- 2) Only for continuous operation or operating fluid 'water' (TW...).

xxxx Nonrepairable items (→ the following table)

xxxx Repair parts / wearing parts (V) (→ the following table)

Item No.	Nonrepairable items	Item No.	Repair parts / wearing parts (V)
0260	Fusible plug	0050	Fixing bolt
0265	Blind screw	0060	Locking plate/lock washer
0270	Sealing ring	0070	Roll pin
0390	Filler plug	0080	Holding disk
0394	Blind screw	0130	Grooved ball bearing (V)
0395	Fusible plug	0135	Needle bearing (TRI) (V)
0396	Sight glass	0140	Grooved ball bearing (TR) (V)
0400	Sealing ring	0150	Snap ring
0405	Sealing ring	0155	Snap ring
0455	Nozzle screw	0165	Radial shaft sealing ring (V)
0456	Screw plug	0170	Radial shaft sealing ring (V)
		0175	Radial shaft sealing ring (V)
		0180	Circlip
		0320	Tolerance ring (V)
		0510	O-ring (V)
<b>Item No.</b>	<b>Description</b>	0545	Sealing tape (V)
0620	Pulley	0610	Radial shaft sealing ring (V)
0630	Hex. screw / socket head screw	0820	O-ring (V)
0950	Bearing cover	0900	Radial shaft sealing ring (V)
0960	Hex. screw / socket head screw	0994	Sealing tape (V)

Table 16

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## 22 Annex



**EU Declaration of Conformity as defined by Directive 2014/34/EU,  
Annex VIII**

**29.3.2014 | EN | Official Journal of the European Union | L 96/309**

We,

Voith Turbo GmbH & Co. KG  
Voithstraße 1  
74564 Crailsheim

hereby declare that the equipment with

**Designation:** Turbo Coupling with Constant Fill and Pulley  
**Type:** TRI... / TR...  
**Serial No.:** see shipping documents

satisfies all relevant requirements as per Annex I of Directive 2014/34/EU up to the interfaces described in the instruction manual. It is necessary to observe the technical data contained in the instruction manual.

The above-described object of the declaration satisfies the relevant harmonization legislation of the union.

The following harmonized standards (or parts thereof) have been applied:

- EN 1127-1:2011
- EN 1127-2:2014
- EN 13463-1:2009
- EN 13463-5:2011
- EN 13463-8:2003
- EN 1710:2005 + A1:2008

Other technical specifications applied:

- EN ISO 12100:2010
- TRGS 727

The manufacturer is solely responsible for the issuance of this declaration of conformity.

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

Voith Turbo GmbH & Co. KG  
Bernhard Schust  
Voithstraße 1  
74564 Crailsheim

Place, Date / Signature: Crailsheim, 2017-11-17

Place, Date / Signature: Crailsheim, 2017-11-17



Senior Vice President Engineering

i.A. S. Pöchlitz  
Technical Documentation



## Work Sheet amd499.5

### Preservation and Packaging Instructions

T...

#### As delivered condition:

The as delivered condition of the Voith Turbo Couplings depends on the mode of transport and the storage period.

Condition No. 1 represents the as delivered standard. For deviations, please see the ordering documents.

No.	Transport and admissible storage period	Packing / Measures taken	Preservation	
			outside	inside
1	- Overland / air transport - Storage up to 6 months indoors (building)	- Device to suit transportation - Packed in PE foil - Weather protection provided by the means of transport	yes	no
2	- Sea transport - Storage up to 6 months indoors (building)	- Means suitable for transport - Sharp edges protected - Desiccant according to DIN 55473/55474 - Shrink-wrapped in PE foil - Water-proof cardboard or wooden box/crate - Inside of box/crate lid lined with sealed ribbed PE sheets (Akylux). PVC foil is put underneath in addition at butt joints	yes	no
3	- Sea transport - Storage up to 12 months indoors (building)	- As stated in 2	yes	yes
4	- Sea transport - Storage up to 24 months indoors (building)	- As stated in 2; shrink-wrapped in aluminum sandwich foil instead of PE foil.	yes	yes

#### Opening of the packaging:

Re-close airtight foils that have been opened for inspection upon receipt for further storage. Renew the desiccants.

#### Extension of the storage period:

The allowable storage period may be extended maximal three times according to the following descriptions. To do so, check the packaging and renew it, if necessary. Replace the desiccants and re-close the foil packing airtight.

#### External preservation / re-preservation:

Renew the external preservation according to the allowable storage period. Spray bright metal parts (hub bores, brake disks, etc.) with Houghton Ensics DWG2462.

#### Internal preservation / re-preservation:

Renew the internal preservation annually (for Condition No. 4: every 2 years). Wet the turbo coupling inside with an oil selected from the selection list.

- Turbo coupling on stock or mounted (turnable):  
For re-preservation, fill the turbo coupling with oil above the axis of rotation center and rotate the turbo coupling input and output at least once.
- Turbo coupling mounted (non-turnable):  
Fill the turbo coupling up to the uppermost fusible plug.

Then drain the oil and close the plug on the turbo coupling according to the specified procedure.

#### Protection Class: 0: PUBLIC

Date: 2017-01-31  
Issued by: tidht - Breg  
Checked by:  
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Replacing: ait499.4  
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Copies to: Sales documents; design documents

9173644-007495 **ENX**  
Rev. 05 / 220130  
Sheet 1 / 2 / Z01



Voith Turbo  
Division Industry

## Work Sheet amd499.5

### Preservation and Packaging Instructions

T...

#### Selection list for internal preservation agents:

Producer	Designation
Castrol	Rustilo 846
Mobil	Mobilarma 524 (SAE 30)
Houghton	Ensis Engine Oil 20
Wintershall	Wintershall Antikorrol 20W-20
The recommended operating fluids may also be used for preservation.	

Protect the turbo coupling against weather and environmental influences if it is installed in a machine that is not set into operation. Renew the external re-preservation every 6 months, internal re-preservation once a year. If necessary, clean the turbo coupling outside before performing re-preservation. Proceed for external and internal re-preservation as described above.

#### Protection Class: 0: PUBLIC

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Rev. 05 / 220130  
Sheet 2 / 2 / Z01

# Directive D-0503.0

## Operating Fluids for Voith Turbo Couplings

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Version 0, 2017-09-25

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Uncontrolled copy

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# 1 Field of Application

The list below contains the requirements to be fulfilled by operating fluids and a selection of types proposed for hydrodynamic couplings.

Turbo coupling with constant fill	(T...)
Fill-controlled turbo coupling	(TP...)
Variable speed turbo coupling	(S...)

**Any other fluids require Voith's prior approval.**

**For all materials getting in contact with the operating fluid, the manufacturer's approval is required.**


In individual cases, special requirements can rule out a selection according to this list; in this case, the deviating specifications will be agreed upon order handling or they will be specified in the operating manual.

Density / filling and heat capacity of fluids which may deviate from those of mineral oil need to be considered when designing the coupling.

Application instructions specified by the producers that are normally stated in the product and safety data sheets are to be observed.

## 2 Requirements to be fulfilled by the Operating Fluid

The characteristics as per Directive D-0502 are required as far as the product is concerned. Special attention has to be paid to:

- Viscosity: ISO VG 32 as per DIN ISO 3448 \*)
- Viscosity on start-up:
  - less than 15000mm<sup>2</sup>/s (T...)
  - less than 1000mm<sup>2</sup>/s (S... - displacement pump)
  - less than 500mm<sup>2</sup>/s (TP...)
  - less than 250mm<sup>2</sup>/s (S... - centrifugal pump)
- Pour point: 4°C below the minimum ambient temperature or lower
- Flash point: higher than 180°C and at least 40°C above the nominal response temperature of the fusible plugs
- Resistance to aging: aging-resistant refined product
- Cleanliness grade:
  - 21/18/15 as per ISO 4406
  - 9 as per NAS 1638
  - 10 as per SAE AS 4059
- Sealing compatibility: NBR (Nitril-Butadien caoutchouc)  
FPM / FKM (fluor-caoutchouc)
- Fire point : at least 50°C above the max. surface temperature
- Air release property: ≤ 5 min. at 50°C as per DIN ISO 9120 (TP... / S...)

### Beneficial additional characteristics:

- Test to FE8:D7.5/80-80: abrasion of rolling elements <30mg
- Resistance to aging: increased resistance to aging

\*) In special cases ISO VG 10 – 46 (T...), ISO VG 22 – 68 (TP...), ISO VG 100 (S...) can be applied.



## 3 Usable Operating Fluids

### 3.1 Specifications / approvals

- Hydraulic oils HLP 32 to DIN 51524, Part 2 \*)
- Lubricating oils CLP 32 to DIN 51517, Part 3
- Steam turbine oils LTD 32 to DIN 51515, Part 1 \*)
- HD engine oils SAE 10 W (T... / TP...)
- ATF type A Suffix A (TASA) and type Dexron II, IID, IIE, III, MERCON (T... / TP...)
- M-891205 and M-921253 (T... / TP...)

\*) In special cases ISO VG 10 – 46 (T...), ISO VG 22 – 68 (TP...), ISO VG 100 (S...) can be applied.

### 3.2 Operating temperature frequently above 100°C

FPM/FKM is recommended as sealing material; when selecting the mineral oil, please ensure that it provides excellent oxidation resistance.

### 3.3 Proposed operating fluids VG 32 (T... / TP...)

Producer	Designation	Pour point in °C	Flash point in °C	Ignition point > 250°C	FE8 fulfilled
<b>Addinol Lube Oil GmbH</b>	Hydraulic oil HLP 32	-21	195		
<b>Avia</b>	Avia Fluid RSL 32	-27	214	X	
	Gear RSX 32 S	-33	210	X	
<b>Castrol</b>	Alpha EP 32	-27	218	X	X
	Alpha VT 32	-42	234	X	X
	Hyspin ZZ 32	-30	216		X
	Hyspin AWS 32	-27	200		
<b>Cepsa</b>	HIDROSIC HLP 32	-24	204		
	EP 125	-30	206		
<b>Chevron-Exxon</b>	Texaco Rando HD 32	-30	196		
<b>ENI</b>	Agip Oso 32	-30	204		
	Agip Blasia 32	-29	215		
<b>ExxonMobil</b>	DTE 24	-27	220	X	
	Mobilfluid 125	-30	225		
	Mobil SHC 524	-54	234		
<b>Fuchs Europe</b>	Renolin MR10	-30	210		
	Renolin B10	-24	205		

Producer	Designation	Pour point in °C	Flash point in °C	Ignition point > 250°C	FE8 fulfilled
<b>Klüber</b>	Lamora HLP 32 (Next Generation)	-18	210		
	Klübersynth GEM 4-32 N <sup>1)</sup>	-50	200		<b>X</b>
<b>Kuwait National Lubricant Oil Company (KNLOC)</b>	Q8 Haydn 32	-30	208		
	Q8 Holst 32	-30	208		
<b>Ravenol</b>	Hydr. oil TS32	-24	220		
<b>Shell</b>	Tegula V32 <sup>2)</sup>	-33	211	<b>X</b>	<b>X</b>
	Tellus Oil S4 ME 32 <sup>1)</sup>	-54	240		
	Tellus Oil S3 M 32	-39	236		
<b>SRS</b>	Wiolan HS 32	-24	220	<b>X</b>	
	Wiolan HF 32 synth <sup>1)</sup>	-60	245		<b>X</b>
<b>Total</b>	Azolla ZS 32	-27	210		
	Azolla VTR 32	-36	230	<b>X</b>	<b>X</b>
	Preslia GT	-15	225		<b>X</b>

- 1) The operating fluid has got a lower density, its use has to be agreed with Voith.  
2) Not admitted for use in TP... / DTP... .

### Notice



The values mentioned above are approximate values and data originating from the oil suppliers. Voith Turbo does not assume any warranty! Country-specific production of the basic oil may result in different pour point, fire point and flash point values.

In case of critical applications, we recommend consulting the respective oil supplier!

## 3.4 Proposed operating fluids VG 32 (S...)

Producer	Designation	Pour point in °C	Flash point in °C	Ignition point > 250°C	FE8 fulfilled
<b>ABC Maziva</b>	INA Fluid V 32	-36	230	<b>X</b>	
<b>Addinol Lube Oil GmbH</b>	Hydraulic oil HLP 32	-33	235	<b>X</b>	
	Hydrodynamic transmission oil SGL 18	-39	225	<b>X</b>	
	Turbine oil TP 32	-15	220	<b>X</b>	
<b>AP Oil International</b>	AP Torque Oil 32	-25	210	<b>X</b>	
<b>Autol</b>	Hydraulic Oil HYS 32	-28	208	<b>X</b>	
<b>Avia</b>	Gear RSX 32-S	-33	211	<b>X</b>	<b>X</b>

Producer	Designation	Pour point in °C	Flash point in °C	Ignition point > 250°C	FE8 fulfilled
<b>Bharat Petroleum Corp. Ltd.</b>	MAK Hydrol HLP 32	-9	190	X	
<b>Caltex</b>	Torque Fluid 32	-27	210	X	
<b>Castrol</b>	Alpha EP 32	-27	218	X	X
	Alpha VT 32	-42	234	X	X
	Hyspin AWS 32	-27	200	X	
	Hyspin HL-XP 32	-36	230	X	
	Hyspin ZZ 32	-30	216		X
<b>Cepsa</b>	EP 125	-30	206	X	
	Hidraulico HM 32	-24	204	X	
	Mistral 32	-24	204	X	
	Turbinas EP 32	-12	218	X	
<b>Chevron-Exxon</b>	Chevron Clarity Hydraulic Oil AW 32	-33	222		
	Chevron GST Oil 32	-36	222		
	Chevron Hydraulic Oil AW 32	-25	220		
	Exxon Rando HD 32	-30	196	X	
	Exxon Textran V 32	-39	220		
<b>ENI</b>	Agip Blasina 32	-29	215	X	
	Agip OSO 32	-27	210	X	
	Agip OTE 32 GT	-15	220		
<b>ExxonMobil</b>	Mobil DTE 10 Excel 32	-54	250	X	
	Mobil DTE 24	-27	220	X	
	Mobil DTE Oil Light	-18	218	X	
	Mobilfluid 125	-30	225	X	
<b>Fabrika Maziva (FAM)</b>	Hidrofluid 125	-27	207	X	X
<b>Fuchs Europe</b>	Renofluid TF 1500	-24	224	X	
	Renolin Eterna 32	-18	220	X	
	Renolin ZAF 32 B	-30	215	X	
<b>Fuchs Lubricants PTE Limited</b>	Titan RR TF	-25	210	X	
<b>Gulf Oil Corp. Ltd.</b>	Crest EP 32	-24	212	X	
	Harmony AW 32	-24	202	X	
<b>Hindustan Petroleum Corp.</b>	Enklo HLP 32	-18	180	X	
<b>Idemitsu Oil</b>	Daphne Super Hydraulic Fluid 32	-35	216		
<b>INA Maziva</b>	INA Fluid V 32	-27	230		
<b>Indian Oil Corp. Ltd.</b>	Servo Torque 10	-34	213	X	
	Servosystem 32	-6	190		
	Servosystem HLP 32	-21	200	X	
<b>Klüber</b>	Lamora HLP 32 (New Generation)	-18	210	X	
<b>Kuwait National Lubricant Oil Company (KNLOC)</b>	Hydraulic Oil 32	-30	210	X	
	Q8 Haydn 32	-30	208	X	
	Q8 Holst 32	-18	208	X	X
	Q8 van Gogh EP 32	-12	208	X	

Producer	Designation	Pour point in °C	Flash point in °C	Ignition point > 250°C	FE8 fulfilled
<b>Lotos Oil</b>	Corvus 32	-30	225		
<b>Lukoil LLK International</b>	Geyser ST 32	-30	218	X	
<b>Maziva Zagreb d.o.o.</b>	INA Fluid V 32	-36	230	X	
<b>MOL Hungarian Oil</b>	Hydro HM 32 hydraulic oil	-18	190		
<b>Morris Lubricants</b>	Liquimatic No. 4	-35	220	X	
<b>OEST</b>	Hydraulic Oil H-LP 32	-27	210	X	
	Turbo Hyd 32 S	-30	210	X	X
<b>OMV</b>	fluid VWG 32	-36	225	X	
	hyd HLP 32	-30	220	X	
	power turb 32	-15	218	X	
<b>Orlen Oil</b>	Hydrol L-HM / HLP 32	-34	215	X	
	Transol V 32	-36	218	X	X
<b>Paramo / Mogul</b>	HM 32	-40	195	X	
	OT-HP 3	-30	205	X	
<b>Petrobras</b>	Lubrax Hydra XP 32	-21	232		
	Lubrax Industrial EGF 32 PS	-12	222		
	Lubrax Turbina EP 32	-21	234		
<b>Petro-Canada</b>	Environ AW 32	-42	233	X	
	Hydrex AW 32	-39	217	X	
	Turboflo EP 32	-33	220	X	
<b>Petrol Ofisi</b>	Hydro Oil HD 32	-27	238	X	
<b>Petronas</b>	Hidraulik EP 32	-9	222	X	
	Jenteram HC 32	-12	214	X	
	Jenteram HC Extra 32	-12	218	X	
<b>Phillips 66</b>	Diamond Class AW Turbine Oil 32	-40	227	X	X
	Powerflow AW Hydraulic Oil 32	-37	216	X	X
<b>Prista Oil</b>	Prista MHP 32	-30	218	X	
<b>PTT Public Company Limited</b>	Votera 32	-25	210	X	
<b>Repsol</b>	Telex E 32	-24	218	X	
<b>Shell</b>	Tellus Oil S2 MX 32 (old designation: Tellus Oil S2 M 32)	-30	220	X	
	Tellus Oil S3 M 32	-30	207	X	
	Turbo Oil CC 32	-12	222	X	
	Turbo Oil S4 GX 32	-33	230	X	X
<b>Sinopec</b>	Greatwall L-HM 32	-21	222	X	
	Greatwall L-TSA 32	-13	226	X	
<b>SK Lubricants</b>	ZIC Supervis AW 32	-40	230		
<b>SRS</b>	Wiolan HF 32	-27	200	X	
	Wiolan HF 32 DB	-27	200	X	
	Wiolan HX 32	-27	210	X	

Producer	Designation	Pour point in °C	Flash point in °C	Ignition point > 250°C	FE8 fulfilled
<b>Statoil</b>	HydraWay HMA 32	-27	218	<b>X</b>	
	TurbWay GT 32	-30	239		
<b>Tide Water Oil Co. (India) Limited</b>	Veedol Avalon HLP 32	-21	212		
<b>TNK Oil</b>	Turbo 32	-17	207		
<b>Total</b>	Azolla AF 32	-27	227	<b>X</b>	
	Azolla ZS 32	-27	210	<b>X</b>	
<b>Valvoline Cummins Ltd.</b>	Valvoline HLP 32	-18	220		
<b>Wisura</b>	Kineta 32 V	-24	224	<b>X</b>	

### 3.5 Proposed operating fluids for low temperature application PAO VG 32 (S...)

Producer	Designation	Pour point in °C	Flash point in °C	Ignition point > 250°C	FE8 fulfilled
<b>BASF SE</b>	ProEco HE 801-32	-48	200	<b>X</b>	
<b>Castrol</b>	Aircol SR 32	-50	238	<b>X</b>	
	Alphasyn T 32	-54	210	<b>X</b>	
	Perfecto SN 32	-54	264	<b>X</b>	
<b>ENI</b>	Agip Dicrea SX 32	-60	248		
<b>ExxonMobil</b>	Mobil SHC 524	-54	234	<b>X</b>	
	Mobil SHC 824	-54	248	<b>X</b>	
<b>Fuchs Europe</b>	Renolin Unisyn OL 32	-60	240		<b>X</b>
<b>Klüber</b>	Summit HySyn FG 32	-50	230	<b>X</b>	
<b>Kuwait Petroleum International Lubricants (Q8 Oils)</b>	Q8 Schumann 32	-54	224	<b>X</b>	
<b>Lubrication Engineers Inc</b>	LE 9032 Monolec	-54	240		
<b>Phillips 66</b>	Syncon AW Hydraulic Fluid 32	-60	240		<b>X</b>
<b>Royal Purple</b>	Synfilm GT 32	-62	249	<b>X</b>	
<b>Shell</b>	Tellus Oil S4 ME 32	-54	230	<b>X</b>	<b>X</b>
<b>Statoil</b>	Mereta 32	-60	235		<b>X</b>
<b>Total</b>	Dacnis SH 32	-57	250	<b>X</b>	
<b>Wunsch</b>	Syntholube compressor oil 32	-54	224	<b>X</b>	

### 3.6 Proposed operating fluids VG 46 (S...)

Producer	Designation	Pour point in °C	Flash point in °C	Ignition point > 250°C	FE8 fulfilled
<b>Addinol Lube Oil GmbH</b>	Hydraulic oil HLP 46 AF	-27	240	X	X
	Turbine oil TP 46	-15	230	X	
<b>Adnoc (Abu Dhabi National Oil Company)</b>	Hydraulic Oil H 46	-34	228		
<b>Caltex</b>	Regal EP 46	-21	234		
<b>Castrol</b>	Hyspin XP 46	-27	215	X	X
	Hyspin ZZ 46	-30	225	X	X
	Perfecto XEP 46	-15	234	X	
<b>Cepsa</b>	HD Turbinas 46	-12	220	X	
	Transmisiones EP 225	-30	232	X	
<b>Chevron-Texaco</b>	Texaco Rando HD 46	-30	204		
	Texaco Regal Premium EP 46	-15	235	X	
<b>ExxonMobil</b>	Mobil DTE 10 Excel 46	-45	232	X	
	Mobil DTE 846	-30	244	X	
	Mobil DTE Excel 46	-33	226	X	
<b>Fuchs Europe</b>	Renolin Eterna 46	-15	220	X	
<b>Gulf Oil Corp. Ltd.</b>	Crest EP 46	-21	220	X	
	Harmony AW 46	-24	210	X	
<b>Idemitsu Oil</b>	Daphne Super Hydraulic Fluid 46	-32	230		
<b>JOMO</b>	Hydlux A 46	-35	224		
<b>Kuwait National Lubricant Oil Company (KNLOC)</b>	Hydraulic Oil 46	-30	215	X	
	Q8 Haydn 46	-30	222	X	
	Q8 Holst 46	-18	222	X	X
	Q8 Hydraulic S-46	-30	222	X	
	Q8 van Gogh EP 46	-12	222	X	
<b>Lotos Oil</b>	Corvus 46	-27	30		
	Remiz TG 46	-18	228		
<b>Lukoil LLK International</b>	Geyser ST 46	-27	232	X	
<b>Neste Oil</b>	Neste Paine 46 ZFX	-27	220	X	
<b>OMV</b>	hyd HLP-AL 46	-27	232	X	
	turb HTU 46	-15	216	X	
	power turb 46	-15	254	X	
<b>Paramo / Mogul</b>	HM 46	-15	185	X	
<b>Petrobras</b>	Lubrax Turbina EP 46	-21	238	X	
<b>Petro-Canada</b>	Environ AW 46	-33	239	X	
	Hydrex AW 46	-33	227	X	
	Turboflo EP 46	-30	237	X	
<b>Petronas</b>	Jenteram HC 46	-9	218	X	
	Jenteram HC Extra 46	-9	218	X	

Producer	Designation	Pour point in °C	Flash point in °C	Ignition point > 250°C	FE8 fulfilled
<b>Phillips 66</b>	Diamond Class AW Turbine Oil 46	-36	231	X	X
	Powerflow AW Hydraulic Oil 46	-34	221	X	X
<b>PTT Public Company Limited</b>	Terbin EP 46	-15	224	X	
<b>Repsol</b>	Hidróleo 46	-40	200	X	
<b>Shell</b>	Tellus Oil S3 M 46	-30	222	X	X
	Turbo Oil CC 46	-12	238	X	
	Turbo Oil S4 GX 46	-21	245	X	X
<b>Sinopec</b>	Greatwall Ashless L-HM 46	-12	224	X	
	Greatwall L-HM 46	-12	224	X	
	Greatwall L-TSA 46	-13	221	X	
	Greatwall L-TSE EP 46	-15	230	X	
<b>TNK Oil</b>	Turbo 46	-18	215		
<b>Total</b>	Azolla AF 46	-27	238	X	
	Preslia 46	-9	230	X	

### 3.7 Proposed operating fluids for low temperature application PAO VG 46 (S...)

Producer	Designation	Pour point in °C	Flash point in °C	Ignition point > 250°C	FE8 fulfilled
<b>BASF SE</b>	ProEco HE 801-46	-45	280	X	
<b>Castrol</b>	Alphasyn T 46	-57	220	X	
<b>Chevron-Exxaro</b>	Cetus PAO 46	-57	250	X	
<b>Fuchs Europe</b>	Renolin Unisyn OL 46	-60	260	X	X
<b>Klüber</b>	Summit HySyn FG 46	-45	240	X	
<b>Kuwait Petroleum International Lubricants (Q8 Oils)</b>	Q8 Schumann 46	-54	238	X	
<b>Lubrication Engineers Inc</b>	LE 9046 Monolec	-51	248	X	
<b>Royal Purple</b>	Synfilm GT 46	-60	262	X	
<b>Shell</b>	Tellus Oil S4 ME 46	-51	250	X	X
<b>Statoil</b>	Mereta 46	-60	252	X	X

### 3.8 Proposed operating fluids VG 100 (S...)

Producer	Designation	Pour point in °C	Flash point in °C	Ignition point > 250°C	FE8 fulfilled
<b>Caltex</b>	Regal EP 100	-18	255	<b>X</b>	
<b>Castrol</b>	Perfecto T 100	-12	215		
<b>Chevron-Texaco</b>	Texaco Ragal EP 100	-18	255	<b>X</b>	
<b>ENI</b>	Agip OTE 100	-8	250	<b>X</b>	
<b>ExxonMobil</b>	Mobil DTE Oil Heavy	-15	237		
	Teresstic T 100	27	242		
<b>Kuwait National Lubricant Oil Company (KNLOC)</b>	Q8 van Gogh 100	-12	254	<b>X</b>	
<b>Petro-Canada</b>	Hydrex AW 100	-30	250	<b>X</b>	
<b>Shell</b>	Turbo Oil T 100	-9	250	<b>X</b>	
<b>Total</b>	Azolla AF 100	-21	263	<b>X</b>	
	Preslia 100	-9	250	<b>X</b>	
<b>Wunsch</b>	Hydraulic oil HLP 100	-27	254	<b>X</b>	



## 4 Operating Fluids for Use in Food Industry (T... / TP...)

Producer	Designation	Pour point in °C	Flash point in °C	Ignition point > 250°C	FE8 fulfilled
Klüber	Summit HySyn FG 32	-45	>230		

### Notice

USDA H1-Registration, satisfies the FDS requirements



## 5 High-flash Point Fluids - HFD-U (T...)

Producer	Designation	Pour point in °C	Flash point in °C	Ignition point > 250°C	FE8 fulfilled
VOITH	HI-Fluid	-33	305	X	
Fuchs	Renosafe DU 46	-33	305	X	
	Renosafe FireProtect 46	-42	270	X	X

### Notice

These high-flash point fluids of viscosity class ISO VG 46 contain neither chlorinated hydrocarbons nor phosphorus acid ester. The density of the fluids is lower than the density of water.



## 6 Quickly Biodegradable Fluids - HEES (T...)

Producer	Designation	Pour point in °C	Flash point in °C	Ignition point > 250°C	FE8 fulfilled
Fuchs	Plantosyn 3268	-36	230		

### Notice



Fuchs Plantosyn 3268 is a quickly biodegradable fluid of viscosity class ISO VG 46 corresponding to VDMA 24568.

The water risk class is 1 and the density of this fluid is lower than the density of water.

## 7 Requirements to be fulfilled by the Operating Fluid 'Water'

Use of water is only possible in couplings suitable for this operating medium due to a corresponding sealing and corrosion protection (e.g. TW... / TPW... / SVTW...).

## 8 Criteria and Information for Evaluation of used Oils

### 8.1 General

Mineral oils change with advanced operating time under the influence of atmospheric oxygen, temperature and impurities with catalytic effect. Additives applied are used up. This finally results in the fact that the mineral oil does no longer meet the requirements. Information enabling such an evaluation is based, above all, on the comparison of results of used oil analysis with the relevant data of the fresh oil. Considering the variety of the oils, it is not advisable to define fixed limit values for individual characteristics. Only the interpretation of all combined characteristic values can provide a verifying statement as to the fitness for continued use of the operating fluid.

---

#### Notice

The decision regarding the suitability of the operating oil for continued use thus remains reserved to the respective oil producer / oil supplier.

---



### 8.2 Sampling

Used oils should be checked for continued usability (trend analysis) in regular intervals (see instruction manual). Correct and careful sampling is of utmost importance for the informative value of analysis results. Preferably, samples should be taken during operation or immediately upon standstill of the unit from an area with oil in motion. It is important here to observe that a certain flow quantity is drained before filling the sample container.

---

#### Notice

The sample quantity depends on the scope of inspection.  
For a standard scope as per Chapter 8.3 a sample quantity of 0.5 liters is required.

---



### 8.3 Scope of analysis

The scope of the analysis depends on the condition of the unit and possible problems. The following scope may be selected for a standard analysis to evaluate the condition of the oil and the unit:

- Additives:  
Calcium, magnesium, zinc, phosphorous, barium, boron
- Contaminants:  
Silicone, potassium, sodium, water as per Karl Fischer in ppm (or %)
- Condition of oil:  
Viscosity at 40° and 100°C, viscosity index, oxidation, appearance, neutralization number
- Wearing metals:  
Iron, chromium, tin, aluminum, nickel, copper, lead, molybdenum, PQ index
- Particle counting as per ISO 4406 / SAE 4059
- Air release property (LAV) as per DIN ISO 9120 I ASTM D 3427

### 8.4 Criteria / information for the evaluation of used oils

The following list contains aspects to be considered and rough standard limits for evaluating the suitability of operating oils for continued use from Voith Turbo's point of view. These data can only be considered as reference values as they depend on the different operating conditions and also on the composition and type of oil.

#### 8.4.1 Additives

Increasing aging of the oil may reduce the value of the failure load stage.

Apart from visual inspections of the components (see instruction manual), the oil producer/supplier should issue a statement about the residual content of additives by using the infrared spectrum. A residual content of EP additives of more than 30% normally guarantees that the reduction of the FZG load stage is not more than one stage. A lower residual content of EP additives indicates that the oil needs to be changed.

### 8.4.2 Oil condition

A visual / sensory test (severe blackening, settling of residues (formation of sludge) and precipitation and / or sharp or burning smell) and the results of the oil analysis indicate that the oil needs to be changed.

A change in viscosity of  $> \pm 10 \%$  compared to the fresh oil is also an indication for a necessary oil change.

---

#### Notice

It is necessary to find the cause for the change in viscosity!

---



### 8.4.3 Neutralization number NZ (DIN 51558)

The increase of the neutralization number is not a general criterion for the aging of oil.

However, it is recommended changing the oil at the following increase of the neutralization number compared to the one of fresh oil:

- for turbine oils: 0.5 - 1.0 mg KOH / g
- for HLP oils: 1.0 - 1.5 mg KOH / g
- for CLP oils: 1.5 - 2.0 mg KOH / g

#### 8.4.4 Water content (DIN ISO 3733)

If the water content exceeds 0.05 weight-percent (500 ppm), measures to remove the water have to be taken.

Procedure: Centrifuging, filtering using a coalescer (multi-phase separator), vacuum treatment, settling (by letting the oil rest for 1 to 2 days) and draining through a drain cock or by heating up.

At a water content of  $\geq 0.2$  weight-% (already visible as cloudiness of the oil) the oil needs to be changed.

Oils with verified water release property are capable of emulsifying up to approx. 0.2 % water without any negative effect on the function.

---

#### Notice

Find the cause for water content!

---



#### 8.4.5 Air release property LAV (DIN ISO 9120)

Air release property of new oil  $\leq 5$  minutes (0.2 % at 50 °C).

It is necessary to change the oil in case of pressure and speed variations, if other causes, as e.g. too low oil level, can be excluded.

We recommend determining the air release property value.



## Work Sheet amd 683.0

### Arrangement of fusible plugs (FP)

TR... / DTR...

### VTCs of type TR, TRI and DTR, DTRI and Ex-protection as per Directive 2014/34/EU

Number and arrangement of fusible plugs (FP), blind screws, and switching elements for outer wheel and/or inner wheel drive for the standard design.

#### General:

- From VTC size 366, a sight glass is installed
- For VTC size 650, the outer wheel for M24 is to be used
- The BTM is not approved for explosive atmospheres
- A deviating arrangement, in consideration of the thermal behavior, is only permitted upon consultation with Voith (with the exception of the next item)
- Deviating arrangement is not permitted for
  - blocking driven machines with inner wheel drive
  - a position from which the operating medium sprays in V-belt pulley direction

Outer wheel 1				Coupling shell - outer wheel 2		Optional	V-belt pulley side	Remark
VTC size <sup>3)</sup>	FP	Blind screw	Sight glass	FP	Blind screw	MTS-BTS-BTM- <sup>2)</sup> Switching element <sup>1)</sup>		
154 TR	1	-	-	-	-	-	Shell	
154 DTR	2	1	-	-	1	-	OW1	
206 TR/TRI	1	2	-	-	1	1	OW	
206 DTR/DTRI	2	1	-	-	1	1	OW1	
274 TR	1	2	-	-	1	1	OW	
274 TRI	1	-	-	-	1	-	Shell	
274 DTR/DTRI	2	1	-	-	1	1	OW1	
366 TR/TRI	2	3	1	-	2	1	Shell	
422 TRI	4	3	1	-	2	1	Shell	
487 TRI	4	3	1	-	2	1	Shell	
562 TRI	4	3	1	-	2	1	Shell	
650 TRI**	3	2	1	-	3	1	Shell	**OW-M24

- 1) Optional: The MTS, BTS or BTM switching element is inserted instead of a blind screw.  
The BTM switching element may only be inserted in the outer wheel.
- 2) The blind screw opposite the BTM has to be replaced by the counterweight.
- 3) For VTCs 154 – 274, the FPs are installed radially in outer wheel 1.

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